APPENDICES

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Appendix A :

Zoning and Land Use

Zoning and Land Use

In accordance with the Zoning Resolution of the City of New York, there are three basic zoning designations within New York City: residential (R), commercial (C), and manufacturing (M). There are ten residential, eight commercial, and three manufacturing zoning districts of varying densities (lower, medium and higher densities). Manufacturing zoning districts are further classified into performance zones which establish limits on the amount and type of nuisances permitted. Development within these districts is regulated by use, building size and parking regulations.

Table A1
Residential Zoning Districts Within the Study Area

Residential Zoning District*	Maximum Residential FAR	Maximum Community Facility FAR	Maximum Commercial Overlay FAR	General Permitted Housing Types
R1-2	0.5	0.5	1.0	Single-family detached residences
R2	0.5	0.5	1.0	Single-family detached residences
R3-1	0.5	1.0	1.0	Single and two-family detached and semi-detached residences
R3-2	0.5	1.6	1.0	Low density general residence district: a variety of housing types
R3A	0.5	1.0	1.0	Single and two-family detached residences
R3X	0.5	1.0	1.0	Single and two-family detached residences
R4	0.75	2.0	1.0	Low density general residence district: a variety of housing types
R4-1	0.75	2.0	1.0	Single and two-family detached and semi-detached residences
R4A	0.75	2.0	1.0	Single and two-family detached residences
R5	1.25	2.0	1.0	Low density general residence districts: a variety of housing types
R6	0.78-2.43	4.8	2.0	R6 height factor regulations; R6 Quality Housing Option
R6A	3.0	3.0	2.0	R6A general residence district: a variety of housing types; Quality Housing is mandatory
R6B	2.0	2.0	2.0	R6B general residence district: a variety of housing types; Quality Housing is mandatory
R7A	4.0	4.0	2.0	R7A general residence district: a variety of housing types; Quality Housing is mandatory

Note that in the R1 and R2 districts listed above, regulations may differ in a Lower Density Growth Management Plan. Also, in the R3 and R4 districts listed above, the FAR may be increased up to 20 percent for an attic allowance.

Table A2
Commercial Zoning Districts Within the Study Area

Commercial Zoning District	Maximum Commercial FAR	Maximum Community Facility FAR	Maximum Residential FAR	Residential District Equivalent
C3	0.50	1.0	0.5[1]	R3-2
C8-1	1.0	2.4	N/A	N/A

[1] The FAR may be increased up to 20 percent for an attic allowance.

Table A3
Manufacturing Zoning Districts Within the Study Area

Manufacturing Zoning District	Maximum Manufacturing FAR	Maximum Commercial FAR	Maximum Community Facility FAR[1]
M1-1	1.0	1.0	2.4
M1-2	2.0	2.0	4.8
M2-1	2.0	2.0	N/A

[1] Only community facilities in Use Group 4 are permitted.

Appendix B :

Street Network

Street Network

a) Definitions

Arterial Roadway. An arterial roadway is a high-speed divided highway, serving through traffic with access partially or fully controlled. It is a main, direct roadway that connects communities throughout the city.

Major Collector Roadway. A major collector roadway caries a significant amount of vehicular traffic within a study area. It generally runs through a study area and beyond to adjacent outlying peripheral areas, sometimes via bridges over waterways. A major collector roadway tends to be a long street which may provide linkage to a highway. It is likely to be two-directional and wider than a minor collector street. The major collector roadways may also serve as a designated truck route, a bus route, and/or the location for a subway station and may contain commercial stores.

Truck Routes. There are two major truck route designations: a through truck route is designated for trucks having neither an origin nor a destination within the local area and a local truck route is designated for trucks with origins or destinations within an area for the purpose of delivery, loading, or providing services.

b) Level of Service Analysis and Methodology – Vehicular Traffic
The operation of the intersections within the study area was analyzed applying the methodologies presented in the 2000 Highway Capacity Manual (HCM2000). These procedures evaluate intersections for average delay per vehicle and level of service (LOS).

Signalized Intersections
The capacity analysis methodology separates an intersection approach into lane groups on the basis of the movements occurring during each signal phase. The lane groups are then analyzed to determine the specific vehicular capacity and LOS. This analysis requires the following input parameters: intersection geometry, lane utilization, number of travel lanes, width of travel lanes, on-street parking conditions, locations of bus stops, number of buses stopping per hour, vehicle turning movements, vehicle classification, conflicting pedestrian movements, traffic signal cycle length, and allocation of green time.

The operating characteristics of signalized intersections can be estimated and evaluated by analyzing capacity and performance. The capacity of an intersection represents the throughput of a facility (i.e., the maximum number of vehicles that can be served in one hour). Capacity analysis results in the volume-to-capacity ratio (v/c ratio) which presents the proportion of capacity (supply) utilized by the existing traffic volume (demand). High v/c ratios (>0.85) indicate some traffic congestion, and low v/c ratios (<0.60) indicate a smooth traffic flow.

The performance of an intersection is based on the estimated average delay time (i.e., the average stopped time per vehicle) for each vehicle utilizing a roadway segment. Delay time is determined by the capacity of a lane group, the amount of green time allotted to a lane group, and the signal cycle length. Delay time is a factor which determines the LOS for a lane group. Short delays receive a good LOS while long delays receive a poor LOS.

Unsignalized Intersections
The capacity analysis is based on the use of "gaps" in a major traffic stream by vehicles crossing through or turning into that stream. At unsignalized intersections, "Stop" or "Yield" signs are used to assign the right-of-way to one street while controlling the movements from the other street(s). The methodology assumes that major street traffic is not affected by minor street flows. Left turns from the major street are assumed to be affected by the opposing, oncoming, major street flow. Minor street traffic is obviously affected by all conflicting movements, vehicular and pedestrian. Table B1 describes the LOS definitions for signalized intersections and Table B2 describes the LOS definitions for unsignalized intersections.

Table B1 – Level of Service Definitions for Signalized Intersections

Flow Quality	Description
Level A	Describes operation with very low delay, i.e., less than or equal to 10 seconds per vehicle. This occurs when progression is extremely favorable and most vehicles arrive during the green phase.
Level B	Describes operation with delay in the range of >10-20 seconds per vehicle. This generally occurs with good progression and/or short cycle lengths.
Level C	Describes operation with delay in the range of >20-35 seconds per vehicle. These higher delays may result from fair progression and/or longer cycle lengths.
Level D	Describes operation with delay in the range of >35 -55 seconds per vehicle. At level D, the influence of congestion becomes more noticeable.
Level E	Describes operation with delay in the range of >55 – 80 seconds per vehicle. This is considered to be the limit of acceptable delay.
Level F	Describes operation with delay in excess of 80.0 seconds per vehicle. This is considered to be unacceptable to most drivers.

Source: Highway Capacity Manual, Transportation Research Board, National Research Council, Washington, D.C., 2000.

Table B2 – Level of Service Definitions for Unsignalized Intersections

Level of Service	Control Delay (s/veh)
A	0 – 10
B	>10-15
C	>15-25
D	>25-35
E	>35-50
F	>50

<u>Data Collection</u>

Traffic volumes including vehicle classification and turning movement volumes were collected for a total of eight (8) intersections of which 6 are signalized and 2 are unsignalized. These counts were conducted for a typical weekday (Tuesday, Wednesday or Thursday) in 15-minute intervals during the AM (7:00 – 9:00AM), MD (12:00 – 2:00 PM), PM (4:00 – 6:00 PM) and Saturday Midday (1:00 – 3:00 PM) peak periods. The following is a list of the signalized intersections:

- Jamaica Avenue and 102nd Street
- Atlantic Avenue and 104th Street
- Rockaway Boulevard and 102nd Street
- Beach Channel Drive and Beach 134th Street
- Beach Channel Drive and Beach 122nd Street
- Beach Channel Drive and Beach 108th Street

The following is a list of the unsignalized intersections:

- Rockaway Beach Boulevard and Beach 133rd Street
- Rockaway Beach Boulevard and Beach 143rd Street

Automatic Traffic Recorders (ATR) were also used to conduct automatic 24-hour traffic counts for one full week including weekends (7 days) at the following locations:

- On Freedom Drive between Myrtle Avenue and Park Lane South
- On Centreville Street between 133rd Avenue and Linden Blvd
- On Centreville Street between 149th Avenue and Eckford Avenue
- On 92nd Street between 162nd and 163rd Avenues
- On 165th Avenue between 91st and 92nd Streets

<u>Network Traffic Volumes</u>

The traffic volume, including turning movement volumes, data analysis revealed the following for a typical weekday:

102nd Street (bet Jamaica Av and Rockaway Blvd)	**AM – NB**	**AM – SB**	**MD – NB**	***MD – SB***	**PM – NB**	**PM - SB**
Average 15-min Volumes	351	104	214	95	242	158

104th Street at Atlantic Avenue	**AM – SB**	**MD – SB**	**PM - SB**
Average 15-min Volumes	245	210	297

Jamaica Avenue at 102nd Street	**AM – EB**	**AM – WB**	**MD – EB**	**MD – WB**	**PM – EB**	**PM - WB**
Average 15-min Volumes	247	219	224	198	279	237

Rockaway Blvd at 102nd Street	**AM – EB**	**AM – WB**	**MD – EB**	**MD – WB**	**PM – EB**	**PM - WB**
Average 15-min Volumes	686	1,034	490	491	780	654

Beach Channel Dr at Beach 108th St	**AM – EB**	**AM – WB**	**MD – EB**	**MD – WB**	**PM – EB**	**PM - WB**
Average 15-min Volumes	569	624	419	437	531	698

Beach Channel Dr at Beach 122nd St	**AM – EB**	**AM – WB**	**MD – EB**	**MD – WB**	**PM – EB**	**PM - WB**
Average 15-min Volumes	498	678	408	422	590	606

Beach Channel Dr at Beach 134th St	**AM – EB**	**AM – WB**	**MD – EB**	**MD – WB**	**PM – EB**	**PM - WB**
Average 15-min Volumes	373	725	334	378	559	494

Rockaway Beach Blvd at B133rd St	**AM – EB**	**AM – WB**	**MD – EB**	**MD – WB**	**PM – EB**	**PM - WB**
Average 15-min Volumes	224	344	154	167	223	207

Rockaway Beach Blvd at B143rd St	**AM – EB**	**AM – WB**	**MD – EB**	**MD – WB**	**PM – EB**	**PM - WB**
Average 15-min Volumes	116	319	160	167	259	206

The results of the Automatic Traffic Recorder (ATR) volumes are presented in the tables below. They represent the volumes during the peak hour where traffic operation is at its most critical on a typical weekday for these locations:

Table B3 – Automatic Traffic Recorder Volumes (1 of 2)

Locations	AM Peak Hour Volume (NB)	PM Peak Hour Volume (NB)	AM Peak Hour Volume (SB)	PM Peak Hour Volume (SB)
Freedom Dr between Myrtle Av and Park Lane South	232	139	82	169
Centerville St between 133rd Av and Linden Blvd	238	199	260	326
Centerville St between 149th Av and Eckford Av	205	175	254	449
92nd St between 162nd and 163rd Aves	98	96	n/a	n/a

Table B3 – Automatic Traffic Recorder Volumes (2 of 2)

Locations	AM Peak Hour Volume (EB)	PM Peak Hour Volume (EB)	AM Peak Hour Volume (WB)	PM Peak Hour Volume (WB)
165th Av between 91st and 92nd Sts	46	56	24	53

Intersection Analysis

Typical intersections were identified and analyzed for roadway capacity using the 2000 Highway Capacity Manual (HCM) methodology. Volume-to-capacity (v/c) ratios, vehicular delay, and the level of service (LOS) were determined for the respective peak hours.

The analysis shows that most intersections operate at an acceptable level of service LOS C or better during the AM, MD, PM and Saturday midday peak hours. However the 102nd Street and Jamaica Avenue intersection experienced LOS D, E or F for some of the lane groups during the weekday peak hours. (see Tables B4 and B5 on the following pages for details).

The approaches or lane groups with mid-LOS D (equal to 45 sec/ veh) or worse are:

- Northbound on 102nd Street (AM)
- Southbound on 102nd Street (AM, MD, and PM)

Table B4 - Traffic Capacity Analysis of Signalized Intersections

		2008 Existing Conditions - Signalized Intersections											
Jamaica Avenue & 102nd Street		AM			Midday			PM			Saturday		
Approach	Lane Group	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS
EB	LT	0.35	8.6	A	0.30	8.0	A	0.28	7.7	A	0.29	7.9	A
WB	TR	0.27	7.7	A	0.21	7.2	A	0.23	7.3	A	0.23	7.4	A
NB	LTR	0.97	71.1	E	0.74	42.0	D	0.73	41.6	D	0.46	32.8	C
SB	LR	1.00	111.4	F	0.73	55.9	E	0.99	97.2	F	0.60	41.2	D
	Intersection:		44.3	D		25.7	C		34.3	C		18.8	B
Atlantic Avenue & 104th Street		AM			Midday			PM			Saturday		
Approach	Lane Group	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS
EB	TR	0.50	15.7	B	0.58	18.4	B	0.63	18.0	B	0.62	19.2	B
WB	L	0.68	32.7	C	0.50	24.7	C	0.69	43.1	D	0.48	26.8	C
	T	0.49	9.3	A	0.39	9.4	A	0.41	8.5	A	0.29	8.6	A
SB	LTR	0.56	44.7	D	0.31	27.6	C	0.54	44.0	D	0.29	26.4	C
	Intersection:		18.8	B		16.8	B		20.3	C		17.6	B
Rockaway Blvd. & 102nd Street		AM			Midday			PM			Saturday		
Approach	Lane Group	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS
EB	LT	0.33	0.3	A	0.21	0.2	A	0.29	0.2	A	0.23	0.2	A
WB	TR	0.37	0.3	A	0.17	0.1	A	0.23	0.2	A	0.21	0.1	A
	Intersection:		0.3	A		0.1	A		0.2	A		0.2	A
Beach Channel Drive & 134th Street		AM			Midday			PM			Saturday		
Approach	Lane Group	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS
EB	T	0.24	7.9	A	0.23	7.8	A	0.34	8.6	A	0.25	8.0	A
WB	T	0.50	10.0-	A	0.25	7.9	A	0.36	8.7	A	0.27	8.1	A
NB	LR	0.23	15.5	B	0.11	14.3	B	0.06	14.0	B	0.04	13.8	B
	Intersection:		9.8	A		8.3	A		8.8	A		8.2	A
Beach Channel Drive & 122nd Street		AM			Midday			PM			Saturday		
Approach	Lane Group	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS
EB	T	0.35	8.7	A	0.28	8.2	A	0.36	8.7	A	0.28	8.2	A
WB	T	0.46	9.6	A	0.26	8.0	A	0.36	8.7	A	0.31	8.4	A
NB	LR	0.13	14.5	B	0.05	13.8	B	0.08	14.1	B	0.05	13.9	B
	Intersection:		9.5	A		8.2	A		8.9	A		13.9	A
Beach Channel Drive & 108th Street		AM			Midday			PM			Saturday		
Approach	Lane Group	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS
EB	TR	0.28	9.4	A	0.19	8.7	A	0.27	9.3	A	0.17	8.5	A
WB	LT	0.55	12.7	B	0.30	9.7	A	0.55	12.4	B	0.30	9.6	A
NB	L	0.17	24.6	C	0.17	24.6	C	0.11	23.9	C	0.18	24.7	C
	R	0.11	24.0	C	0.08	23.6	C	0.06	23.4	C	0.07	23.5	C
	Intersection:		12.1	B		10.7	A		11.7	B		10.8	B

Table B5 - Traffic Capacity Analysis of Unsignalized Intersections

		2008 Existing Conditions - UnSignalized Intersections											
Rockaway Beach Blvd & B133rd St		AM			Midday			PM			Saturday		
Approach	Lane Group	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS
WB	LT	0.00	8.2	A	0.00	7.8	A	0.00	7.9	A	0.00	7.7	A
NB	LR	0.05	12.9	B	0.02	11.0	B	0.01	9.1	A	0.02	8.9	A
SB	LTR	0.15	13.7	B	0.06	10.0+	B	0.05	11.1	B	0.04	10.1	B
Rockaway Beach Blvd & B143rd St		AM			Midday			PM			Saturday		
Approach	Lane Group	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS
WB	LT	0.00	7.6	A	0.00	7.7	A	0.00	8.0	A	0.00	7.5	A
NB	LR	0.02	10.4	B	0.01	8.9	A	0.02	12.3	B	0.02	9.8	A
SB	LTR	0.03	10.9	B	0.02	10.3	B	0.01	8.9	A	0.02	10.1	B

c) Street Widths and Traffic Direction

Table B6 – Street Widths, Traffic Direction, Travel Lanes

Street	Block (From/To Street)	Width	Traffic Direction	Number of Travel Lanes per Direction of Traffic	Width of Median or Traffic Island, if any
Memorial Drive - small street that leads into Forest Park path	Greenway path to intersection of Myrtle Avenue and Park Lane South	40 ft	2-way	1	
Park Lane South	Myrtle Avenue to 102nd Street	30 ft	2way	1	
102nd St	Park Lane South to 85th Avenue	43 ft	2 -way	1	1 - 5.5 ft
102nd St	85th Avenue and 85th Road	43 ft	2 -way	1	5.5 ft
102nd St	85th Road and 85th Drive	43 ft	2 -way	1	5.5 ft
102nd St	85th Drive and 86th Avenue	43 ft	2 -way	1	5.5 ft
102nd St	86th Avenue and 86th Road	43 ft	2 -way	1	1 - 5.5 ft
102nd St	86th Road and Jamaica Avenue	43 ft	2 -way	1	
Jamaica Avenue	102nd St to 104th St	39 ft	2-way	1	
102nd St	Jamaica Avenue to 87th Avenue	30 ft	1-way (NB)	1	
102nd St	87th Avenue to 88th Avenue	30 ft	1-way (NB)	1	
102nd St	88th Avenue to 89th Avenue	30 ft	1-way (NB)	1	
102nd St	89th Avenue to 90th Avenue	30 ft	1-way (NB)	1	
102nd St	89th Avenue to 90th Avenue	30 ft	1-way (NB)	1	
102nd St	90th Avenue to 91st Avenue	30 ft	1-way (NB)	1	
102nd St	91st Avenue to 92nd Avenue	30 ft	1-way (NB)	1	
102nd St	92nd Avenuet to 93rd Avenue	30 ft	1-way (NB)	1	
102nd St	93rd Avenue to Atlantic Avenue	30 ft	1-way (NB)	1	
102nd St	Atlantic Avenue to 94th Avenue	30 ft	1-way (NB)	1	
102nd St	94th Avenue to 95th Avenue	30 ft	1-way (NB)	1	
102nd St	95th Avenue to 97th Avenue	30 ft	1-way (NB)	1	
102nd St	97th Avenue to 101st Avenue	27.5 ft	1-way (NB)	1	
102nd St	101st Avenue to 103rd Avenue	27.5 ft	1-way (NB)	1	
102nd St	103rd Avenue to Liberty Avenue	28 ft	1-way (NB)	1	
102nd St	Liberty Avenue to Rockaway Boulevard	28 ft	1-way (NB)	1	

Street	Block (From/To Street)	Width	Traffic Direction	Number of Travel Lanes per Direction of Traffic	Width of Median or Traffic Island, if any
104th St	Jamaica Avenue to 87th Avenue	30 ft	1-way (SB)	1	
104th St	87th Avenue to 88th Avenue	30 ft	1-way (SB)	1	
104th St	88th Avenue to 89th Avenue	30 ft	1-way (SB)	1	
104th St	89th Avenue to 90th Avenue	30 ft	1-way (SB)	1	
104th St	90th Avenue to 91st Avenue	30 ft	1-way (SB)	1	
104th St	91st Avenue to 92nd Avenue	30 ft	1-way (SB)	1	
104th St	92nd Avenue to 93rd Avenue	30 ft	1-way (SB)	1	
104th St	93rd Avenue to Atlantic Avenue	30 ft	1-way (SB)	1	
104th St	Atlantic Avenue to 94th Avenue	30 ft	1-way (SB)	1	
104th St	94th Avenue to 95th Avenue	30 ft	1-way (SB)	1	
104th St	95th Avenue to 97th Avenue	30 ft	1-way (SB)	1	
104th St	97th Avenue to 101st Avenue	30 ft	1-way (SB)	1	
104th St	101st Avenue to 103rd Avenue	30 ft	1-way (SB)	1	
104th St	103rd Avenue to Liberty Avenue	30 ft	1-way (SB)	1	
104th St	Liberty Avenue to 107th Avenue	30 ft	1-way (SB)	1	
104th St	107th Avenue to Rockaway Boulevard	30 ft	1-way (SB)	1	
Rockaway Boulevard	101st Street to 102nd Street	60 ft	2-way	2	
Rockaway Boulevard	102nd Street to 103rd Street (where 103rd St south of Rockaway Blvd starts)	60 ft	2-way	2	
Rockaway Boulevard	103rd Street (where 103rd St south of Rockaway Blvd starts) to 104th Street	Varies from 64.5 ft to 66 ft (from west to east)	2-way	2	Varies from 1.5 ft to 7.5 ft (from west to east)

Street	Block (From/To Street)	Width	Traffic Direction	Number of Travel Lanes per Direction of Traffic	Width of Median or Traffic Island, if any
Rockaway Boulevard	104th Street to 105th Street	70 ft	2-way	2 travel lanes and a left turn lane for EB traffic	Varies from 11ft to 2 ft (from west to east)
Rockaway Boulevard	105th Street to Centreville Street/ Plattwood Avenue	70 ft	2-way	2 travel lanes and a left turn lane for EB traffic	
Centerville Street (north of Linden Blvd)	Rockaway Blvd to Rosita Road	30 ft	2-way	1	
Centerville Street (north of Linden Blvd)	Rosita Rd to Sutter Ave/ 133rd Ave	30 ft; 52 ft where there is no sidewalk	2-way	1	
Centerville Street (north of Linden Blvd)	Sutter Ave/ 133rd Ave to Peconic St/ Linden Blvd	40 ft; street width widens to 50 ft near intersection where there is a dirt sidewalk	2-way	1	
101st Street	Rockaway Blvd to 133rd Ave	36 ft	2-way	1	
Peconic Street	133rd Ave to Boss St	30 ft	1 way (NB)	1	
Peconic Street	Boss St to Linden Blvd/ Centreville St	30 ft	1 way (NB)	1	
Linden Boulevard	Hawtree St to Peconic St/ Centerville St	45ft west of the elevated rail line; 50 ft east of the elevated rail line	2-way	1	
Hawtree Street	Linden Blvd to 135th Rd	38 ft	2-way	1	
Hawtree Street	135th Rd to Pitkin Ave	38 ft	2-way	1	
Hawtree Street	At intersection of Hawtree St and Pitkin Ave, near corner	Curbed section of road widens from 38ft to 140 ft	2-way	1	
Centerville Street (south of Pitkin Ave)	Pitkin Ave to 135th Dr	23ft to 21ft (narrows from north intersection to south intersection)	2-way	1	
Centerville Street (south of Pitkin Ave)	135th Dr to 149th Ave/ Bristol Ave	Varies from 21 to 25 ft in width due to dirt sidewalk - east side of road	2-way	1	

Street	Block (From/To Street)	Width	Traffic Direction	Number of Travel Lanes per Direction of Traffic	Width of Median or Traffic Island, if any
Centerville Street (south of Pitkin Ave)	149th Ave/ Bristol Ave to Eckford Ave	40 ft	2-way	1	
Centerville Street (south of Pitkin Ave)	Eckford Ave to Albert Road	38 ft	2-way	1	
Albert Road	Centerville St to Tahoe St (where Tahoe St ends north of Albert Rd)	33 ft	1-way (WB)	1	
Albert Road	Tahoe St-north (where Tahoe St ends north of Albert Rd) to Tahoe St-south (where Tahoe St starts south of Albert Rd)	Varies from 33 to 30 ft in width (west to east) due to dirt sidewalk on south side of road	1-way (WB)	1	
Albert Road	Tahoe Street - south (where Tahoe St starts south of Albert Rd) to Raleigh Street	Varies from 28 to 30 ft in width (west to east) due to sections of an uneven curb on south side of road	1-way (WB)	1	
Albert Road	Raleigh Street to Huron Street	33 ft	1-way (WB)	1	
Albert Road	Huron Street to 99th Place	24 - 25 ft	1-way (WB)	1	
Albert Road	99th Place to Cohancy Street	24 - 25 ft	1-way (WB)	1	
Eckford Avenue	Centerville St to Tahoe St	30 ft	1-way (EB)	1	
Eckford Avenue	Tahoe Street to Raleigh Street	30 ft	1 way (EB)	1	
Hawtree Street	Raleigh Street to Huron Street	30 ft wide with sidewalks on both sides of the street; Varies from 35 to 32 ft in width (from west to east) where there are no sidewalks	1 way (EB)	1	

Street	Block (From/To Street)	Width	Traffic Direction	Number of Travel Lanes per Direction of Traffic	Width of Median or Traffic Island, if any
Hawtree Street	Huron Street to 99th Place	Varies from 55 to 45 ft in width (from west to east) due to sections of roadway with no sidewalks	1 way (EB)	1	
Hawtree Street	99th Place to Cohancy Street	Width is 30 ft with dirt both sides of the road; no sidewalks on both sides of the road	1 way (EB)	1	
Cohancy Street	Hawtree Street to 155th Avenue	33 ft	2-way	1 SB travel lane and 2 NB travel lanes (total = 3 travel lanes)	
Cohancy Street	155th Avenue to 156th Avenue	33 ft	1-way (NB)	1	
Cohancy Street	156th Avenue to 157th Avenue	33 ft	1-way (SB)	1	
155th Avenue	Bridgeton Street to Cohancy Street	50 ft	2-way	1	
156th Avenue	Bridgeton Street to Cohancy Street	51 ft	2-way	1	
Bridgeton Street	156th Avenue to 157th Avenue	30 ft	1-way (SB)	1	
91st Street	157th Avenue to 165th Avenue	30 ft	1-way (SB)	1	
92nd Street	157th Avenue to 165th Avenue	30 ft	1-way (NB)	1	
96th Street	157th Avenue to 165th Avenue	30 ft	1-way (SB)	1	
97th Street	157th Avenue to 165th Avenue	30 ft	1-way (NB)	1	
165th Avenue	91st Street and Cross Bay Boulevard	50 ft	2-way	1	
Esplanade under ramps of Veteran’s Memorial Bridge		16 - 18 ft			
Beach 94th Street	Beach Channel Drive to Rockaway Freeway	26 ft	1-way (NB)	1	

Street	Block (From/To Street)	Width	Traffic Direction	Number of Travel Lanes per Direction of Traffic	Width of Median or Traffic Island, if any
Beach 94th Street	Rockaway Freeway to Shore Front Parkway	65 ft total, 32 ft main road, 25 ft service road	1-way (NB)	Room for 3 on main road, 1 on service road	8 ft (grass median), 125 ft (parking area in between B94 and B95 Sts)
Beach 95th Street	Beach Channel Drive to Rockaway Freeway	26 ft	1-way (SB)	1	
Beach 95th Street	Rockaway Freeway to Shore Front Parkway	65 ft total, 32 ft main road, 25 ft service road	1-way (SB)	Room for 3 on main road, 1 on service road	8 ft (grass median), 125 ft (parking area in between B94 and B95 Sts)
Beach 96th Street	Beach Channel Drive to Rockaway Freeway	28 ft	1-way (NB)	1	
Beach 101st Street	Beach Channel Drive to Rockaway Freeway	30 ft	1-way (SB)	1	
Beach 102nd Street	Beach Channel Drive to Rockaway Freeway	30 ft	1-way (NB)	1	
Beach 102nd Street	Rockaway Freeway to Rockaway Beach Blvd	70 ft, narrows to 40 ft near Rockaway Freeway intersection	2-way	1 per direction, room for more lanes	
Beach 102nd Street	Rockaway Beach Blvd to Shore Front Parkway	80 ft total, 37 ft each way	2-way	1	6 ft
Beach 108th Street	Beach Channel Drive to Rockaway Freeway	80 ft total, 37 ft each way	2-way	2 NB, 1 SB	6 ft
Beach 108th Street	Rockaway Freeway to Rockaway Beach Blvd	92 - 110 ft total, 40 ft each way	2-way	2	12 - 30 ft
Beach 108th Street	Rockaway Beach Blvd to Shore Front Parkway	110 ft total, 40 ft each way	2-way	2	30 ft
Beach 121st Street	Beach Channel Drive to Ocean Promenade (bdwlk)	30 ft	1-way (SB)	1	
Beach 122nd Street	Beach Channel Drive to Ocean Promenade (bdwlk)	30 ft	1-way (NB)	1	
Beach Channel Drive	Beach 90th Street to Beach 92nd Street	52 ft	2-way	2 WB, 1 EB	
Beach Channel Drive	Beach 92nd Street to Beach 96th Street	52 ft	2-way	2 WB, 1 EB	6 ft
Beach Channel Drive	Beach 96th Street to Beach 97th Street	70 ft	2-way	2 WB, 3 EB	6 ft

Street	Block (From/To Street)	Width	Traffic Direction	Number of Travel Lanes per Direction of Traffic	Width of Median or Traffic Island, if any
Beach Channel Drive	Beach 97th Street to Beach 98th Street	68 ft	2-way	2 WB, 3 EB	6 ft
Beach Channel Drive	Beach 98th Street to Beach 99th Street	80 ft	2-way	2 WB, 2EB	6 - 10ft gradually, then merges with the 17ft median
Beach Channel Drive	Beach 99th Street to Beach 100th Street	80 ft	2-way	3 WB, 3EB	17 ft
Beach Channel Drive	Beach 100th Street to Beach 101st Street	80 ft	2-way	2 WB, 2 EB, plus 1 left turn bay for WB traffic at B 101st St	6 ft
Beach Channel Drive	Beach 101st Street to Beach 102nd Street	80 ft	2-way	2 (WB), 2 (EB)	17 ft
Beach Channel Drive	Beach 102nd Street to Seaside Avenue	80 ft	2-way	2 (WB), 2 (EB), plus 1 left turn bay for WB traffic at Seaside Av	6 ft
Beach Channel Drive	Seaside Avenue to Beach 104th Street	80 ft	2-way	2 (WB), 2 (EB), 1 left turn bay for EB traffic at Seaside Av	6 - 10ft gradually, then merges with the 17ft median
Beach Channel Drive	Beach 104th Street to Beach 108th Street	80 ft, narrows to 73.5 ft near B 108th St	2-way	2 (WB), 2 (EB)	17 ft, narrows gradually to 6 ft near B 108th St
Beach Channel Drive	Beach 108th Street to Rockaway Freeway	70 ft, widens to 75 ft near Rockaway Freeway	2-way	2 (WB), 2 (EB)	6 ft, widens to 12.5 ft near Rockaway Freeway
Beach Channel Drive	Rockaway Freeway to Beach 116th Street	80 ft	2-way	2 (WB), 2 (EB), 1 left turn bay for WB traffic at parking lot entrance across shopping strip	17ft median narrows to 6 ft at or near intersections
Beach Channel Drive	Beach 116th Street to Beach 129th Street	52 ft	2-way	2	No medians, ends at B116th
Beach Channel Drive	Beach 129th Street to Beach 145th Street	52 ft	2-way	2	No medians

Street	Block (From/To Street)	Width	Traffic Direction	Number of Travel Lanes per Direction of Traffic	Width of Median or Traffic Island, if any
Rockaway Freeway	Beach 101st Street to Beach 102nd Street	45 ft total, 11 ft each way	2-way	1	Traffic island markings underneath elevated structure = 23 ft wide
Rockaway Beach Blvd	Beach 108th Street to Beach 109th Street	46 - 48 ft	2-way	1	
Rockaway Beach Blvd	Beach 109th Street to Beach 110th Steet	39 -43 ft	2-way	1	
Rockaway Beach Blvd	Beach 110th Street to Beach 111th Street	45 ft	2-way	1	
Rockaway Beach Blvd	Beach 111th Street to Beach 116th Street	33 ft	2-way	1	
Rockaway Beach Blvd	Beach 116th Street to Beach 117th Street	31 ft	2-way	1	
Rockaway Beach Blvd	Beach 117th Street to Beach 118th Street	30 ft	2-way	1	
Rockaway Beach Blvd	Beach 118th Street to Beach 120th Street	31 ft	2-way	1	
Rockaway Beach Blvd	Beach 120th Street to Beach 124th Street	40 ft	2-way	1	
Rockaway Beach Blvd	Beach 124th Street to Beach 125th Street	40 - 45 ft	2-way	1	
Rockaway Beach Blvd	Beach 125th Street to Beach 126th Street	45 - 50 ft	2-way	1	
Rockaway Beach Blvd	Beach 126th Street to Beach 127th Street	55 - 60 ft	2-way	2	8 -14 ft
Rockaway Beach Blvd	Beach 127th Street to Beach 140th Street	60 ft	2-way	2	14 ft
Rockaway Beach Blvd	Beach 140th Street to Beach 141st Street	65 ft	2-way	2	16 ft
Rockaway Beach Blvd	Beach 141st Street to Beach 149th Street	70 ft	2-way	2	20 ft

Appendix C :

Public Transportation

Subway Lines Information

A Line

The A Line, known as the 8^{th} Avenue Express, runs between Inwood/207^{th} Street in Manhattan and Ozone Park/Lefferts Boulevard or Far Rockaway and sometimes Rockaway Park (during rush hours), Queens.

It makes stops within the study area at 104^{th} Street station, 111^{th} street station, and Ozone Park/Lefferts Boulevard stations.

The line which also runs to the Rockaways, makes stops within the study area at Aqueduct/North Conduit Avenue (southbound) /Aqueduct Racetrack (northbound), Howard Beach/JFK Airport (connection with Airtrain to JFK Airport), and Broad Channel subway stations.

After the Broad Channel station, the A train route splits into two routes: to Far Rockaway and to Rockaway Park. The A train route proceeding to Far Rockaway does not stop within the area of study. The A train proceeding to Rockaway Park terminus station makes stops during the weekday rush hours in the peak direction at Beach 90^{th} Street, Beach 98^{th} Street, Beach 105^{th} Street and Rockaway Park/Beach 116^{th} Street stations within the study area.

J and Z Lines

The J and Z subway lines travel along the same subway line and through the same subway stations. The J and Z routes, called Nassau Street Express, run between Jamaica Center, Queens, and Broad Street, Manhattan, during weekday rush hours in the peak direction. On evenings, weekends, and late nights, the J runs run between Jamaica Center and either Broad Street or Chambers Street in Manhattan, making all local stops. The Z line does not operate outside of weekday rush hours.

The J and Z trains make stops within the study area at the 75^{th} Street station, 85^{th} Street-Forest Parkway station, Woodhaven Boulevard station, 104^{th} Street station, 111^{th} Street station, and 121^{st} Street station. These station stops are all located along Jamaica Avenue. The subway line is elevated within the study area.

S Shuttle

Known as the Rockaway Park Shuttle runs between Broad Channel and Rockaway Park in Queens. While the A route operates between Broad Channel station and Rockaway Park/Beach 116^{th} Street station during the rush hours, at other times, passengers must transfer from the A train at Broad Channel station for the S shuttle train which makes all A train stops between Broad Channel station and Rockaway Park/Beach 116^{th} Street station. The stops are: Broad Channel station, Beach 90^{th} Street station, Beach 98^{th} Street station, Beach 105^{th} Street station, and Rockaway Park-Beach 116^{th} Street station.

Bus Information

1) Q56: Jamaica Avenue

This bus route operates between 171^{st} Street/Jamaica Avenue, Jamaica, and Broadway Junction/East New York.

The Q56 route utilizes Jamaica Avenue when traveling within the study area.

2) Q24: Atlantic Avenue/ Broadway

The bus route extends between Archer Avenue/168th Street, Jamaica, and Lafayette/Patchen Avenues, Brooklyn.

Within the study area, the Q24 travels along Atlantic Avenue.

3) Q8: 101st Avenue

The Q8 bus route operates between Euclid Avenue, East New York, and 165th Street Bus Terminal, Jamaica.

Within the study area, the Q8 route runs entirely along 101st Avenue.

4) Q112: Liberty Avenue

The bus route operates between Parsons Boulevard, Jamaica, and Rockaway Boulevard, Ozone Park.

Within the study area, the bus route travels along Liberty Avenue, 100th Street, and Rockaway Boulevard.

5) Q41: 127th Street/111th Avenue

The bus route operates between 164th Avenue/Cross Bay Boulevard, Lindenwood, and 165th Street Bus Terminal, Jamaica.

6) Q7: Rockaway Boulevard/ Pitkin Avenue

The bus route operates between Euclid Avenue, East New York (at the borough boundary) and 148th Street/South Cargo Road, JFK Airport.

7) B15: Marcus Garvey Boulevard/New Lots Avenue/JFK Airport

This bus route provides service between Broadway/Marcus Garvey Boulevard, Brooklyn, and either JFK Airport, Queens, or Brooklyn General Mail Facility, Brooklyn (Spring Creek area).

8) Q11: Woodhaven Boulevard

The route operates between Woodhaven Boulevard, Elmhurst, and either 164th /99th Streets, Howard Beach, or 164th Avenue/104th Street, Hamilton Beach, daily. Additional service is provided between Woodhaven Boulevard, Elmhurst, and Rockaway Boulevard, Ozone Park.

9) Q53: Woodside/ Rockaway Park Limited

The Q53 bus route runs between Woodside - 61st Street and Rockaway Park/Beach 116th Street, Rockaway Park.

10) Q21: Cross Bay Boulevard

The bus route travels between Rockaway Boulevard, Ozone Park, and Beach 116th Street/Ocean Promenade, Rockaway Park.

11) Q37: 111th Street/ 135th Avenue
This bus route operates between Kew Gardens - Union Turnpike, Kew Gardens and 131st Street/135th Avenue, South Ozone Park.

12) Q10: Lefferts Boulevard/ JFK Airport
Overall, the Q10 bus route operates between Union Turnpike, Kew Gardens and Central Terminal Area, JFK Airport. Additional service operates between Union Turnpike and Lefferts Boulevard/Rockaway Boulevard or 150th Avenue/130th Street, South Ozone Park.

13) Q22: Rockaway Beach Boulevard/Beach Channel Drive
The Q22 bus route operates between Far Rockaway - Mott Avenue, Far Rockaway and Beach 169th Street/Rockaway Point Boulevard, Roxbury.

14) Q35: Rockaway Park/ Brooklyn College
The Q35 bus route runs between Beach 116th Street/Newport Avenue, Rockaway Park and Flatbush Avenue - Brooklyn College, Midwood.

15) QM15: Lindenwood/ Midtown (Queens Express Bus Service)
The QM15 bus route operates between 157th Avenue/ 92nd Street, Lindenwood and East 57th Street/ Third Avenue, Manhattan.

16) QM16: Neponsit/ Midtown (Queens Express Bus Service)
The QM16 bus route operates between Rockaway Beach Boulevard/ Beach 147th Street, Neponsit and East 57th Street/ Third Avenue, Manhattan.

17) QM17: Far Rockaway/ Midtown (Queens Express Bus Service)
The QM17 bus route operates between Beach 21st Street/ Mott Avenue, Far Rockaway and East 57th Street/ Third Avenue, Manhattan.

18) QM23: Brooklyn Manor/ Midtown (Queens Express Bus Service)
The QM23 bus route operates between Jamaica Avenue/ 102nd Street, Brooklyn Manor and 33rd Street/ Seventh Avenue, Manhattan.

Appendix D :

Literature Search

Information on design guidelines and standards for bicycle facilities has been gathered for the literature search section of the Woodhaven – Cross Bay Bicycle Corridor Study. Innovative solutions from other cities of the Unites States such as San Francisco, Seattle, and Portland etc. were also researched and incorporated into the report.

New York City Bicycle Master Plan Document

The guidelines of the 1997 Bicycle Master Plan were developed to create a framework for roadway designers and planners. The guidelines are based on national guidelines and examples of existing or proposed facilities in the city with particular attention paid to the national standards as defined by the American Association of State Highway and Transportation Officials (AASHTO) Guide to the Development of Bicycle Facilities, by the Manual on Uniform Traffic Control Devices (MUTCD), by the Federal Highway Administration, by the Guidelines for Greenways (Greenway Collaborative), by the Design and Maintenance Manual for Multi-Use Trails (Rails-to-Trails Conservancy), and by the Guidelines for Establishing In-Line Skate Trails in Park and Recreation Areas (International In-Line Skating Association).

AASHTO requires that the minimum bicycle lane width be 4 feet. In the case of curbed streets with a parking lane, bicycle lanes should never be located between the curb and parking lane so that visibility could be preserved and so that left turns would still be permitted. It is also recommended that the bicycle lane is 5’. Where parking is permitted but there is no lane for it, a combination lane for cycling and parking should be at least 12’. There must also be a 4’ clearance between the edge of gutter pavement and the motor vehicle lane. On highways without a curb or gutter, bicycle lanes should be located between the travel lane and shoulder with a minimum width of 4’, though 5’ is preferable.

In New York City, the 1978 Bikeway Planning and Policy Guidelines for New York City document recommended a minimum bicycle lane width of 3 feet 6 inches though 4 feet was preferable. Newer on-street lanes have surpassed these recommendations allowing variable bicycle lane widths of 5 to 6 feet and a buffer to separate the bike lanes from the travel lane.

The Bicycle Master Plan identifies two kinds of signed bicycle routes: short routes that connect dispersed bicycle facilities and longer routes which are also called touring routes. Signed routes are indicated with MUTCD signage. Signs from the city’s greenway system developed by city planning are also often used. Roadways with wide curb lanes are acceptable for signed routes. AASHTO recommends a minimum 12 feet though 14 feet is ideal. However, where vehicles travel faster, there should also be a larger separation between the travel and bicycle lanes.

As far as markings are concerned, the MUTCD has provided national standards for the three sign categories that affect motorists, pedestrians and cyclists: Regulatory, Warning, and Guidance Signs. Regulatory signs should convey traffic laws or regulations. Designated bicycle lane signs should be visible before the beginning of the bicycle lanes in order to indicate to motorists of the presence of cyclists. Warning signs serve the purpose of warning cyclists of the potentially hazardous conditions ahead. These signs should be limited to areas where the hazard is not immediately obvious to avoid overuse of the sign. Guidance signs provide cyclists with information such as route identification and direction. Most states conform to the MUTCD standards.

AASHTO Guide to the Development of Bicycle Facilities Document

Shared Roadways

AASHTO recommends that bicycle-safe design practices should be considered for implementation when developing new roadways, though it acknowledges that many roads were nonetheless designed without any consideration for bicycles. In order to make roadways compatible with bicycle travel, they recommend including "bicycle-safe drainage gates and bridge expansion joints, improved railroad crossings, smooth pavements, adequate sight distances, and signal timing detector systems that respond to bicycles" (page 16). AASHTO acknowledges that width is the "most important variable" in the compatibility between roadways and bicycle traffic. It delineates the following recommendations:

- Paved Shoulders

AASHTO recommends a useable width of 4 feet where possible, though any width of shoulder is better than having none. Further, it is recommended that the shoulder should be 5 feet from the face of a guardrail and that additional width should be provided where vehicles travel in excess of 50 mph, where there is a high percentage of trucks, buses, and recreational vehicles, and where there are static obstructions. Rumble strips and raised pavement markers are not recommended on shoulders for cyclists' use unless there is a clear path of 1 foot from the rumble strip to travel lane, 4 feet from the rumble strip to the edge of the paved shoulder, or 5 feet to the guardrail.

- Increased Lane Width

Wide curb lanes are preferable where paved shoulders are not available. An outside curb lane of 12 feet can support both vehicle traffic and cyclists while providing enough room for vehicles to pass cyclists without having to change lanes. 14 feet of usable lane width is recommended, though it should be extended to 15 feet where there are steep inclines for cyclist maneuvering space. However, wide lanes in excess of 14 feet may encourage more than one vehicle to occupy the same lane, which can detract from bicycle space. Where more than 15 feet is provided, bicycle lane striping should be considered.

- On-Street Parking

In urban settings, many cyclists use the space between the parking lane and travel lanes, which expose them to moving vehicles and such dangers as opening car doors and vehicles entering or exiting parking spaces. AASHTO recommends a minimum of 12 feet combined parking and bicycle travel lane width.

- Pavement Surface Quality

Pavement surfaces should be smooth and uniform in width in order to provide the maximum comfort, safety, and speed for cyclists.

- Drainage Inlet Grates

Bicycle-safe drainage inlets should be used and should not be placed with grates parallel to the roadway in order to prevent trapping of bicycle wheels.

- Signed Shared Roadways

Prior to signing a route for bicycle usage, AASHTO recommends that the route can provide direct travel in bicycle-demand corridors, that it connects discontinuous segments of other paths, that traffic control devices give priority to cyclists, that street parking has been removed or reduced, that the surface is smooth, that the road will be maintained regularly, that wider curb lanes are provided than along parallel roads, and that these curb lanes meet the recommendations of 14 to 15 feet of usable space.

- Designating Sidewalks as Shared Bikeways

AASHTO acknowledges that it is not optimal for cyclists and pedestrians to share the sidewalk. This option should only be considered if the bikeway provides bikeway continuity between high speed or high traffic roadways and is uninterrupted by driveways or intersections for long distances. It can also be considered for long, narrow bridges. All unnecessary obstacles should be removed from the sidewalk. Curb cuts should be flush with the street and should be wide enough to accommodate adult tricycles or two-wheeled bicycle trailers.

- Signing of Shared Roadways

In order to make signs of a signed bicycle route more effective, it is recommended that they also point in the direction of high demand destinations such as “To Downtown.” It can also be used to direct cyclists toward the next logical destination or away from certain sections of a highway. In urban settings, signs are typically spaced out every ¼ mile.

- Bicycle Lanes

Bicycle lanes provide cyclists with a preferable traveling space while making both cyclist and motor vehicle behavior more predictable. For most circumstances, these should be single lane and should carry cyclists in the same direction as motor vehicles in the adjacent travel lane. These should generally be placed on the right side of the street as placing them on the left side can be unfamiliar and unexpected for motorists. Left side bike lanes should only be used where it reduces the number of traffic conflicts or where there are a significant number of left-turning cyclists.

- Bicycle Lane Widths

Bicycle lanes should be 4 feet where there is no curb and/or gutter. Where there is a parking lane, the bicycle lane should be between the parking lane and travel lane and should be a minimum 5 feet in width. Where parking is permitted but there are no parking stripes or stalls, the shared use area should be at least 11 feet without a curb face or 12 feet with, and an additional 1 – 2 feet is recommended where there is high volume or turnover. The bike lane should never be placed between the parking lane and curb.

Bicycle lanes should be free of structures and should be 5 feet’ in width where there is a curb face or guardrail. They should have a minimum rideable surface width of 3 feet in order to accommodate for gutter pans. They can be 4 feet where the area beyond the paved shoulder can provide additional maneuvering width. 5 feet is preferable where there is substantial truck traffic or where vehicles travel in excess of 50 mph. There should be a 6-inch white line separating the bicycle lane from the travel lane, though some jurisdictions require 8 inches for better distinction. A 4-foot white line can be used to separate the parking lane from the bike lane, which can encourage parking closer to the curb. There should be adequate drainage in order to prevent flooding in bicycle lanes.

Innovative Designs

Portland, Oregon : Colored Bicycle Lanes

In 1999, the City of Portland's Office of Transportation initiated a study using colored pavement markings -specifically, solid-blue-colored bike lanes - in order to determine whether it could reduce the number of bicyclist-motorist conflicts at certain crossing areas. It focused specifically on exit ramps, right-turn lanes, and entrance ramps.

The study concluded that most behavior changes amongst cyclists and motorists were positive. There was an increased use by cyclists of the colored path recommended path which the Office of Transportation found encouraging. However, they also noticed that the use of colored paths created a false sense of security. While it did improve cyclist confidence, it also contributed to a decline in cyclist caution - the study counted fewer cyclists turning their heads to make sure there was no oncoming traffic or using hand signals to notify motorists that they were turning.

These results were similar to what had been found by the City of Montreal in 1996.

The entire study can be found at: http://www.portlandonline.com/shared/cfm/image.cfm?id=58842

California Department of Transportation

Source: http://www.dot.ca.gov/hq/traffops/survey/pedestrian/TR_MAY0405.pdf

- Bicycle Lane-Parking Lane Conflicts

As noted above, conflicts may arise between the bicycle lane and parking lane. Motorists opening their doors or vehicles entering or exiting the parking lane may be hazardous to cyclists. As a result, some cyclists will ride in the travel lane just outside the bicycle lane in order to avoid such hazards from parked cars.

The California Department of Transportation has proposed several solutions to this problem:

a- Minimize the parking lane width to 7 feet and/or widen the bike lane width to 6.5 feet based on research showing that narrower parking lanes is correlated with vehicles parking closer to the curb.

b- Mark parking spaces with cross hatches to denote parking lane limits and to guide drivers closer to the curb.

c- Place bicycle route stencils where there is a parking lane that can be used to inform drivers in the travel lane that they have to share the road with cyclists.

d- Angled parking should be avoided where there is high bike traffic. However, one option is to have reverse angled parking, requiring drivers to back into the parking space, which allows greater visibility of bicyclists as drivers enter or leave.

- Shared-Use Arrows

On shared-use roads, cyclists trying to avoid vehicles in the parking lane often ride closer to the center of the travel lane. Vehicles may become a hazard as a result of drivers that are unaware of this allowed use. A study conducted by the San Francisco Department of Parking and Traffic found that using shared-use arrows, or "sharrows," to notify both drivers and cyclists of the allowed shared use has found that it improved both drivers' and cyclists' positions on the roadway and reduced sidewalk or wrong-way riding.

<u>Oregon Bicycle and Pedestrian Plan</u>

Source: http://www.oregon.gov/ODOT/HWY/BIKEPED/docs/bp_plan_2_ii.pdf

- Bicycle Boulevards

Bicycle boulevards allow cyclists and drivers to share the same road while giving priority to through bicycle movement. They can act as traffic calming devices, slowing down motor vehicle traffic. They can also improve travel conditions for pedestrians by reducing traffic and improved crossings. However, there are downsides to the boulevard. They can cause traffic to build up on other streets and are often located on streets that do not provide direct access to cyclist destinations. Recommendations for successful bicycle boulevards include turning stop signs toward intersecting streets so that bicycle through traffic is mostly uninterrupted and using directional signs to point cyclists toward nearby destinations and alerting motorists of cyclist presence.

- Raised Bicycle Lanes

A raised bicycle lane is separated from the travel lane with a slight incline. The separation provides more safety to cyclists and it lets drivers know when they have strayed from the travel lane as they feel the bump from the raised lane. Being that it is mountable, it also allows cyclists to enter and exit as necessary, and novice cyclists become more likely to stay in the bike lane rather than the sidewalk. The downside of the raised bike lane, however, is that it is expensive to construct. On the other hand, it is subjected to much less wear and tear than a normal road and is much easier to maintain than the travel lane. Where there is parking, it is still recommended that the raised bike lane goes between the travel lane and parking lane.

- Bicycle Lanes and Bus Lanes

While bicycles and buses can normally share the same road space, areas where there is higher bus and bicycle traffic it should be considered to separate the two with lanes. Bus lanes should be located closest to the curb, extending to the face, while the bike lane remains between the bus lane and travel lane.

<u>City of Toronto Bicycle Plan – Shifting Gears</u>

Source: http://www.toronto.ca/cycling/bikeplan/pdf/chapter04.pdf

- Bicycle Actuated Signals

In 1995, the former Metro Transportation Department began adjusting the sensitivity of the sensors so that bicycles would also be able to actuate the signal. In order to alert cyclists as to which signals could be actuated, three white dots were stenciled as pavement markers. However, it turned out that many cyclists did not even know what the purpose of those dots was, nor did they know how to use them properly. Other solutions for traffic signals that have been proposed include using video detectors or push buttons located close to the bike lane so cyclists do not need to dismount to actuate a green light.

- Bicycle Exemption

Another innovative option Toronto has considered is the exemption of bicycles from certain traffic regulations. While the Highway Traffic Act states that bicycles are required to follow the same regulations as motor vehicles, there are some circumstances in which the rules do not make sense for bicycles. The example brought up in Shifting Gears is that of restricting through traffic from quiet residential neighborhoods - a regulation that shouldn't apply to bicycles, which do not make as much noise as motor vehicles. For this to be implemented, however, there would need to be an exhaustive review of each law in order to determine which ones should apply to bicycles and which should not.

Seattle Bicycle Master Plan

Source: http://www.seattle.gov/transportation/docs/bmp/final/AppendixE.pdf

- Climbing Lanes

Not all topography is equally level. One solution that Seattle has looked into is using climbing lanes, where there is a 5-foot bike lane on one side of the incline and a designated shared-use lane on the other. This is designed so that uphill bicyclists moving at a slower pace in their separated, uphill bike lane can easily be passed by drivers. Meanwhile, fast-moving downhill bicyclists can share the road with cars in order to avoid the hazards posed by parked vehicles.

- Bikes on Buses

In order to improve multimodal transit, several agencies have equipped buses with front-mounted bicycle racks able to hold two bicycles at a time. However, these have often been limited only to a select few routes rather than all. These bikes can be loaded and unloaded without much delay and specially-designed racks prevent the bikes from obstructing the bus's headlights. In most instances, bikes are not allowed inside the bus itself.

Cities that have used this method include Sacramento (California), Portland (Oregon), and Washington, D.C.

Links to each specific program can be found at: http://www.bicyclinginfo.org/transit/solutions-buses.cfm

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