# DOWNTOWN FLUSHING
## MOBILITY AND SAFETY IMPROVEMENT PROJECT

## EVALUATION REPORT


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# Contents

# Downtown Flushing Mobility and Safety Improvement Project
**Evaluation Report**

## Executive Summary

Downtown Flushing is a thriving community with a dense concentration of businesses and residences. The area serves as one of the largest intermodal transportation hubs in New York City with the Flushing-Main Street stop of the No. 7 subway line, the Long Island Railroad (LIRR), and 20 New York City Transit Authority (NYCT) and Metropolitan Transportation Authority (MTA) Long Island bus lines all converging in the downtown. With the density of development and transit options, the area's sidewalks are overcrowded and the traffic network is clogged. Moreover, certain intersections have proven to be problematic for both pedestrians and vehicles, particularly Union Street and Northern Boulevard, which had the highest number of pedestrian accidents in the entire borough in 2009.

The New York City Department of Transportation (NYCDOT) has been working with elected officials, Community Board (CB) 7, local businesses, MTA/NYCT and New York City Economic Development Corporation (NYCEDC) to address transportation and pedestrian issues throughout the downtown area. Specifically, NYCDOT developed improvement measures (the "project") to enhance mobility and safety for all street users (pedestrians, transit riders and motorists).

NYCDOT evaluated three scenarios to determine how to best achieve its goal and serve Downtown Flushing. The scenarios were:

- One-way Pair with Contra-flow Bus Lanes on Main and Union Streets;
- True One-way Pair (no contra-flow bus lanes); and
- Modified Two-way Operation.

After careful review and analysis of each scenario, NYCDOT, in consultation with elected officials, CB 7, local business, MTA/NYCT and NYCEDC, implemented the Modified Two-way Operation scenario in July 2010. Overall, the project improved mobility of vehicles and pedestrians while also showing positive safety results. The following are key findings from the report:

### Mobility

- Vehicular levels of service (LOS) improved at nine of the intersections in the study area during the AM peak hour and seven during the PM peak hour. LOS was maintained at the remaining intersections, with only one decrease during the AM peak hour.
- Travel speeds along the eastbound and westbound Northern Boulevard increased by 16% and 15% in the PM peak hour, respectively, and 34% and 37% in the Saturday Midday peak hour.
- Turn prohibitions eliminated vehicle-pedestrian and vehicle-vehicle conflicts and improved traffic operations.
- Bus passengers benefit from reduced traffic congestion and improved pedestrian environment.

## Safety

- Crashes with injuries in the study area declined by 20% compared with the average of the three prior years.
- Total injuries decreased by 29%.
- Injuries to motor vehicle occupants decreased by 55%, a statistically significant improvement.
- Area-wide pedestrian injuries were down 8%.
- At the intersection of Northern Boulevard and Union Street, pedestrian injuries were down 18%, while at Roosevelt Avenue and Main Street, they were down 29%.

Given the safety and mobility improvements, NYCDOT recommends that changes implemented as part of the project be maintained. NYCDOT will continue to work with all stakeholders to further enhance safety and mobility of all street users as future developments continue to flourish in this vibrant and dynamic area. Future changes could include enhancing the Main Street corridor by upgrading the operational treatments (i.e., corner extensions using painted marking and flexible delineators) used in the project through future capital programs.

# Downtown Flushing Mobility and Safety Improvement Project

This report is organized into the following sections:

- Introduction – provides a brief overview of the study background;
- Pre-Project Conditions – presents a synopsis of the pre-project condition safety and operational issues
- Development of Improvement Scenarios - describes details of the developments of Modified Two-way Operation and other improvement alternatives;
- Project Evaluation - presents the findings of the project by comparing the pre- and post-implementation conditions;
- Conclusion - summarizes findings of the monitoring program; and
- Recommendations - proposes the project to become permanent.

## 1.0 Introduction

Downtown Flushing and its surrounding areas contain a dense mix of land uses including commercial, residential, institutional, recreational and industrial. The downtown area is a vibrant center of retail and commercial activities that contains national chains (i.e., Macys, Old Navy) as well as an enormous variety of retail stores, food establishments, convenience stores, and neighborhood services. Although found throughout the study area (see Figure 1 for study area boundaries), commercial uses are concentrated along the major thoroughfares—Main Street (the commercial spine of the neighborhood), Union Street, Northern Boulevard, Roosevelt Avenue, and Kissena Boulevard. Due to the density of uses within the area, Flushing ranks as the fourth largest central business district in the city.

The No. 7 subway line with its terminal station at the Main Street-Flushing station, the LIRR station on the Port Washington Branch, 20 bus lines connecting Flushing to other parts of Queens and Nassau County, and also to the Bronx, and motor vehicles make Downtown Flushing a most significant hub for transit and commercial activities.

With the density of uses and transit options, the area has experienced extreme vehicular and pedestrian congestion with concomitant safety issues at specific locations. Moreover, development projects within the downtown Flushing area as well as other future developments (i.e., Flushing Commons at Municipal Lot 1, Willets Point Urban Renewal Area) could add significant vehicular and pedestrian traffic. The NYCDOT and other stakeholders recognized that these compounding pressures—existing pedestrian and traffic congestion coupled with significant future developments—intensified the need for a comprehensive traffic plan that addressed existing safety concerns and improved mobility of all street users. The NYCDOT developed the project, which is described in detail below, to address both of these issues.

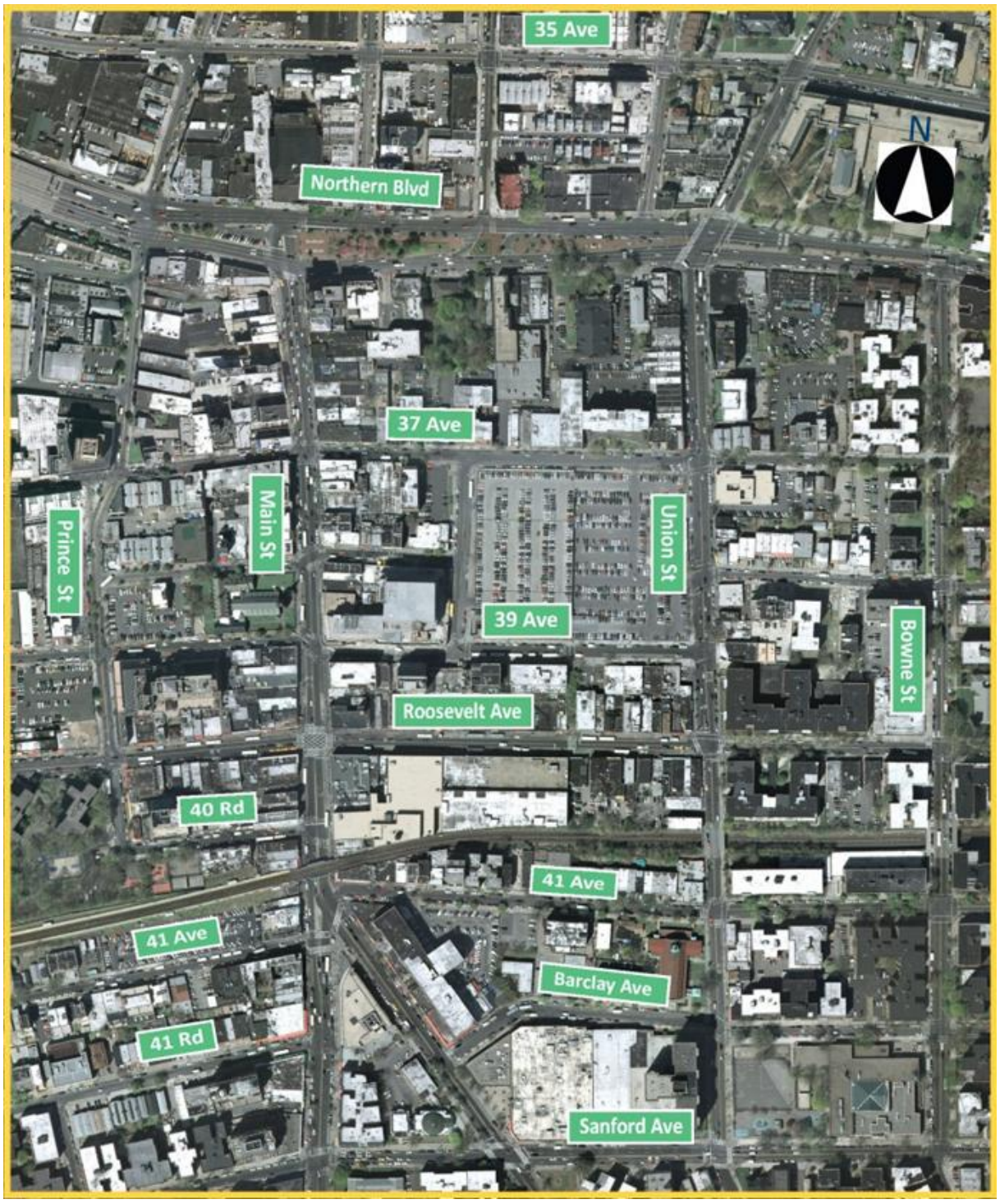



Figure 1 Study Area

## 2.0 Pre-Project Conditions

The Downtown Flushing street network is a typical north-south and east-west grid except Kissena Boulevard which is diagonally connected with Main Street. Beginning on the west, College Point Boulevard, Prince Street, Main Street, and Union Street serve as the major north-south streets, with Main Street serving as the primary commercial and transportation corridor. Northern Boulevard and Roosevelt Avenue are the major east-west streets, with 37th, 38th, 39th, 41st, and Sanford Avenues serving as minor streets that carry low volume of traffic. Most of the east-west minor streets are one-way streets that consist of one travel lane along with parking on both sides of the street. The capacity of Main Street, Roosevelt Avenue, and Kissena Boulevard is very limited due to the heavy bus transit activities, double parking, and significant vehicle-pedestrian conflicts.

Downtown Flushing has been experiencing the following significant transportation-related challenges:

- Traffic congestion along Main Street from Kissena Boulevard/41st Avenue to Northern Boulevard, Northern Boulevard from Prince Street to Union Street, Union Street from Northern Boulevard to Roosevelt Avenue, and Roosevelt Avenue between Main and Union Streets.


Eastbound Northern Boulevard at Main Street


Eastbound Roosevelt Avenue at Main Street


Northbound Main Street at 40th Road

Southbound Union Street at Northern Boulevard


37th Avenue at Main Street


39th Avenue between Main and Prince Streets

- Traffic congestion resulting from conflicts between vehicles (particularly oversized vehicles such as buses and trucks) making left and right turns at major intersections across continuous streams of pedestrians in crosswalks, specifically at the intersection of Main Street and Roosevelt Avenue where approximately 8,000 pedestrians in the weekday midday peak hour and 7,500 pedestrians in the weekday PM peak hour were counted in June 2010.


Main Street and Roosevelt Avenue


Northern Boulevard and Union Street

- Approximately 97,000 pedestrians were counted along Main Street between Roosevelt and 41st Avenues during 8 AM and 8 PM in 2007[1].

East Sidewalk on Main Street at 41st Avenue


West Crosswalk on Main Street at 40th Road

[1] Gehl Architects/Urban Quality Consultants' Public Space/Public Life Survey in Fall 2007

- The downtown area serves as a major intermodal transfer facility, with over 50,000 transit riders transferring every workday between the 20 bus routes and No.7 subway/LIRR. These transfers cause congestion and crowding on streets and sidewalks.

Eastbound Roosevelt Avenue at Main Street

Bus Stops and Subway Entrance on Roosevelt Avenue

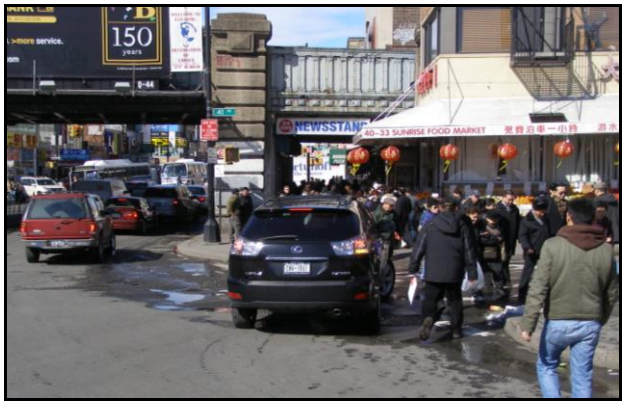
- Transit riders waiting to board buses along both sides of Main Street between Kissena Boulevard/40th Road and 39th Avenue create sidewalk congestion and narrow the effective sidewalk width, particularly on sidewalks just north and south of Roosevelt Avenue. In addition, subway stairwells on Main Street further reduce sidewalk space.


West Sidewalk on Main Street at 40th Road

East Sidewalk on Main Street at 39th Avenue

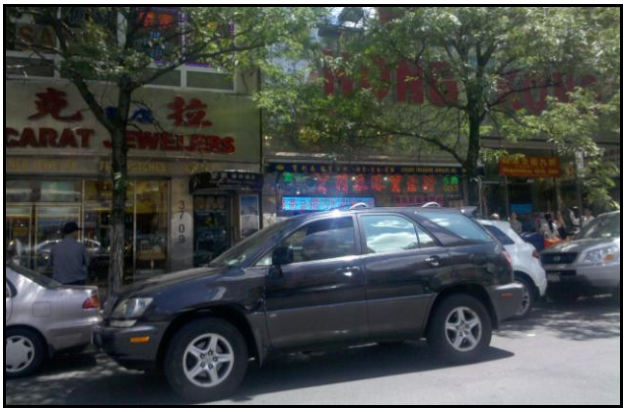
- Vehicle-pedestrian conflicts and pedestrian standing or walking in the street due to sidewalk overcrowding create a substandard pedestrian environment.

Main Street and 40th Road




Main Street and Eastbound 41st Avenue

- Parking shortages cause excessive circulation by vehicles looking for hard-to-find spaces either on-street or within the area's off-street parking facilities.



Main Street at 37th Avenue

Main Street at 38th Avenue

# 3.0 Development of Improvement Scenarios

The following scenarios were evaluated to address the existing condition issues as identified in Section 2.0, and improve safety and mobility of all street users (pedestrians, transit riders, and motorists):

- One-way Pair with Contra-flow Bus Lane on Main and Union Streets;
- True One-way Pair (without contra-flow bus lane); and
- Modified Two-way Operations

## *3.1 One-way Pair with Contra-flow Bus Lane on Main and Union Streets*

### *3.1.1 Scenario Description:*

The One-way Pair with Contra-flow Bus Lane scenario included the following recommendations:

- Main Street one-way northbound and Union Street one-way southbound between Sanford Avenue and Northern Boulevard
- Northbound contra-flow bus lanes on Main Street between Kissena Boulevard and Northern Boulevard, and southbound contra-flow bus lane on Union Street between Roosevelt Avenue and Northern Boulevard
- Parking prohibitions along both curbs of Main Street, west curb (contra-flow bus lane) of Union Street, south curb of Northern Boulevard approaching Union Street, as well as daylighting at various locations
- Maintain two general travel lanes on northbound Main Street between Kissena Boulevard and Northern Boulevard, and southbound Union Street between Northern Boulevard and Roosevelt Avenue

### *3.1.2 Issues:*

While the scenario would have improved bus transit operations, it would have:

- Worsened mobility and increased congestion, particularly along Main Street, due to the reduction in general travel lanes from existing four northbound lanes (both Main and Union Streets carry two travel lanes) to only a total of two northbound lanes on Main Street
- Adversely affected northbound bus transit service on Main Street due to increased congestion
- Increased vehicular and pedestrian conflicts by adding turning volumes at Northern Boulevard/Union Street, Northern Boulevard/Main Street, and Sanford Avenue/Union Street
- Provided very limited opportunities for sidewalk widening and improved pedestrian environment
- Eliminated curbside loading/unloading activities along Main Street
- Compromised pedestrian safety due to contraflow bus lanes
- Limited signal timing, phasing and coordination improvements because of the contra-flow bus lanes

### *3.2 True One-way Pair (without contra-flow bus lane) on Main and Union Streets*

*3.2.1 Scenario Description:*

After recognizing the potential safety and operational issues associated with the One-way Pair with Contra-flow Bus Lane, as well as its ineffectiveness of improving the pedestrian environment (i.e., sidewalk widening, bulb-outs), a True One-way Pair scenario was initiated by NYCEDC in conjunction with NYCDOT, MTA/NYCT and other stakeholders. The True One-way Pair scenario required:

- Converting Main Street one-way northbound and Union Street one-way southbound between Sanford Avenue and Northern Boulevard (no contra-flow bus lanes)
- Four travel lanes including curbside bus lane along Main Street with off-peak hour loading/unloading parking regulations along the west curb
- 40th Road one-way westbound between Main Street and Prince Street and Prince Street one-way northbound between 40th Road and Roosevelt Avenue
- Widening the sidewalks along Main Street between Kissena Boulevard/41st Avenue and Northern Boulevard, and along Union Street between Northern Boulevard and Roosevelt Avenue
- Reducing the number of signal phases and added pedestrian walk time at critical intersections (i.e., Northern Boulevard/Main Street, Northern Boulevard/Union Street), as well as enhanced signal coordination
- Rerouting of southbound Main Street and northbound Union Street buses (e.g., most of the southbound buses on Main Street would be diverted to Union Street)

The improvements recommended as part of the True One-way Pair were projected to:

- Improve mobility and reduce congestion along northbound Main Street
- Reduce vehicle-pedestrian and vehicle-vehicle conflicts
- Decrease sidewalk overcrowding by providing sidewalk widening
- Simplify signal phases at two critical intersections (Northern Boulevard/Main Street and Northern Boulevard/Union Street) and improve signal coordination
- Minimize curbside parking removal along Union Street and provide curbside loading/unloading during off-peak hours along Main Street

*3.2.2 Issues:* After a review of the traffic simulation study, rerouted buses, and additional turning vehicles, the stakeholders concluded that the True One-way Pair scenario would not achieve the goals set out at the beginning of this report. First, MTA/NYCT would have had to have made significant changes to the bus routes through the downtown area, which would have exacerbated existing pedestrian and vehicle conflicts. As Table 1 shows, the number of turning vehicles, including buses, would have dramatically increased at high pedestrian locations, significantly compromising pedestrian safety and mobility. Bus hourly volumes making the right turn from Main Street onto Roosevelt Avenue would have increased by 425% (from 8 to 42 in the peak hour of 5 - 6 PM). In the existing condition, there are no MTA/NYCT buses making the southbound through and eastbound right turn movements at the intersection of Roosevelt Avenue and Union Street. However, as a result of rerouting, each movement would have significantly increased in bus volumes from zero to 30 and 61 per hour, respectively.

Table 1 Turning Volume Comparison (Weekday PM Peak Hour): True One-Way Pair Scenario

| Movements | Existing Condition | True One-way Pair | Percent Change |
|---|---|---|---|
| Right turns from Eastbound Northern Boulevard onto Union Street | 405 | 925 | **128%** |
| Right turns from Southbound Union Street onto 37 Avenue | 480 | 635 | **32%** |
| Left turns from Southbound Union Street onto Roosevelt Avenue | 135 | 480 | **256%** |
| Right turns from Southbound Union Street onto Sanford Avenue | 440 | 840 | **91%** |
| Right turns from Westbound Kissena Boulevard onto Sanford Avenue | 155 | 240 | **55%** |
| Left turns from Westbound Kissena Boulevard at Sanford Avenue | 210 | 290 | **38%** |
| Bus Right turns from Northbound Main Street onto Roosevelt Avenue | 8 | 42 | **425%** |
| Bus Right turns from Eastbound Roosevelt Avenue onto Union Street | 0 | 61 | **N/A** |

The rerouting plan would not only have affected pedestrian safety, but also would have increased bus travel time and operating costs. As described earlier, Downtown Flushing serves as an important intermodal transfer point, largely due to the proximity of bus stops to subway entrances, and the True One-way Pair scenario would have diminished this advantage by increasing the walking distance for bus to subway transfers for southbound buses on Main Street.

Finally, the plan could not accommodate crucial NYCT/MTA bus needs:

- Dual bus lanes on Main Street between Kissena Boulevard/41st Avenue and 39th Avenue. If installed, this would have created an unacceptable level of congestion for non-transit vehicles on this street.
- A bus-only right-turn lane and a right-turn phase for buses to make right turn from eastbound Northern Boulevard (mainline) onto southbound Prince Street. This improvement would have required shifting the center median of the Northern Boulevard bridge and utilities. It also posed safety concerns for pedestrians faced with turning vehicles that would not comply with the turning restrictions.
- A bus stop median on Union Street at Roosevelt Avenue would have created safety and operational issues.

### *3.3 Modified Two-way Operation and Implementation*

As described above both the One-way Pair with Contra-flow Bus Lanes scenario and the True One-way Pair scenario each had significant operational and safety concerns that could not be resolved. As a third alternative, NYCDOT, in consultation with elected officials, CB 7, local business, MTA/NYCT

and NYCEDC, developed a Modified Two-way Operation scenario that, generally, maintained the existing street directions but prohibited turns at key intersections. This scenario was implemented in July 2010. Before and during implementation, NYCDOT collected data and conducted a detailed traffic analysis using Synchro 7 software for the weekday AM and PM peak hours. Nineteen intersections were selected for capacity and levels of service (LOS) analysis within the study area.

The Modified Two-way Operation scenario maintained the two-way operations on Main and Union Streets, and included the following improvement measures:

- No left turns from westbound Northern Boulevard onto southbound Main Street (except buses)
- No left turns from northbound/southbound Union Street onto Northern Boulevard
- No turns from northbound/southbound Main Street onto Roosevelt Avenue
- Curb and/or sidewalk extensions at locations with high pedestrian activities
- "No Standing Anytime" signs to improve safety and sight distance, and facilitate turning movements
- No left turns (except buses) from northbound Main Street onto 37th Avenue from 7 AM to 7 PM
- No left turns (except buses) from southbound Main Street onto 38th and 39th Avenues during 7-10 AM and 4-7 PM
- Extension of left-turn bay on westbound Northern Boulevard at Prince Street and additional green time to accommodate the rerouted vehicles
- Reconfiguration of the muni-parking lot in the center of Northern Boulevard west of Main Street between eastbound and westbound Northern Boulevard and relocation of parking lot access at westbound Northern Boulevard

Prior to implementing the project, the NYCDOT took a number of steps to make the community aware of the impending changes. The Borough Commissioner's office briefed the community board, elected officials, civic groups, the police department, the fire department, and local business groups. NYCDOT also:

- deployed Variable Message Signs (VMS) at seven locations starting the week of July 7, 2010 for a four-week period (started two weeks prior to the implementation of the project and lasted two weeks after implementation).
- received assistance from other agencies during the first weeks of implementation:
  - NYPD traffic agents were deployed during the first weeks of operations to enforce the new turning restrictions.
  - NYCT staff were deployed during the first weeks of operations to redirect bus passengers to new bus stop locations.
- distributed fliers throughout the community detailing new traffic patterns, changes to bus routes and bus stop locations, proposed turn prohibitions and the project's implementation date.


Figure 2 Implemented Improvement Measures as Part of the Project

The following section describes the specific changes made as part of the project.

### *3.3.1 Northern Boulevard and Prince Street*

- Extended westbound left turn bay on Northern Boulevard at Prince Street
- Modified signal timing and provided additional green time for left-turning vehicles during each peak period

### *3.3.2 Northern Boulevard and Main Street*

- Prohibited left-turns from westbound Northern Boulevard onto southbound Main Street except buses
- Relocated eastbound bus stop and removed parking on the south curb between Main and Prince Streets to create an eastbound right-turn lane on Northern Boulevard at Main Street
- Added three parking spaces on the north curb of Northern Boulevard at Main Street between two crosswalks (in front of RKO project site)
- Modified signal timing and phasing and coordinated signals
- Reconfigured the muni-parking field from 18 parking spaces to 10 parking spaces on Northern Boulevard between Main and Prince Streets and relocated the parking lot access to westbound Northern Boulevard

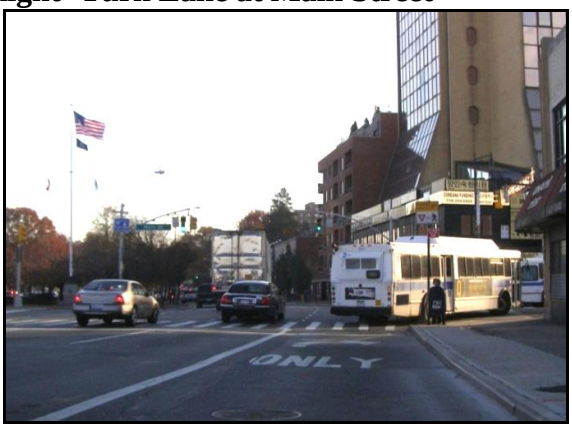
**Westbound Northern Boulevard Bus Left-Turn Lane at Main Street**

Pre-Implementation Condition

Post-Implementation Condition

**Eastbound Northern Boulevard Right -Turn Lane at Main Street**

Pre-Implementation Condition




Post-Implementation Condition

**Extended Westbound Northern Boulevard Left-Turn Lane at Prince Street**

Pre-Implementation Condition

Post-Implementation Condition

*3.3.3 Northern Boulevard and Union Street*

- Prohibited left turns from northbound and southbound Union Street onto Northern Boulevard
- Provided curb extension at the northwest corner of Northern Boulevard and Union Street to shorten crossing distance and improve pedestrian safety
- Installed a pedestrian countdown signal and provided additional walk time to improve the pedestrian crossing across Northern Boulevard
- Modified signal timing and phasing to improve traffic safety and operations

**Reduced Crosswalk Conflict at Northern Boulevard and Union Street**

Pre-Implementation Condition

Post-Implementation Condition

*3.3.4 Main Street and Roosevelt Avenue*

- Prohibited all turns from northbound and southbound Main Street onto Roosevelt Avenue, including buses, to eliminate vehicle-pedestrian conflicts at the east and west crosswalks and enhance pedestrian safety and mobility at these crosswalks
- Provided painted curb extensions at northwest, northeast and southeast corners of Main Street at Roosevelt Avenue to provide pedestrian storage
- Provided additional pedestrian space along Main Street between Roosevelt and 39th Avenues with flexible bollards to address overcrowding and improve pedestrian environment

**Corner Extension at Main Street and Roosevelt Avenue**

Pre-Implementation Condition

Post-Implementation Condition

**East Sidewalk Extension on Main Street between 39th and Roosevelt Avenues**

Pre-Implementation Condition

Post-Implementation Condition

- Daylighted the eastbound and westbound approaches of Roosevelt Avenue at Main Street to improve mobility
- Relocated taxi stand from south curb of Roosevelt Avenue to north curb to eliminate the congestion created by taxi activities and provide additional space for right turning vehicles
- Provided muni-meter parking on Roosevelt Avenue between Main Street and Prince Street
- Modified signal timing and coordination
- Provided new bus stops, extended layover areas and relocated bus stops on Main Street between Roosevelt and 39th Avenues
- Removed and relocated news racks/stands at the southeast and southwest corners of Main Street and Roosevelt Avenue to improve pedestrian mobility and safety

*3.3.5 Main Street and Kissena Boulevard*

- Prohibited parking along the west curb of Main Street approaching 41st Avenue to improve safety and traffic operations

*3.3.6 Main Street and 39th Avenue*

- Prohibited southbound left turns from Main Street onto eastbound 39th Avenue during 7-10 AM and 4-7 PM except buses to improve mobility and enhance pedestrian safety

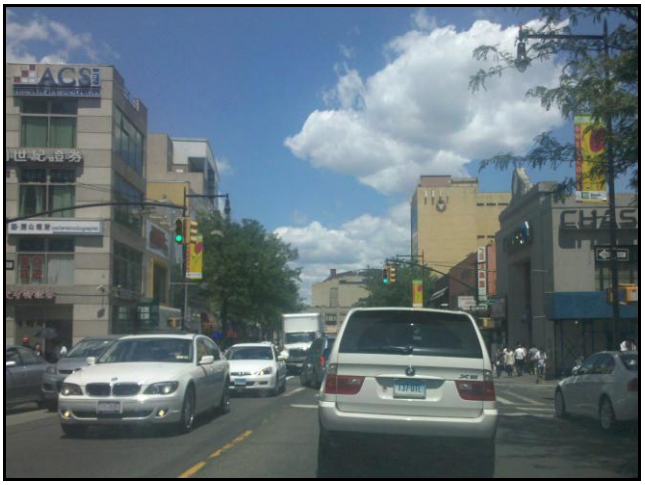
*3.3.7 Main Street and 38th Avenue*

- Daylighted southbound Main Street approach and eastbound 38th Avenue approach to reduce turning conflicts and improve safety and mobility of vehicular and pedestrian traffic
- Extended the hours of southbound left turn prohibition (from Main Street onto eastbound 38th Avenue) from 7 to 9AM (Monday through Friday) to 7 to 10AM except buses

*3.3.8 Main Street and 37th Avenue*

- Prohibited left turns from northbound Main Street onto westbound 37th Avenue from 7 AM to 7 PM except buses

**Northbound Left-Turn Prohibition Except Buses**



Pre-Implementation Condition

Post-Implementation Condition

- Daylighted northbound and southbound Main Street approaches at 37th Avenue, and northwest curb of 37th Avenue at Main Street to improve safety and turning radii for buses

*3.3.9 Union Street and Roosevelt Avenue*

- Daylighted westbound Roosevelt Avenue approach at Union Street to reduce turning conflicts and improve safety and mobility of vehicular and pedestrian traffic

*3.3.10 Union Street and 39th Avenue*

- Relocated the Q20/Q44 bus stops from Union Street to Main Street

*3.3.11 Signal Timing/Offset Modifications*

As part of the on-going monitoring efforts of the project, signal timings and/or offsets were modified along Prince Street between Roosevelt and 37th Avenue Avenues, 35th Avenue between Prince and Union Streets, and Main Street between 40th Road and Kissena Boulevard to improve safety and traffic operations, particularly for bus transit.

# 4.0 Project Evaluation

The project was implemented on July 18, 2010. In order to assess the effectiveness of the proposed improvement measures and how well the new network changes within the study area (particularly along Main Street, Northern Boulevard, Union Street and Roosevelt Avenue) achieved the project goals, NYCDOT collected pre-implementation condition traffic data during the first week of June 2010. Post-implementation data were collected during the first week of August and October 2010. The traffic data collection efforts included Automatic Traffic Recorder (ATR) counts, vehicle turning movement/classification counts, pedestrian counts, travel time and delay runs, and field observations. Manual counts were collected at 19 intersections within the study area for one midweek day during the AM (7:00 to 9:00 AM), midday (12:00 PM to 2:00 PM), PM (4:30 to 6:30 PM) and Saturday midday (12:00 PM to 2:00 PM) peak periods, concurrently with the ATR counts.

The pre-implementation condition traffic data and analysis created a baseline condition against which post-implementation operational and safety improvements would be assessed. NYCDOT determined that the traffic data collected in August 2010 were not representative of normal traffic condition as they were collected during the summer season. Therefore, the October counts (which represent normal traffic condition) were used in the analysis and assessment of post-implementation operation and safety improvements.

The major findings of the project are:

## *4.1 Levels of Service Analysis*

- Vehicular levels of service (LOS) improved at nine of the intersections in study area during the AM peak hour and seven during the PM peak hour. LOS was maintained at the remaining intersections, with only one decrease during the AM peak hour.

To evaluate the operational benefits of the improvement measures implemented as part of the project, capacity and levels of service (LOS) analyses were performed at 19 intersections in Downtown Flushing during the weekday AM (8-9 AM) and PM (5-6 PM) peak hours for the pre- and post-implementation conditions using the Synchro 7 software. The analysis results showed significant improvements in terms of intersection delay and LOS at several intersections during both analysis peak hours under the post-implementation conditions. As shown in Figures 3 and 4, the overall intersection LOS under the post-implementation condition when compared to the pre-implementation condition:

- improves at nine intersections during the AM and PM peak hours;
- remains unchanged to the pre-implementation condition at nine and ten intersections during the AM and PM peak hours, respectively; and
- deteriorates at one intersection (Northern Boulevard and Main Street) during the AM peak hour.


Figure 3 Intersection Levels of Service (LOS) Comparison - Weekday AM Peak Hour


Figure 4 Intersection Levels of Service (LOS) Comparison - Weekday PM Peak Hour

The pre- and post-implementation LOS analysis comparison shows significant operational improvements at the following movements:

- Eastbound Northern Boulevard movement at Main Street
- Northbound and southbound Union Street movements at Northern Boulevard
- Eastbound and westbound Northern Boulevard left turn movements at Prince Street
- Southbound Main Street left turn movement at Kissena Boulevard

### *4.2 Travel Time and Delays*

- Travel speeds along the eastbound and westbound Northern Boulevard increased by 16% and 15% in the PM peak hour, respectively, and 34% and 37% in the Saturday Midday peak hour.

Travel time and delay run data, a basic indicator for vehicular congestion, were collected along Northern Boulevard, Roosevelt Avenue, Union Street, Main Street and Prince Street within the project study area during the weekday AM, midday, PM and Saturday midday peak periods. The travel time and delay data were collected for three midweek days and one Saturday for the pre- and post-implementation conditions using the "floating" car method.[2]

A comparison of the travel time data (in minutes and seconds) as shown in Table 2 for the pre- and post-implementation of the project illustrates the following significant travel time improvements:

- Weekday AM Peak Hour
  - Northern Boulevard – improved eastbound by 7% (from 3:00 to 2:48) and westbound by 17% (from 2:17 to 1:54)
  - Roosevelt Avenue – improved eastbound by 22% (from 2:46 to 2:09) and westbound by 18% (from 2:39 to 2:10)
  - Union Street – improved northbound by 2% (from 3:26 to 3:23) and southbound by 8% (from 4:23 to 4:02)
  - Main Street – maintained the same travel time as the pre-implementation condition for the northbound due to increased traffic volumes; southbound travel time increased by 11 % (from 1:59 to 2:12) due to the modified signal timing to accommodate rerouted bus movements.
  - Prince Street – improved southbound by 2% (from 3:21 to 3:17); northbound travel time increased by 7% (from 2:46 to 2:57) due to bus rerouting and increased traffic volumes.

[2] It is a technique to measure travel times by driving test cars through study sections. The test car approximates the behavior of an average vehicle traffic stream.
Source: Traffic Engineering (4th Edition), Roger P. Roess, Elena S. Prassas, and William R. McShane, Prentice Hall, 2011

Table 2 Travel Time Comparison

| | Corridor | Direction | Segment | Pre-Implementation (June 2010) (mm:ss) | Post-Implementation (October 2010) (mm:ss) | Percent Change |
|---|---|---|---|---|---|---|
| Weekday AM Peak Hour | Northern Boulevard | Eastbound | Prince Street - Bowne Street | 03:00 | 02:48 | **-7%** |
| | | Westbound | | 02:17 | 01:54 | **-17%** |
| | Roosevelt Avenue | Eastbound | Prince Street - Union Street | 02:46 | 02:09 | **-22%** |
| | | Westbound | | 02:39 | 02:10 | **-18%** |
| | Union Street | Northbound | Sanford Avenue - 35th Avenue | 03:26 | 03:23 | **-2%** |
| | | Southbound | | 04:23 | 04:02 | **-8%** |
| | Main Street | Northbound | Kissena Boulevard - Northern Boulevard | 02:05 | 02:05 | **0%** |
| | | Southbound | | 01:59 | 02:12 | **11%** |
| | Prince Street | Northbound | Roosevelt Avenue - 35th Avenue | 02:46 | 02:57 | **7%** |
| | | Southbound | | 03:21 | 03:17 | **-2%** |
| Weekday Midday Peak Hour | Northern Boulevard | Eastbound | Prince Street - Bowne Street | 03:04 | 02:54 | **-5%** |
| | | Westbound | | 03:03 | 01:59 | **-35%** |
| | Roosevelt Avenue | Eastbound | Prince Street - Union Street | 02:52 | 01:59 | **-31%** |
| | | Westbound | | 02:22 | 02:11 | **-7%** |
| | Union Street | Northbound | Sanford Avenue - 35th Avenue | 03:55 | 03:50 | **-2%** |
| | | Southbound | | 05:00 | 04:10 | **-17%** |
| | Main Street | Northbound | Kissena Boulevard - Northern Boulevard | 03:50 | 02:48 | **-27%** |
| | | Southbound | | 03:56 | 02:57 | **-25%** |
| | Prince Street | Northbound | Roosevelt Avenue - 35th Avenue | 03:12 | 03:08 | **-2%** |
| | | Southbound | | 03:16 | 02:57 | **-10%** |
| Weekday PM Peak Hour | Northern Boulevard | Eastbound | Prince Street - Bowne Street | 02:46 | 02:20 | **-16%** |
| | | Westbound | | 02:38 | 02:14 | **-15%** |
| | Roosevelt Avenue | Eastbound | Prince Street - Union Street | 03:25 | 02:22 | **-31%** |
| | | Westbound | | 02:41 | 02:32 | **-6%** |
| | Union Street | Northbound | Sanford Avenue - 35th Avenue | 04:11 | 03:37 | **-14%** |
| | | Southbound | | 05:50 | 04:43 | **-19%** |
| | Main Street | Northbound | Kissena Boulevard - Northern Boulevard | 03:42 | 02:38 | **-29%** |
| | | Southbound | | 03:27 | 03:13 | **-7%** |
| | Prince Street | Northbound | Roosevelt Avenue - 35th Avenue | 02:57 | 02:49 | **-4%** |
| | | Southbound | | 03:02 | 02:38 | **-13%** |
| Saturday Midday Peak Hour | Northern Boulevard | Eastbound | Prince Street - Bowne Street | 03:42 | 02:26 | **-34%** |
| | | Westbound | | 03:37 | 02:17 | **-37%** |
| | Roosevelt Avenue | Eastbound | Prince Street - Union Street | 01:30 | 01:30 | **0%** |
| | | Westbound | | 03:31 | 02:25 | **-31%** |
| | Union Street | Northbound | Sanford Avenue - 35th Avenue | 04:08 | 03:47 | **-8%** |
| | | Southbound | | 04:38 | 04:25 | **-5%** |
| | Main Street | Northbound | Kissena Boulevard - Northern Boulevard | 03:38 | 02:46 | **-24%** |
| | | Southbound | | 04:58 | 03:20 | **-33%** |
| | Prince Street | Northbound | Roosevelt Avenue - 35th Avenue | 03:55 | 03:09 | **-20%** |
| | | Southbound | | 02:58 | 02:58 | **0%** |

- Weekday Midday Peak Hour
  - Northern Boulevard – improved eastbound by 5% (from 3:04 to 2:54) and westbound by 35% (from 3:03 to 1:59)
  - Roosevelt Avenue – improved eastbound by 31% (from 2:52 to 1:59) and westbound by 7% (from 2:22 to 2:11)
  - Union Street – improved northbound by 2% (from 3:55 to 3:50) and southbound by 17% (from 5:00 to 4:10)
  - Main Street – improved northbound by 27% (from 3:50 to 2:48) and southbound by 25% (from 3:56 to 2:57)
  - Prince Street – improved northbound by 2% (from 3:12 to 3:08) and southbound by 10% (from 3:16 to 2:57)

- Weekday PM Peak hour
  - Northern Boulevard – improved eastbound by 16% (from 2:46 to 2:20) and westbound by 15% (from 2:38 to 2:14)
  - Roosevelt Avenue – improved eastbound by 31% (from 3:25 to 2:22) and westbound by 6% (from 2:41 to 2:32)
  - Union Street – improved northbound by 14% (from 4:11 to 3:37) and southbound by 19% (from 5:50 to 4:43)
  - Main Street – improved northbound by 29% (from 3:42 to 2:38) and southbound by 7% (from 3:27 to 3:13)
  - Prince Street – improved northbound by 4% (from 2:57 to 2:49) and southbound by 13% (from 3:02 to 2:38)

- Saturday Midday Peak Hour
  - Northern Boulevard – improved eastbound by 34% (from 3:42 to 2:26) and westbound by 37% (from 3:37 to 2:17)
  - Roosevelt Avenue – improved westbound by 31% (from 3:31 to 2:25) while eastbound travel time remains the same as the pre-implementation condition because of bus rerouting.
  - Union Street – improved northbound by 8% (from 4:08 to 3:47) and southbound by 5% (from 4:38 to 4:25)
  - Main Street – improved northbound by 24% (from 3:38 to 2:46) and southbound by 33% (from 4:58 to 3:20)
  - Prince Street – improved northbound by 20% (from 3:55 to 3:09) while southbound travel time remains the same as the pre-implementation condition because of bus rerouting.

### *4.3 Bus Transit Operation*

- Bus passengers benefit from reduced traffic congestion and improved pedestrian environment.

Downtown Flushing is one of the key transit hubs in New York City, so accommodating the needs of bus riders was an important part of this mobility and safety improvement project. By addressing safety and mobility issues for vehicles and pedestrians, the project also attempted to speed bus service, and to provide a better pedestrian environment for passengers accessing the bus. NYCDOT worked closely with MTA New York City Transit (NYCT) and MTA Bus to ensure that the changes made as part of the project could accommodate all needed bus routes, bus stops, and layovers with minimal disruption to riders or the larger community.

The measures implemented as part of the project resulted in enhanced bus passenger experience by:

- Improving traffic flow along major bus corridors, including Main Street, Roosevelt Avenue, and Northern Boulevard (as described in 4.2)
- Relocating bus stops and layover areas in order to clear the curbs at departure and/or receiving legs to improve mobility
- Consolidating existing bus stops and/or providing new bus stops and layover areas

The project included a number of measures specifically designed to maintain bus operations through Flushing without causing any substantial disruptions to service. These included:

- Creating new bus stops to replace those removed where new pedestrian space was added along Main Street (since buses cannot safely pick up passengers from street level)
- Creating new bus layover areas to accommodate new bus routing patterns
- Allowing bus exemptions to new turn restrictions at:
  - westbound Northern Boulevard onto southbound Main Street
  - eastbound Roosevelt Avenue onto northbound Main Street
  - southbound Main Street onto eastbound 38th and 39th Avenues
  - northbound Main Street onto westbound 37th Avenue

The traffic changes described above required MTA Bus and NYCT to reroute many buses that serve the downtown Flushing area, and some passengers now must use bus stops somewhat farther from the subway entrances. However, these changes are balanced by the improvements to traffic flow and road safety, which both benefit transit riders. NYCDOT will continue to work closely with MTA Bus and NYCT to adjust bus stops and bus layovers as needed to maximize benefits to transit passengers, while accommodating needed transit operational functions and maintaining the safety improvements for Flushing's pedestrians, motorists and transit users.

### *4.4 Changes in Travel Patterns*

- Turn prohibitions eliminated vehicle-pedestrian and vehicle-vehicle conflicts and improved traffic operations.

The turn prohibitions implemented as part of the project resulted in rerouting of vehicular traffic. A comparison of the pre- and post-implementation peak hour vehicular counts illustrate that under the post-implementation condition:

- Westbound Northern Boulevard at Main Street carried approximately 130 to 205 fewer vehicles during all analysis peak hours (i.e., AM, midday, PM and Saturday midday). The volume reduction is probably attributable to the left-turn prohibition from:
  - northbound Union Street onto westbound Northern Boulevard, and
  - westbound Northern Boulevard onto southbound Main Street (this turn prohibition may have caused some motorists to divert at upstream intersections)

- Eastbound Northern Boulevard at Main Street processed about 125 and 100 more vehicles during the weekday AM and Saturday midday peak hours, respectively. The other analysis peak hours had insignificant increases in traffic volumes. The apparent causes of volume increase are due to:
  - the improved operation (added right-turn bay, reduced signal phases and improved signal coordination) on the eastbound approach which resulted in processing more vehicles
  - the left-turn prohibition from westbound Northern Boulevard onto southbound Main Street, which may have caused motorists to make U-turn from westbound Northern Boulevard at Prince Street and then turn right from eastbound Northern Boulevard onto southbound Main Street

- Northbound Main Street at Northern Boulevard carried approximately 120 to 160 more vehicles during all analysis peak hours. The volume increase is likely due to:
  - the improved operation at the Main Street and Roosevelt Avenue intersection,
  - the right-turn prohibition from northbound Main Street onto eastbound Roosevelt Avenue which caused vehicles to turn right at eastbound 39th Avenue and/or eastbound Northern Boulevard, and
  - the left-turn prohibition from northbound Union Street onto westbound Northern Boulevard which may have diverted vehicles on northbound Main Street which turn left onto Northern Boulevard.

- Northbound Union Street at 35th Avenue carried approximately 100 to 290 more vehicles during all analysis peak hours. The apparent cause of volume increase may be due to:
  - the left-turn prohibition from northbound Union Street onto westbound Northern Boulevard, and
  - the improved traffic operation at Northern Boulevard (reduced signal phases, additional green time and no lane blockages due to the left-turn prohibition).

- Northbound Union Street at Northern Boulevard processed about 70 to 180 fewer vehicles during all analysis peak hours. The probable reason of volume reduction is due to:
  - the left-turn prohibition from northbound Union Street onto westbound Northern Boulevard.

- Westbound Roosevelt Avenue at Main Street processed approximately 90 to 170 more vehicles during all analysis peak hours. The volume increase is likely due to:
  - the left-turn prohibition from northbound Union Street onto westbound Northern Boulevard,
  - the left-turn prohibition from westbound Northern Boulevard onto southbound Main Street, and
  - the improved traffic operations (i.e., clearing the curbs at approaches) which resulted in processing more vehicles.

- Eastbound Kissena Boulevard east of Main Street carried approximately 70 to 120 more vehicles during all analysis peak hours. Westbound Kissena Boulevard processed slightly more vehicles (about 25 to 60) during all analysis peak hours. The probable cause of volume increases is due to:
  - the signal timing modification and coordination between Main Street/Kissena Boulevard/41st Avenue and Main Street/40th Road intersections

- Southbound Prince Street at 38th Avenue processed about 45 to 150 more vehicles during all analysis peak hours with the exception of the weekday PM peak hour where the post-implementation volumes were about the same as the pre-implementation volumes. The volume increase is likely due to:
  - the left-turn prohibition from westbound Northern Boulevard onto southbound Main Street, and
  - the improved traffic operation (additional green time for westbound left-turning vehicles) which may have caused more vehicles to be processed.

### *4.5 Pedestrian and Vehicular Safety Assessment*

- Crashes with injuries in the study area declined by 20% compared with the average of the three prior years.
- Total injuries decreased by 29%.
- Injuries to motor vehicle occupants decreased by 55%, a statistically significant improvement.
- Area-wide pedestrian injuries were down 8%.
- At the intersection of Northern Boulevard and Union Street, pedestrian injuries were down 18%, while at Roosevelt Avenue and Main Street, injuries were down 29%.

The project was intended to improve safety of all street users (pedestrians, transit riders, and motorists) within the study area with a main focus on Northern Boulevard/Union Street and Roosevelt Avenue/Main Street intersections. The Northern Boulevard/Union Street intersection, which was the highest pedestrian crash location in Queens in 2009, experienced 14 pedestrian injuries during an 11-month period (August 1, 2009 through June 30, 2010) prior to the implementation of the projet. During the same period, nine pedestrian injuries occurred at the Roosevelt Avenue/Main Street intersection.

The improvement measures which included turn prohibitions, curb extensions/bulbouts (painted), sidewalk extensions (painted), signal timing/phasing modifications and parking restrictions at selected locations have:

- reduced vehicle-pedestrian and vehicle-vehicle conflicts, particularly at the Northern Boulevard/Union Street and Roosevelt Avenue/Main Street intersections
- enhanced pedestrian safety and mobility by providing added
  - pedestrian storage space at crowded corners through curb extensions
  - walking space at congested sidewalks through temporary sidewalk widening
  - walk time including a pedestrian countdown signal at the intersection of Northern Boulevard /Union Street
- improved sight distance and reduced turning conflicts by restricting parking (daylighting) at intersection corners

Figure 5 presents crash analysis locations and Table 3 compares crash data in the study area for the 11-month period (August 1, 2010 through June 30, 2011) after implementation of the project with the average of the previous three-year period (August 1, 2007 – June 30, 2010). Figure 6 shows crash data after implementation of the project and in the three prior years. Following implementation of the project, the number of total crashes and crashes with injuries decreased by approximately 1% and 20%, respectively, when compared to the three-year average crashes.

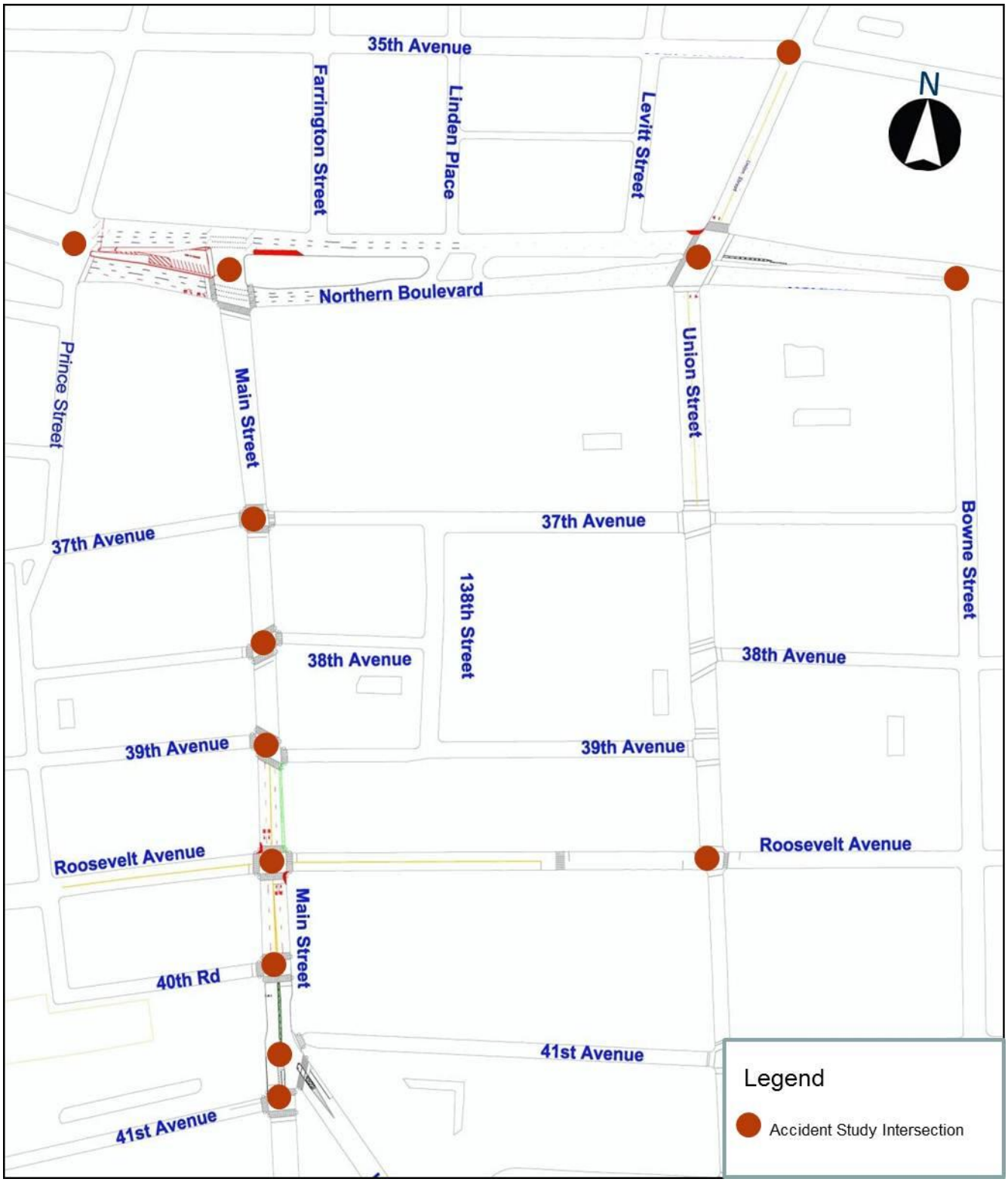



Figure 5 Accident Study Intersection

The most significant improvements were noted in the vehicle occupant injuries which were reduced by 55% compared to the average of the previous three years. This improvement is statistically significant, taking into account fluctuations in crash volumes over the last ten years. In addition, the post-project data show that pedestrian and bicycle injuries decreased by approximately 8% and 25%, respectively, as compared to the average of the previous three years.

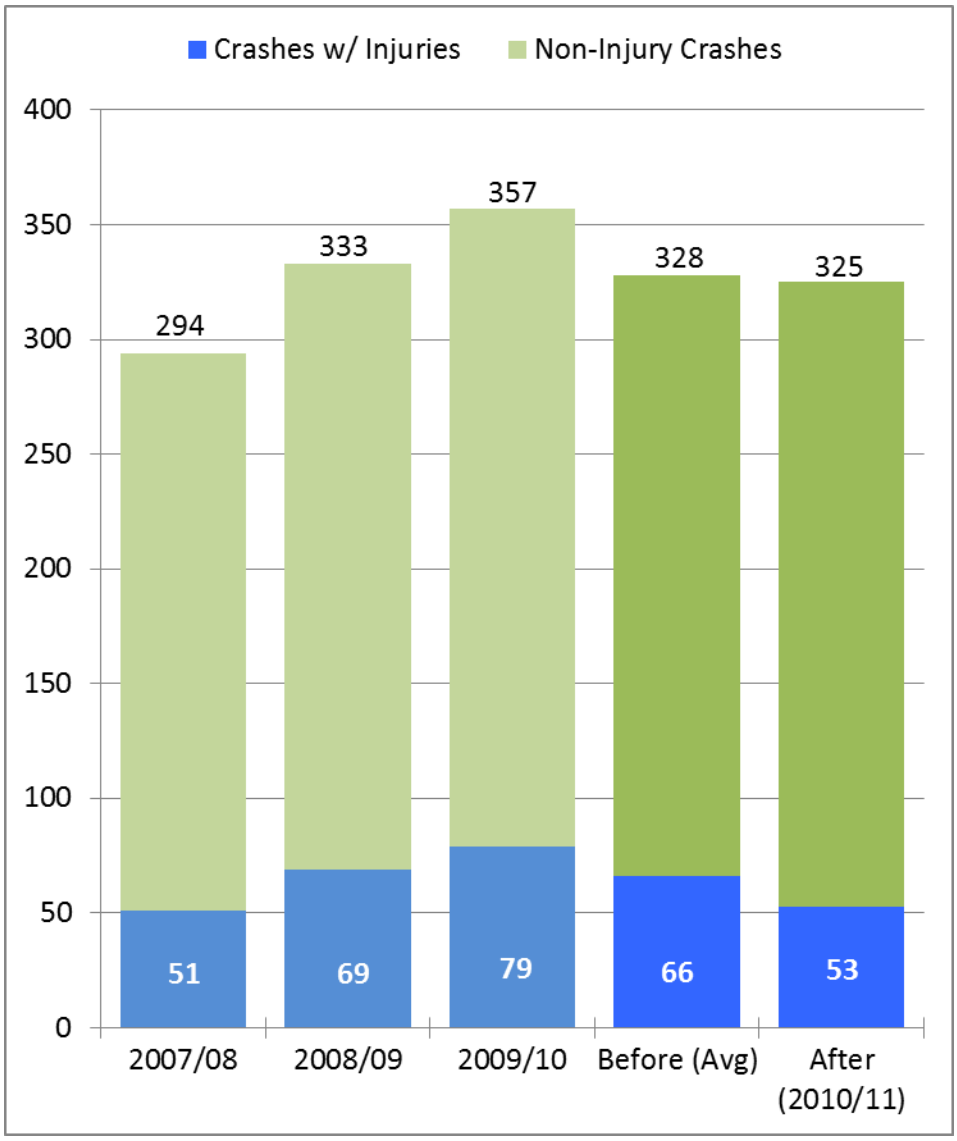



Figure 6 Crash Data Comparison

Table 3 Crash Data Comparison

| | Pre-Implementation Crashes | | | | Post-Implementation Crashes | Percent Change |
|---|---|---|---|---|---|---|
| | August 2007 - June 2008 | August 2008 - June 2009 | August 2009 - June 2010 | 3-Year Average | August 2010 - June 2011 | |
| Total crashes | 294 | 333 | 357 | **328** | **325** | **-1%** |
| Crashes with injuries | 51 | 69 | 79 | **66** | **53** | **-20%** |
| Total injuries | 59 | 75 | 99 | **77** | **55** | **-29%** |
| Pedestrian injuries | 31 | 41 | 45 | **39** | **36** | **-8%** |
| Bicycle injuries | 3 | 6 | 7 | **5** | **4** | **-20%** |
| Vehicle occupant injuries | 25 | 28 | 47 | **33** | **15** | **-55%** |

*4.5.1 Northern Boulevard and Union Street*

Improving safety at the intersection of Northern Boulevard and Union Street was particularly important because this intersection was the highest pedestrian accident intersection in Queens in 2009. The intersection also experienced significant safety improvements. As shown in Table 4, accidents at the intersection decreased in all categories compared with the prior three years.

The number of total crashes and crashes with injuries decreased by approximately 12% and 22%, respectively, when compared to the average of the previous three years. The vehicle occupant injuries and total injuries decreased by approximately 33% and 29%, respectively, compared to the average of the previous three years. In addition, the number of post-project pedestrian injuries decreased from 11 to 9 while the number of bicycle injuries was down to zero.

Table 4 Crash Data Comparison at Northern Boulevard and Union Street

| | Pre-Implementation Crashes | | | | Post-Implementation Crashes | Percent Change |
|---|---|---|---|---|---|---|
| | August 2007 - June 2008 | August 2008 - June 2009 | August 2009 - June 2010 | 3-Year Average | August 2010 - June 2011 | |
| Total crashes | 45 | 70 | 81 | **65** | **57** | **-12%** |
| Crashes with injuries | 12 | 20 | 22 | **18** | **14** | **-22%** |
| Total injuries | 14 | 23 | 28 | **21** | **15** | **-29%** |
| Pedestrian injuries | 7 | 13 | 14 | **11** | **9** | **-18%** |
| Bicycle injuries | 0 | 1 | 3 | **1** | **0** | **-100%** |
| Vehicle occupant injuries | 7 | 9 | 11 | **9** | **6** | **-33%** |

*4.5.2 Roosevelt Avenue and Main Street*

Approximately 8,000 pedestrians in the weekday midday peak hour and 7,500 pedestrians in the weekday PM peak hour crossed the intersection of Roosevelt Avenue and Main Street. The intersection also experienced significant safety improvements. As shown in Table 5, reportable and pedestrian accidents and total injuries were reduced following the project's implementation.

Total crashes and injuries were reduced by approximately 22% and 36%, respectively, when compared to the average of the previous three years. In addition, the number of pedestrian injuries decreased by approximately 29%. However, post-project bicycle crashes remained at the same level compared to the average of the previous three years.

Table 5 Crash Data Comparison at Roosevelt Avenue and Main Street

| | Pre-Implementation Crashes | | | | Post-Implementation Crashes | Percent Change |
|---|---|---|---|---|---|---|
| | August 2007 - June 2008 | August 2008 - June 2009 | August 2009 - June 2010 | 3-Year Average | August 2010 - June 2011 | |
| Total crashes | 26 | 24 | 32 | **27** | **21** | **-22%** |
| Crashes with injuries | 6 | 9 | 14 | **10** | **7** | **-30%** |
| Total injuries | 6 | 10 | 15 | **11** | **7** | **-36%** |
| Pedestrian injuries | 5 | 7 | 9 | **7** | **5** | **-29%** |
| Bicycle injuries | 1 | 1 | 3 | **2** | **2** | **0%** |
| Vehicle occupant injuries | 0 | 2 | 3 | **2** | **0** | **-100%** |

## 5.0 Conclusion

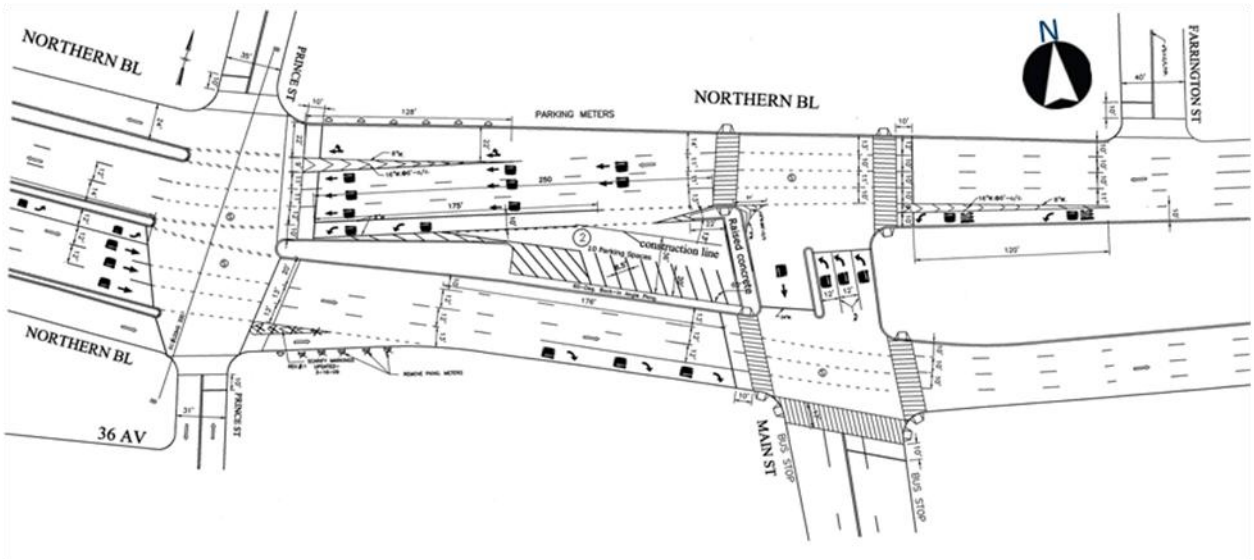
The analysis of the pre- and post-implementation data shows that the project has improved:

- Safety of vehicular and pedestrian traffic by reducing vehicle-vehicle and vehicle-pedestrian conflicts at key intersections;
- Pedestrian operation by adding pedestrian storage and walking space as well as providing additional walk time at certain locations;
- Mobility by reducing overall motor vehicle travel time and vehicle-pedestrian conflicts; and
- Bus transit operations.

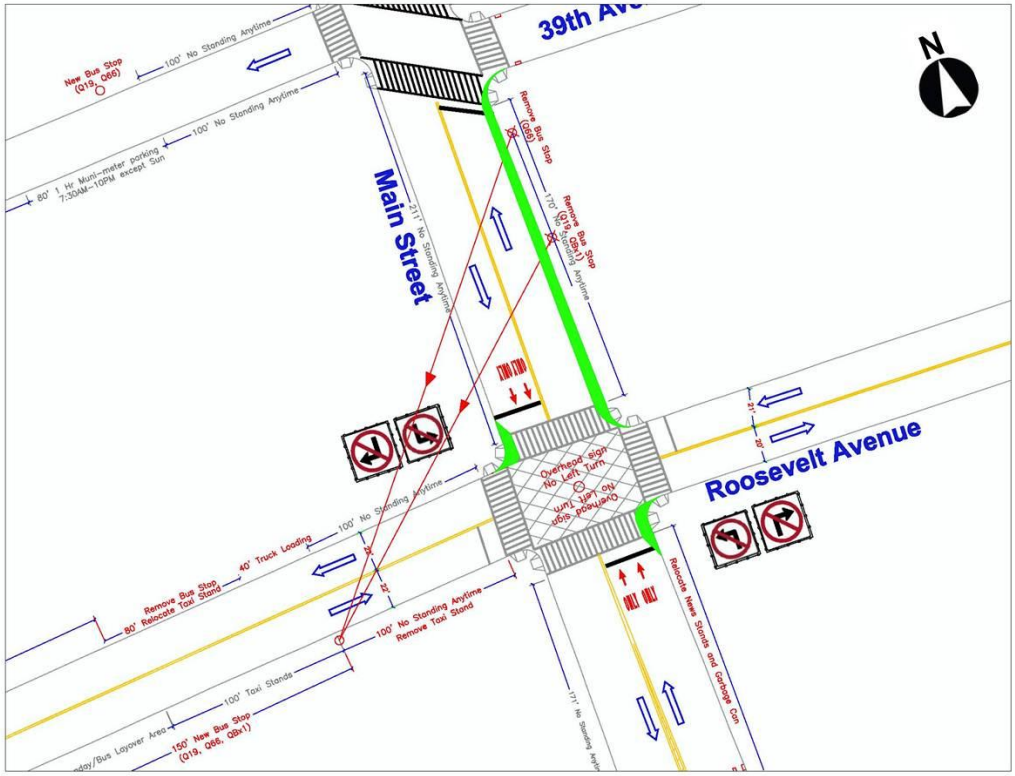
## 6.0 Recommendations

Given the safety and mobility improvements, NYCDOT recommends that the changes implemented as part of the project be maintained. NYCDOT will continue to work with all stakeholders to further enhance safety and mobility of all street users as future developments continue to flourish in this vibrant and dynamic area of Downtown Flushing. Future changes could include enhancing the Main Street corridor by upgrading the operational treatments (i.e., corner extensions using painted marking and flexible delineators) used in the project as well as other improvements including potential center median redesign on Main Street at Northern Boulevard, and sidewalk extension along the Main Street and Union Street corridors through future capital programs.

# Appendix A  Implemented Geometry Designs

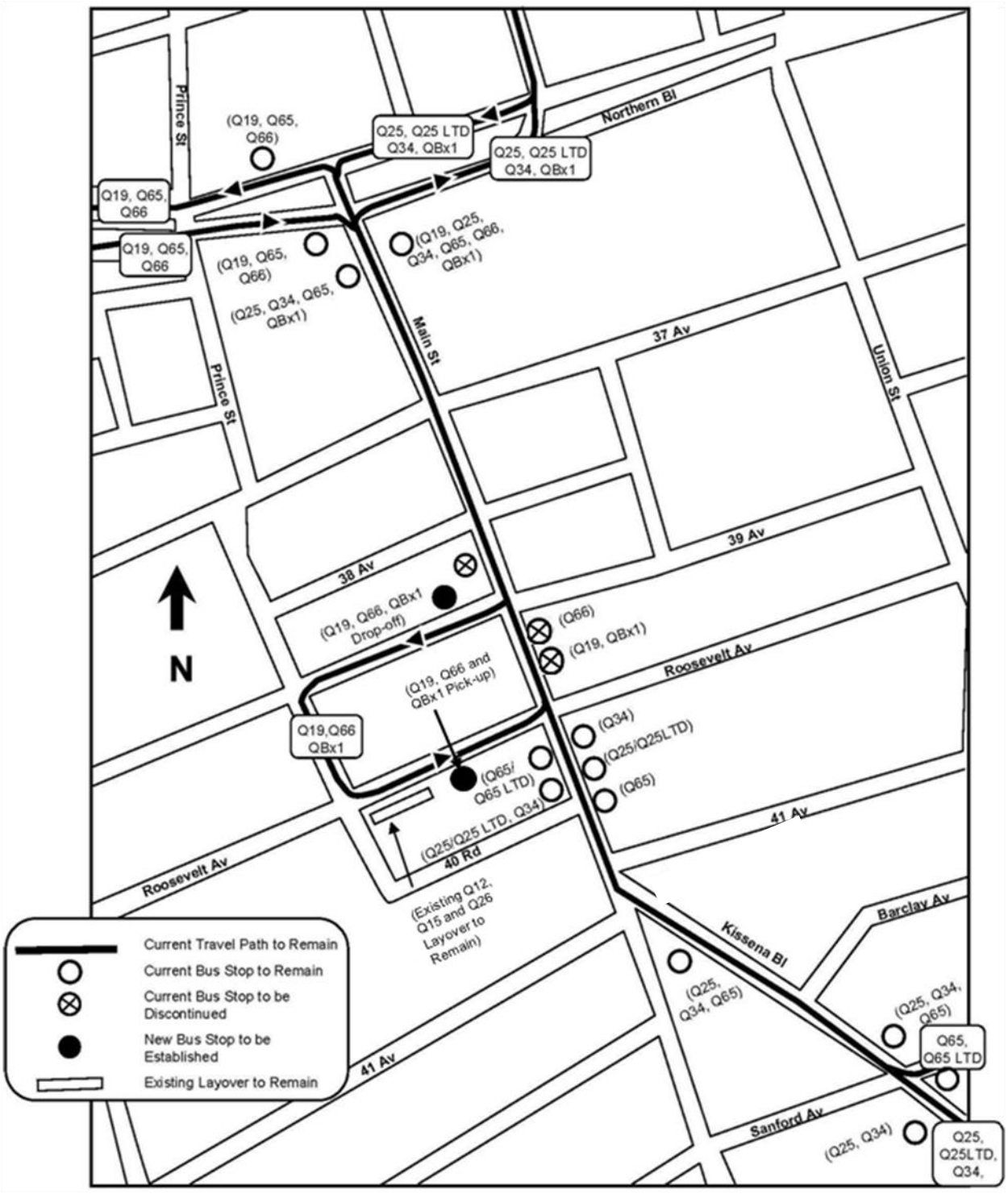


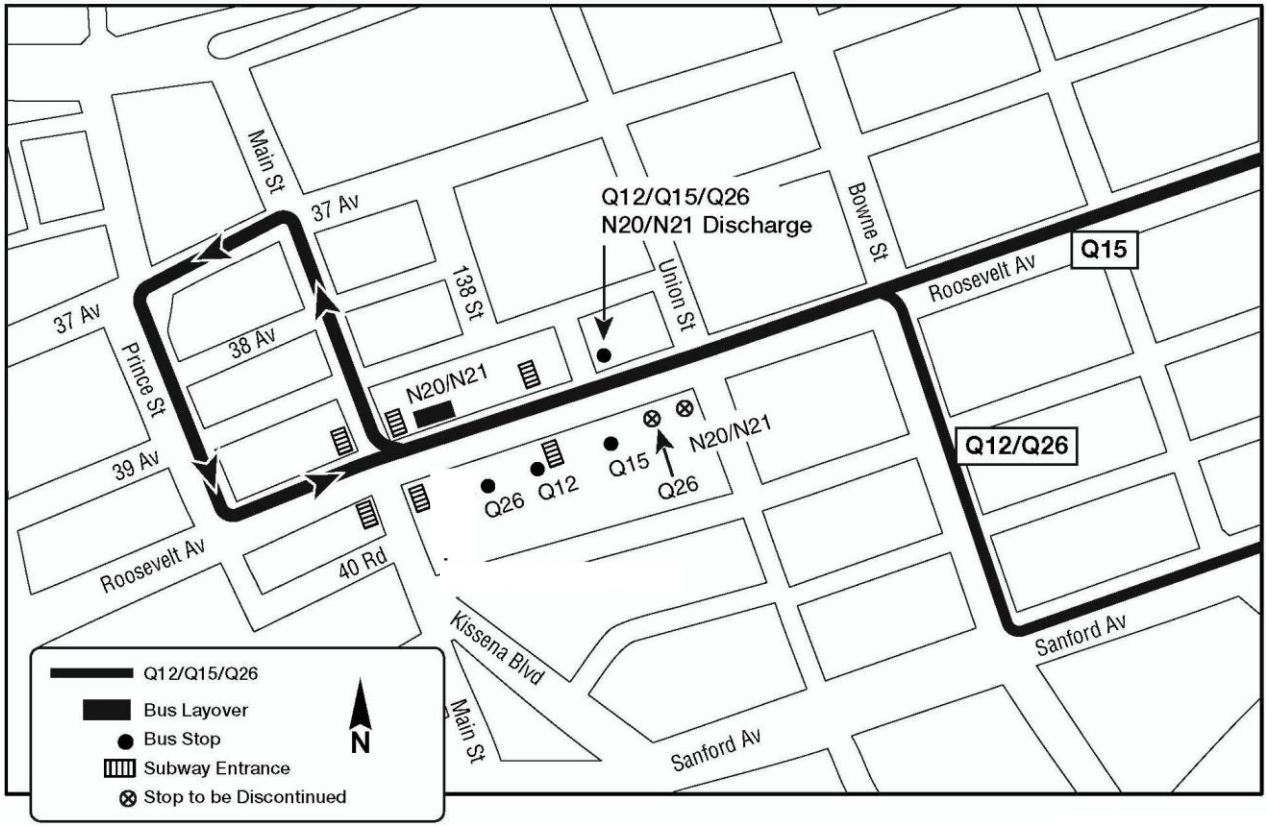

Northern Boulevard between Prince and Main Streets

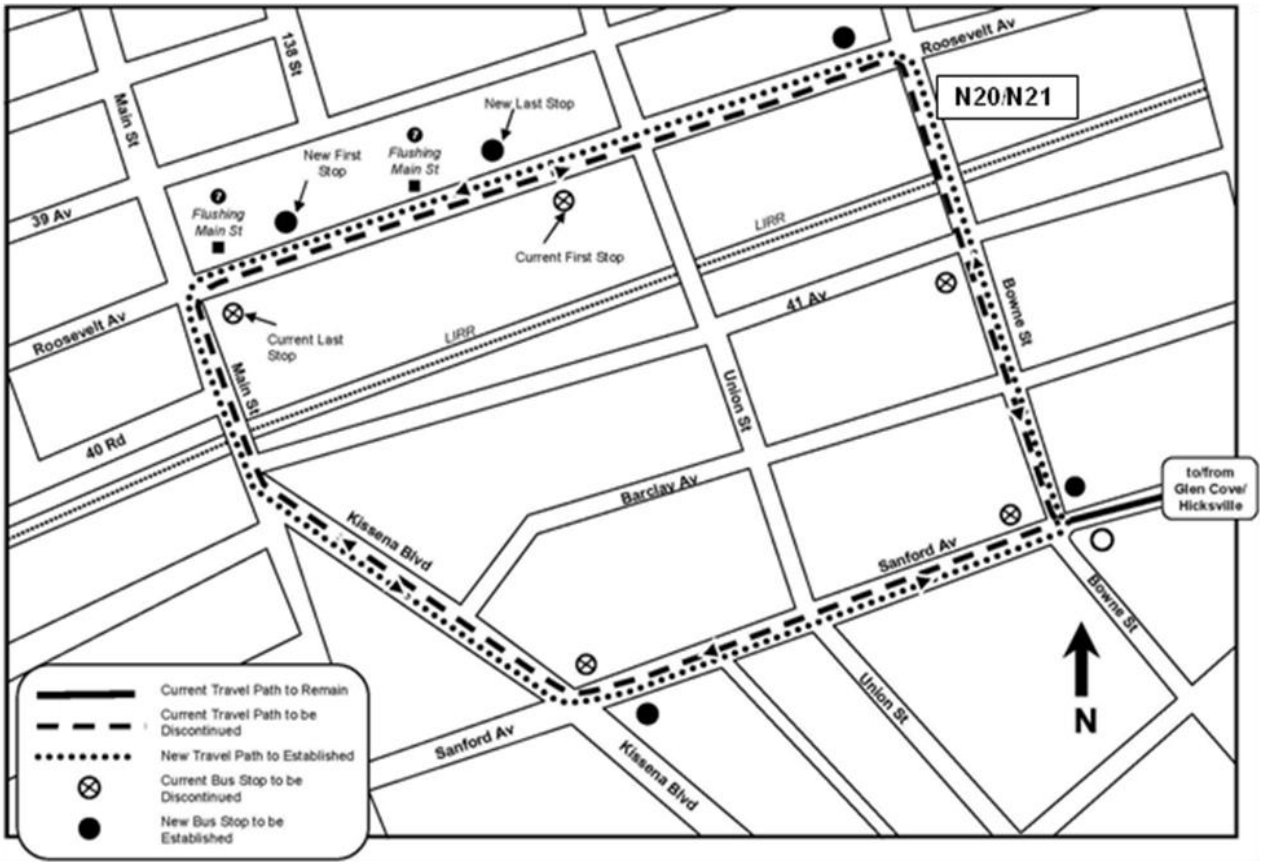


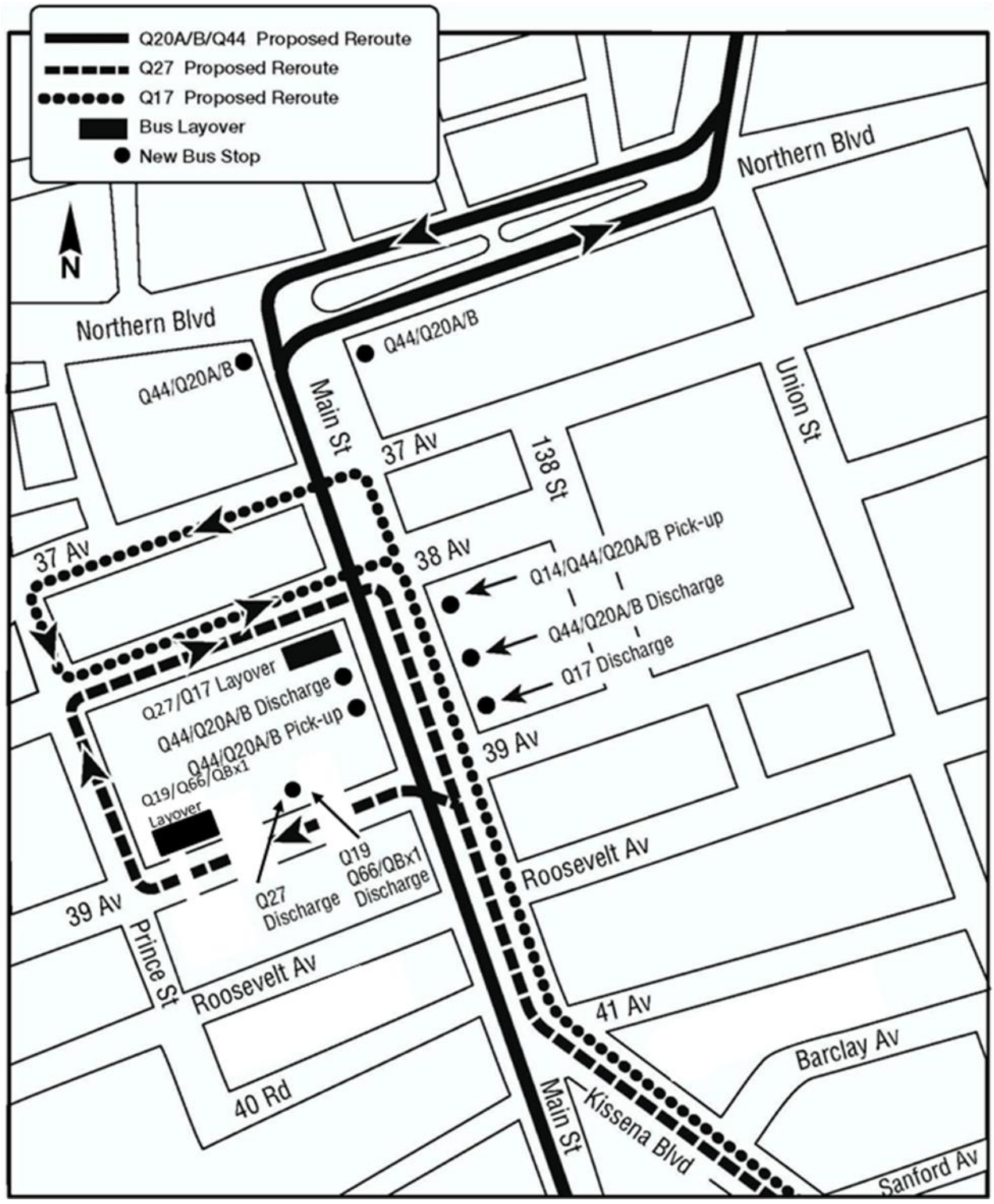

Roosevelt Avenue and Main Street

# Appendix B Bus Reroutes and Related Facilities for the Project




Main St
37 Av
Q12/Q15/Q26
N20/N21 Discharge
Bowne St
Roosevelt Av
Q15
37 Av
38 Av
138 St
Union St
Prince St
N20/N21
Q12/Q26
39 Av
Q26
Q12
Q15
N20/N21
Q26
Roosevelt Av
40 Rd
Kissena Blvd
Sanford Av
Main St
Sanford Av
Q12/Q15/Q26
Bus Layover
Bus Stop
Subway Entrance
Stop to be Discontinued
N


138 St
Roosevelt Av
N20/N21
Main St
New Last Stop
New First Stop
Flushing Main St
39 Av
Flushing Main St
Current First Stop
LIRR
41 Av
Bowne St
Roosevelt Av
Current Last Stop
LIRR
Main St
Union St
40 Rd
Barclay Av
to/from Glen Cove/ Hicksville
Kissena Blvd
Sanford Av
Bowne St
Union St
Sanford Av
Kissena Blvd
N
Current Travel Path to Remain
Current Travel Path to be Discontinued
New Travel Path to Established
Current Bus Stop to be Discontinued
New Bus Stop to be Established


Q20A/B/Q44 Proposed Reroute
Q27 Proposed Reroute
Q17 Proposed Reroute
Bus Layover
New Bus Stop
N
Northern Blvd
Northern Blvd
Q44/Q20A/B
Q44/Q20A/B
Main St
37 Av
138 St
Union St
37 Av
38 Av
Q14/Q44/Q20A/B Pick-up
Q44/Q20A/B Discharge
Q17 Discharge
Q27/Q17 Layover
Q44/Q20A/B Discharge
Q44/Q20A/B Pick-up
Q19/Q66/QBx1
Layover
39 Av
Roosevelt Av
Q27
Discharge
Q19
Q66/QBx1
Discharge
39 Av
Prince St
Roosevelt Av
41 Av
Barclay Av
40 Rd
Main St
Kissena Blvd
Sanford Av

# Appendix C Comparison of Synchro Levels of Service (LOS) Analysis

| Intersection | Approach | Movement | Weekday AM Peak Hour | | | | | | Weekday PM Peak Hour | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Pre-Implementation | | | Post-Implementation | | | Pre-Implementation | | | Post-Implementation | | |
| | | | V/C Ratio | Avg Delay | LOS | V/C Ratio | Avg Delay | LOS | V/C Ratio | Avg Delay | LOS | V/C Ratio | Avg Delay | LOS |
| Main Street/ Northern Boulevard | NB | TR | 0.39 | 40.5 | D | 0.48 | 27.6 | C | 0.39 | 35.0 | C | 0.48 | 34.1 | C |
| | | R | 0.22 | 15.4 | B | 0.46 | 29.0 | C | 0.35 | 35.7 | D | 0.46 | 35.8 | D |
| | SB | T | 0.11 | 30.9 | C | 0.06 | 36.4 | D | 0.09 | 3.6 | A | 0.08 | 23.4 | C |
| | EB | TR/T | 0.70 | 23.1 | C | 0.61 | 10.9 | B | 1.00 | 75.4 | E | 0.77 | 7.6 | A |
| | | R | 1.09 | 112.9 | F | 0.61 | 14.1 | B | 1.12 | 241.5 | F | 0.67 | 9.3 | A |
| | WB | L | 0.26 | 5.4 | A | 0.13 | 2.7 | A | 0.81 | 58.5 | E | 0.18 | 26.7 | C |
| | | T | 0.81 | 10.5 | B | 0.81 | 8.3 | A | 0.62 | 38.5 | D | 0.59 | 33.3 | C |
| | Overall | | 1.09 | 39.7 | D | 0.81 | 16.6 | B | 1.12 | 84.6 | F | 0.77 | 14.4 | B |
| 37 Avenue/ Main Street | NB | L/LT | 0.78 | 21.0 | C | 0.18 | 12.5 | B | 0.68 | 18.3 | B | 0.08 | 6.8 | A |
| | | T | | | | 0.66 | 17.7 | B | | | | 0.55 | 10.5 | B |
| | SB | T/TR | 0.90 | 54.1 | D | 0.40 | 2.5 | A | 0.88 | 41.5 | D | 0.49 | 7.1 | A |
| | | R | | | | 0.38 | 3.8 | A | | | | 0.49 | 9.7 | A |
| | WB | LT | 0.50 | 32.7 | C | 0.54 | 34.3 | C | 0.54 | 34.7 | C | 0.67 | 39.4 | D |
| | | R | 0.83 | 76.2 | E | 0.81 | 68.0 | E | 0.87 | 71.5 | E | 0.89 | 75.5 | E |
| | Overall | | 0.90 | 42.5 | D | 0.81 | 20.9 | C | 0.88 | 38.9 | D | 0.89 | 24.7 | C |
| 38 Avenue/ Main Street | NB | TR | 0.25 | 1.2 | A | 0.32 | 0.9 | A | 0.23 | 1.2 | A | 0.28 | 1.5 | A |
| | SB | LT | 0.75 | 14.9 | B | 0.31 | 11.7 | B | 0.74 | 18.2 | B | 0.36 | 7.6 | A |
| | EB | LTR | 0.57 | 38.1 | D | 0.58 | 24.8 | C | 0.72 | 42.6 | D | 0.81 | 42.6 | D |
| | Overall | | 0.75 | 15.6 | B | 0.58 | 10.4 | B | 0.74 | 20.7 | C | 0.81 | 16.6 | B |
| 39 Avenue/ Main Street | NB | LTR | 0.41 | 8.0 | A | 0.58 | 8.3 | A | 0.44 | 4.8 | A | 0.60 | 7.8 | A |
| | SB | LTR | 0.53 | 9.7 | A | 0.42 | 6.5 | A | 0.53 | 10.4 | B | 0.39 | 10.0 | A |
| | Overall | | 0.53 | 9.0 | A | 0.58 | 7.5 | A | 0.53 | 8.0 | A | 0.60 | 8.8 | A |
| Main Street/ Roosevelt Avenue | NB | LTR/T | 0.65 | 22.3 | C | 0.39 | 14.1 | B | 0.66 | 21.2 | C | 0.38 | 4.3 | A |
| | SB | LTR/T | 0.61 | 13.7 | B | 0.24 | 4.6 | A | 0.58 | 10.9 | B | 0.25 | 2.2 | A |
| | EB | LTR | 0.58 | 36.4 | D | 0.28 | 25.2 | C | 0.56 | 24.3 | C | 0.31 | 21.8 | C |
| | WB | LTR | 0.61 | 35.5 | D | 0.54 | 34.3 | C | 0.30 | 26.4 | C | 0.39 | 31.1 | C |
| | Overall | | 0.65 | 24.0 | C | 0.54 | 18.9 | B | 0.66 | 19.0 | B | 0.39 | 12.2 | B |
| Main Street/ 40th Road | NB | TR | 0.31 | 23.3 | C | 0.36 | 13.9 | B | 0.32 | 24.8 | C | 0.34 | 11.3 | B |
| | SB | LT | 0.28 | 5.8 | A | 0.26 | 6.0 | A | 0.26 | 5.8 | A | 0.26 | 2.8 | A |
| | EB | LTR | 0.62 | 44.6 | D | 0.59 | 26.1 | C | 0.76 | 49.2 | D | 0.60 | 53.4 | D |
| | WB | LR | 0.06 | 28.8 | C | 0.07 | 30.2 | C | 0.03 | 28.1 | C | 0.04 | 34.8 | C |
| | Overall | | 0.62 | 21.1 | C | 0.59 | 13.8 | B | 0.76 | 23.6 | C | 0.60 | 14.7 | B |
| Main Street/ Kissena Boulevard/ 41 Avenue | NB | L | 0.58 | 26.5 | C | 0.38 | 20.2 | C | 0.54 | 24.8 | C | 0.77 | 43.7 | D |
| | | TR | 0.30 | 3.4 | A | 0.32 | 3.1 | A | 0.48 | 10.3 | B | 0.92dr | 22.8 | C |
| | SB | L | 0.40 | 66.7 | E | 0.37 | 15.9 | B | 0.29 | 43.5 | D | 0.28 | 14.9 | B |
| | | T | 0.39 | 14.6 | B | 0.37 | 47.1 | D | 0.36 | 15.0 | B | 0.17 | 27.5 | C |
| | WB | R | 0.38 | 27.6 | C | 0.45 | 29.3 | C | 0.42 | 29.2 | C | 0.61 | 30.8 | C |
| | Overall | | 0.58 | 25.2 | C | 0.45 | 23.0 | C | 0.56 | 20.7 | C | 0.79 | 24.9 | C |
| Union Street/ 35th Avenue | NB | LTR | 0.38 | 13.2 | B | 0.50 | 5.8 | A | 0.35 | 11.0 | B | 0.62 | 18.2 | B |
| | SB | LTR | 0.90 | 35.9 | D | 0.71 | 21.2 | C | 0.80 | 26.8 | C | 0.43 | 13.4 | B |
| | EB | LTR | 0.51 | 15.7 | B | 0.55 | 20.1 | C | 0.98 | 52.0 | D | 0.76 | 29.5 | C |
| | WB | LTR | 0.57 | 16.9 | B | 0.67 | 24.3 | C | 0.34 | 12.7 | B | 0.46 | 18.1 | B |
| | Overall | | 0.90 | 22.5 | C | 0.72 | 16.7 | B | 0.98 | 29.7 | C | 0.76 | 19.2 | B |
| Union Street/Northern Boulevard | NB | LTR | 2.45DL | 78.3 | E | 0.40 | 28.3 | C | 2.65DL | 135.4 | F | 0.55 | 31.4 | C |
| | SB | LT | 1.10 | 104.5 | F | 0.72 | 34.6 | C | 1.24 | 156.1 | F | 0.61 | 35.8 | D |
| | | R | 0.33 | 36.6 | D | 0.49 | 28.4 | C | 0.41 | 37.6 | D | 0.49 | 34.0 | C |
| | EB | L | 0.26 | 27.8 | C | 0.77 | 56.0 | E | 0.49 | 77.7 | E | 0.56 | 79.3 | E |
| | | T/TR | 0.86 | 55.1 | E | 0.86 | 56.8 | E | 1.05 | 51.8 | D | 1.03 | 47.6 | D |
| | | R | | | | | | | 0.40 | 18.6 | B | 0.68 | 23.1 | C |
| | WB | L | 0.69 | 76.4 | E | 0.67 | 62.5 | E | 0.55 | 57.6 | E | 0.53 | 56.3 | E |
| | | TR | 1.05 | 60.4 | E | 0.99 | 49.5 | D | 0.88 | 46.6 | D | 0.83 | 38.2 | D |
| | Overall | | 1.10 | 66.8 | E | 0.99 | 47.4 | D | 1.02 | 74.1 | E | 1.03 | 40.6 | D |
| 37 Avenue/ Union Street | NB | LT | 0.58 | 9.9 | A | 0.47 | 9.5 | A | 0.52 | 14.9 | B | 0.56 | 11.6 | B |
| | SB | TR | 0.61 | 18.6 | B | 0.71 | 21.4 | C | 0.48 | 16.5 | B | 0.60 | 18.6 | B |
| | WB | LTR | 0.32 | 27.6 | C | 0.47 | 12.0 | B | 0.40 | 27.6 | C | 0.46 | 16.3 | B |
| | Overall | | 0.61 | 16.0 | B | 0.71 | 16.3 | B | 0.52 | 17.3 | B | 0.60 | 15.6 | B |
| 38 Avenue/ Union Street | NB | LTR | 0.75 | 16.4 | B | 0.71 | 14.5 | B | 0.57 | 16.3 | B | 0.58 | 10.8 | B |
| | SB | LTR | 0.60 | 6.4 | A | 0.48 | 6.7 | A | 0.38 | 6.1 | A | 0.44 | 6.6 | A |
| | EB | LTR | 0.28 | 20.6 | C | 0.32 | 21.4 | C | 0.59 | 27.3 | C | 0.56 | 26.6 | C |
| | Overall | | 0.75 | 12.8 | B | 0.71 | 12.6 | B | 0.59 | 15.7 | B | 0.58 | 12.8 | B |
| 39 Avenue/ Union Street | NB | T | 0.40 | 11.4 | B | 0.34 | 12.6 | B | 0.36 | 18.1 | B | 0.29 | 26.2 | C |
| | SB | T | 0.28 | 3.3 | A | 0.22 | 2.1 | A | 0.23 | 5.1 | A | 0.23 | 5.8 | A |
| | EB | L | 0.23 | 19.8 | B | 0.25 | 20.1 | C | 0.29 | 20.7 | C | 0.28 | 20.6 | C |
| | | R | 0.20 | 20.1 | C | 0.31 | 21.8 | C | 0.39 | 23.4 | C | 0.46 | 25.1 | C |
| | Overall | | 0.40 | 10.1 | B | 0.34 | 11.4 | B | 0.39 | 15.5 | B | 0.46 | 18.9 | B |
| Roosevelt Avenue/ Union Street | NB | TR | 0.64 | 24.1 | C | 0.58 | 20.7 | C | 0.58 | 22.4 | C | 0.49 | 18.5 | B |
| | SB | LT | 0.48 | 32.7 | C | 0.51 | 13.9 | B | 0.64 | 32.0 | C | 0.61 | 36.1 | D |
| | | R | 0.59 | 42.1 | D | 0.55 | 20.8 | C | 0.39 | 18.9 | B | 0.45 | 29.8 | C |
| | EB | LT | 0.44 | 20.2 | C | 0.30 | 19.2 | B | 0.41 | 19.1 | B | 0.36 | 20.1 | C |
| | | R | 0.20 | 17.1 | B | 0.15 | 18.1 | B | 0.26 | 18.4 | B | 0.21 | 19.4 | B |
| | WB | LTR/LT | 0.37 | 18.6 | B | 0.53 | 23.4 | C | 0.27 | 16.6 | B | 0.38 | 20.3 | C |
| | | R | | | | 0.53 | 29.5 | C | | | | 0.26 | 21.3 | C |
| | Overall | | 0.64 | 25.9 | C | 0.58 | 20.3 | C | 0.64 | 23.6 | C | 0.61 | 25.2 | C |

| Intersection | Approach | Movement | Weekday AM Peak Hour | | | | | | Weekday PM Peak Hour | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Pre-Implementation | | | Post-Implementation | | | Pre-Implementation | | | Post-Implementation | | |
| | | | V/C Ratio | Avg Delay | LOS | V/C Ratio | Avg Delay | LOS | V/C Ratio | Avg Delay | LOS | V/C Ratio | Avg Delay | LOS |
| Northern Boulevard/ Bowne Street | NB | L | 0.52 | 39.1 | D | 0.55 | 38.6 | D | 0.38 | 35.8 | D | 0.49 | 36.9 | D |
| | | R | 0.16 | 32.1 | C | 0.15 | 30.5 | C | 0.19 | 32.7 | C | 0.23 | 31.8 | C |
| | EB | TR | 0.71 | 11.5 | B | 0.66 | 7.2 | A | 0.66 | 10.5 | B | 0.65 | 5.8 | A |
| | WB | L | 0.60 | 36.4 | D | 0.70 | 41.6 | D | 0.48 | 34.3 | C | 0.55 | 38.6 | D |
| | | T | 0.80 | 20.1 | C | 0.81 | 21.8 | C | 0.61 | 14.6 | B | 0.57 | 15.0 | B |
| | Overall | | 0.80 | 19.5 | B | 0.82 | 20.0 | B | 0.66 | 15.0 | B | 0.65 | 13.9 | B |
| Northern Boulevard/ Prince Street | NB | L | 0.58 | 13.2 | B | 0.46 | 6.2 | A | 0.12 | 7.0 | A | 0.59 | 7.6 | A |
| | | T | 0.14 | 4.0 | A | 0.07 | 2.2 | A | 0.13 | 2.7 | A | 0.10 | 3.4 | A |
| | SB | LT | 0.17 | 0.7 | A | 0.21 | 0.7 | A | 0.18 | 2.0 | A | 0.14 | 5.4 | A |
| | | R | 0.80 | 27.2 | C | 0.69 | 14.9 | B | 0.69 | 17.9 | B | 0.64 | 22.1 | C |
| | EB | L | 0.89 | 93.7 | F | 0.67 | 60.8 | E | 0.66 | 195.3 | F | 0.61 | 48.3 | D |
| | | T | 0.41 | 11.8 | B | 0.52 | 19.0 | B | 0.57 | 16.7 | B | 0.74 | 30.0 | C |
| | WB | L | 0.52 | 78.6 | E | 0.56 | 65.6 | E | 0.59 | 74.1 | E | 0.66 | 72.4 | E |
| | | T | 0.94 | 20.0 | B | 1.05 | 58.5 | E | 1.02 | 107.1 | F | 1.06 | 76.7 | E |
| | Overall | | 0.94 | 20.9 | C | 1.05 | 38.3 | D | 1.02 | 62.4 | E | 1.06 | 45.3 | D |
| WB Northern Boulevard Sr Rd/ Prince Street | SB | TR | 0.45 | 43.4 | D | 0.48 | 39.7 | D | 0.41 | 39.6 | D | 0.30 | 33.5 | C |
| | WB | TR | 0.32 | 15.4 | B | 0.47 | 24.6 | C | 0.44 | 28.0 | C | 0.54 | 35.3 | D |
| | Overall | | 0.94 | 26.8 | C | 1.05 | 25.2 | C | 1.02 | 29.0 | C | 1.06 | 22.4 | C |
| EB Northern Boulevard Sr Rd/Prince Street | NB | TR | 0.71 | 48.4 | D | 0.5 | 34.8 | C | 0.58 | 41.1 | D | 0.67 | 44.1 | D |
| | EB | TR | 0.50 | 47.5 | D | 0.24 | 16.4 | B | 0.27 | 13.2 | B | 0.41 | 24.9 | C |
| | Overall | | 0.94 | 42.9 | D | 1.05 | 20.0 | B | 1.02 | 25.1 | C | 1.06 | 28.2 | C |
| Prince Street/ 37th Avenue | NB | LT | 0.27 | 4.9 | A | 0.17 | 14.1 | B | 0.30 | 6.9 | A | 0.43 | 12.2 | B |
| | SB | TR | 0.43 | 15.0 | B | 0.49 | 13.7 | B | 0.48 | 12.9 | B | 0.77 | 24.0 | C |
| | WB | LTR | 0.66 | 23.9 | C | 0.53 | 18.7 | B | 0.73 | 23.8 | C | 0.62 | 20.2 | C |
| | Overall | | 0.66 | 14.9 | B | 0.53 | 15.8 | B | 0.73 | 15.3 | B | 0.77 | 19.9 | B |
| Prince Street/ 39th Avenue | NB | LT | 0.33 | 5.9 | A | 0.32 | 11.9 | B | 0.54 | 16.1 | B | 0.63 | 19.9 | B |
| | SB | TR | 0.22 | 5.4 | A | 0.32 | 11.0 | B | 0.39 | 10.5 | B | 0.51 | 17.8 | B |
| | WB | LTR | 0.33 | 17.9 | B | 0.24 | 12.3 | B | 0.30 | 12.1 | B | 0.40 | 8.7 | A |
| | Overall | | 0.33 | 8.4 | A | 0.32 | 11.7 | B | 0.54 | 13.3 | B | 0.63 | 16.0 | B |
| Prince Street/ Roosevelt Avenue | SB | LTR | 0.46 | 35.2 | D | 0.42 | 29.9 | C | 0.58 | 50.6 | D | 0.58 | 35.2 | D |
| | EB | LTR/LT | 1.01 | 65.7 | E | 0.67 | 27.5 | C | 0.77 | 31.0 | C | 0.76 | 33.3 | C |
| | | R | | | | | | | 0.21 | 14.4 | B | 0.22 | 16.9 | B |
| | WB | LTR | 0.44 | 16.2 | B | 0.51 | 7.0 | A | 0.43 | 15.0 | B | 0.35 | 16.3 | B |
| | Overall | | 1.01 | 46.4 | D | 0.67 | 20.2 | C | 0.77 | 29.4 | C | 0.76 | 28.0 | C |
| WB Northern Boulevard SR Rd/ College Point Blvd | NB | TH | 0.31 | 9.3 | A | 0.33 | 11.0 | B | 0.33 | 9.5 | A | 0.35 | 11.2 | B |
| | SB | TH | 0.40 | 10.2 | B | 0.42 | 12.0 | B | 0.47 | 11.0 | B | 0.42 | 11.9 | B |
| | WB | L | 0.34 | 27.8 | C | 0.25 | 24.1 | C | 0.21 | 25.7 | C | 0.18 | 23.1 | C |
| | | R | 0.24 | 26.2 | C | 0.19 | 23.4 | C | 0.68 | 45.2 | D | 0.30 | 25.1 | C |
| | Overall | | 0.40 | 12.6 | B | 0.42 | 13.2 | B | 0.68 | 14.2 | B | 0.42 | 13.4 | B |