CITYWIDE CONGESTED CORRIDORS PROJECT

Flatbush Avenue

From Ocean Avenue to Nostrand Avenue

Borough of Brooklyn

FINAL REPORT

November 2015

City of New York
Bill de Blasio, Mayor

NEW YORK CITY DOT Department of Transportation

A Member of the New York Metropolitan Transportation Council

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EXECUTIVE SUMMARY

The Citywide Congested Corridors Project (CCCP) is a study undertaken by the New York City Department of Transportation (NYCDOT) of selected roadways across the five boroughs, with the goals of improving mobility, safety, air quality and the quality of life for all street users (pedestrians, bicyclists, transit users and motorists). Flatbush Avenue between Ocean Avenue/Empire Boulevard and Nostrand Avenue in Brooklyn has been selected as one of the congested corridors.

The corridor serves as both a major arterial for through traffic and a destination for local activities including retail, school facilities and cultural and religious institutions. Based on the analysis of collected data, field visits and observations, and discussions with community boards, local officials and other stakeholders, the following operational and safety deficiencies were identified before improvements were made in 2013 and 2014:

- The four-lane corridor (two lanes and parking in each direction) had substandard lane widths for the section between Lincoln Road and East 26th Street.
- Vehicles were often forced to abruptly change lanes, causing unsafe merging movements:
  - Because of insufficient parking lane width, double parked cars, legally parked trucks, and buses making stops often encroached into the right lane, forcing drivers to merge to the left lane.
  - Due to the lack of left-turn bays, left-turning vehicles often forced through traffic in the left lane to merge to the right lane.
- The sudden lane change and forced merging conditions, combined with the many skewed intersecting streets, created unsafe driving conditions, and contributed to being categorized as a high-crash corridor.

In light of these findings, improvements were recommended and refined to address the operational safety of the corridor, while maintaining acceptable levels of service for traffic flow. The following improvements were proposed and implemented:

- The roadway was remarked to allow for one travel lane in each direction with left-turn bays, consistent with acceptable lane-width standards, along with wider parking lanes on each side.
- Because of the heavier volumes in the northbound direction during the morning peak period, “No Standing 7-10 AM Mon-Fri” parking regulations were implemented along the east curb to transform the northbound parking lane into a second travel lane during this time.
- Right-turn bays were added at key locations to minimize traffic delays.
- Several location-specific improvements at select intersections to improve traffic operations and/or safety.

Community outreach was a key component of the planning process. The summary of findings of the traffic operations and safety analysis was presented to the two local community boards and the Flatbush Avenue Business Improvement District, as were the proposed improvements and their projected analysis. A public meeting was also held on September 30, 2013. Upon voting, both boards submitted letters of approval and implementation began soon thereafter in November 2013. Once full implementation was complete and traffic was considered stabilized, the corridor was monitored to assess the impacts of the improvements and to investigate any further recommended actions. Supplemental improvements were implemented in September 2014. This report documents the efforts involved in the pre-improvement conditions analysis, the planning process, the projected impacts of the improvements, and the post-implementation monitoring, and post-implementation refinements. Further monitoring will continue as necessary.

CHAPTER 1 INTRODUCTION

1.1 Report Organization

This document presents a brief synopsis of the planning process and summarizes the analysis for the 2012 Pre-Improvement Conditions and 2014 Improved Conditions for the Flatbush Avenue Congested Corridor Project. The identification of deficiencies along the corridor was based on analysis of traffic, roadway, parking, safety, goods movement, transit, pedestrian and bicycle data, collected as part of a comprehensive data collection effort. Improvements were recommended, implemented, monitored, and modified.

This technical memorandum is organized in the following sections:

- Chapter 1 "**Introduction**" is a brief overview of the study's objectives and background information;
- Chapter 2 "**Pre-Improvement Conditions**" first presents a synopsis of the data collection efforts and then uses data analysis to determine the conditions that existed before improvements were implemented in 2012. Preliminary findings are presented based on the technical analysis and community input to highlight the previously existing deficiencies along the Flatbush Avenue Congested Corridor;
- Chapter 3 **"Improvements**" documents the recommended improvements, and uses future-estimated traffic volumes, roadway conditions and land use changes to project conditions that can be expected along the corridor and compares the projected future without the recommended improvements to the projected future with the recommended improvements;
- Chapter 4 **"Post-Implementation Monitoring and Refinements**" identifies the results of the post-implementation monitoring, post-implementation refinements, the need for further monitoring and post-implementation analysis, as well as further recommended actions.
- Chapter 5 "**Conclusions**" summarizes the findings of the report.

1.2 Purpose of Study

The New York City Department of Transportation (NYCDOT) has commenced a Citywide Congested Corridor Program (CCCP) as part of the Congestion Mitigation and Air Quality (CMAQ) Program. This includes studies and preparation of improvement strategies for a number of selected congested corridors throughout the five boroughs of the City of New York.

The key goals of this program are to:

- Conduct a planning level traffic operations analysis of the corridors including identification of operational deficiencies for existing and future conditions;
- Develop a plan that will improve operations, safety and air quality within the study corridor and promote the use of efficient travel modes (bus, bicycle, walking);
- Develop an implementation plan for sequencing of improvements;

- Develop measures of effectiveness, including cost effective measures, that will be considered when assessing overall traffic operations;
- Assess mobility and safety for all street users, and;
- Prepare study reports that summarize the above noted findings, which can be used for the preparation of programming documents for state and federal funds for the implementation of the recommended improvements.

1.3 Study Area Background

The study area, as shown in Figure 1, is a 2.5 mile stretch of Flatbush Avenue in Brooklyn that extends from Empire Boulevard and Ocean Avenue on the north to Nostrand Avenue on the south. It passes through Community Boards 9 and 14, including the neighborhoods of Prospect/Lefferts Gardens, Flatbush and Midwood, and also abuts community boards 17 and 18. It is a major commercial arterial connector to Kings Highway, the Belt Parkway, and the Rockaways south of the study corridor, and Prospect Park, Downtown Brooklyn, and the Manhattan Bridge north of the study corridor. Key intersections along the corridor include:

- Flatbush Avenue & Empire Boulevard/Ocean Avenue;
- Flatbush Avenue and Parkside Avenue;
- Flatbush Avenue & Caton Avenue;
- Flatbush Avenue & Church Avenue;
- Flatbush Avenue & Cortelyou Road;
- Flatbush Avenue & Bedford Avenue/Stephens Court;
- Flatbush Avenue & Foster Avenue/Bedford Avenue;
- Flatbush Avenue & Farragut Road/Rogers Avenue;
- Flatbush Avenue & Nostrand Avenue/Hillel Place;

1.4 Street Network

In 2012, prior to improvements, Flatbush Avenue generally consisted of two travel lanes in each direction accompanied by curbside parking on both sides. It crosses many major east-west avenues that also have high levels of activity, such as Empire Boulevard, Caton Avenue, Parkside Avenue, Church Avenue, Foster Avenue and Farragut Road. North of Lincoln Road and south of Clarendon Road, it cuts across the street grid on a diagonal and intersects with major north-south avenues like Ocean Avenue, Bedford Avenue, Rogers Avenue and Nostrand Avenue, resulting in many askew intersections with acute angles. This configuration, combined with many offset cross-streets, results in difficult and unsafe movements for both motorists and pedestrians attempting to cross the roadway.

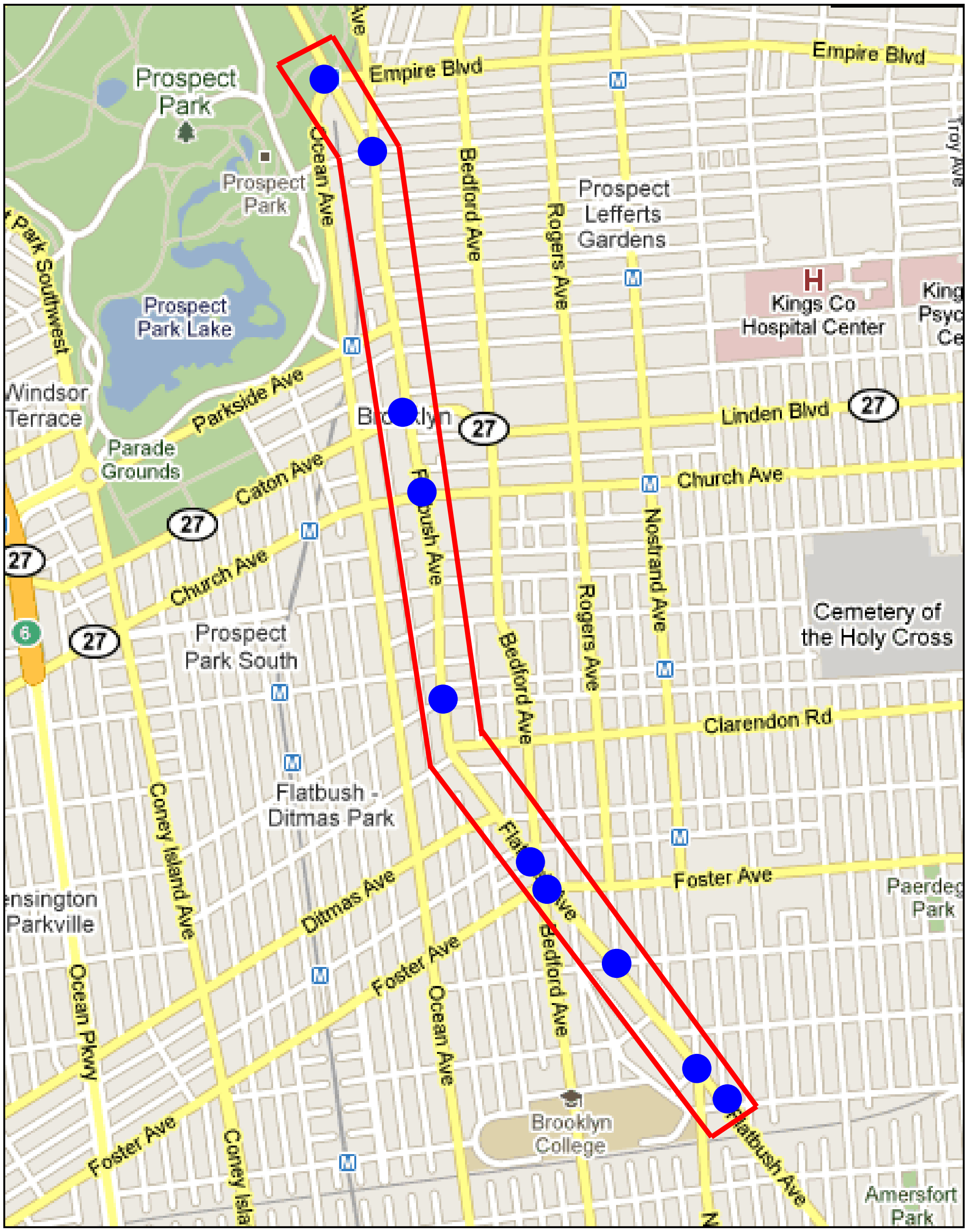

Figure 1: Flatbush Avenue Study Area

1.5 Land Use

The study area contains a mix of heavy local retail, residential and institutional uses, while also serving as both a designated truck route and a high-ridership bus route. Pedestrian volumes are heavy along the corridor near transit stops. Institutions along the corridor include Erasmus Hall High School at Church Avenue, and Brooklyn College, which is situated just west of the southern end of the study area. A major development with Target as the anchor store opened at Flatbush Avenue and Avenue H in 2008. A $70 million project for the restoration of the Loew's Kings Theatre, was begun in 2010 and completed in 2015. This will add to the already bustling multi-cultural commercial activity that takes place along the corridor which acts as a major shopping location as well a primary arterial for north-south through traffic.

Flatbush Avenue functions as both a major thoroughfare for drivers as well as a destination for local activity. As a result, there is ongoing competition between the street users, including pedestrians, bicyclists, passenger cars, buses, trucks and parked vehicles. This study aims to address transportation related issues while balancing the needs and safety of all street users.

CHAPTER 2 PRE-IMPROVEMENT CONDITIONS

2.1 Data Collection Methodology

A comprehensive data collection program was conducted along the corridor during the fall of 2012 in order to obtain a full understanding of the existing physical and traffic conditions present on Flatbush Avenue at that time. The collection plan is presented in Figure 2 and summarized below.

- Physical Inventories - Geometries for each study intersection were inventoried and included the number of lanes per direction, lane widths, pavement markings, sidewalk widths, corner radii, crosswalk widths and lengths, curbside parking regulations, bus stops, signal timings and all other traffic signs.
- Automatic Traffic Recorder (ATR) Machines – ATR machines were placed at 5 key locations and recorded in 15-minute intervals, 24 hours per day, during the 7 day week of October 20th to October 27th, 2012, including both Saturdays.
- Manual Turning Movement Counts (TMC) and Vehicle Classification Counts (VCC) - TMC and VCC (cars, trucks and buses) were conducted over the three day period from Tuesday, October 23rd to Thursday, October 25th, 2012, during the same week as the ATRs. Because of the numerous intersections along the corridor only major cross-streets were counted for a full peak period. However, in order to be able to analyze the corridor as an arterial, the minor streets were counted for only a portion of the period as described below.
    - Full Counts - 13 locations were counted for the full peak periods in 15-minute intervals from 7:30-9:30am, 12:30-2:30pm and 4:30-6:30pm on weekdays and from 3:00-7:00pm on Saturdays.
    - Sample Counts - 31 locations were counted as a sample count for 15-minutes within the peak periods.
- Pedestrian Counts - Pedestrians volumes at crosswalks were counted in 15-minute intervals concurrent with the manual turning movement counts during the same peak periods for 6 selected locations identified to have high pedestrian activities.
- Travel Time Runs - Travel time and delay runs were conducted using the ‘floating car technique’ to measure travel speeds and delays. Approximately 4 to 5 runs were performed for each direction for a three weekdays and two Saturdays during the four peak periods mentioned above and concurrent with the turning movement counts.
- Parking Inventory - In addition to the curbside regulations collected mentioned above, a detailed parking analysis was conducted, which included overall on-street parking capacity, curbside parking occupancy and turnover rates on an hour-by-hour basis, loading/unloading frequencies, and double parking occurrences and duration.

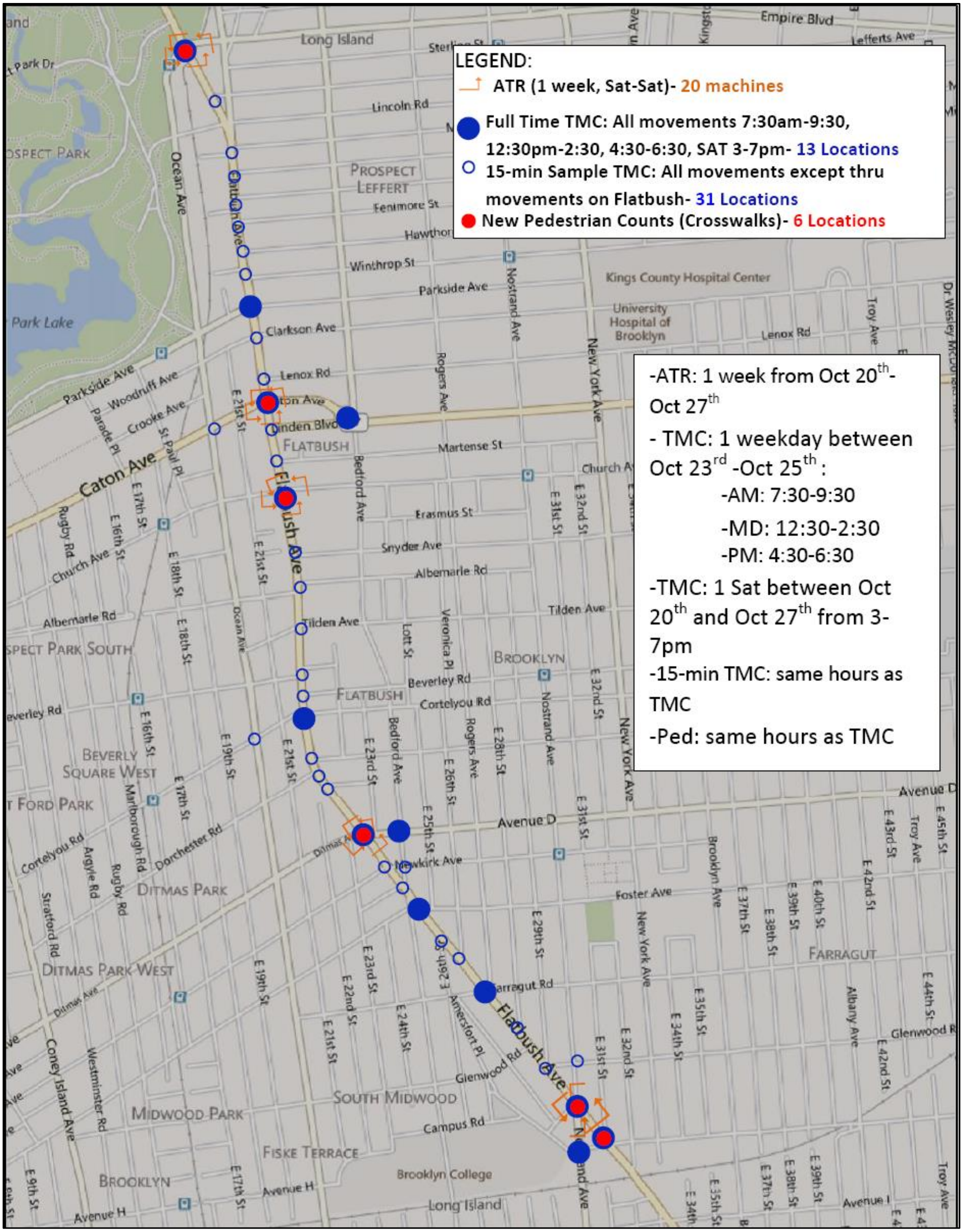

Figure 2: Data Collection Map

2.2 Pre-Improvement Roadway Configuration and Operations

During the 2012 Pre-Improvement Condition, Flatbush Avenue was a two-way roadway providing two travel lanes in each direction with parking and bus stops along both curbs. In the central section of the study area between Lincoln Road and East 26th Street, Flatbush Avenue is at its narrowest curb to curb width of about 54 feet. The Pre-Improvement dimensions are shown in Figure 3.

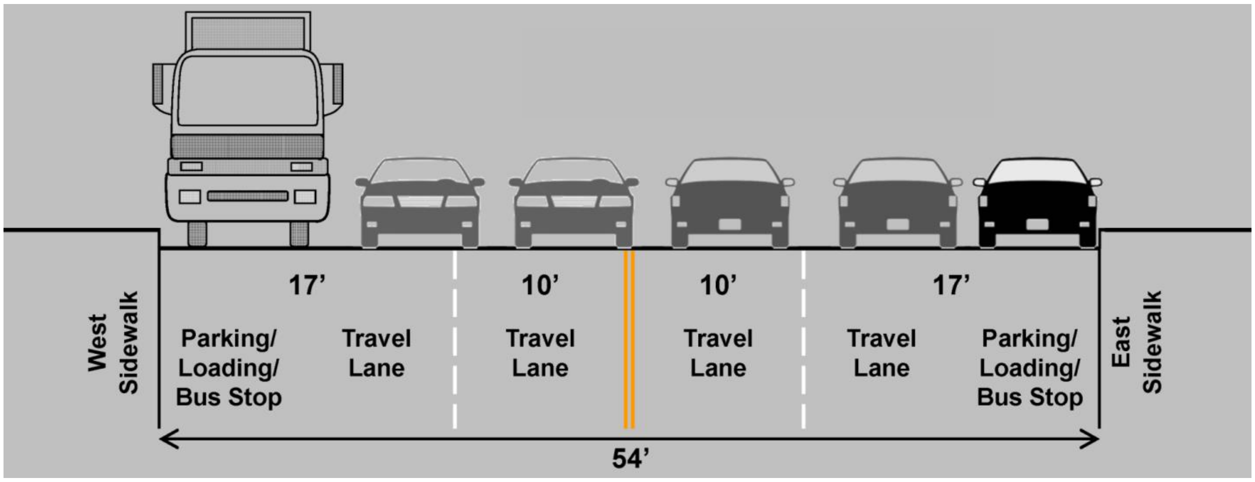

Figure 3: Pre-Improvement Cross Section between Lincoln Road and East 26th Street

Standard travel lane widths for truck routes in urban areas are 11 feet. Standard parking lane widths are 8 feet. For buses not to encroach on the travel lane when making stops, parking lanes would need to be 11 feet wide. As shown above, the pre-improvement left travel lane in both directions was 10 feet wide, one foot short of standard width. The combined right lane and parking lane was 17 feet wide, two feet short of standard. Buses pulling into curb-side bus stops partially blocked the right travel lane. Double parked cars and, as shown in Figure 3, single parked trucks also partially blocked the right travel lane, causing abrupt lane-change merging movements into the left lane. In addition, the lack of left-turn bays caused through vehicles to change from the left to the right lane. The result is that through vehicles were forced to frequently change lanes back and forth to avoid double parkers, single parked trucks, and buses making stops in the right lane, and to avoid left-turning vehicles in the left lane.

The photographs below highlight the operational inadequacies that existed on the corridor and illustrate how Flatbush Avenue operated like a one lane roadway even though it was marked as two lanes.

Photograph 1: Double parked vehicles blocking the right travel lane.

Photograph 2

Photograph 3: Trucks legally loading and unloading in parking lane blocked the right travel lane, even when pulled all the way to the curb.

Photograph 4: The narrow lanes made for a tight squeeze when operating as two lanes even when trucks were not parked.

Many of the cross-streets that intersect Flatbush Avenue in this section are misaligned from each other. A misaligned intersection that has two-way traffic can limit visibility of oncoming vehicles and can cause driver confusion. As an example, at Flatbush Avenue and Avenue D/Ditmas Avenue, the west leg (Ditmas Avenue) is misaligned to the north relative to the east leg (Avenue D), but it is treated as one big intersection. As a result, the intersection paths conflict so that eastbound left turning vehicles pulling into the intersection waiting for gaps are immediately in the path of westbound through vehicles. When the signal turns red, vehicles often get stuck waiting in the crosswalk, which creates a conflict with pedestrians and limits visibility. Other operational problems arise at intersections where the east and west legs are misaligned, but act as two separate but closely spaced intersections, like at the intersections of Clarendon Road/Dorchester Road, the two legs of Glenwood Road, and the two legs of Beverley Road. Because these intersections have high turning volumes and very short link distances, turning vehicles hit the red light at the downstream intersection and result in queues that can often block the upstream intersection. Offset intersections can also create unsafe crossings for pedestrians because vehicles traveling on the cross-street who wish to continue straight are forced to turn twice by zig-zagging across Flatbush Avenue, significantly increasing the potential for pedestrian conflicts.

As mentioned previously, south of Clarendon Road, Flatbush Avenue cuts across the grid at a diagonal. The following are locations where major east-west roadways and north-south roadways intersect Flatbush Avenue, creating five or six legged intersections:

1. Foster Avenue/Bedford Avenue – At this intersection, three major avenues intersect and are misaligned. Bedford Avenue extends north-south through central Brooklyn with one lane of traffic, a bicycle lane and curbside parking in both directions. As Flatbush Avenue cuts across on a diagonal, this intersection is skewed and irregular, as it also intersects with the offset east-west cross street of Foster Avenue. Also, the southbound vehicle path on Bedford Avenue intersects Flatbush Avenue at a point where vehicles are queued at the signal. Northbound vehicles on Bedford Avenue are directed in a zigzag pattern to turn left onto northbound Flatbush Avenue before making a right onto Bedford Avenue. Because of the irregularity of the intersection, jaywalking is a common occurrence.
2. Farragut Road/Rogers Avenue – This intersection is the southern terminus of Rogers Avenue, which is two-lane one-way northbound arterial. Because of the skewed angle that Rogers Avenue forms as it intersects with Flatbush Avenue, there is no direct crosswalk that lines up with the east sidewalk of Flatbush Avenue.
3. Nostrand Avenue/Hillel Place - This location, nicknamed "The Junction," is where two major avenues and one minor street intersect. It is a major intermodal transfer point between the nos. 2 and 5 trains, and buses along Flatbush Avenue, Nostrand Avenue, Glenwood Avenue and Avenue H. Brooklyn College's campus and a new shopping development are nearby. The skewed angle creates long crosswalks and confusing paths for the high volumes of pedestrians and limits visibility for the heavy traffic volumes. NYCDOT has recently implemented dedicated bus lanes along Nostrand Avenue as part of a Select Bus Service (SBS) project.

2.3 Traffic Volumes

Average daily 24-hour traffic volumes (ADT) were obtained from ATRs along Flatbush Avenue. As a spot sample for the corridor, the ADT along Flatbush Avenue at Church Avenue was 24,918 vehicles, with 12,681 traveling in the northbound direction and 12,237 traveling southbound.

Peak hours for each peak period were selected based on the ATR and TMC data collected as well as levels of activity:

- Weekday AM peak hour: 7:30 AM – 8:30 AM
- Weekday midday peak hour: 12:30 PM –1:30 PM
- Weekday PM peak hour: 5:00 PM – 6:00 PM
- Weekday Saturday peak hour: 5:15 PM – 6:15 PM

Figure 5 compares the northbound and southbound volumes, respectively, for the four peak hours at different points along Flatbush Avenue. The northbound volumes were significantly higher at all intersections during the AM peak compared to the other peak hours. The southbound volumes were higher at most intersections during the PM peak compared to the other peak hours,

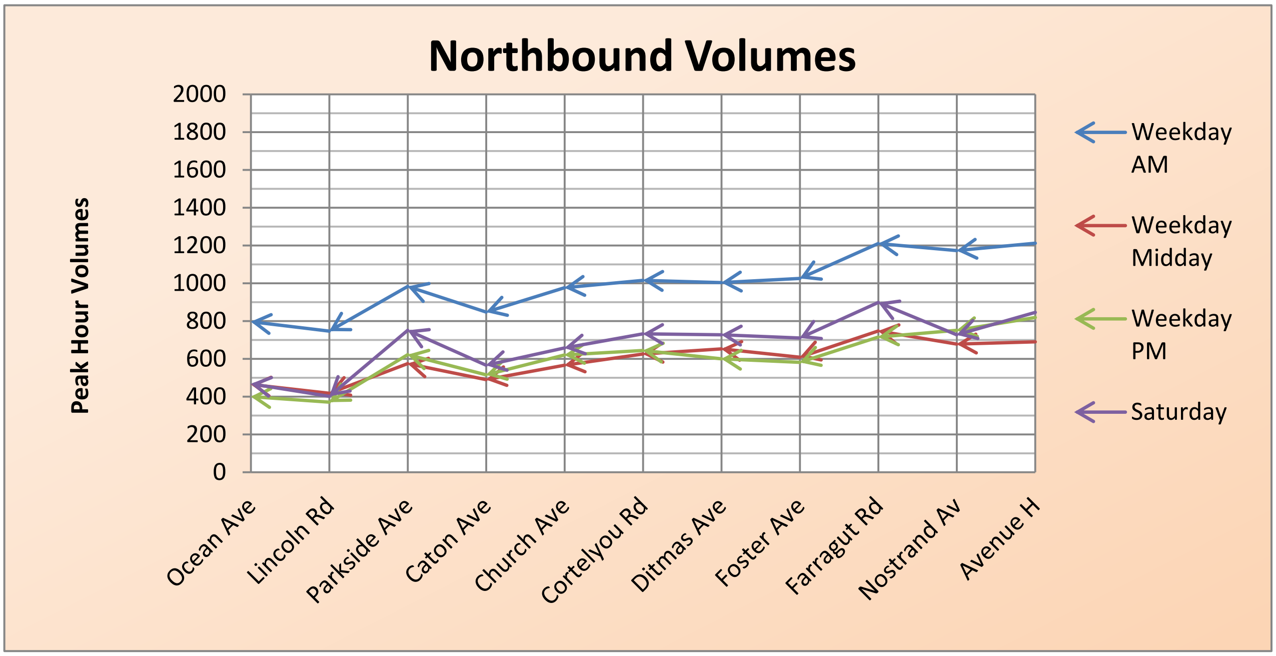

Figure 4: Northbound Volumes by Peak Hour

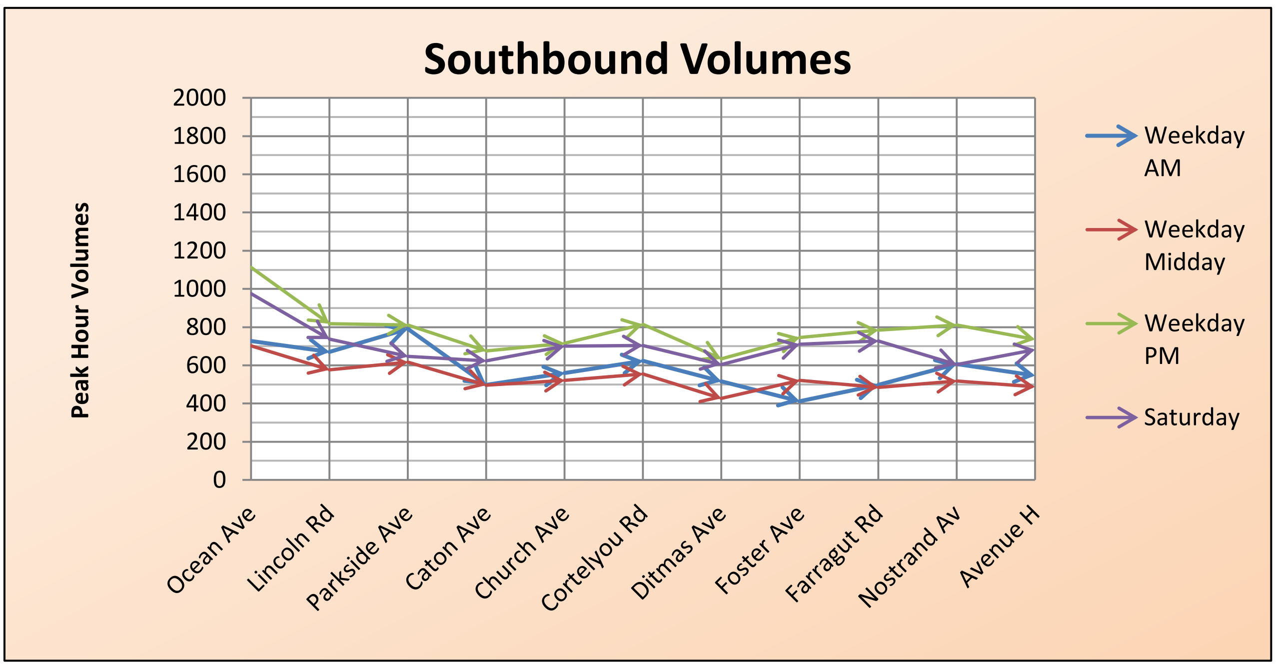

Figure 5: Southbound Volumes by Peak Hour

but are not as pronounced as northbound during the AM peak hour. This confirms that the peak direction is towards Manhattan during weekday mornings and away from Manhattan during weekday evenings. However, the northbound volume during the weekday AM peak hour, which varies from about 1200 to 800 vehicles, is significantly higher than the southbound volume during the weekday PM peak hour, which varies from about 1050 to 750 vehicles. Saturday peak hour volumes were the second highest of the four peak hours for both directions. Although weekday midday volumes were the lowest of the four peak hours, deliveries are more frequent, increasing the likelihood of double parking, which can significantly restrict capacity and degrade operating conditions.

The northbound volumes show a steep drop at Farragut Avenue/Rogers Avenue, illustrating the heavy turning volume onto Rogers Avenue, and at Parkside Avenue. Likewise, the southbound volumes show a steep drop at Ocean Avenue, because of the heavy turning volume there.

Balanced traffic flow maps for all four peak hours and are shown in Figure 6 through Figure 9.

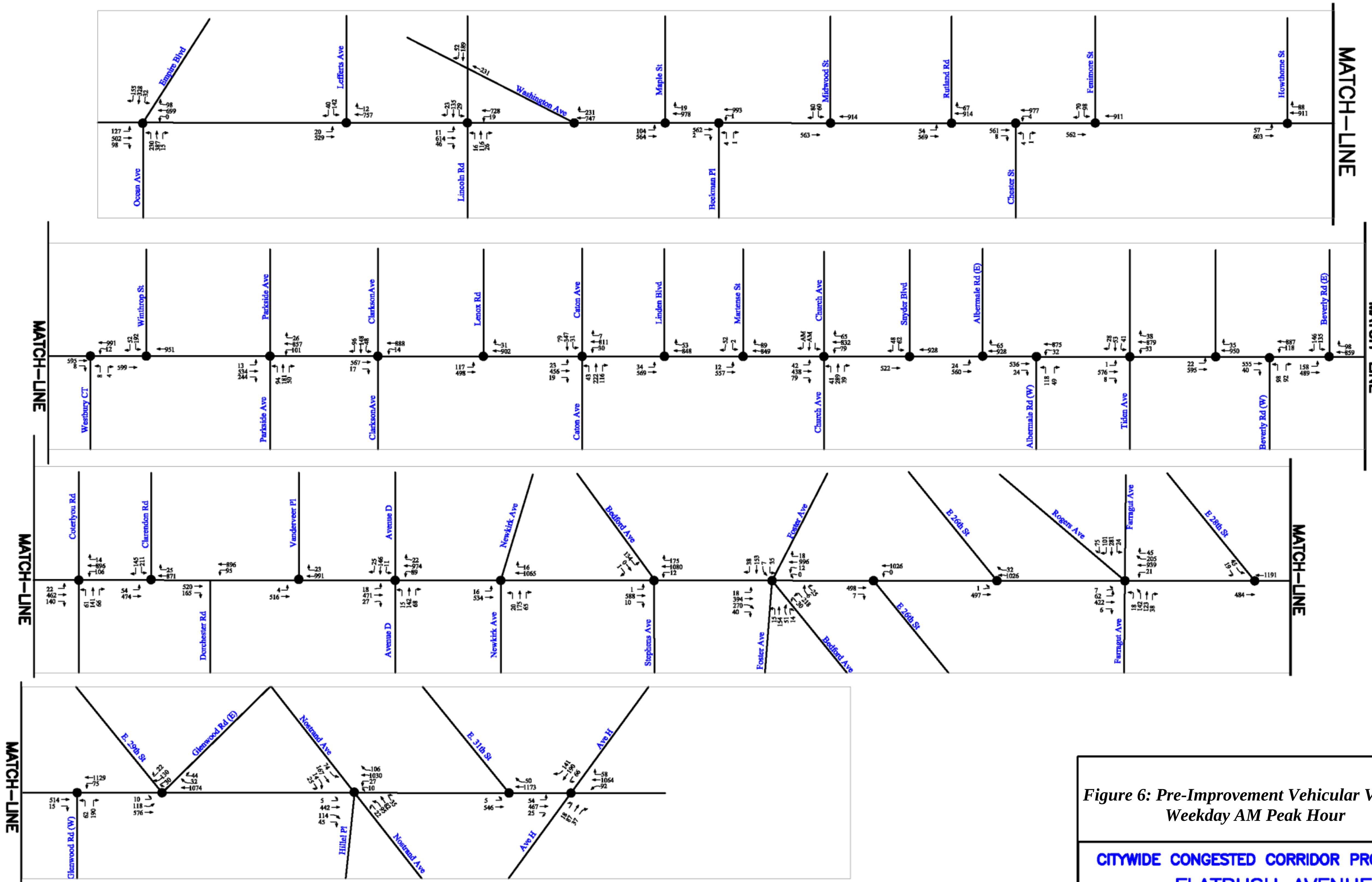

Figure 6: Pre-Improvement Vehicular Volumes Weekday AM Peak Hour

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FLATBUSH AVENUE

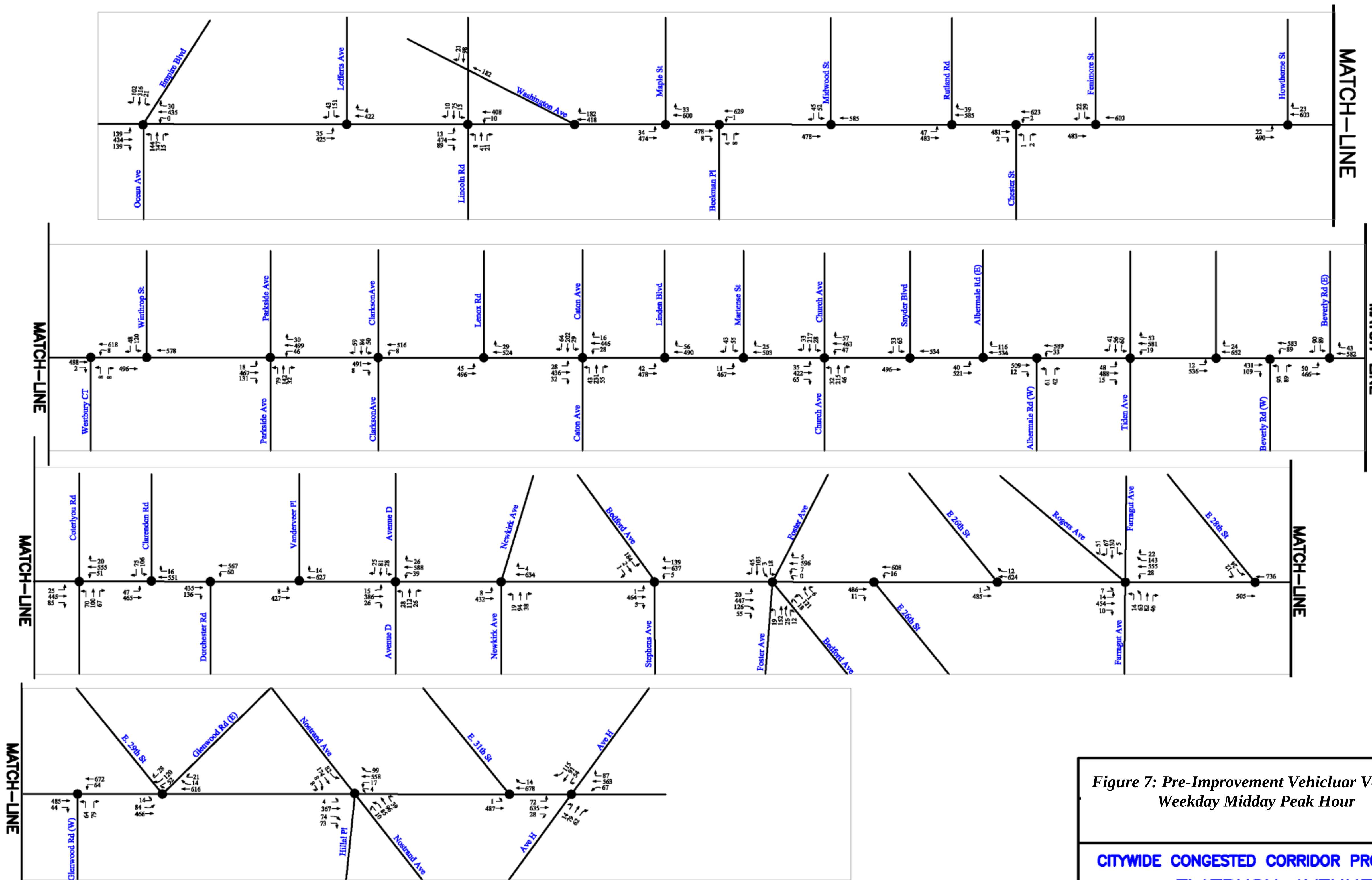

Figure 7: Pre-Improvement Vehicluar Volumes
Weekday Midday Peak Hour

CITYWIDE CONGESTED CORRIDOR PROJECT
FLATBUSH AVENUE

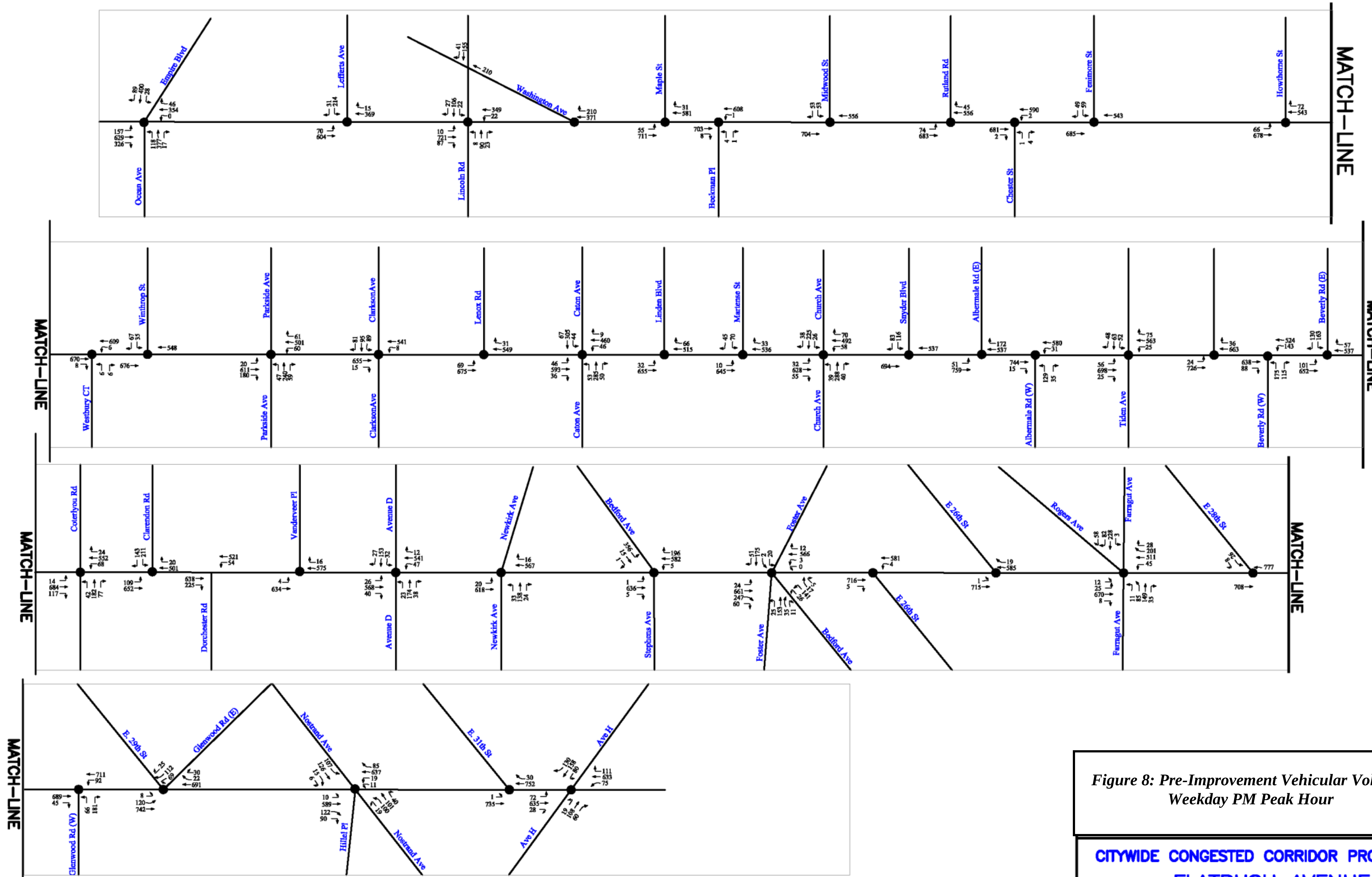

Figure 8: Pre-Improvement Vehicular Volumes
Weekday PM Peak Hour

CITYWIDE CONGESTED CORRIDOR PROJECT

FLATBUSH AVENUE

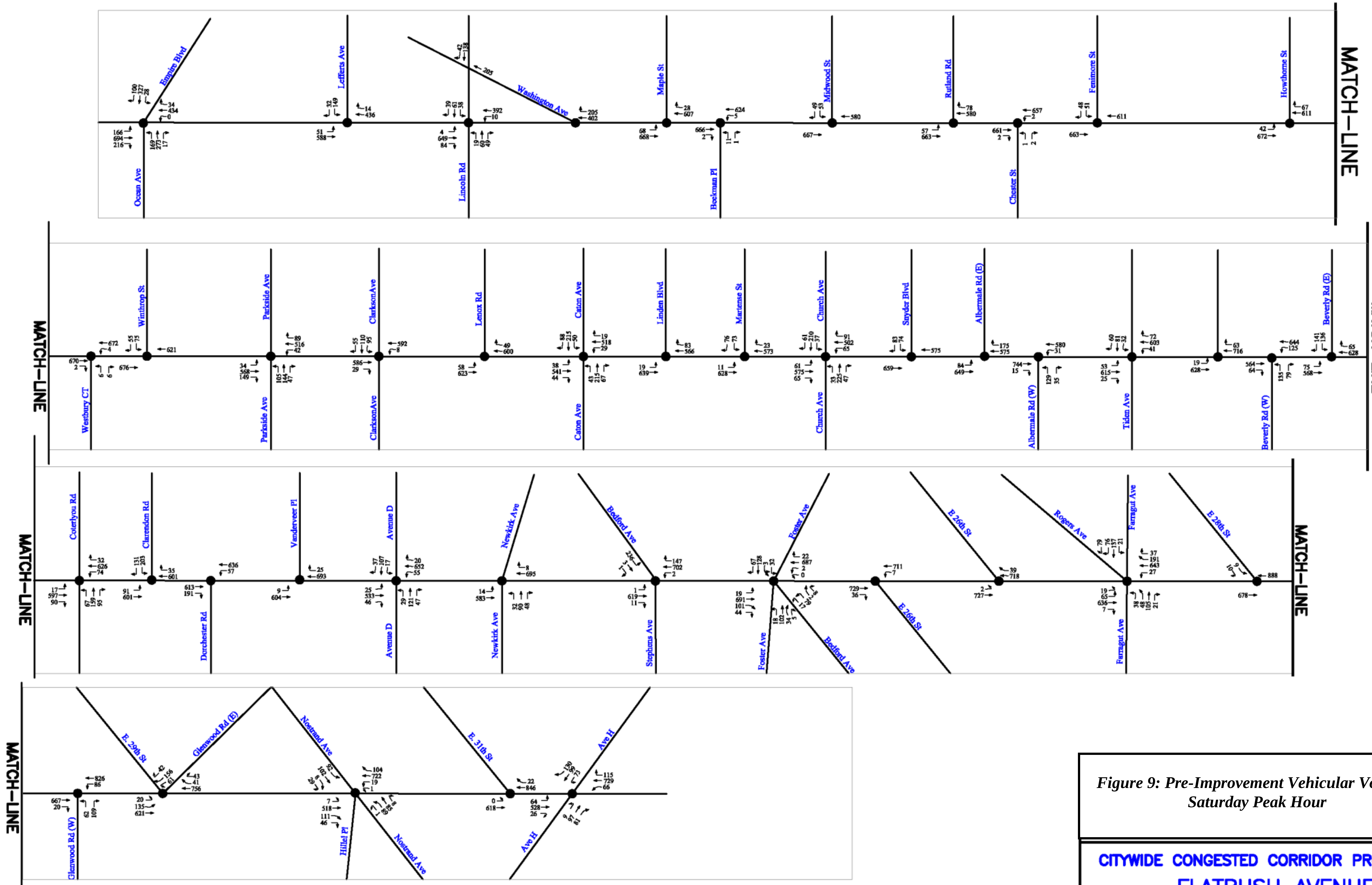

Figure 9: Pre-Improvement Vehicular Volumes Saturday Peak Hour

CITYWIDE CONGESTED CORRIDOR PROJECT

FLATBUSH AVENUE

2.4 Parking

Curbside regulations and usage is a critical element of this corridor because it affects health of the many local businesses. These businesses require parking spaces for both customers and delivery trucks. However, parking maneuvers can significantly slow down traffic. As the photographs in Section 2.2 have shown, even legally parked trucks block traffic lanes due to the corridor's narrow width. It was, therefore, a focal point of the proposed improvements to consider all parking factors.

Figure 10 below breaks down the types of on-street parking spots available on weekdays from 8AM to 6PM. From 10 AM to 6 PM, there were a total of approximately 574 parking spots along the project corridor, of which 448 were one-hour metered parking, 82 were two-hour metered parking, 36 were free and approximately eight (depending on truck size) were designated for trucks loading or unloading. During the morning hours from 8 AM to 10 AM, there were a total of 509 parking spots, of which 415 were one-hour metered parking, 53 were two-hour metered parking, 35 were free and 6 were for trucks loading or unloading. These lower numbers were due to weekday morning "No Parking 7-10 AM Mon-Fri" regulations that existed on the east curb north of Caton Avenue.

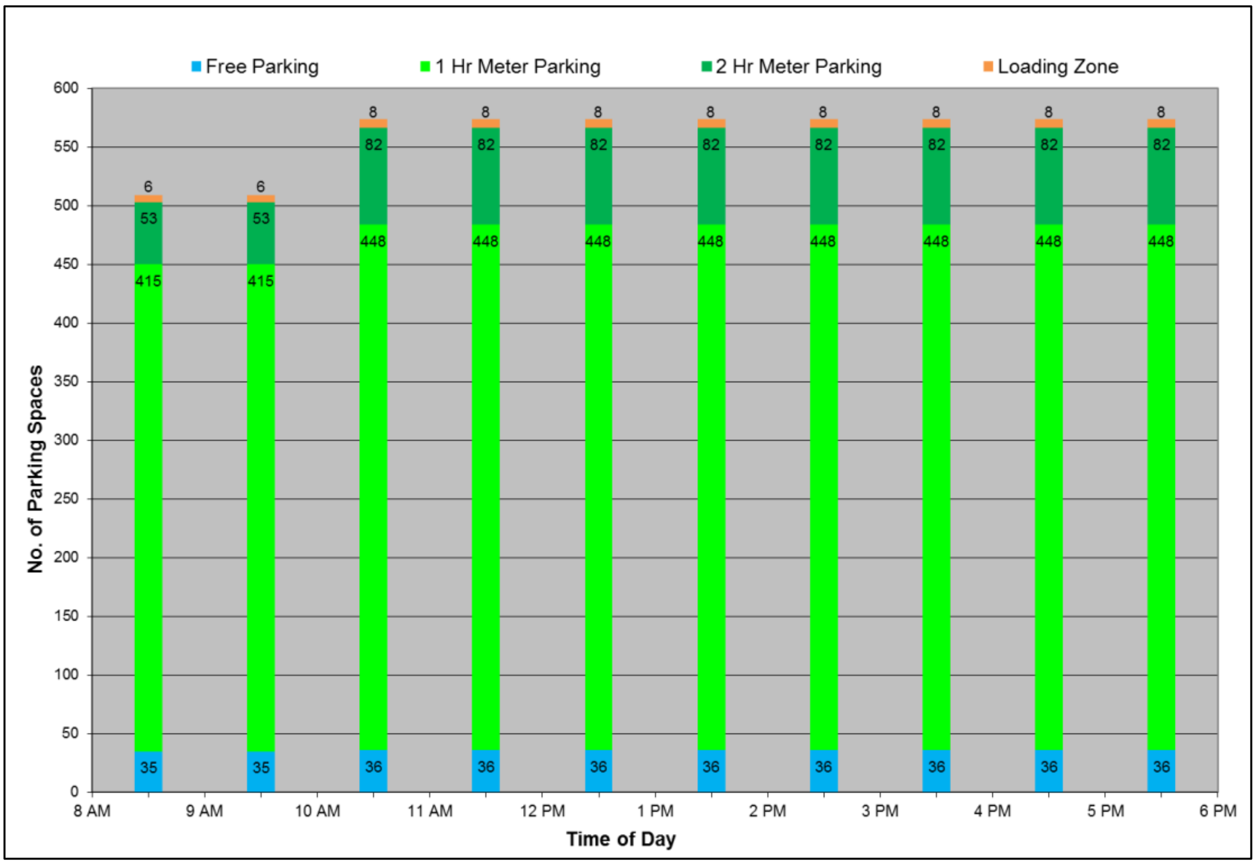

Figure 10: Legal Parking Space Capacity during Weekdays

Figure 11 summarizes the occupancy rate by hour. The different colors depict the number of legally parked cars, legally parked trucks and illegally parked vehicles. This figure illustrates, and observations have confirmed, that even though capacity was underutilized, motorists still parked illegally, including double parking. This is important because it indicates that the presence of double parking does not reflect a lack of capacity, but rather parking behavior. Double parking was commonly observed when there were legal spaces on the next block, and sometimes on the same block.

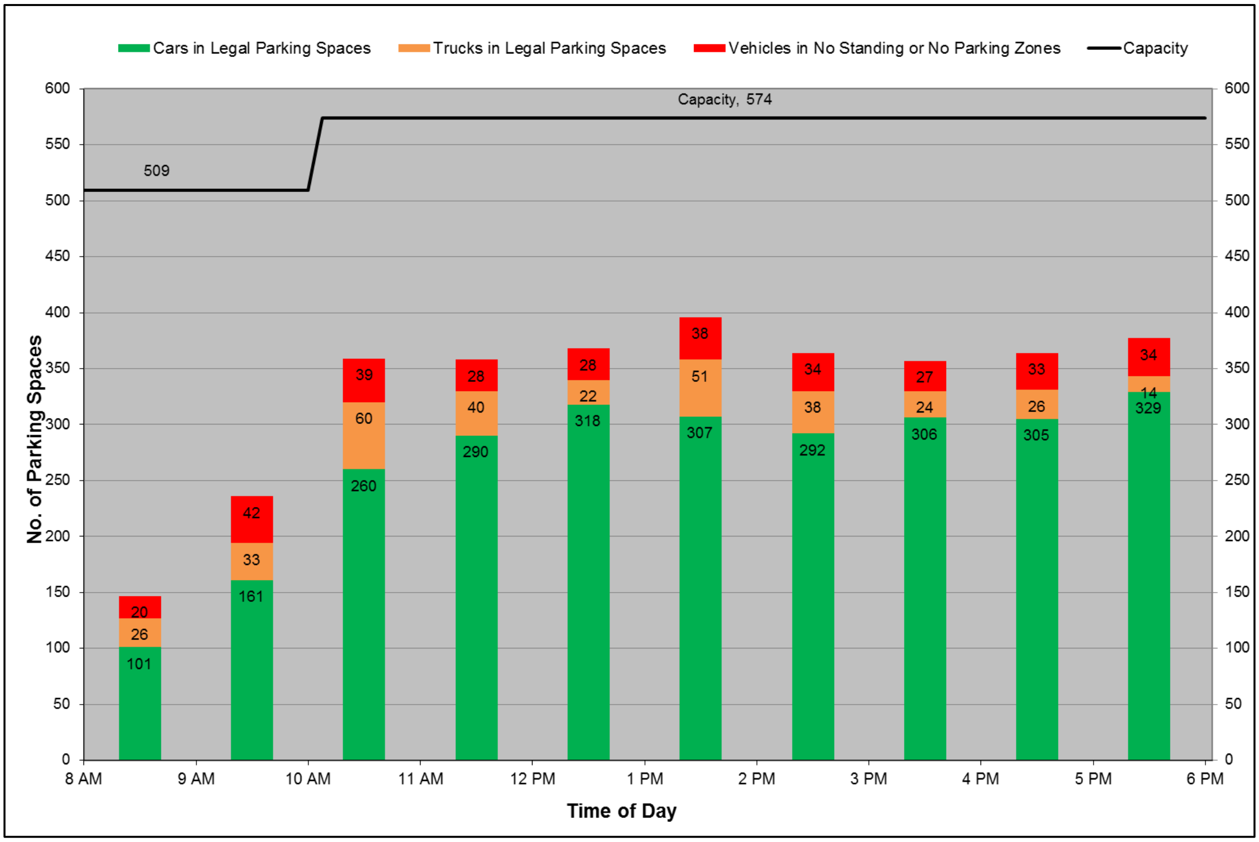

Figure 11: Parking Occupancy during a Typical Weekday

Figure 12 through ***Figure*** 15 are illustrations of all the curbside parking regulations along with the parking capacity and occupancy for each block segment. Next to each block segment is a graph that shows the parking utilization rate of that block for a typical weekday and how it fluctuated throughout the hours of the day between 8AM and 6PM. These results help to identify the demand for passenger car parking vs. truck loading or unloading for each individual block. Understanding these behaviors helped suggest potential spots for loading windows and if there was available parking capacity to use the curb for travel lanes or turning lanes.

Figure 12: Parking Occupancy by Block (Segment A)

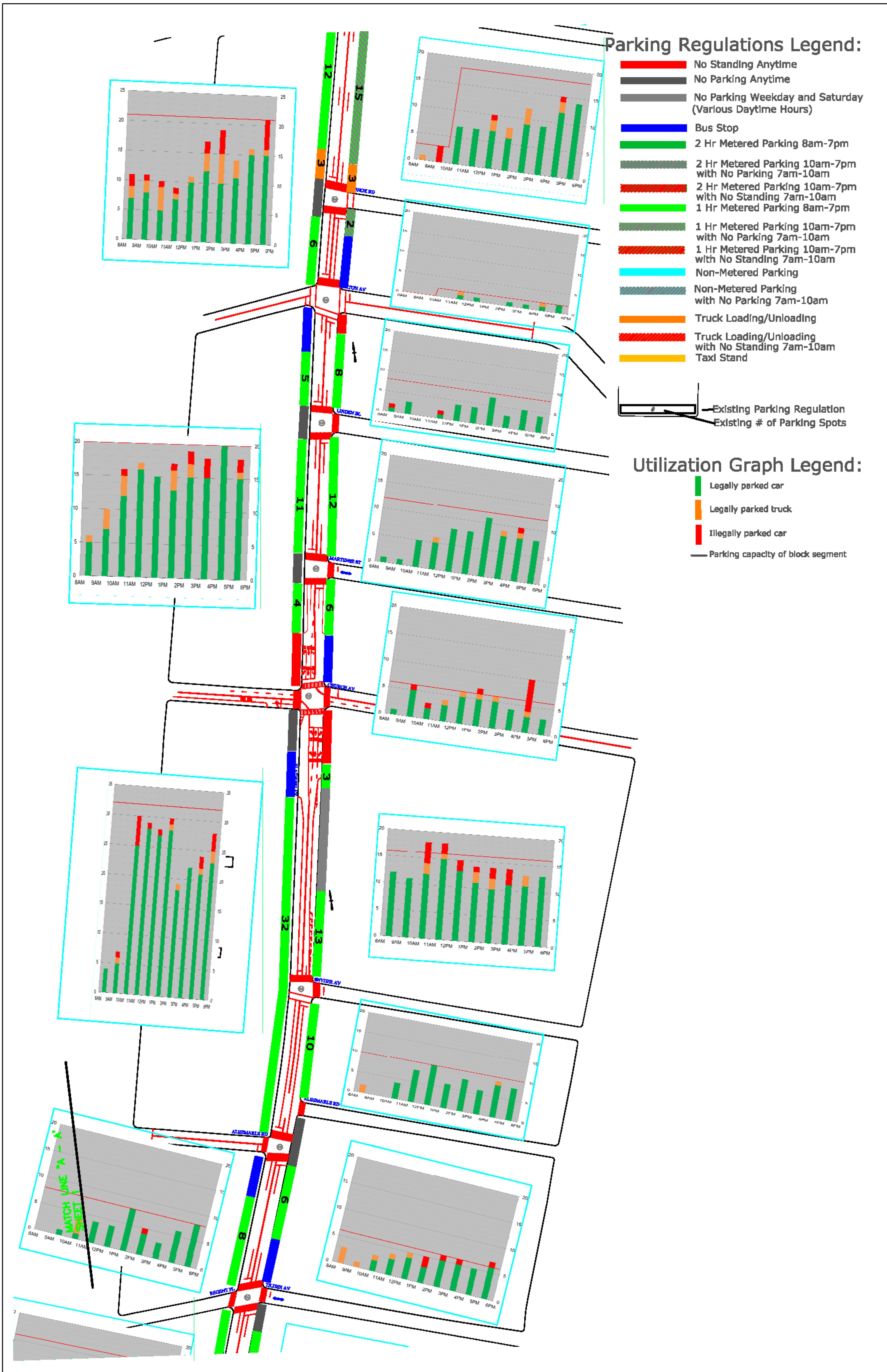

Figure 13: Parking Occupancy by Block (Segment B)

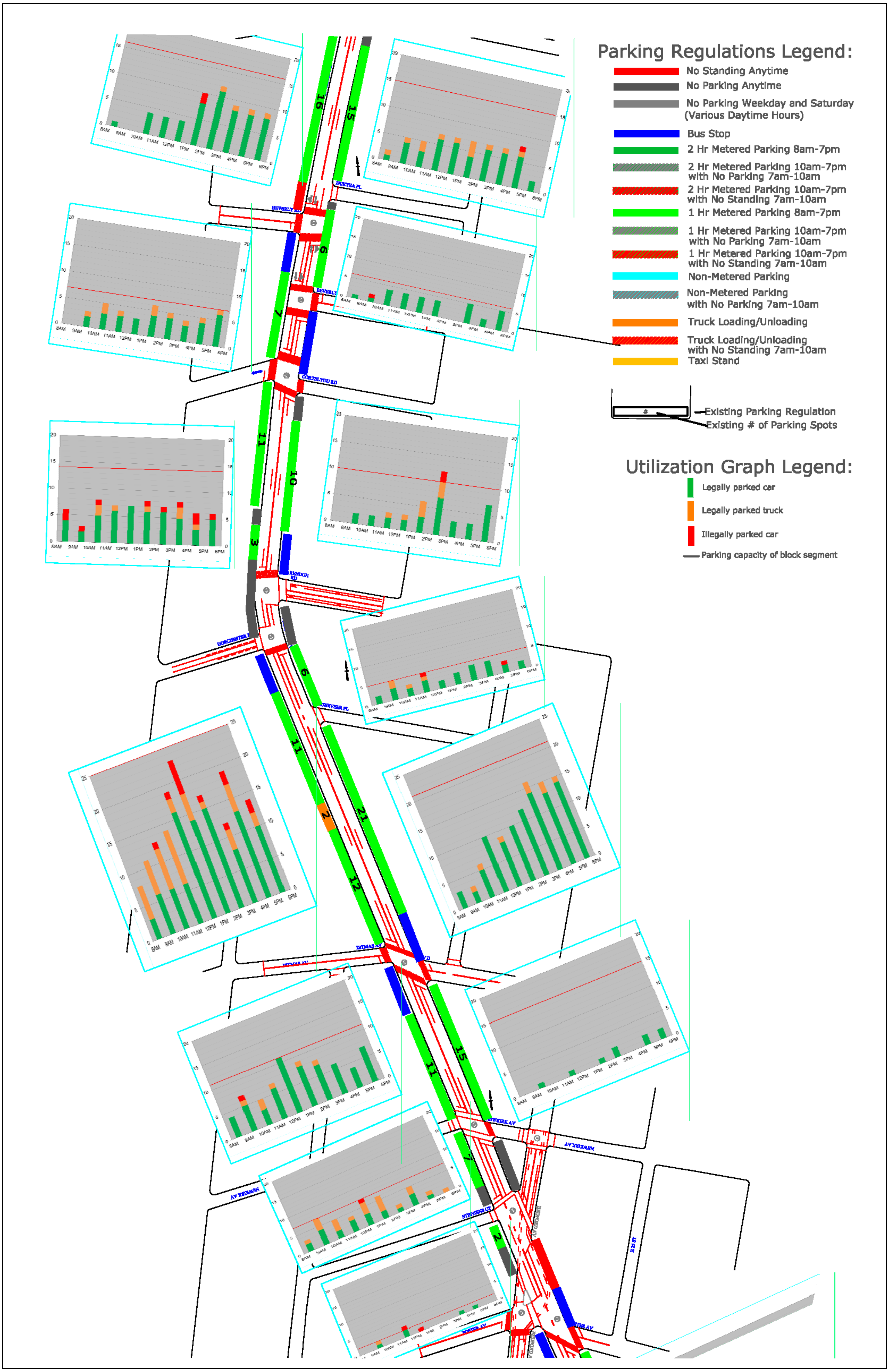

Figure 14: Parking Occupancy by Block (Segment C)

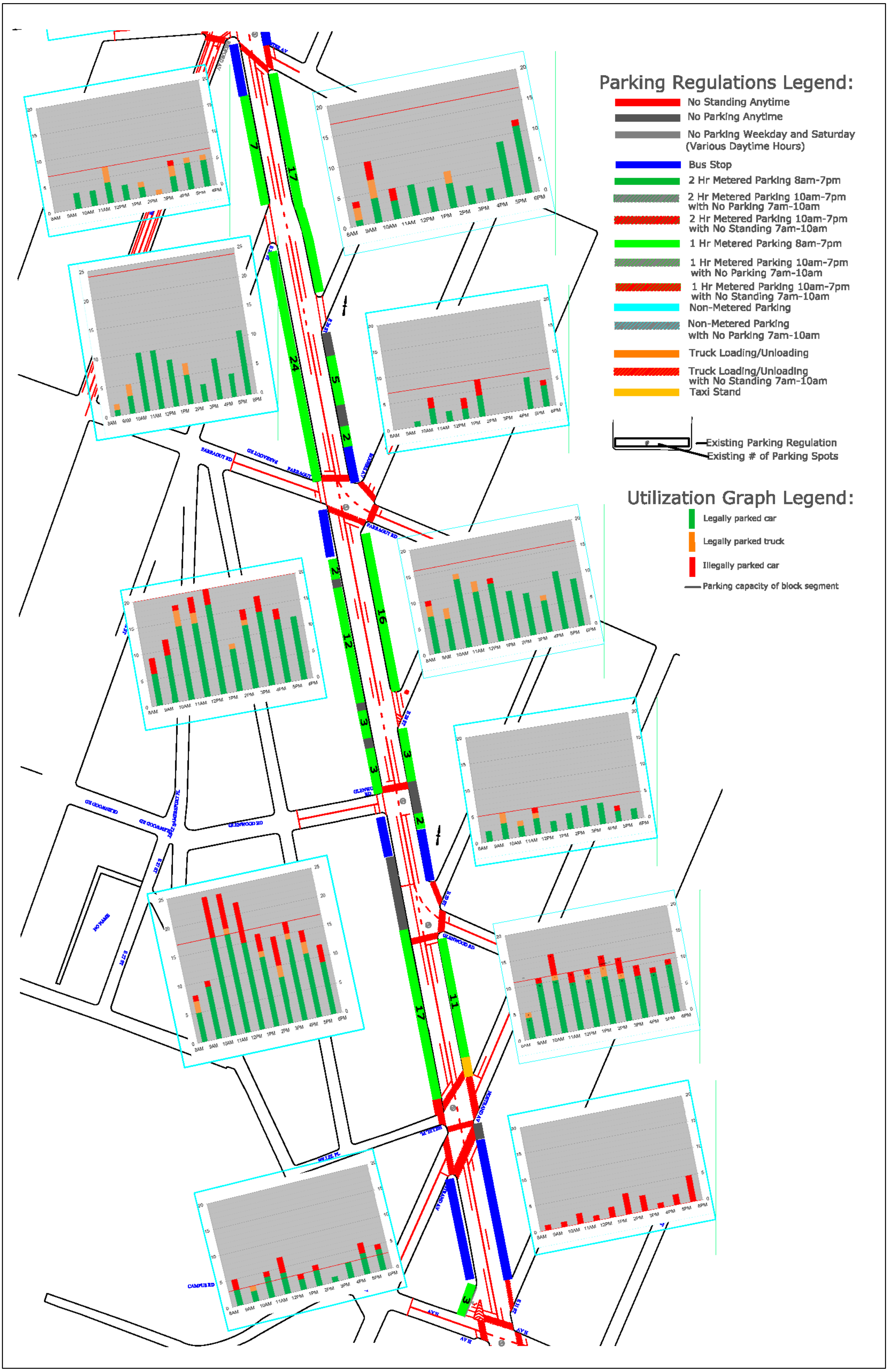

Figure 15: Parking Occupancy by Block (Segment D)

A perceived parking problem is that some parkers refill the meter as the time has expired in order to park longer than the allowed time. Parking duration was determined for all vehicles that were parked at one- and two-hour metered spaces in order to quantify the number of vehicles that illegally "feed the meter." During the time meters were in effect, a total of 298 vehicles – 241 at one-hour spaces and 57 at two-hour spaces – exceeded the time limit. The breakdown is as follows:

(448) One-Hour Parking Spaces

- 84.1% of the time meters are in effect, one-hour time limit was not exceeded.
- 129 vehicles parked between 1 and 2 hours, accounting for 4.4% of the time meters are in effect.
- 43 vehicles parked between 2 and 3 hours, accounting for 2.4% of the time meters are in effect.
- 22 vehicles parked between 3 and 4 hours, accounting for 1.7% of the time meters are in effect.
- 47 vehicles parked longer than 4 hours, accounting for 7.4% of the time meters are in effect.

(82) Two-Hour Parking Spaces

- 90.3% of the time meters are in effect, two-hour time limit was not exceeded.
- 9 vehicles parked between 2 and 3 hours, accounting for 3.0% of the time meters are in effect.
- 5 vehicles parked between 3 and 4 hours, accounting for 2.3% of the time meters are in effect.
- 6 vehicles parked longer than 4 hours, accounting for 4.5% of the time meters are in effect.

2.5 Transit

The study area is served by MTA/NYC transit buses and subways. The service is presented in Figure 16.

Figure 16: MTA/NYC Transit Map

The B41 bus operates between Downtown Brooklyn and Mill Basin, running the entire length of Flatbush Avenue with 15 stops in each direction within the study area. The average weekday ridership is about 33,678 passengers, ranking as the 9th highest ridership of local buses in the five boroughs. The bus route runs with the following peak hour frequencies:

B-41	**NB**	**SB**
AM	*25*	*23*
MD	*17*	*15*
PM	*19*	*20*
SAT	*18*	*18*

The B-41 bus was often observed to blocking the right travel lane when at a bus stop, due to insufficient curbside width. The narrow travel lanes also made it a very tight squeeze for a passenger vehicle to be traveling adjacent to a traveling bus, as indicated in the photograph below that shows the bus taking up both lanes.

Both the B103 and the BM2 buses run along a portion of Flatbush Avenue between Cortelyou Road and Avenue H, making stops on Flatbush Avenue at Foster Avenue and at Nostrand Avenue. The B6 bus runs along the one-block portion of Flatbush Avenue between the two offset intersections of Glenwood Road. The B16 runs along the one-block portion of Flatbush Avenue between Lincoln Road and Ocean Avenue.

While there is no subway line that runs directly along the corridor, there are two subway lines that run roughly parallel to it. The local Q and express B train of the Brighton Line stop at the Prospect Park station at the northern end of the study area at the intersection of Flatbush Avenue, Ocean Avenue and Empire Boulevard. As the Brighton Line continues south, it veers further to the west of Flatbush Avenue as follows: Parkside Avenue local Q station along Ocean Avenue, Church Avenue local Q and express B station along East 18th Street, and then along East 16th Street, the following three stops: local Q at Beverley Road, local Q at Cortelyou Road, and local Q and express B at Newkirk Plaza. South of Newkirk Plaza, the Brighton Line is more than a half mile away from Flatbush Avenue. The local Q train runs at all times, and the express B train does not run weekends or late nights.

The Nos. 2 and 5 trains run under Nostrand Avenue, a few blocks east of Flatbush Avenue in the portion of the study area north of Clarendon Road. South of Clarendon Road, Flatbush Avenue makes its diagonal turn and eventually intersects Nostrand Avenue at “the Junction.” The No. 2 train runs at all times, and the No. 5 train runs only weekday rush hours and midday. From north to south, there are stops (along Nostrand Avenue) at Sterling Street, Winthrop Street, Church Avenue, Beverley Road, Newkirk Avenue and Flatbush Avenue, which is the terminal station. Known as “The Junction,” this is a major transfer point for subway and bus passengers.

2.6 Goods Movement

The truck routes in the study area are illustrated in Figure 17. Flatbush Avenue is designated as a local truck route between the Manhattan Bridge and Church Avenue, and a through truck route from Church Avenue to the Marine Parkway Bridge. The west leg of Church Avenue is a through truck route. The local truck routes that cross Flatbush Avenue are Empire Boulevard, Caton Avenue, the east leg of Church Avenue, Rogers Avenue and Nostrand Avenue north of Flatbush Avenue.

Data based on vehicle classification counts show that the heavy vehicle (trucks and buses) percentage of total vehicles traveling along this section of Flatbush Avenue was high with average frequencies summarized as follows:

	NB	SB
AM	*10%*	*14%*
MD	*10%*	*11%*
PM	*7%*	*10%*
SAT	*5%*	*6%*

Figure 17: Truck Route Map

The highest heavy vehicle percentage occurred during the weekday AM peak hour in the southbound direction at 14%, followed by the weekday midday peak hour in the southbound direction at 11%. The heavy vehicle percentage was 10% for the weekday AM and midday peak hours in the northbound direction, and for the weekday PM peak hour in the southbound direction.

There were only three loading and unloading zones along the study corridor, sufficient for a maximum of eight trucks. A three-space zone was located on the east side of Flatbush Avenue just north of Lenox Avenue, and another three-space zone was located directly across the street on the west side. A two-space zone was located on the west side midway between Dorchester Road and Ditmas Avenue. However, the heavy presence of commercial activity and observations show that loading and unloading of trucks were still blocking a travel lane.

A merchant survey was conducted in order to obtain information on the merchant operations, including store hours, frequency and time of truck deliveries, type of loading trucks required and preferences for loading zones. The results of this survey were used to determine whether there should be additional loading zones.

2.7 Traffic Analysis

A traffic analysis was conducted for the Flatbush Avenue corridor in order to help determine how the corridor will operate under different improvement proposal scenarios. Travel times and travel speeds are the major MOE that was used in quantifying traffic operations. SimTraffic, the micro simulation component of Synchro Studio, was selected as the most appropriate method of analysis for this project because of the nature of the corridor. Flatbush Avenue has many closely spaced intersections with complicated signal layouts and congested intersections, which can cause inaccuracies in a macroscopic Synchro model. While SimTraffic has its limitations as well, it provides methods to more accurately reflect the traffic flow of the pre-improvement conditions.

The first step of this process required creating a baseline condition that closely reflects the pre-improvement conditions. Figure 18 presents the results, which was calibrated to match the results of the travel time runs. As expected, the longest peak hour travel time for the northbound direction from the southernmost intersection (Nostrand Avenue) to the northernmost intersection (Empire Boulevard/Ocean Avenue) was during the weekday AM peak period at 18.5 minutes. The longest peak period travel time for the southbound direction was during the Saturday peak period at 15.5 minutes, followed by the weekday PM peak period at 13.8 minutes. Midday travel times were the shortest in both directions.

The modeling of this information enabled the delay to be quantified, assisted in determining the type and locations of improvements to propose, and provided for assessment of the impacts of improvement scenarios, as discussed in following chapters.

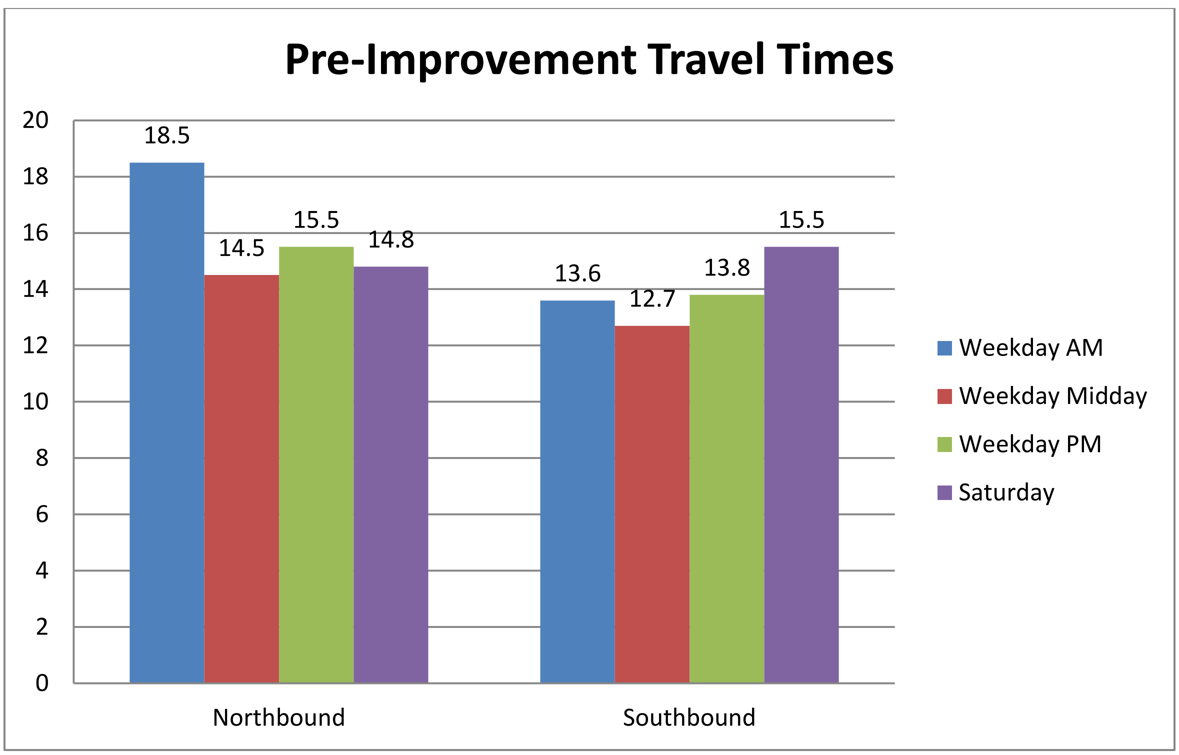

Figure 18: Pre-Improvement Travel Times on Flatbush Ave between Empire Blvd and Nostrand Ave

2.8 Pedestrian Analysis

Many factors contribute to the conditions of pedestrian facilities. This study reviews pedestrian crossing times at all intersections, available sidewalk and crosswalk widths, pavement markings and the general safety of all pedestrian elements.

The crossing time provided by pedestrian signals was calculated for each crosswalk at each intersection along the study corridor, and this was compared to the amount of time it takes to cross. It was determined that there was sufficient crossing time at all crosswalks. However, many other factors affect pedestrian safety. Specific attention was given to intersections where there was either a high number of conflicting turning vehicles, visual obstructions, or skewed alignments.

Based on site visits as well as discussions with community boards, locations were noted that had faded pavement markings or damaged pedestrian facilities.

2.9 Safety Analysis

The safety of all street users, including pedestrians, bicyclists and motorists is a central goal of this study. Examining past crashes can help determine the contributing factors and provide potential recommendations for improving safety.

Summaries of reportable crashes for the most recent three-year period before improvements were made, from 2009-2011, were obtained from NYCDOT for all corridor intersections and mid-block locations along Flatbush Avenue. A reportable crash in NY State is defined as a crash involving death, injury or at least $1,000 in property damage. These crashes were used to identify overall crash patterns and clusters.

During these three-years, a total of 819 reportable crashes occurred along the study corridor, resulting in 997 injuries, of which 35 were considered major and 4 resulted in a fatality. Of the 819 crashes, 789 (96%) occurred at intersections, while 30 (4%) occurred at midblock segments. 560 (68.4%) involved only motor vehicles, 210 (25.6%) involved pedestrians and 49 (6.0%) involved bicyclists.

The average number of reportable crashes for the analyzed time period was 273 crashes per year. This corridor was considered a high crash corridor, ranking in the top 10% of Brooklyn corridors. Figure 19 shows the crashes at each intersection broken down by vehicle type on one axis and on the other axis the crash rate per million vehicles entering each intersection (MEV). The average New York State-wide crash rate for similar facilities is 0.32 MEV for four-legged signalized intersections and 0.19 MEV for three-legged signalized intersections. In comparison, the average of the four-legged intersections along the project corridor was .94 MEV and .36 MEV for three-legged intersections. Of these 41 intersections, 33, or 80%, had crash rates that were higher than the state-wide rate.

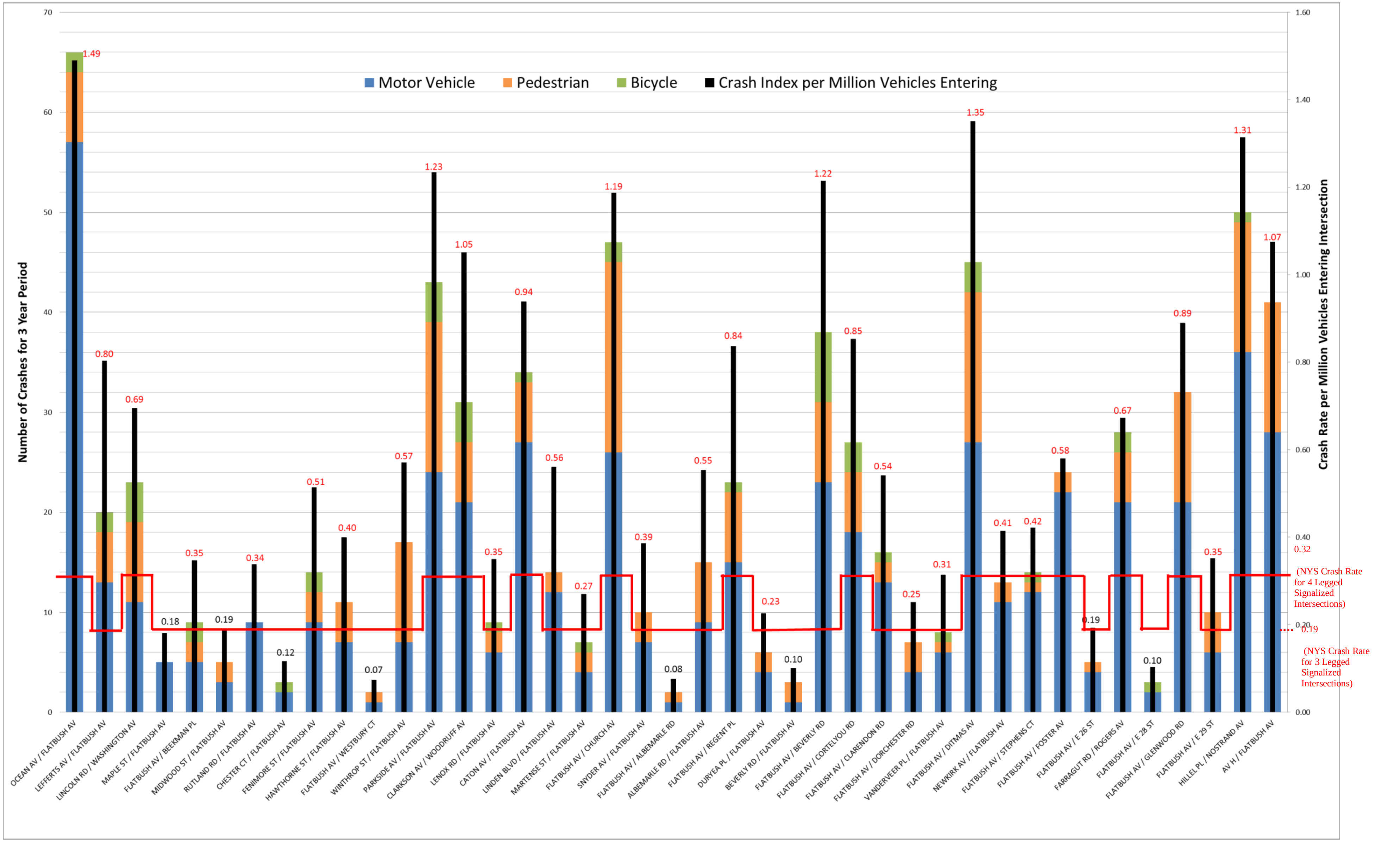

Figure 19: Number of Crashes and Crash Rate by Intersection

Figure 20 presents the breakdown of crashes by time of day. It shows that 47% of the crashes occurred during the evening hours of 6pm to 9pm, followed by 12% during the 3pm to 6pm period. This indicates that even though the traffic volumes were highest during the AM peak period, the high levels of activity during the evening hours can create the highest potential for conflict.

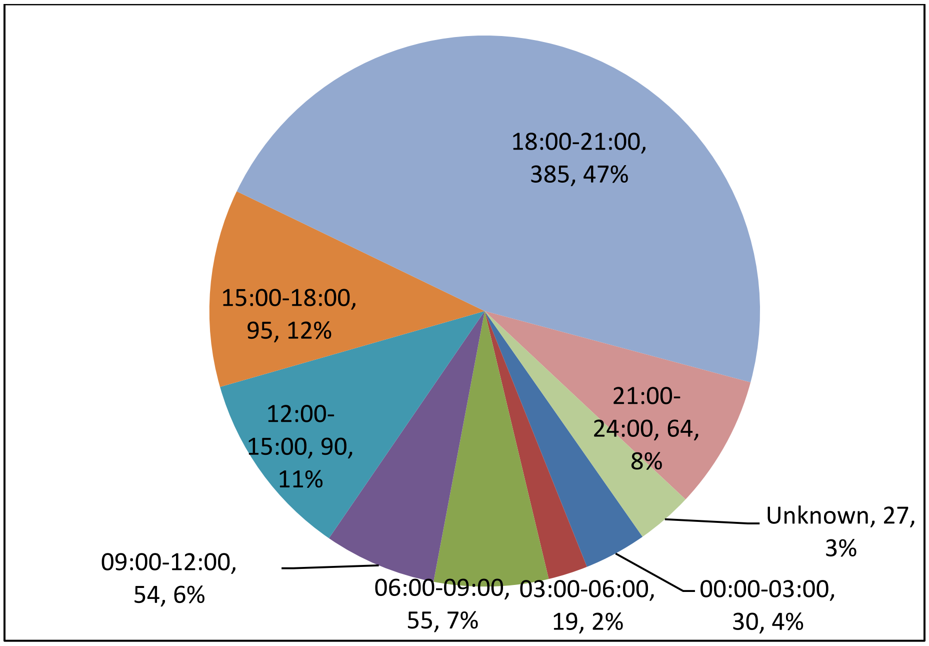

Figure 20: Total Crashes by Time of Day

Figure 21 presents the breakdown of the 560 motor vehicle crashes by collision type. Rear-end collisions occurred the most frequently with 142 crashes (25%), followed by sideswipe (same direction) with 116 crashes (21%). Left turns collisions represented 11% of the data.

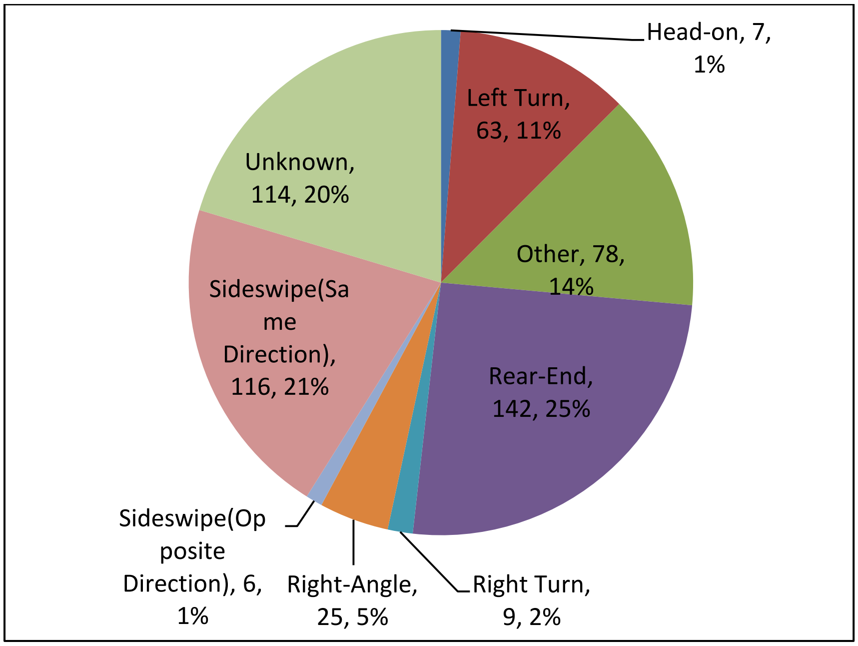

Figure 21: Motor Vehicle Crashes by Type

Figure 22 breaks down the collision type by intersection to better understand what types of collisions are occurring at which intersections. The highest number of crashes along the Flatbush Avenue corridor occurred at Ocean Avenue (57), followed by Nostrand Avenue (36). Other high-crash intersections include Avenue H (28), Ditmas Avenue (27), Caton Avenue (27), Church Avenue (26), Parkside Avenue (24) and Beverley Road (23). These numbers are consistent with the notion that weaving conditions as well as shared left-turn lanes can create unsafe driving conditions.

It is also worthwhile to note that 44 (8%) of the 560 motor vehicle crashes involved trucks and 45 (8%) involved buses.

The contributing factor that was most often documented was driver inattention, followed by the driver's failure to yield to right-of-way. Other frequent contributing factors included the following in descending order: following too closely, another vehicle's action, pedestrian confusion, unsafe speed, improper turning, slippery pavement, improper passing or lane usage and unsafe lane changing. When looking into the pre-crash actions, crashes occurred most frequently to vehicles that were going straight. The second most frequent pre-crash actions involved vehicles that were making left turns, followed by parked vehicles, vehicles stopped in traffic, making right turns and changing lanes.

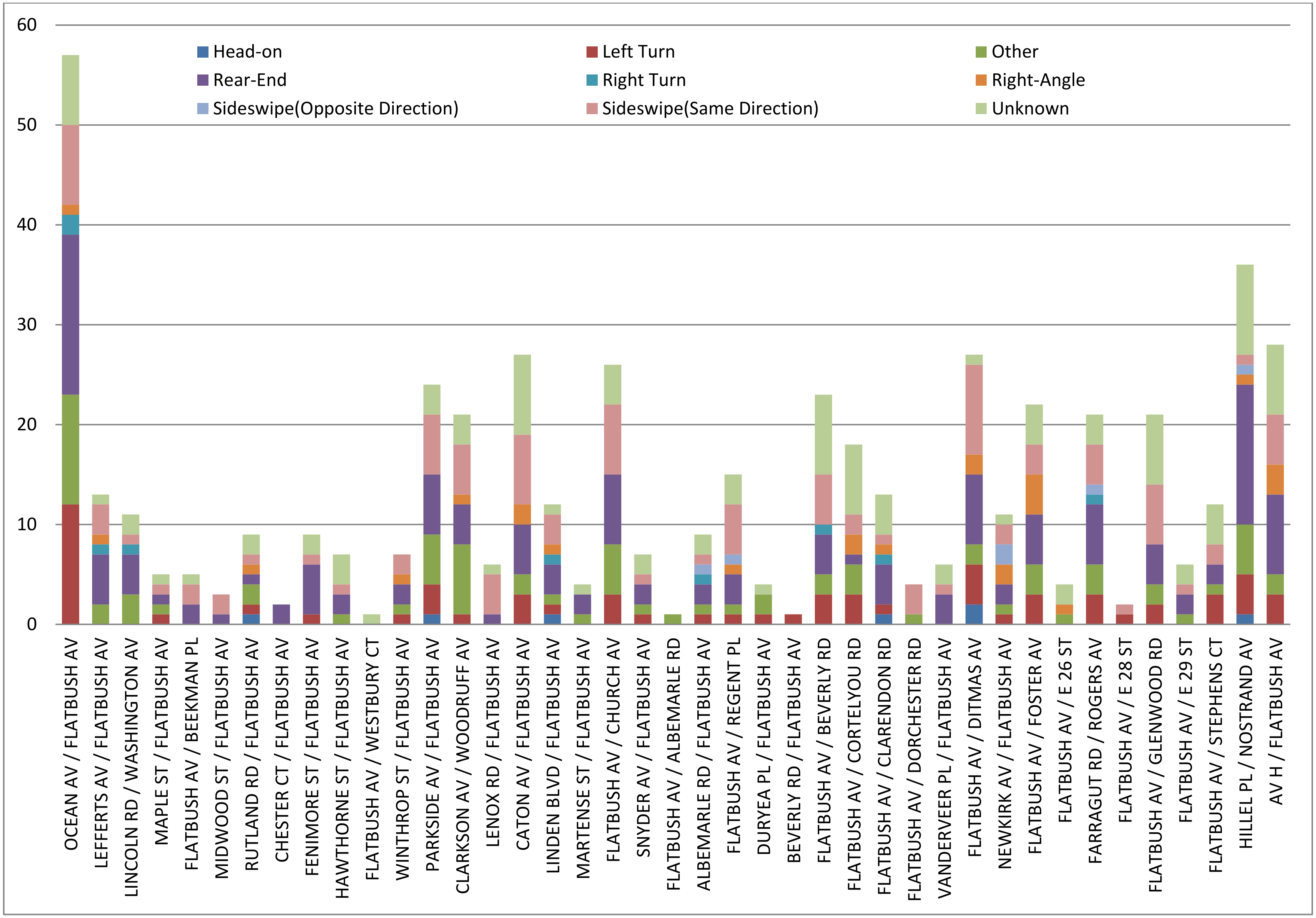

Figure 22: Motor Vehicle Crashes by Type by Intersection

Figure 23 breaks down mid-block crashes by collision type and mid-block segments. Out of the 20 mid-block crashes, a total of 9 crashes were sideswipe and 4 were rear-end. It is important to note that the mid-block segment between Church Avenue and Snyder Avenue had the most mid-block crashes and it is at that point where two lanes merge into one with little advanced warning.

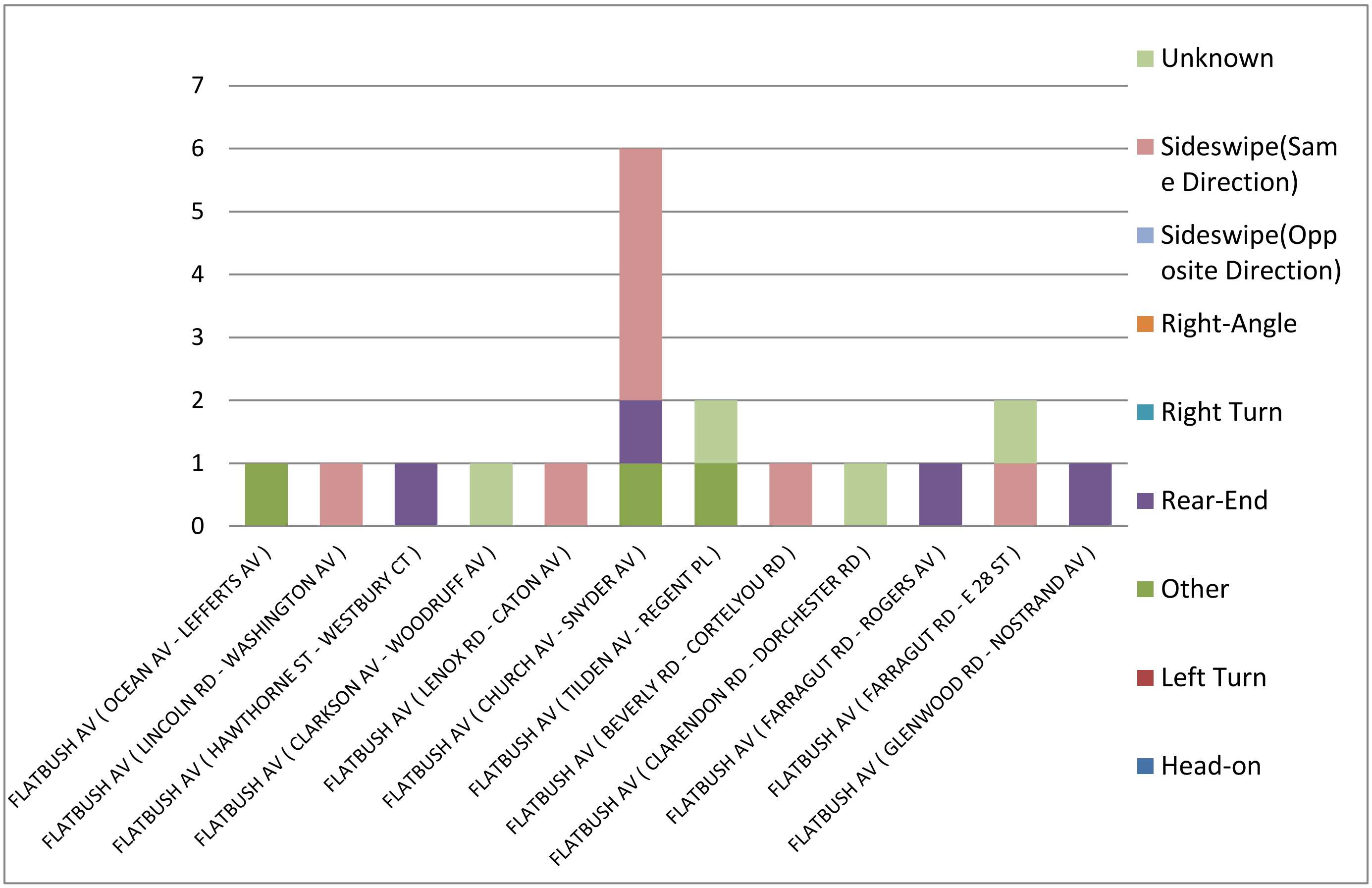

Figure 23: Mid-block Crashes by Type by Intersection

Figure 24 presents a breakdown of crashes involving pedestrians by action for each intersection in the study area. Out of the 210 crashes involving pedestrians, 8 (4%) occurred at mid-block segments, with one occurring at each of the segments shown in blue on ***Figure 25***. Church Avenue had the highest number of pedestrian related crashes with 19, followed by Parkside Avenue and Ditmas Avenue.

Figure 25 presents a corridor-wide breakdown of crashes involving pedestrians by action. It illustrates that at intersections, pedestrian crashes occurred almost three times as much when the pedestrians were crossing with the signal as when they were crossing against the signal. Further investigation needs to be performed at the time of the crash, like determining crosswalk location, pedestrian action, vehicle action and contributing factors, in order to understand why pedestrian crashes are occurring with this frequency.

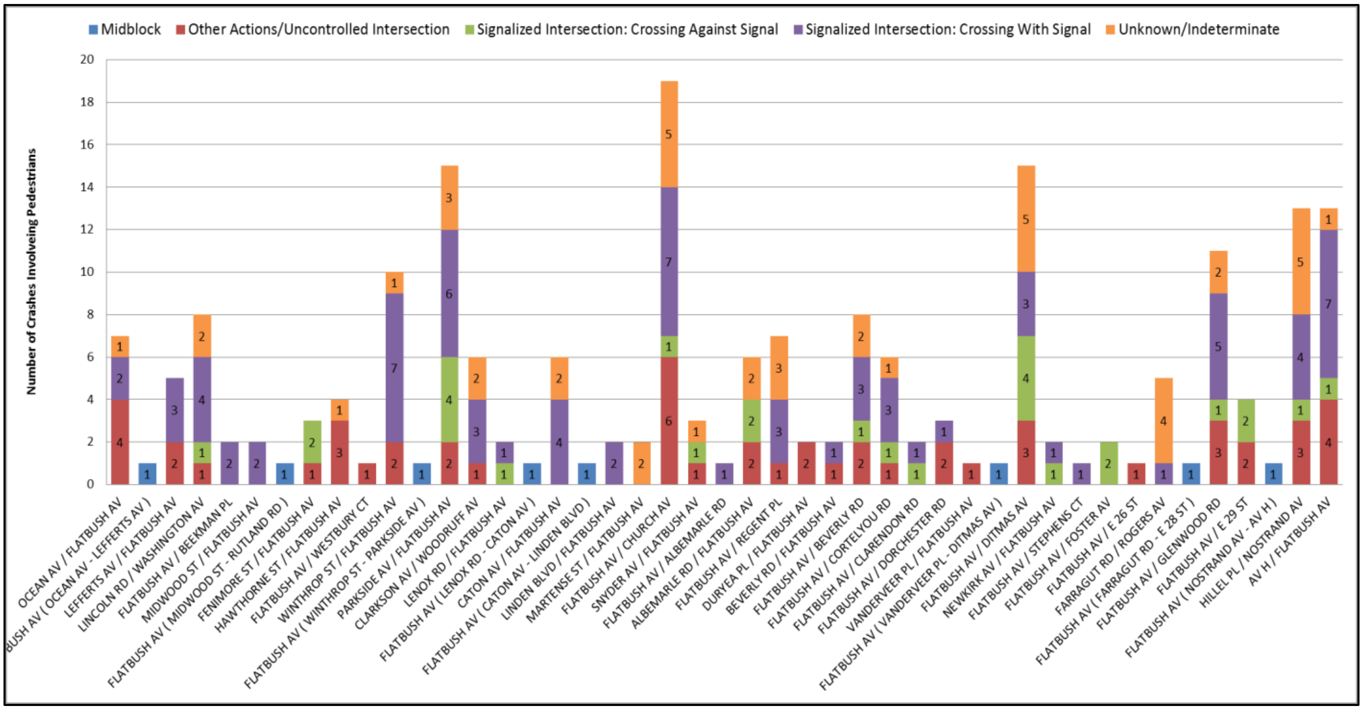

Figure 24: Pedestrian Crashes by Action by Intersection

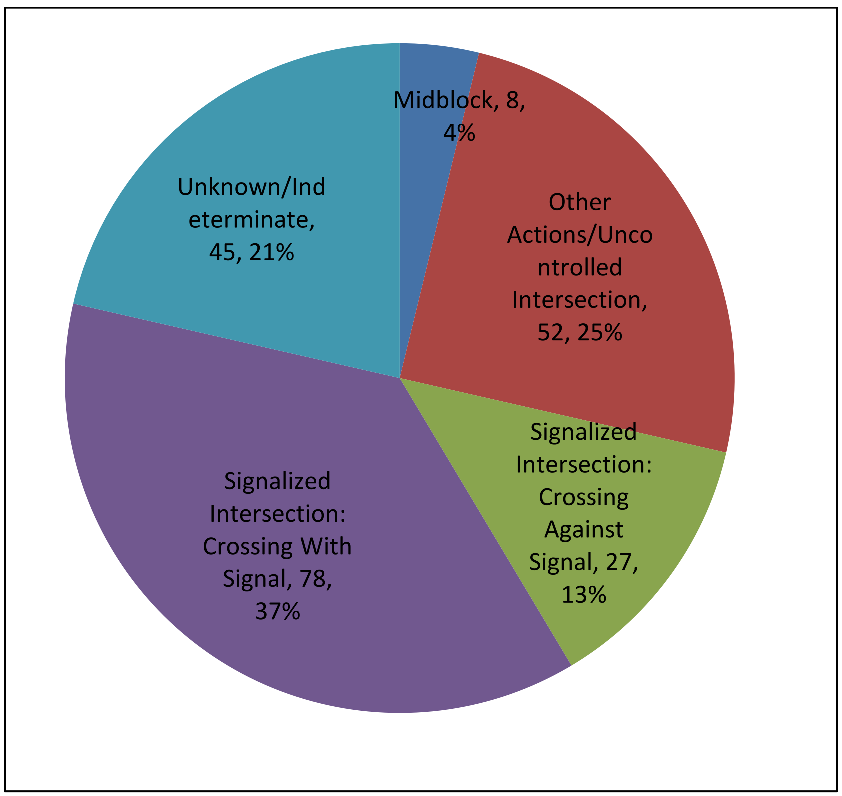

Figure 25: Pedestrian Crashes by Action

Figure 26 presents a breakdown of bicycle crashes by action. Out of 49 bicycle crashes, 2 (4%) occurred at midblock segments, one between Martense Street and Church Avenue and one between Tilden Avenue and Duryea Place. At intersections, crashes involving bicyclists crossing with the signal occurred 2.5 times more than crossing against the signal.

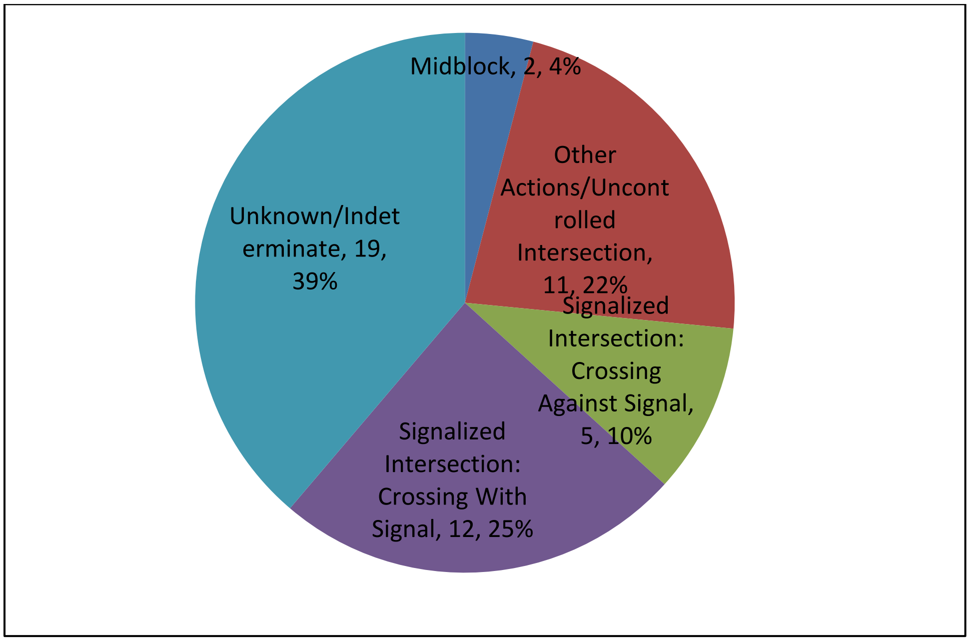

Figure 26: Bicycle Crashes by Action

The in-depth analysis of the number of crashes, the incident types, the contributing factors and their locations revealed that there were substantial safety concerns along the corridor and at specific intersections. When looking at the corridor as a whole, the average crash rate of Flatbush Avenue was higher than the statewide average, and when looking at individual intersections, 80% had crash rates that were higher than the state-wide rate. Opportunities for safety improvements were therefore a crucial element of subsequent chapters.

2.10 Summary of Existing Conditions

A review of the pre-improvement conditions on Flatbush Avenue between Ocean Avenue/Empire Boulevard and Nostrand Avenue, including its crash history, revealed that many deficiencies existed along the corridor.

- The four-lane corridor (two lanes and parking in each direction) had substandard lane widths for most of its length.
- Vehicles were often forced to abruptly change lanes, causing unsafe merging movements:
- Because of insufficient parking lane width, double parked cars, legally parked trucks, and buses making stops often encroached into the right lane, forcing drivers to merge to the left lane.
- Due to the lack of left-turn bays, left-turning vehicles often forced through traffic in the left lane to merge to the right lane.

- The sudden lane change and forced merging conditions, combined with the many skewed intersecting streets, created unsafe driving conditions, and contributed to being categorized as a high-crash corridor.

CHAPTER 3 IMPROVEMENTS

Without-improvement and with-improvement conditions were analyzed and projected for the implementation year 2013 and for the future year 2023 to assess the level-of-service impacts for both the near and distant futures. Without improvement conditions serve as a baseline from which to compare with-improvement conditions. Average travel times are the main measure of effectiveness for traffic operations for without-improvement and with-improvement conditions.

3.1 Without-Improvements Analysis

The volumes used for the 2013 scenarios were the same as reported in the pre-improvement conditions described in Section 2.3. Thus, the 2013 without-improvement conditions are the same as the pre-improvement conditions described in Section 2.3. To project volumes for year 2023, a background growth rate of 0.25% per year was applied, for a total of 4% increase for all peak hours. In addition, in order to take into account any significant increases in vehicle trips generated by major developments that would be built by the year 2023, volumes that were predicted to be generated by the Kings Theater project were added.

If no improvement measures were implemented, by the year 2023 travel times would increase for all periods due to additional traffic volumes present on the network. Figure 27 compares the travel times of pre-improvement 2013 to future 2023 without improvements for both northbound and southbound directions and shows that the northbound AM period would suffer from the most increase in delays if no improvements were implemented.

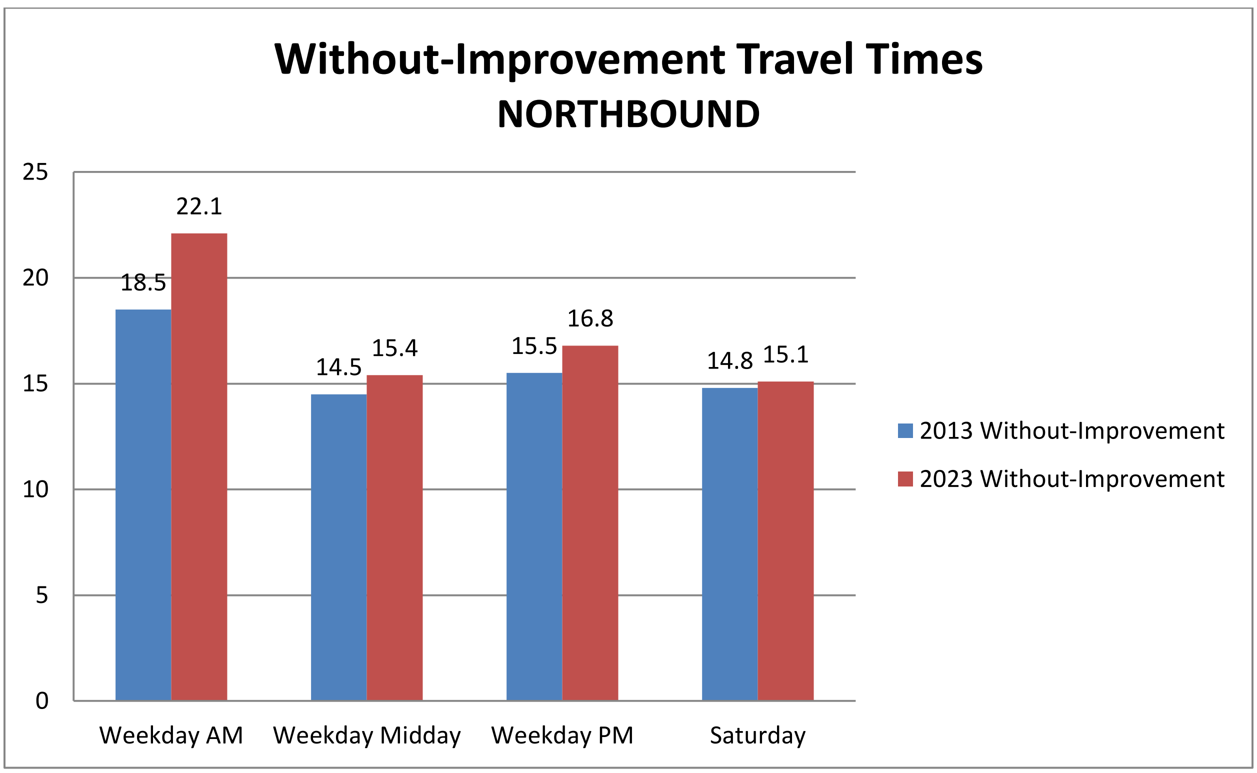

Figure 27: 2013 and 2023 Without-Improvement Travel Times for Northbound Direction

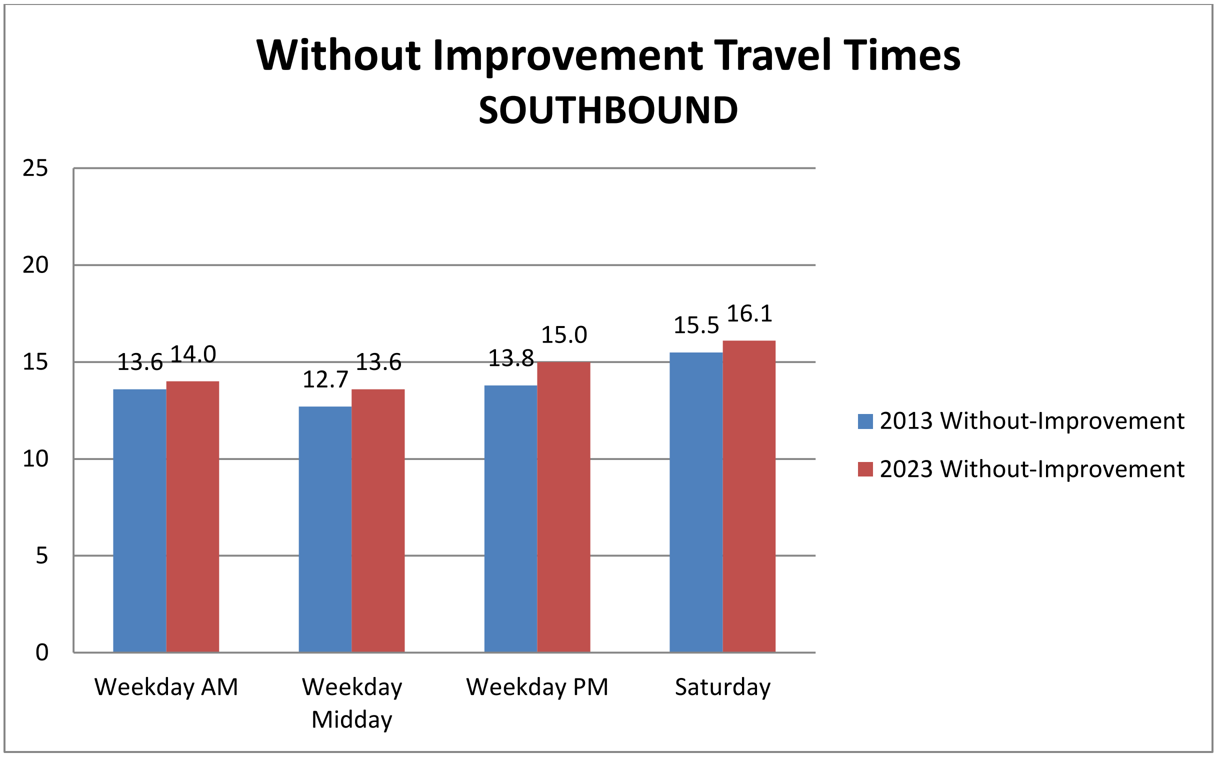

Figure 28: 2013 ansd 2023 Without-Improvement Travel Times for Southbound Direction

3.2 Corridor-Wide Improvements

Although Flatbush Avenue in the pre-improvement condition was striped for two lanes in each direction, it rarely operated as two lanes between Lincoln Road and East 26th Street. As mentioned in previous sections, double parked vehicles, single parked trucks, and buses often blocked the right lane. Left-turning vehicles waiting for gaps in opposing traffic often blocked through vehicles in the left lane. Therefore, it was proposed to provide one "dependable" through lane in each direction of standard 11 feet width. To improve the flow and safety of traffic operations, it generally helps to remove left-turning vehicles from through lanes. Left turn bays were proposed to provide a storage area for vehicles waiting for gaps in opposing traffic and allow through traffic to pass. Also, the parking lane width was increased by about four feet to 11 feet, providing sufficient room for trucks making deliveries, buses making stops, and to keep double parked vehicles from completely usurping a traffic lane. The improved lane configurations are shown in Figure 29. This design reduces some of the factors that are the root causes of unsafe operation and delays for through traffic.

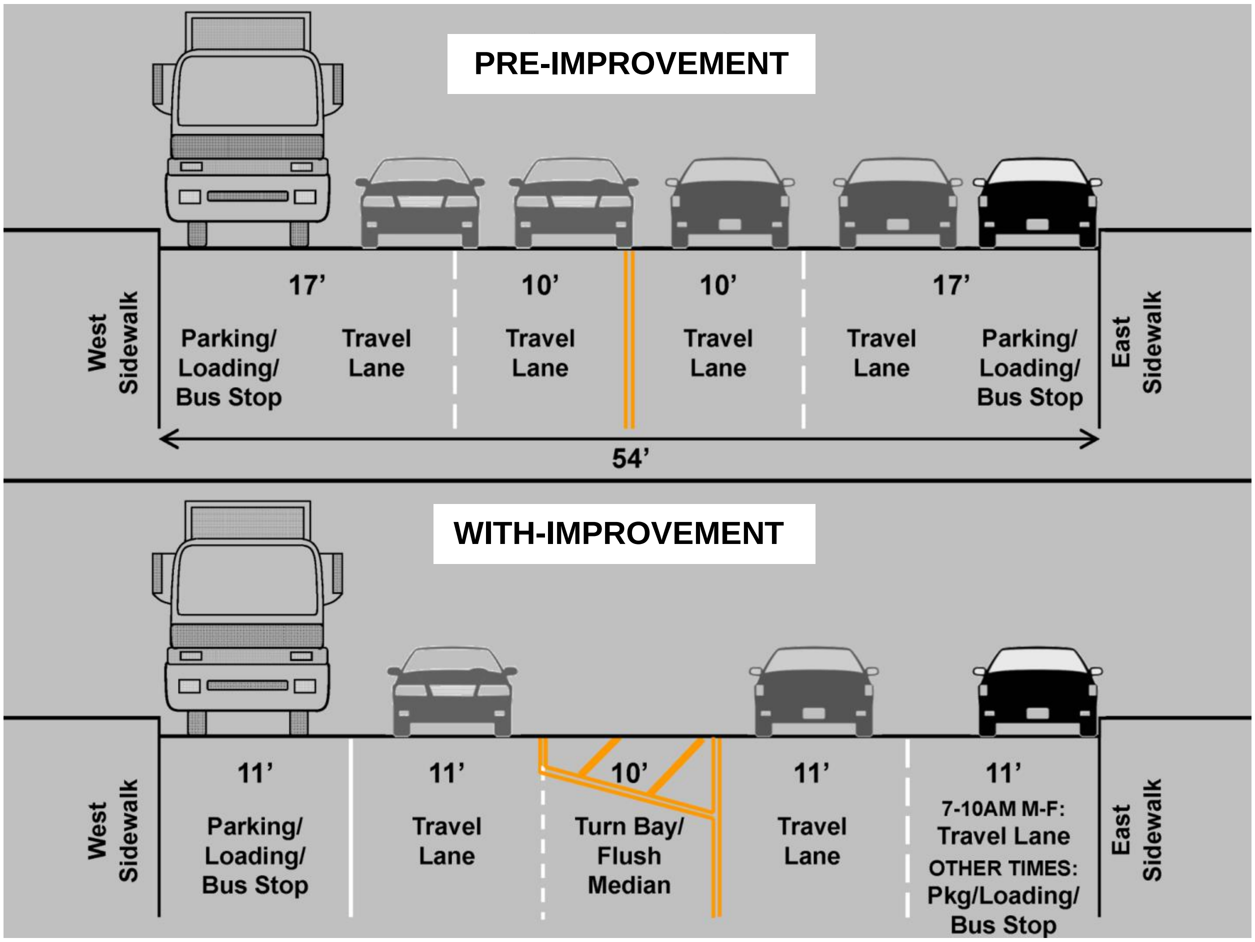

Figure 29: Pre-Improvement and With-Improvement Lane Configurations between Lincoln Rd and East 26th St

As discussed previously in Section 2.2 and analyzed later in Section 3.4, the largest traffic volumes were in the northbound direction during the weekday AM peak hour. Analysis showed that two northbound lanes were needed, in addition to the left-turn bays, to achieve the capacity to satisfy the demand without causing unacceptable delays. It was therefore recommended that "No Standing 7-10 AM Mon-Fri" regulations be implemented on the east side of the corridor between East 26th Street and Lincoln Road in order to maintain two travel lanes in the northbound direction during the critical weekday morning peak period when the volumes are the highest. While this would require the removal of the curbside parking during that time, the parking utilization data shows that only 32% of parking spaces were occupied during this time, and commercial vehicles loading and unloading were minimal. Trucks desiring to load in the morning, therefore, would likely be sufficiently accommodated on the underutilized west curb.

It was decided not to use the same treatment for the southbound direction during the weekday evening peak period. That is, a second travel lane was not added by removing parking on the west curb during this time. There were two reasons for this. First, analysis indicated that the weekday PM peak hour could be accommodated with only one through lane, because the southbound traffic volumes were not as high as the northbound volumes during the weekday AM peak hour. Second, curbside parking occupancy was substantial during this time. If "No Standing 4-7 PM Mon-Fri" regulations were implemented on the west curb, the east curb could not absorb the overflow, which could be detrimental to the merchants.

3.3 Intersection-Specific Improvements

This section summarizes the intersection-specific improvements.

3.3.1 Flatbush Avenue and Ocean Avenue/Empire Boulevard

This intersection is the northern terminus of the southbound corridor-wide treatment described in Section 3.2, and required specific attention for the southbound transition from two to one lanes. In addition, public feedback reported operational deficiencies for the westbound movements due to a previously existing island in the east crosswalk, insufficient through-lane capacity and skewed alignment.

The following improvements were recommended at this intersection. They are presented in Figure 30.

On the north leg, the right lane of the southbound approach was converted to become right-turn-only. This allows for the southbound two to one lane transition. This location was chosen because there is enough merging distance, and the southbound right turn volumes were high enough (over 300 vehicles per hour during the weekday PM peak hour) to justify the lane drop.

On the east leg, the concrete island was removed to provide a second westbound through lane. The community had advised, and observations and analysis had confirmed, that this was a bottleneck for the westbound movement from Empire Boulevard to Ocean Avenue. The eastbound lane assignment on the west leg was revised to accommodate two receiving lanes in the westbound direction. A curb extension was added on the north side of the east crosswalk to reduce the pedestrian crossing distance and to mitigate the loss of the pedestrian refuge island.

This design, specifically, the additional through lane in the westbound direction, allowed for green time to be shifted from the east-west direction to the north-south direction as needed. The additional green time allowed for Flatbush Avenue would reduce the impact of having one southbound through lane.

Figure 30: Flatbush Ave & Ocean Avenue/Empire Boulevard – Pre-Improvement and With-Improvement

3.3.2 Flatbush Avenue, Lincoln Road and Washington Avenue

This five-legged intersection required a unique re-design due to the skewed alignment and the head-on condition of the eastbound movement. The community expressed concerns over this location's dangerous alignment, specifically related to the vehicle path of eastbound left-turning vehicles onto Washington Avenue that conflict with the westbound through movement on Lincoln Road. The improvements are presented in Figure 31.

The first improvement at this location was to extend the curb, using truffle paint and delineators, of the wedge-shaped sidewalk corner on the north side between Flatbush Avenue and Washington Avenue. This allowed the north crosswalk to be straightened as shown, reducing the crossing distance.

The east leg of this intersection is one-way westbound. Therefore, eastbound traffic was forced to either turn right or left onto Flatbush Avenue, or left onto Washington Avenue. The latter movement has been shown to be problematic, since it often conflicted with the westbound through movement, and would be exacerbated by the previously mentioned first improvement, because there is less room for two-way traffic in the tight area between Flatbush Avenue and Washington Avenue. Therefore, this section was designated as one-way westbound, which effectively banned the eastbound left-turn from Lincoln Road to northbound Washington Avenue (and the seldom used U-turn from southbound Flatbush Avenue to northbound Washington Avenue).

This location is the northern terminus for the corridor-wide treatment for the northbound direction described in Section 3.2; that is, one northbound lane flares out to two lanes here.

PRE-IMPROVEMENT WITH-IMPROVEMENT

Figure 31: Flatbush Avenue and Lincoln Road/Washington Avenue – Pre-Improvement and With-Improvement

3.3.3 Flatbush Avenue and Beverley Road

This intersection presented a unique situation because the offset alignment of Beverly Road effectively results in two separate, closely spaced signalized T-intersections, as shown in Figure 32. There is not enough room between the two legs of Beverley Road to provide left-turn bays from Flatbush Avenue onto both intersections. An origin-destination survey was performed to understand if the majority of the left-turning vehicles in either direction were originating from Beverly Road (that is, continuing straight from one leg of Beverley Road to the other), and or if they were originating from Flatbush Avenue. The results indicated that there was a higher volume for northbound left turns onto the west leg than southbound left turns onto the east leg, and that more of those northbound turning vehicles were originating from Beverly Road, performing the westbound zig-zag move from the east leg of Beverley Road to the west leg. The recommendation was, therefore, to ban the southbound left turn onto the east leg, with Duryea Plave and Cortelyou Road – the nearest upstream and downstream intersections, respecitively – as alternatives for eastbound travel.

Other options were considered for this location, each of which was determined to have unacceptable negative impacts, including loss of parking spaces, bus-stop relocation and operational shortcomings.

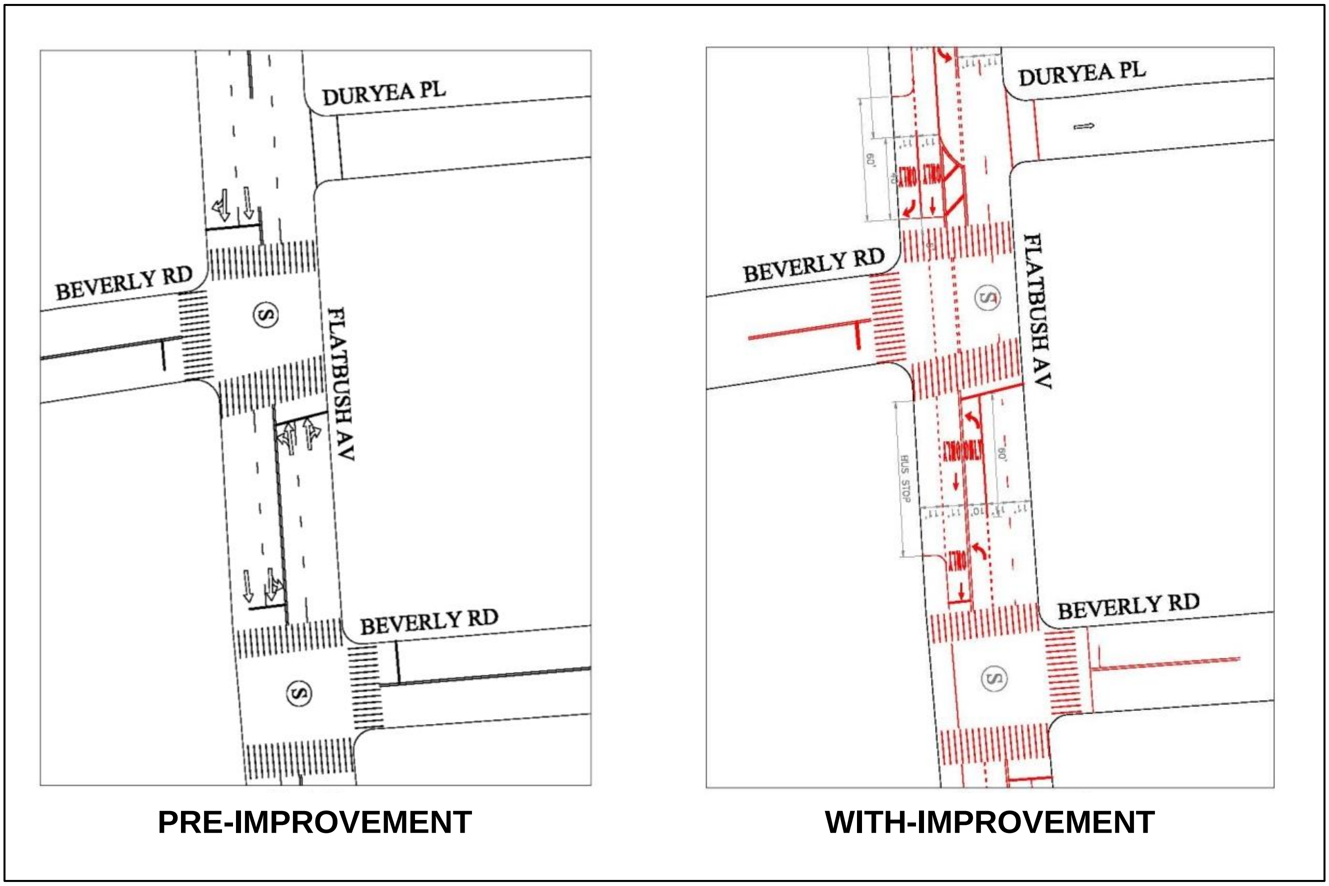

Figure 32: Flatbush Avenue and Beverly Road – Pre-Improvement and With-Improvement

3.3.4 Flatbush Avenue and E. 26th Street

At this point along Flatbush Avenue, the curb to curb roadway widens from approximately 54 feet north of East 26th Street to 66 feet south of it, as shown in Figure 33. It is, therefore, an appropriate location for the southbound direction to widen from one to two lanes, and for the northbound direction to merge from two to one lane (for all time periods excluding 7 to 10 AM weekdays). The design incorporated sufficient merging distance along with appropriate signage.

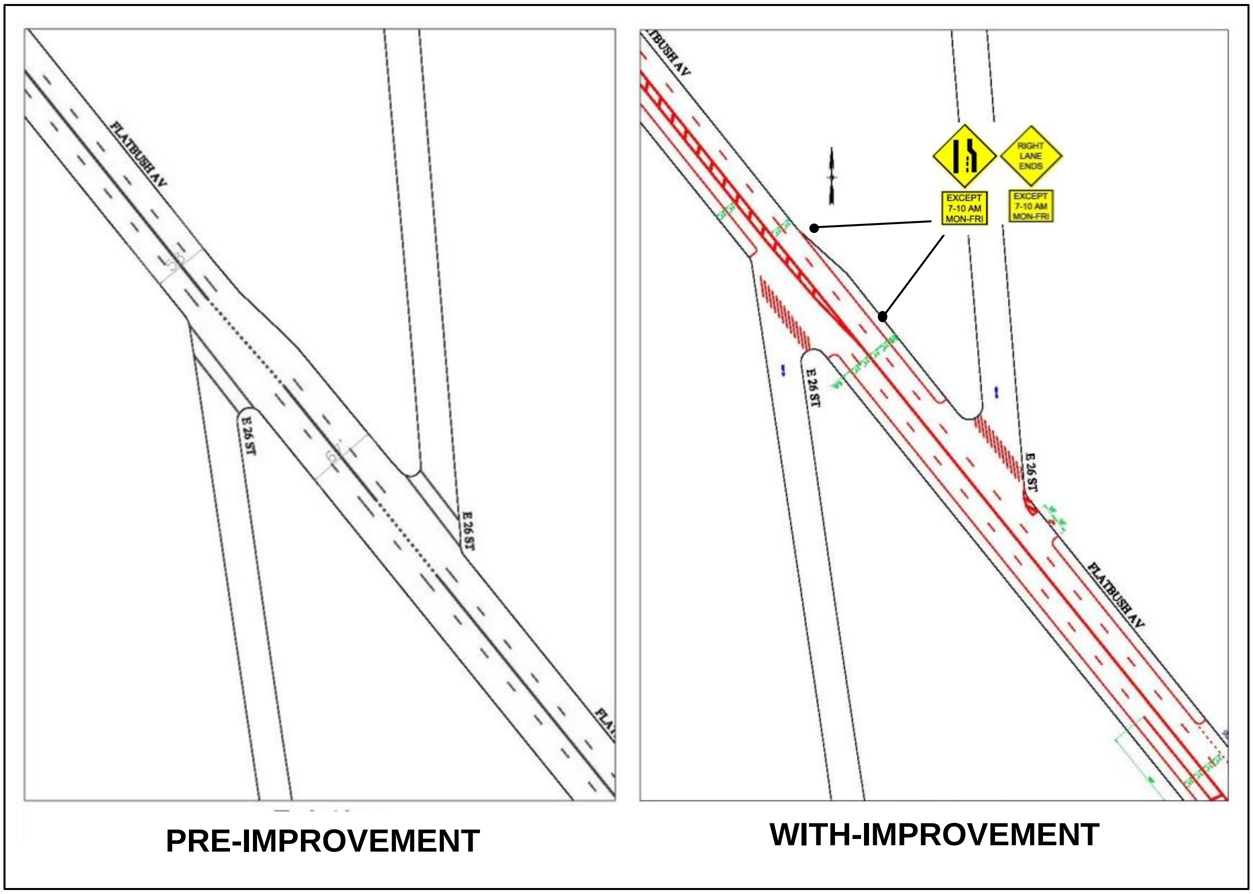

Figure 33: Flatbush Avenue and E. 26th Street – Pre-Improvement and With-Improvement

3.3.5 Multiple Locations - Provide Right Turn Bays

Adding right turn bays is an effective way of reducing delays by removing from the through travel lane right-turning vehicles waiting for pedestrians in the conflicting crosswalk to clear. This improvement is generally recommended for lane movements with higher turning volumes, but the downside is that curbside right turning bays reduce on-street parking spaces. After careful consideration, right turn bays were provided at the following intersections:

- Parkside Avenue (southbound-right)
- Albermale Road (northbound-right)
- Beverley Road (southbound-right)
- Cortelyou Rd (southbound-right)
- Dorchester Rd (southbound-right)
- Bedford Avenue (southbound-right)

3.4 With-Improvement Analysis

3.4.1 Projected Travel Times

To assess the feasibility of the improvements, the with-improvement conditions were modeled and compared to the without-improvement conditions, for the years 2013 and 2023. The main purpose of simulating the improvements of this corridor is to determine if the network has the capacity to operate with one lane instead of two under typical conditions, and not as a method of determining the full impacts or benefits of the design. While SimTraffic assists in predicting typical future travel times under the new design, it is not capable of reflecting vehicular and pedestrian safety. Furthermore, while a reduction in crashes is likely to reduce travel time delays, it is not reflected in the analysis.

The initial run of the analysis of the with-improvement condition was performed with the improvements described in Sections 3.2 and 3.3 with one exception – the second lane provided for the northbound direction during the AM peak hour with the "No Standing 7-10 AM Mon-Fri" on the east curb was not incorporated. In other words, for the initial run, the weekday AM peak hour was modeled with the same lane alignment – only one through lane - as the other periods. The results are shown in Figure 34.

The results show that for the northbound direction, travel times would improve slightly for the weekday midday, weekday PM and Saturday peak hours, but would increase by 5.4 minutes for the weekday AM period. The conclusion is that the corridor can sufficiently operate with one travel lane in the northbound direction during all periods except the weekday AM period.

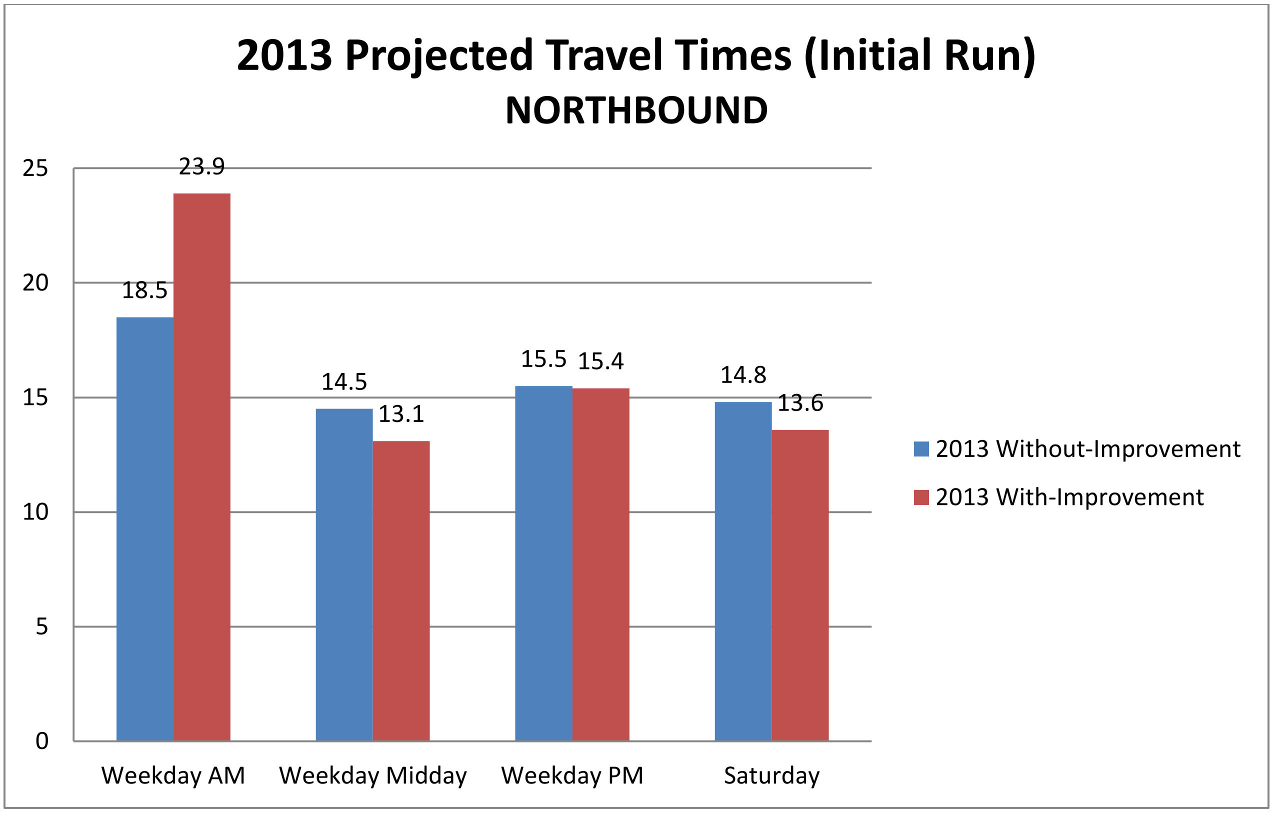

Figure 34: 2013 Projected Travel Times for Northbound Direction (Initial Run)

As a result of this analysis, the proposed improvements were adjusted to include the "No Standing 7-10 AM Mon-Fri" regulations on the east curb between East 26th Street and Lincoln Road to provide the second travel lane in the northbound direction during the weekday AM peak period, as described in Section 3.3. The revised run of the analysis of the with-improvement condition was performed with this refinement. The results are shown in Figure 35.

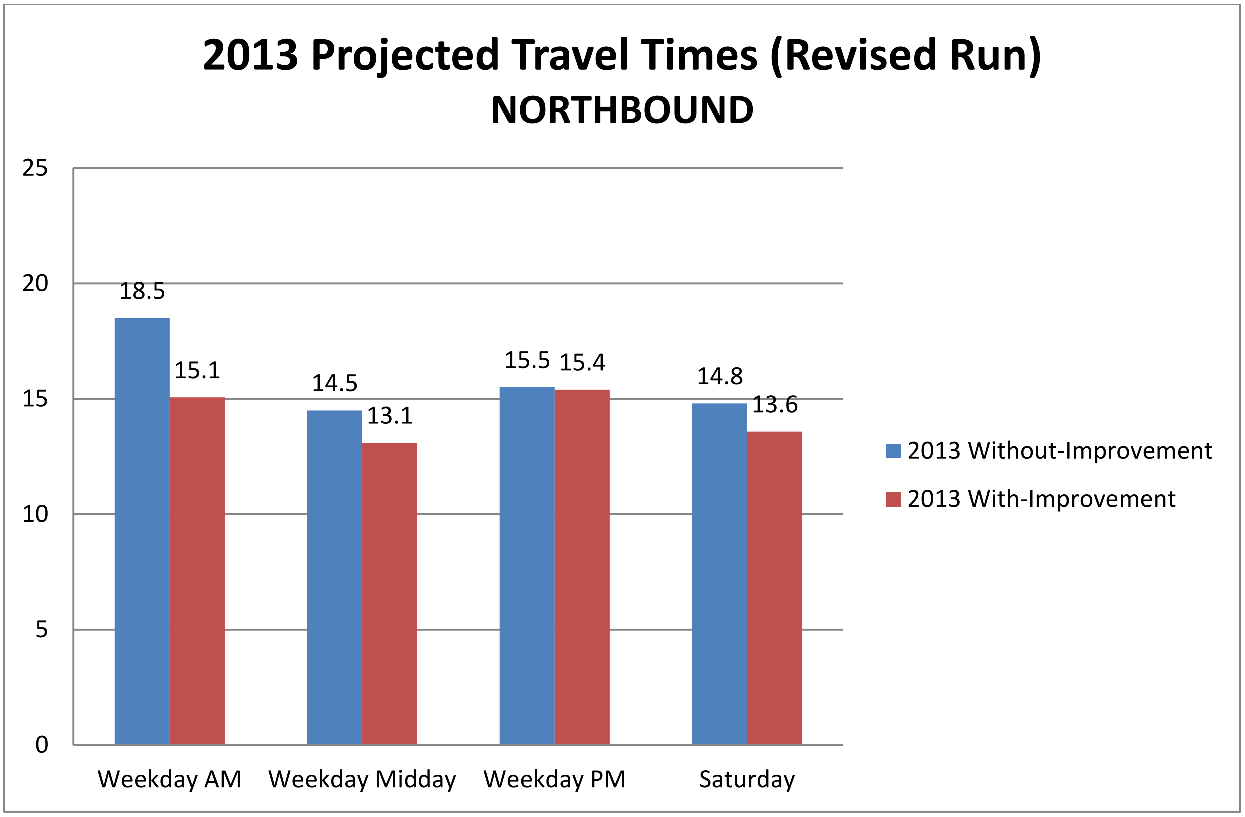

Figure 35: 2013 Projected Travel Times for Northbound Direction (Revised Run)

By adding a second travel lane during the weekday AM peak period as described above, the northbound AM rush hour travel times would be reduced from 18.5 minutes to 15.1 minutes, a 3.4 minute overall reduction from the without-improvement conditions. These regulations, therefore, were included in the proposed improvements. The 70 and 71 precincts of the NYPD were alerted to and requested to enforce the new weekday morning No Standing regulations. However, it was realistically was assumed in the modeling that there would be some non-compliance.

The projections for southbound travel times are shown in Figure 36. Modest improvements in travel times were projected for all but the weekday PM peak hour, where a slight increase in travel time is projected. As mentioned previously, it was decided not to provide a second travel lane in the southbound direction during the weekday PM peak period, as was done for the northbound direction during the weekday AM peak period, because on-street parking and loading was more heavily utilized and it could adversely affect merchants. The late afternoon and early evening hours are more often frequented by shoppers. If future traffic conditions deteriorate as a result of future development, implementing "No Standing 4-7 PM Mon-Fri" is a possible remedy.

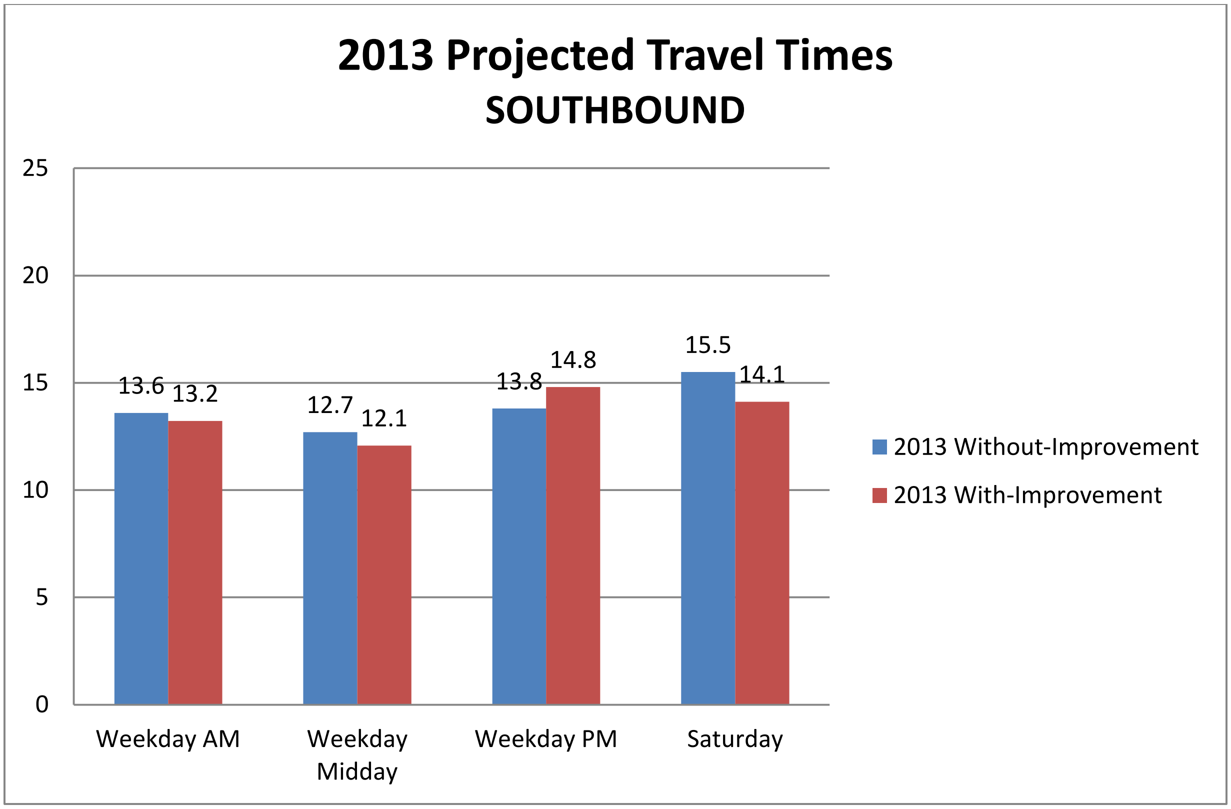

Figure 36: 2013 Projected Travel Times for Southbound Direction

The simulation models were run again with volumes projected to the year 2023. The results for the northbound and southbound directions are shown in Figure 37 and Figure 38, respectively. While travel times would increase due to the increased volumes, the network would still be able to accommodate traffic with the proposed lane configurations and parking regulations.

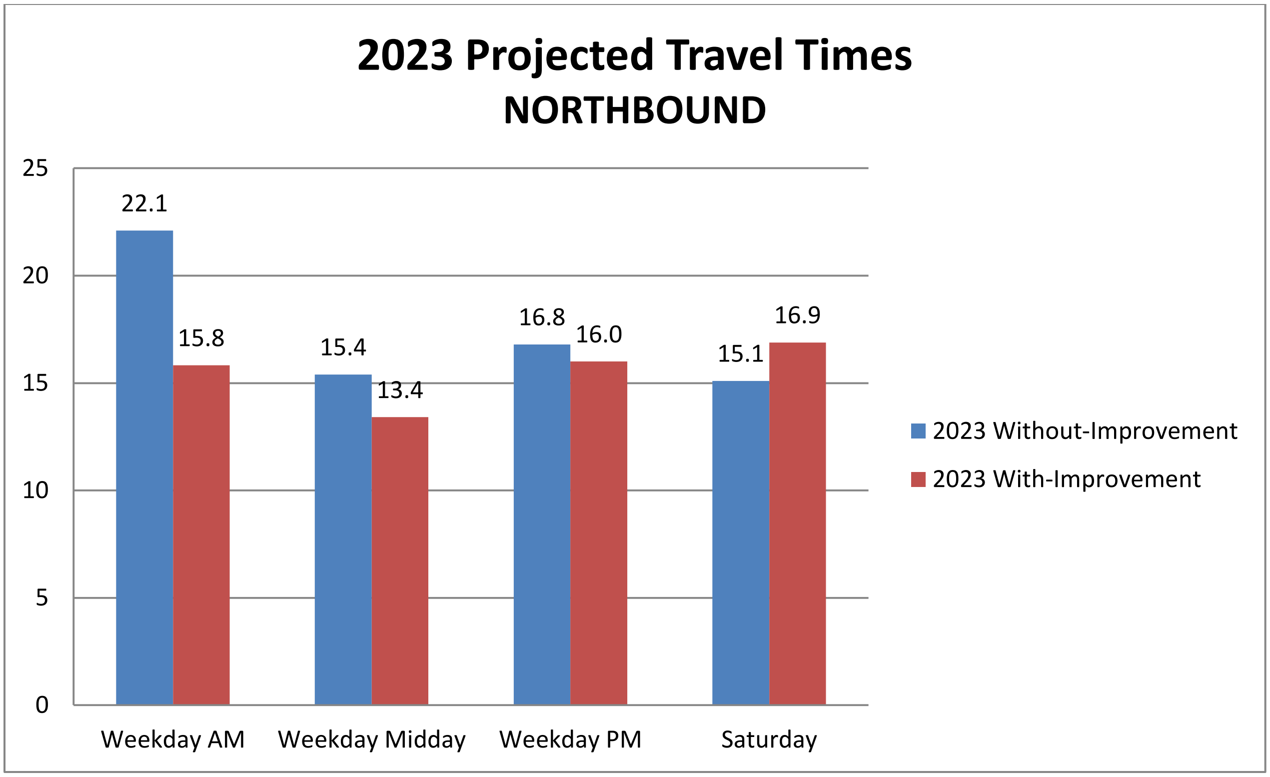

Figure 37: 2023 Projected Travel Times for Northbound Direction

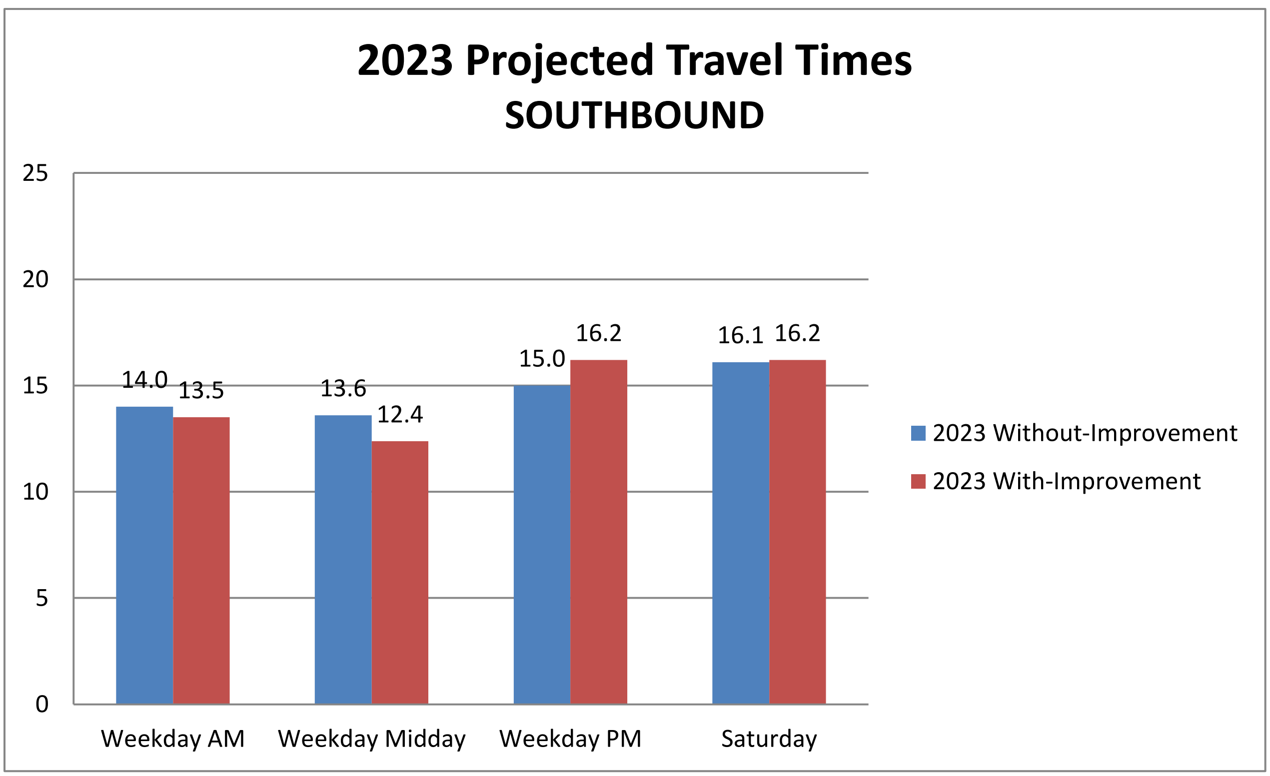

Figure 38: 2023 Projected Travel Times for Southbound Direction

3.4.2 Parking Impacts

The biggest change in parking due to the proposed improvements would be the “No Standing 7-10 AM Mon-Fri” for the east curb between Lincoln Road and East 26th Street. The section from Empire Boulevard to Caton Avenue already had “No Parking 7-10 AM Mon-Fri” regulations previous to improvements. From Caton Avenue to East 26th Street, the existing one-hour metered regulations between 8AM and 7PM became one-hour metered parking between 10AM and 7PM. As discussed, the loss of these parking spots during the morning peak hour would be necessary to accommodate the heavy northbound volume along Flatbush Avenue and would not be expected to have significant impacts on businesses because the majority of the stores open towards the end of that time period with most customers shopping later in the day. In addition, there is excess parking capacity on the west curb between 7AM and 10AM that can absorb parkers who wish to shop on the east side. The table in Figure 39 below summarizes the other parking modifications and the total net loss and gain of spots.

Figure 39: Summary of Parking Modifications

Location Description	# of Parking Spots Gained	# of Parking Spots Lost	
SB right turn bay at Parkside Avenue		-5	
Permit parking at T-intersections at Lenox Rd, Linden Blvd and Martense St	+6		
Replace parking with loading		-3, -1	
Relocate ‘No Parking’ in front of school between Church and Snyder Avenues	+13		
Extend NB right turn bay at Church Avenue		-3	
SB Right turn to Bedford Avenue		-2	
Allow parking by closed clinic south of Fenimore St	+2		
TOTAL:	**+21**	**-14**	**NET: +7**

CHAPTER 4 REFINEMENTS, MONITORING AND ADDITONAL PROPOSALS

The project improvements were implemented in November 2013 and were closely monitored in the months thereafter. Attention was given to both field observations and feedback from the community. Based on this information, refinements were made that were implemented in September 2014.

4.1 Refined Improvements

The original corridor-wide design began its southbound conversion from two lanes to one at Empire Boulevard/Ocean Avenue. However, post-implementation observations and travel time runs showed that there was major queuing and delays occurring in the southbound direction during the weekday PM peak period, especially in the northern section. It was decided, therefore, that two southbound lanes should be retained from Empire Boulevard/Ocean Avenue to Parkside Avenue, and the transition from two to one lanes should begin at Parkside Avenue.

4.1.1 Flatbush Avenue between Ocean Avenue/Empire Boulevard and Lincoln Road

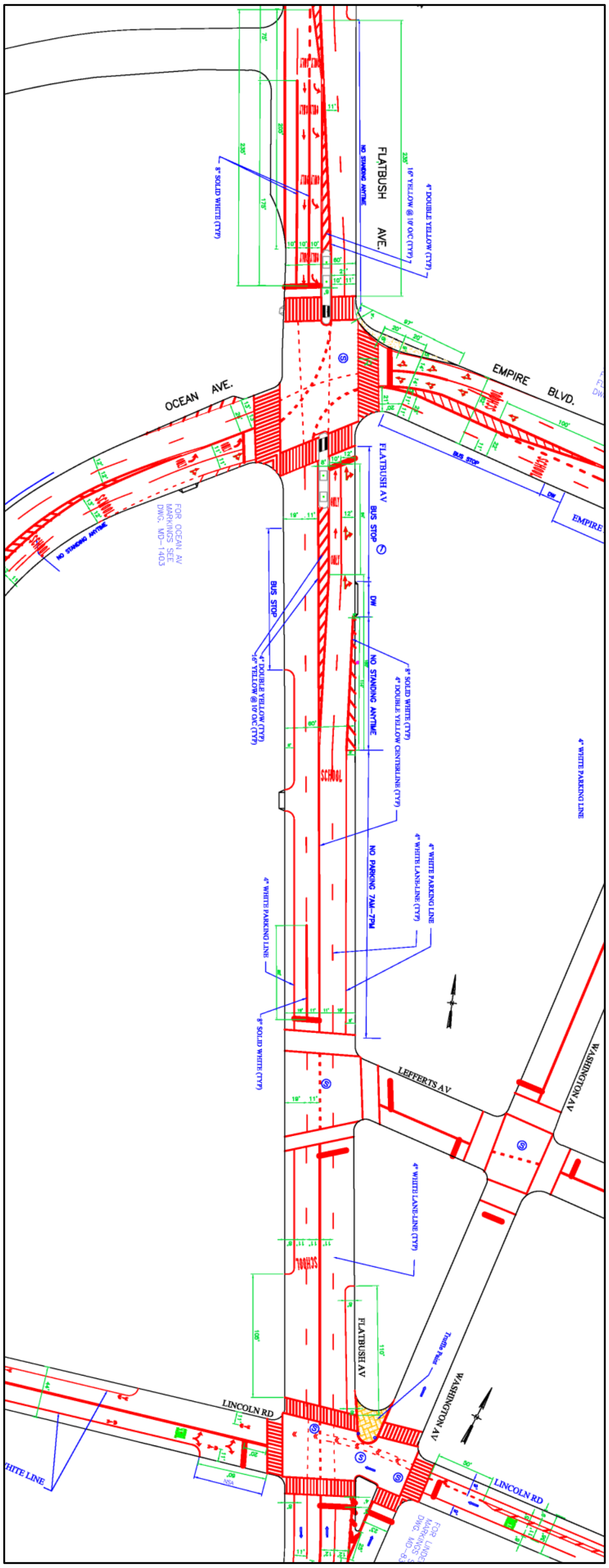

Figure 40 shows the modified design at Ocean Avenue/Empire Boulevard. The signs and markings that previously designated the right lane as right-turn-only were revised to allow through/right, which provided a total of two southbound lanes for through traffic. The two southbound lanes are maintained to Lincoln Road, where the curb to curb distance of 60 feet can easily accommodate two lanes in each direction.

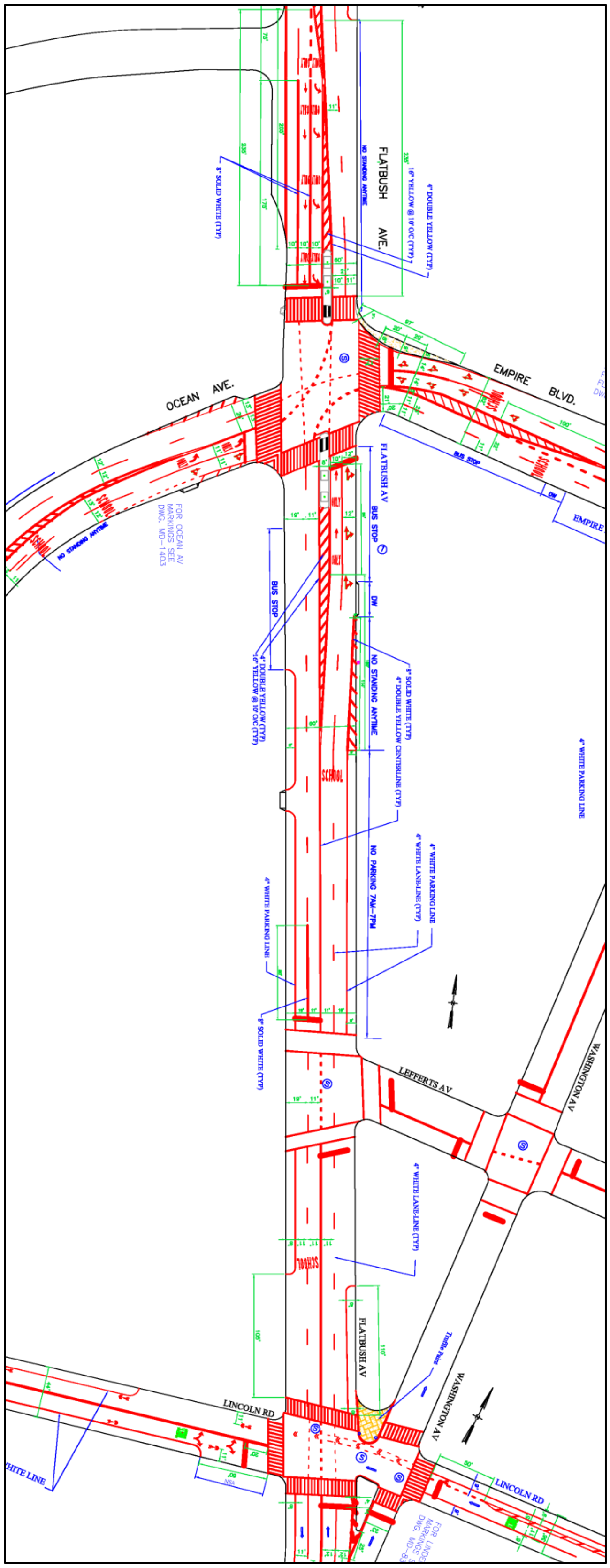

Figure 40: Flatbush Avenue between Ocean Avenue/Empire Blvd and Lincoln Road –Modified Design

4.1.2 Flatbush Avenue between Lincoln Road and Winthrop Street

Between Lincoln Road and Winthrop Street, striping was modified to maintain two southbound through lanes. A typical section is shown in Figure 41. The previous center median, which contained the left-turn bays, provided the space for the second southbound through lane. The northbound direction does not need left-turn bays in this section, because the only northbound left turns are onto three dead end streets, each of which carries less than 10 northbound left-turns per hour.

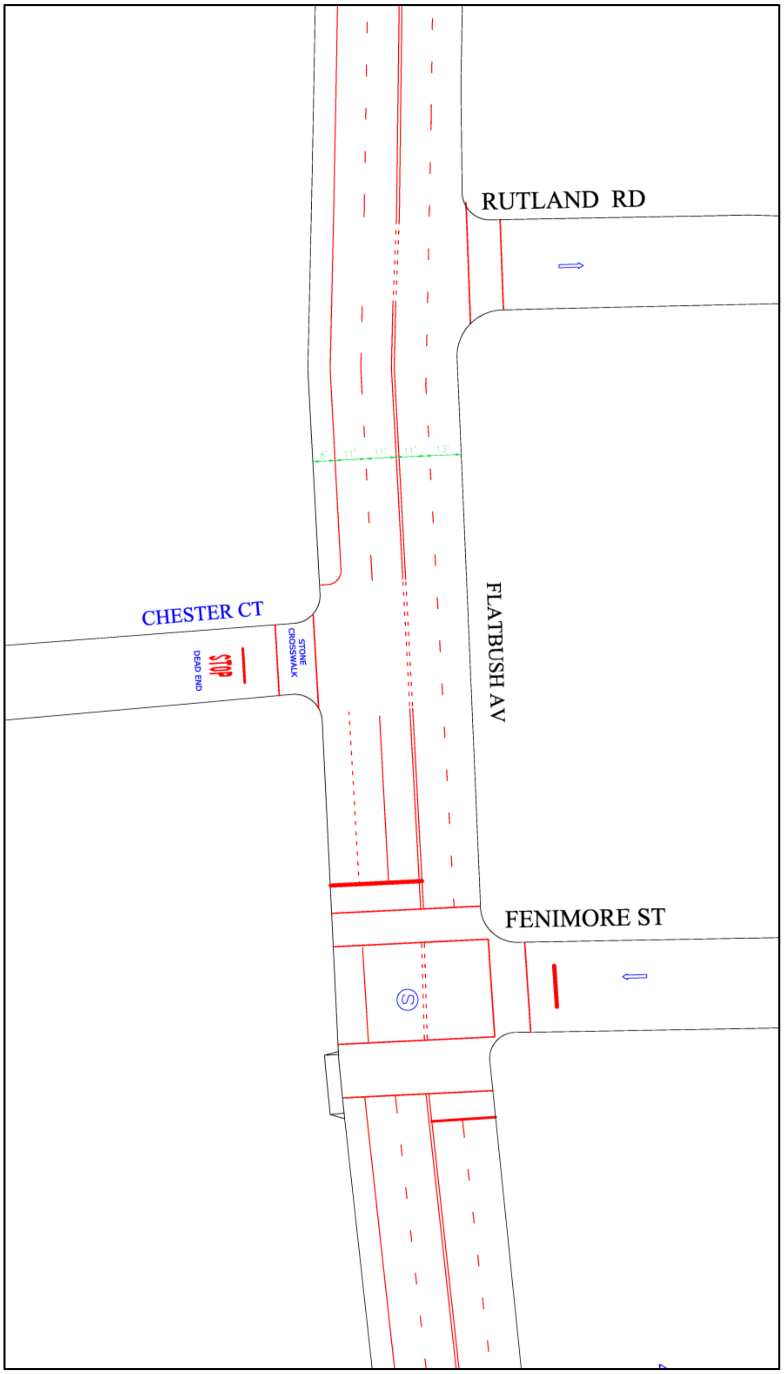

Figure 41: Flatbush Avenue Typical Section between Lincoln Road and Winthrop Street – Modified Design

4.1.3 Flatbush Avenue between Winthrop Street and Parkside Avenue

Because of the heavy southbound right-turning volume from Flatbush Avenue to westbound Parkside Avenue, the right lane approaching Parkside Avenue was striped as right-turn-only, making this the southbound transition point from two to one lanes, as opposed to Ocean Avenue/Empire Boulevard under the original design. This is shown in Figure 42.

It is especially important for the block between Winthrop Street and Parkside Avenue to contain extra storage for the southbound direction as shown in Figure 42, compared to the original design which did not contain such storage. The reason is that the presence of the Brighton subway line right of way acts as a barrier to east-west vehicular travel, and westbound traffic must temporarily use this block of Flatbush Avenue. As shown in Figure 42, eastbound traffic can use Parkside Avenue and simply cross Flatbush Avenue and continue heading eastbound. But westbound traffic from Winthrop Street must turn left at Flatbush Avenue, then right onto Parkside Avenue to continue heading west. Origin-destination surveys revealed that approximately 60% of the southbound right-turning vehicles from Flatbush Avenue to Parkside Avenue originated from the westbound left movement at Winthrop Street. In other words, the block of Flatbush Avenue between Winthrop Street and Parkside Avenue carried more volume and required two lanes of storage, because westbound vehicles on Winthrop Street, which ends as a "T" intersection at Flatbush Avenue, must make the zigzag move onto Parkside Avenue via Flatbush Avenue. Because of this heavy westbound zigzag movement, there was previously insufficient storage space between the two intersections. The modified design provides the storage necessary for this block.

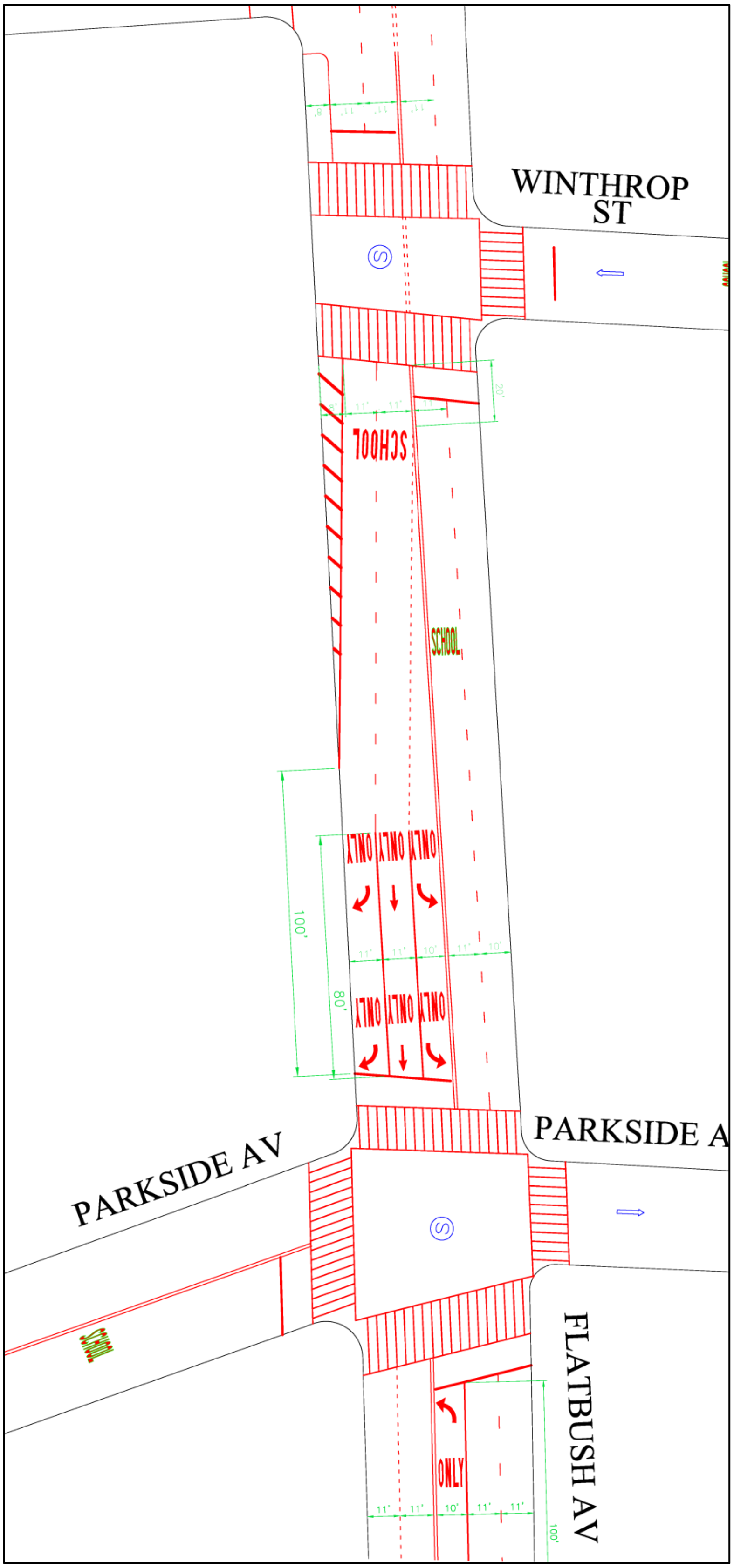

Figure 42: Flatbush Avenue between Winthrop Street and Parkside Avenue –Modified Design

4.2 Post Implementation Monitoring

Post-implementation travel time runs were conducted in October 2014. The northbound results are shown in Figure 43. Results are shown for without improvements (pre-implementation), the with-improvements projections described in Figure 3.4.1, and the actual with-improvement travel times from October 2014. The weekday AM peak hour travel times are 4.6 minutes faster than before implementation, and 1.2 minutes faster than projected. The weekday midday peak hour travel times are 0.2 minutes slower than before implementation, and 1.6 minutes slower than projected. The weekday PM peak hour travel times are 0.1 minutes slower than before implementation, and 0.1 minutes slower than projected. The Saturday peak hour travel times are 1.3 minutes faster than before implementation, and 0.1 minutes faster than projected.

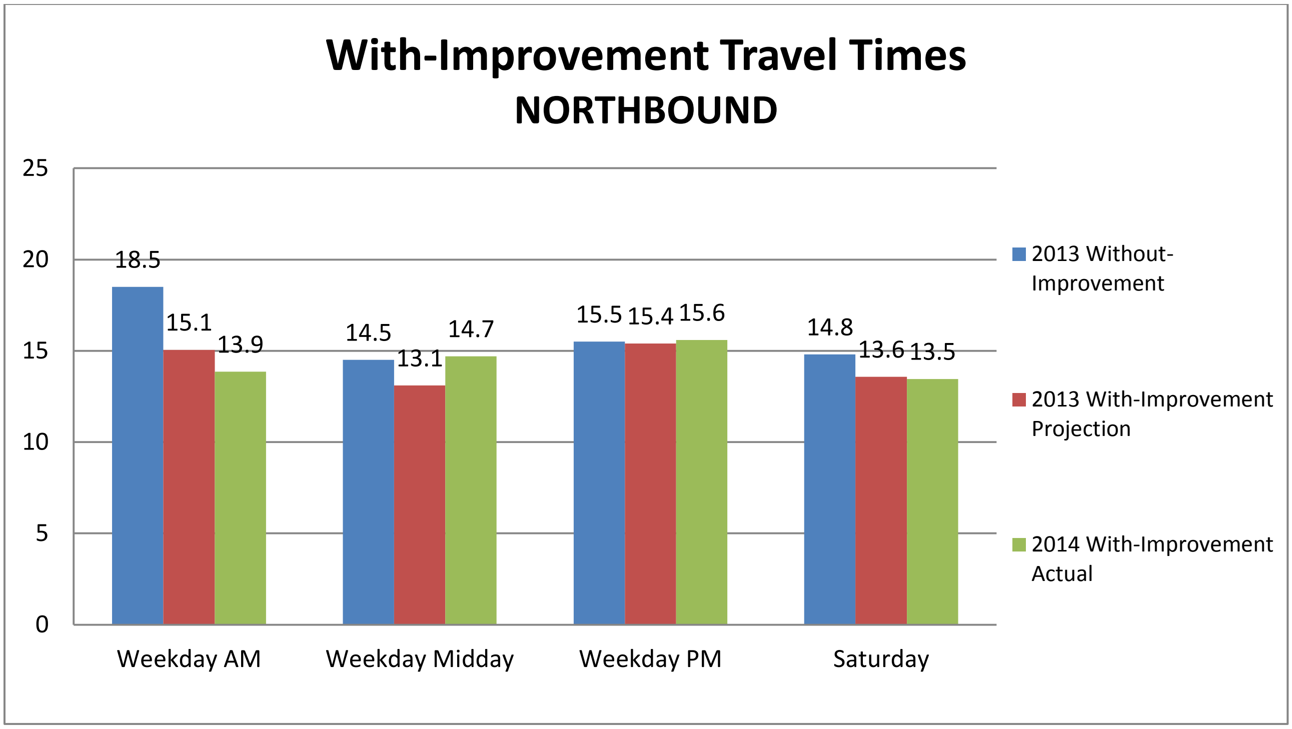

Figure 43: Northbound Post Implementation Travel Time Runs

The southbound results are shown in Figure 44. The weekday AM peak hour travel times are 0.3 minutes faster than before implementation, and 0.1 minutes slower than projected. The weekday midday peak hour travel times are 1.9 minutes slower than before implementation, and 2.7 minutes slower than projected. The weekday PM peak hour travel times are 3.7 minutes slower than before implementation, and 2.7 minutes slower than projected. The Saturday peak hour travel times are 0.6 minutes faster than before implementation, and 0.8 minutes slower than projected.

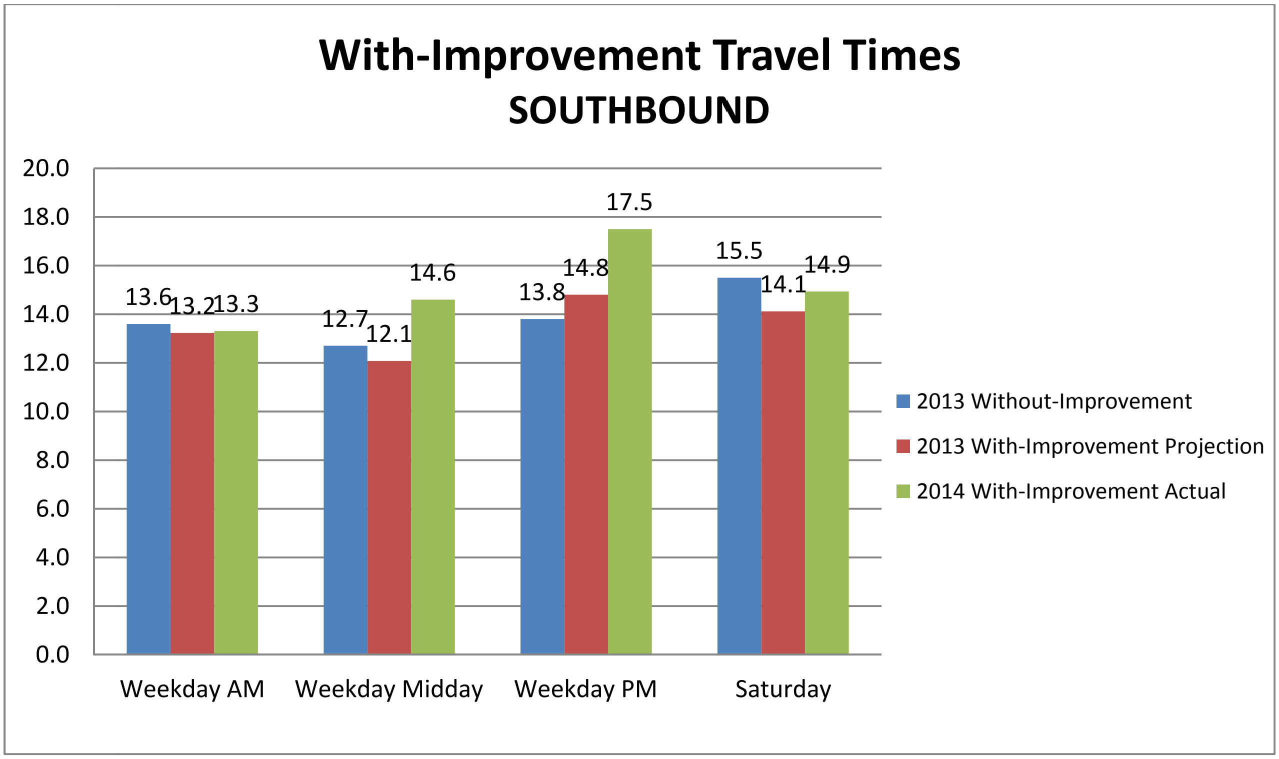

Figure 44: Northbound Post-Implementation Travel Time Runs

All time periods are operating satisfactorily and roughly as predicted, except for the southbound direction in the weekday midday and PM peak periods. Monitoring is ongoing, NYCDOT is continuing to look for ways to improve travel times and safety.

4.3 Additional Proposed Improvements

At the time of this writing, three additional improvements are being proposed and vetted. The following is a brief summary of each.

4.3.1 Flatbush Avenue, Lincoln Road and Washington Avenue

Section 3.3.2 describes improvements for the 5-legged intersection of Flatbush Avenue, Lincoln Road and Washington Avenue that were implemented in 2013. Supplementary improvements for this location are being considered. The first item would be to make permanent with concrete the wedge-shaped sidewalk corner extension on the north side of the intersection between Flatbush Avenue and Washington Avenue, as shown in Figure 45. The feasibility of such construction has been recently investigated, and it was determined that, because of the presence of a catch basin, making this temporary improvement permanent with concrete will require a capital project. Implementation is expected to be completed in 2018.

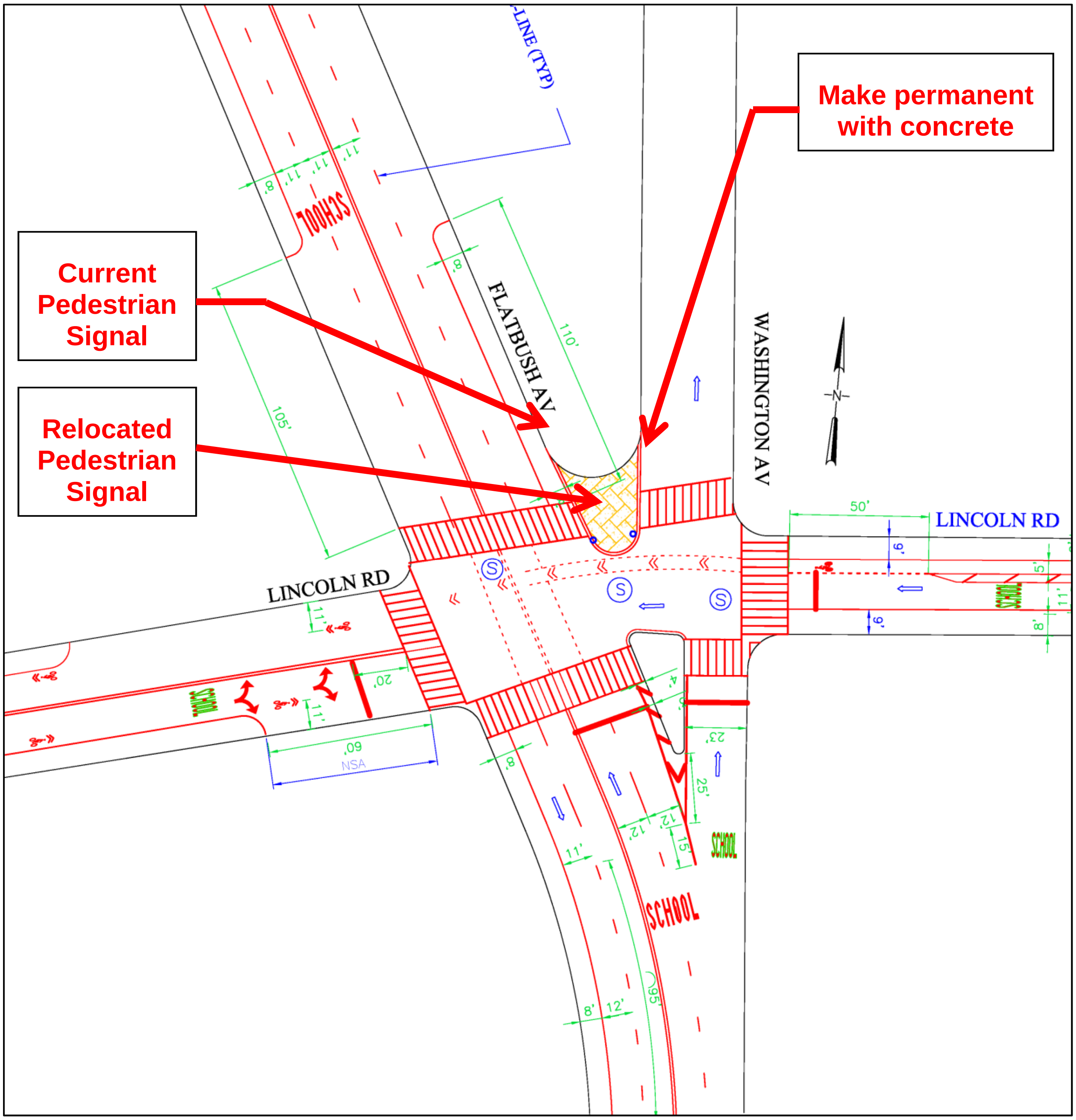

Figure 45: Flatbush Avenue and Lincoln Road/Washington Avenue – Propsed Supplemantary Improvement

In addition to the truffle paint curb extension, the 2013 improvements also included the straightened realignment of the north crosswalk. However, the pedestrian signal is still in its previous location, as shown in Figure 45. Building this corner out in concrete would allow relocating the pedestrian signal to line up with the straightened north crosswalk. Photo 5 also illustrates the current and proposed pedestrian signal relocation.

Photo 5: Looking East from West Side of Flatbush Avenue at Lincoln Road.

The final improvement for this location would be modification to the signal timing. The existing and proposed signal timing is shown in Figure 46. The problem with the existing condition, where eastbound and westbound movements operate on the same phase, is that eastbound vehicles that turn left onto northbound Flatbush Avenue often jump ahead of westbound through vehicles, even though they are supposed to yield to them. This occurs because the westbound STOP bar is located back at Washington Avenue, far enough away from Flatbush Avenue to tempt aggressive eastbound left-turners to jump in front instead of yielding. Problems arise when these eastbound left-turners wait for pedestrians in the north crosswalk to pass, thereby blocking the westbound through vehicles, causing unsafe gridlock conditions.

A solution would be to give the eastbound and westbound movements separate phases as shown in Figure 46. The downside is that green time would have to be taken from Flatbush Avenue and/or Lincoln Road. The tradeoffs for this proposal are being evaluated at this time.

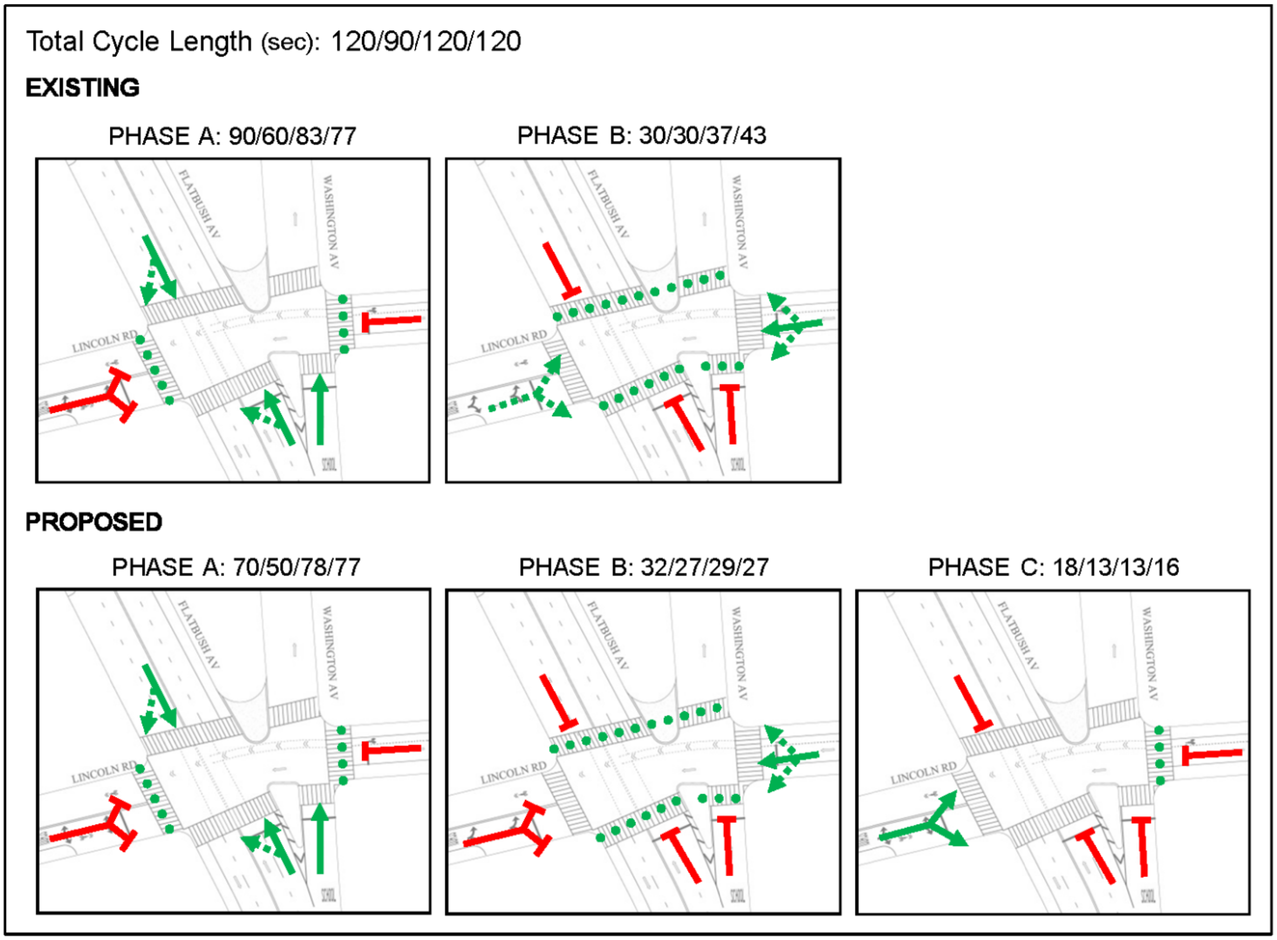

Figure 46: Existing and Proposed Signal Timing for Flatbush Avenue, Lincoln Road and Washington Avenue

4.3.2 Flatbush Avenue and Rutland Road/Hawthorne Street

The intersections of Flatbush Avenue and Rutland Road, and Flatbush Avenue and Hawthorne Street are both unsignalized T shaped intersections. The cross streets are the stems, both one-way outward (eastbound), so both intersections are uncontrolled because there is no compelling reason to signalize these locations from a traffic point of view. However, because the nearest crosswalks are a full block away in both directions, there is a high occurrence of jaywalking across Flatbush Avenue. Therefore, it is proposed to signalize these two intersections to provide crosswalks, as shown in Figure 47. The new signals would have the same splits and progression as the adjacent signals, so there is not expected to be a significant degradation of traffic level of service, although there would be less storage available.

Federal guidelines require that warrants must be met in order to justify new signals. Preliminary analysis indicates that warrants are not met for a new signal at this location. Additional data will be collected during the spring and summer of 2015, particularly the incidence of jaywalking. A final decision of whether to signalize these two locations will be made in early 2016.

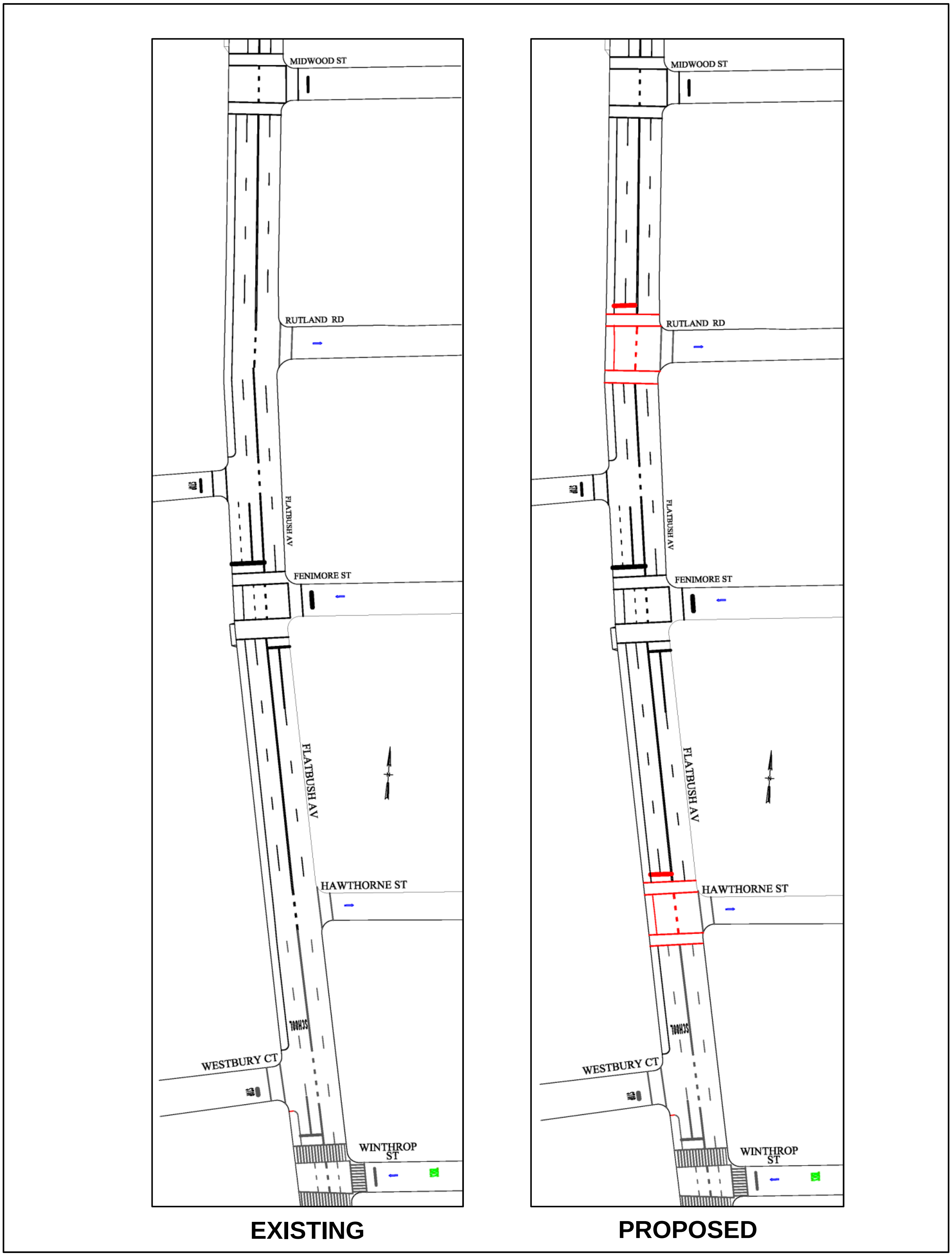

Figure 47: Proposed Signals and Crosswalks at Flatbush Avenue at Rutland Road and Hawthorne Streets

4.3.3 Flatbush Avenue and Church Avenue

The intersection of Flatbush Avenue and Church Avenue is the main crossroads of the central business district in the Flatbush neighborhood. There are high volumes of pedestrians – as many as 1000 per hour in individual crosswalks. To help protect pedestrians in the crosswalks, there are leading pedestrian intervals (LPIs) in both directions. An LPI is a signal phase where pedestrians are given a head start – typically about seven seconds – to "take" the crosswalk before adjacent street traffic is released. It is illustrated in the existing signal timing of Figure 48. This improves motorists' visibility of pedestrians as they establish themselves in the crosswalk. It also discourages aggressive "jackrabbit" starts by motorists trying to turn before pedestrians get in their way. However, this type of treatment does not completely eliminate the conflict.

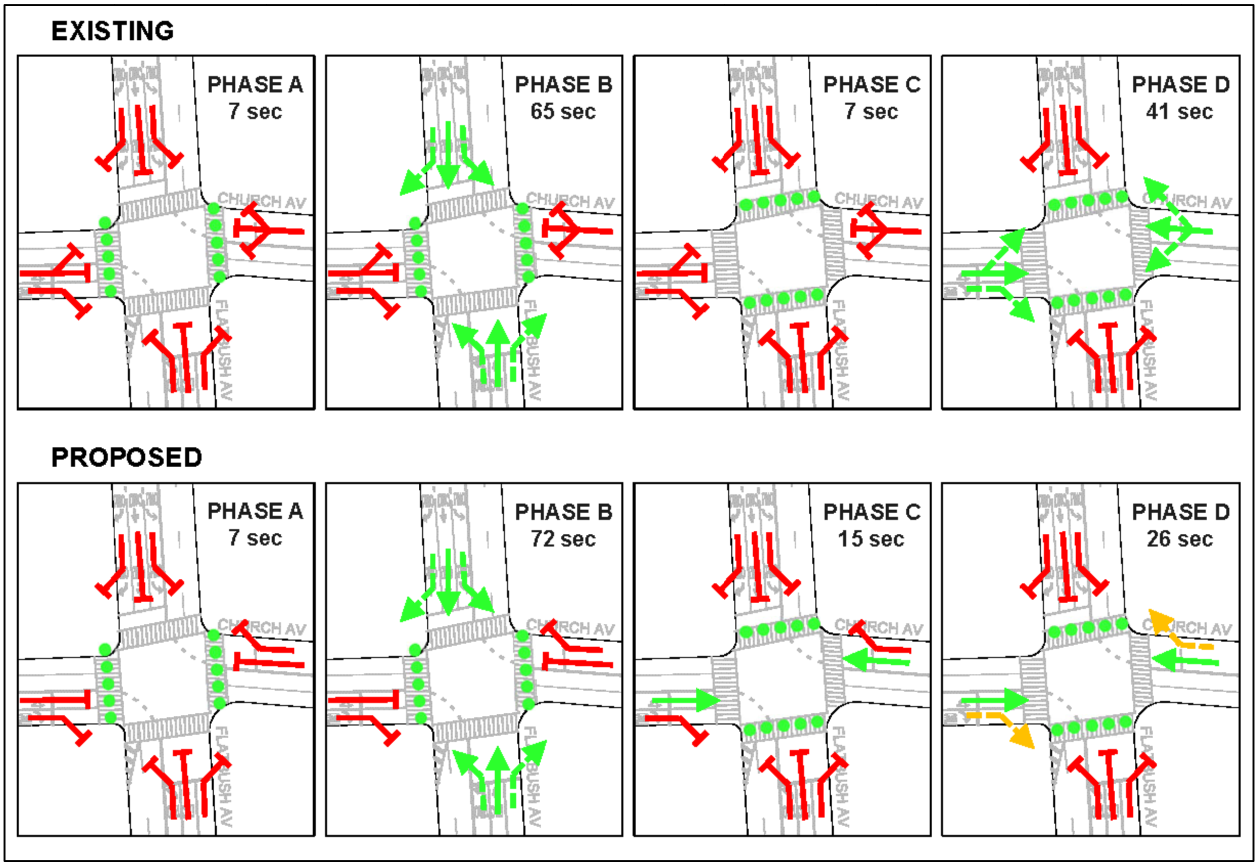

Figure 48: Existing and Proposed Signal Timing for Flatbush and Church Avenues

The LPIs have an adverse effect on traffic, because no traffic moves for 14 seconds out of every 120 second cycle. Also contributing to the bottleneck traffic conditions for this intersection is that the two streets are major cross streets to each other. As shown in the existing timing of Figure 48, Flatbush Avenue gets 65 out of 120 seconds of green time (60 seconds actual green, 3 seconds yellow, and 2 seconds all-red), but at all nearby non-major intersections, Flatbush Avenue gets 78 seconds green time (including yellow and all-red). Likewise, Church Avenue gets 41 out of 120 seconds of green time, but at all nearby non-major intersections, it gets 60 seconds.

Analysis of police reports reveal that, although the LPIs are effective in reducing conflicts between turning vehicles and pedestrians in the conflicting crosswalks, a high rate of these types of crashes still occur. The proposed timing shown in Figure 48 aims to further protect pedestrians in the north and south crosswalks with treatment known as a split LPI. Phase D in the existing plan – the 41 seconds for Church Avenue traffic movement – is split into Phases C and D in the proposed plan. Like the standard LPI, pedestrians are given a head start into the intersection while adjacent turning traffic is held. Unlike the standard LPI, the adjacent through traffic is not penalized. As shown in Phase C, turning traffic is held with a red right arrow while through traffic is released by simultaneously displaying a green through arrow. During Phase D, the red arrow changes to a flashing yellow arrow to release the turning vehicles and to emphasize they must yield to pedestrians in the crosswalk, while the green through arrow continues its display for through traffic. As with standard LPI treatment, split LPI does not completely eliminate the conflict. However, the duration of the LPI can often be longer than with standard LPI – in this case 15 seconds instead of seven seconds – because only the green time of the turning movement must be reduced, not the through movement.

Under this arrangement, the seven seconds of Phase C in the existing timing plan would no longer be needed in the proposed plan, and is reallocated to Phase B of the proposed plan, giving Flatbush Avenue an extra seven seconds green time. This would provide some small relief to the traffic congestion on Flatbush Avenue.

A necessary condition for the split LPI is that right turn bays of sufficient length be provided. Right turning vehicles cannot share the same lane as through vehicles because during Phase C, right-turning vehicles, which are stopped with a red arrow, would prevent through vehicles, which have the green through arrow, from moving. The existing and proposed layout is shown in Figure 49. Eastbound and westbound right-turn bays are provided, and the double yellow line is shifted so that the turn bays are far enough from the curb to allow trucks to turn. The shifting of the double yellow line also has the benefit of lining up this offset intersection.

Under this proposal, left turns would be banned from Church Avenue in both directions. Bedford Avenue and Ocean Avenue provide nearby alternatives. The volume of these turns is low, less than 50 per hour. This would provide some relief to the bottleneck on Church Avenue at this location by diverting the left turns elsewhere where there is less congestion.

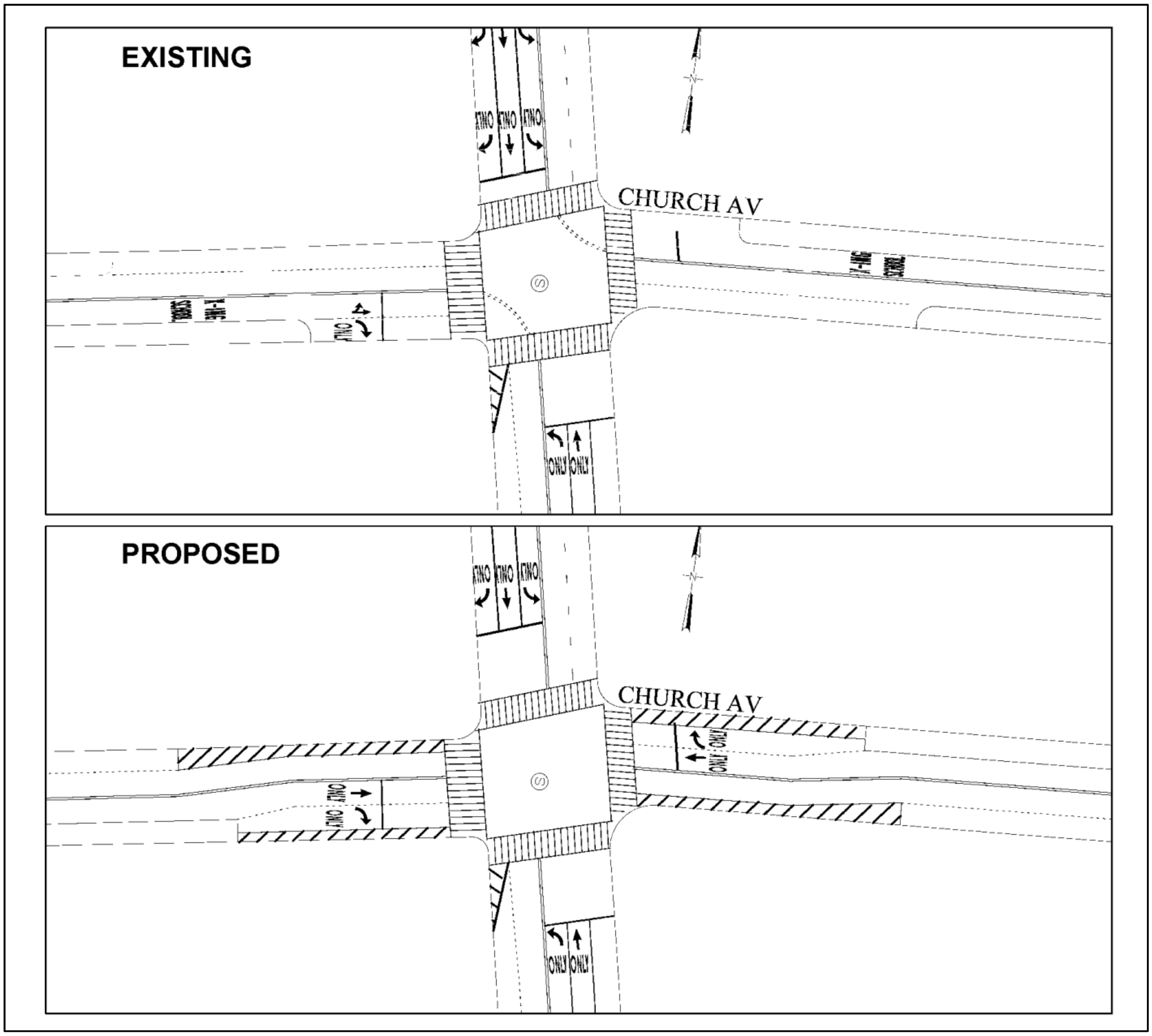

Figure 49: Existing and Proposed layout for Flatbush and Church Avenues

A disadvantage to this proposal is that on-street parking spaces on Church Avenue would have to be removed – about nine metered spaces and five loading spaces. Another more significant disadvantage is that the existing B35 bus stops on Church Avenue on the far side of Flatbush Avenue would have to be moved further away from Flatbush Avenue. This would increase the walk distance between the bus stops and the Flatbush Avenue commercial corridor. It would also increase the walk distance for bus riders transferring between the B35 and B41 buses. Possible bus stop relocation plans are presented in Figure 50. While the bus stop relocations for the Church Avenue B35 bus are a disadvantage of the proposed improvement, buses on both Church Avenue and Flatbush Avenue are expected to benefit from the improved travel times. At the time of this writing, NYCDOT and NYC Transit are working together to further evaluate this proposal.

Figure 50: Proposed Bus Stop Relocations

CHAPTER 5 CONCLUSIONS

The analysis of the conditions along the study corridor of Flatbush Avenue between Ocean Avenue/Empire Boulevard and Nostrand Avenue revealed many deficiencies. The substandard lane widths led to unsafe and unpredictable driver behavior. The presence of trucks loading and unloading, buses making stops, and cars double parking all combined to create a situation where one of the two travel lanes was often blocked. These conditions caused abrupt lane changes and merging, contributing to the potential for crashes. A look at the crash history revealed that this segment has been ranked as one of the top 10% of high crash corridors in Brooklyn.

The focus of the recommended improvements aimed to reduce these unsafe conditions, while maintaining enough capacity to process the demand volume. Simulation analysis and post-implementation travel time runs show that the proposed design would not have adverse impacts on traffic, and during some periods improves traffic, except during the weekday midday and PM peak periods in the southbound direction. However, the improvements are expected to improve safety for all users, including drivers, pedestrians, transit users, bicyclists, parkers and deliveries.

During the design and implementation phases, the community played an important role in providing feedback, identifying problems and refining solutions. In order for the improvements to have optimal benefits, police involvement and enforcement is critical. After implementation, the corridor underwent a monitoring program to help identify any new issues and ensure that traffic flow is moving appropriately. In light of field observations and feedback from the community, the project design was modified to keep in line with original goals of the project.