NEW YORK CITY DOT

TECHNICAL MEMORANDUM

Downtown Brooklyn Surface Transit Circulation Study

Final Report

Engineering Services Agreement (ESA) For Transportation Planning, Transportation Engineering, Urban Design + Related Services City Wide | PIN 84107MBTR187

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CHAPTER 1 Introduction

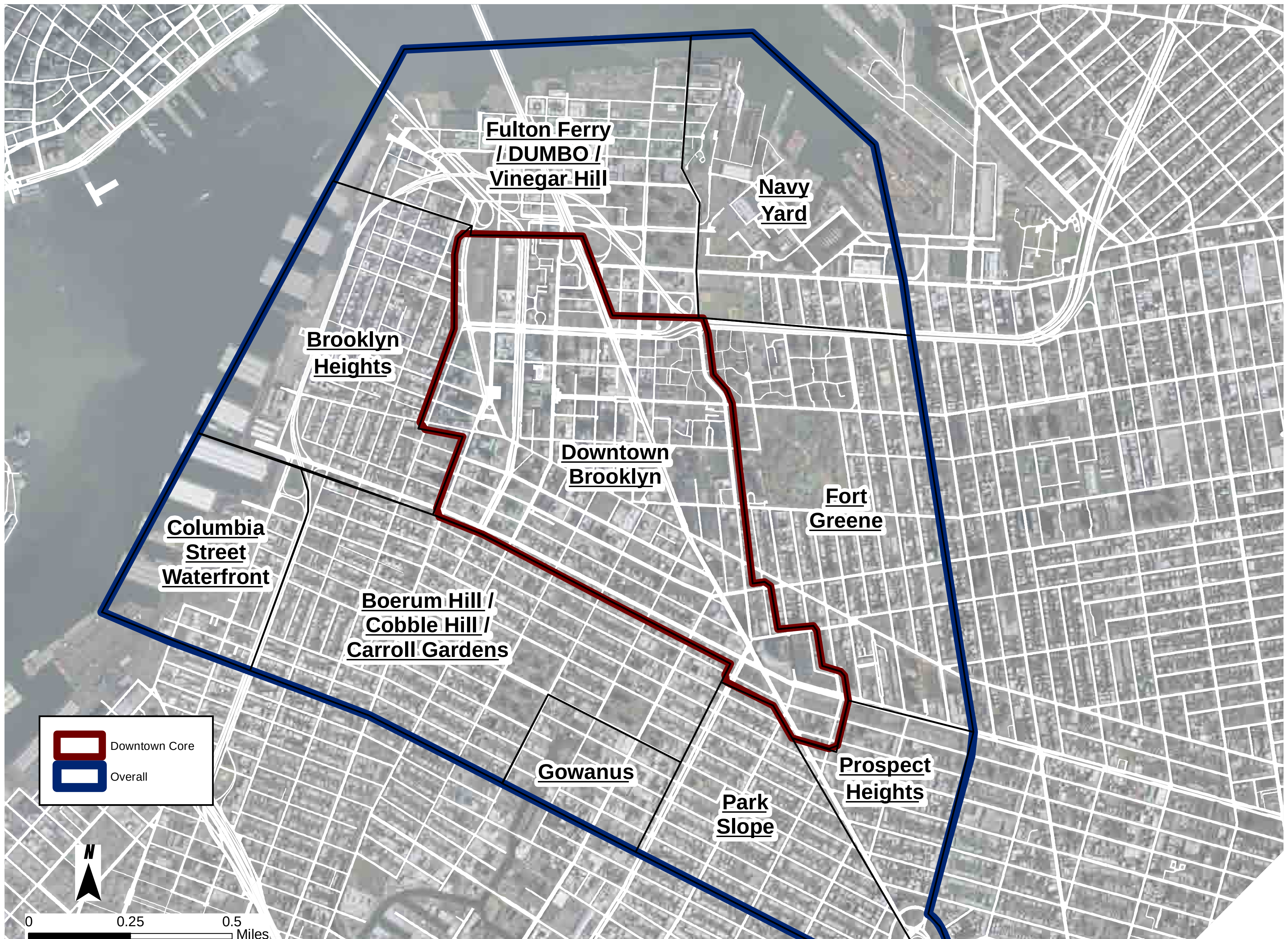

Figure 1-1 | Study Area, Downtown Brooklyn

The New York City Department of Transportation (NYCDOT), with support from the MTA New York City Transit (NYCT) and the Downtown Brooklyn Partnership (DBP), has completed the first phase of a study of surface transit needs in Downtown Brooklyn. This study, entitled Downtown Brooklyn Surface Transit Circulation Study (DBSTCS), has resulted in a number of recommendations for improving surface transit access and mobility throughout Downtown Brooklyn. These results are presented in this Final Report and include a range of short- and long-term improvements to address identified issues and help meet Downtown Brooklyn's future transit needs.

This chapter identifies the Study Area and describes the existing surface transit conditions in Downtown Brooklyn. Chapter 2 identifies the purpose of the DBSTCS, the goals outlining the priorities of the project, and the objectives necessary to implement these goals. In addition, Chapter 2 identifies the surface transit issues within the study area, organizing issues into three categories – reliability, service coverage, and passenger experience. Chapter 3 provides an overview of proposed alternatives that could potentially solve the issues identified and explained in Chapter 2, and Chapter 4 outlines the evaluation process used to compare and rank each of the alternatives in order to identify the most viable alternatives. Based on this evaluation, Chapter 5 presents the short- and long-term recommendations to improve surface transit in Downtown Brooklyn.

1.1 STUDY AREA

The Study Area was divided into two segments, presented in Figure 1-1. The Downtown Core Area consists of the area bounded by Atlantic Avenue and Ashland Place, and the overall Study Area consists of nearly four square miles and is evaluated in terms of its transit links to the Downtown area and specific neighborhoods underserved by surface transit. This area, bound by the waterfront to the north and west, Union Street to the south, and Vanderbilt Avenue to the east, includes the following Brooklyn neighborhoods: Fulton Ferry/DUMBO/Vinegar Hill, Brooklyn Navy Yard, Fort Greene, Prospect Heights, Park Slope, Gowanus, Boerum Hill/Cobble Hill/Carroll Gardens, Columbia Street Waterfront, Brooklyn Heights, and Downtown Brooklyn.

1.2 EXISTING CONDITIONS

Existing surface transit conditions were documented in the DBSTCS, August 2009 - Existing & Future Conditions Technical Memorandum. This report examined the results of previous studies, documented current land use, transit travel patterns and ridership levels. It also assessed existing surface transit performance, and identified the perceived issues and problems with surface transit in the Downtown Brooklyn area through survey and focus groups techniques. The following section summarizes the existing conditions and passenger experience as documented in the Existing & Future Conditions Technical Memorandum.

Figure 1-2 | Study Corridors

Previous Studies

More than twenty previously completed studies focusing on Downtown Brooklyn and the surrounding area were reviewed, including six Environmental Impact Statements, four Environmental Assessment Statements, and twelve Land Use and Transportation Studies. In this review, the study team identified improvement measures that had been previously proposed and examined their analyses of travel patterns, ongoing development, and roadway conditions, all of which impact surface transit demand and traveler experience. The studies demonstrated four main themes that were considered and addressed when developing transportation alternatives within the Downtown Brooklyn area which are summarized below.

Theme #1: Continuous development is occurring in Downtown Brooklyn. The reviewed studies discuss new developments proposed for Downtown Brooklyn between 2001 and 2008. These development projects include 363-365 Bond Street, Atlantic Yards Arena and Redevelopment Project, IKEA Red Hook, Dock Street Rezoning, 85 Jay Street Rezoning, Brooklyn Renaissance Plaza Expansion, and Light Bridges at 100 Jay Street Rezoning. Although not all of the projects have been completed, it is important that the DBSTCS be framed around this continuous pattern of development proposals in the area.

Theme #2: Existing transit services need to be enhanced. Previous land use and transportation studies have identified deficiencies in the transit system that serves Downtown Brooklyn. Enhancements and improvements that have been recommended by previous studies include making the Heart of Brooklyn (HOB) Trolley more efficient (A Bumpy Ride, August 2007), improving deficiencies in mobility, program development, and infrastructure (Transportation Outlook 2006, May 2007), increasing connections between paratransit systems (Interim Coordinated Human Services Public Transit Plan, November 2006), and creating a transit link between the Long Island Rail Road Terminal, Fulton Landing, and Downtown Brooklyn (Transit Antic Study, February 1985).

Theme #3: Congestion must be managed. Previous studies identified the immense presence and negative impacts of congestion in Downtown Brooklyn, and recommended ways to mitigate congestion. These mitigation strategies include instituting congestion pricing (PlaNYC, April 2007), improving pedestrian safety and infrastructure (Downtown Brooklyn Transportation Blueprint Technical Memo, May 2005), creating a Residential Permit Parking Program (Downtown Brooklyn Residential Parking Permit Study, May 2006), implementing traffic calming measures such as widened pedestrian islands, raised intersections, high-visibility on-street bicycling lanes, road closures, and slower signal progression (Downtown Brooklyn Traffic Calming Study, May 2004), and offering a low-fare or free transit loop within Downtown Brooklyn (Downtown Brooklyn Transit Loop Study, October 1994).

Theme #4: The transit system should promote multi-modal travel. Previous studies also identified the importance of encouraging multi-modal travel in Downtown Brooklyn. The first of these studies, Subway-Sidewalk Interface (March 2005), recommended the use of signage, lighting, signal timing, pavement markings, corner clearances, and curb line changes to improve pedestrian and vehicular circulation entrances and encourage subway use. The study also suggested the use of signage, maps, bus-actuated signals, and curb use assignment to decrease confusion at intermodal stations. The second study that examined the importance of multi-modal travel is Mobility for the Millennium (1999). This study identified heavy congestion from commuters traveling to Manhattan and recommended the reconstruction of Atlantic Terminal to reduce congestion and make intermodal transfers easier for users.

Current Land Uses

The Study Area includes ten distinct neighborhoods: Fulton Ferry/DUMBO/Vinegar Hill, Brooklyn Navy Yard, Fort Greene, Prospect Heights, Park Slope, Gowanus, Boerum Hill/Cobble Hill/Carroll Gardens, Columbia Street Waterfront, Brooklyn Heights, and Downtown Brooklyn. Each neighborhood has its own identity, characteristics, and transit options, and the land uses within each of these neighborhoods inextricably impact travel demand.

The Core Study Area, Downtown Brooklyn, can be further broken down into four corridors: Atlantic Avenue, Flatbush Avenue, Jay Street/Adams Street/Cadman Plaza West, and Fulton Street/Livingston Street. Figure 1-2 shows a map of the four study corridors.

The Study Area is highly populated with intense density. Since 1990, population has continually grown, concentrating along the periphery of Downtown Brooklyn. The more central area is composed of retail, restaurant, office, and mixed use development. Downtown Brooklyn is an ideal candidate for transit, based on high densities of residents and employees in the area, with residents leaving and employees arriving in the AM peak hours and vice versa while in the PM peak hours.

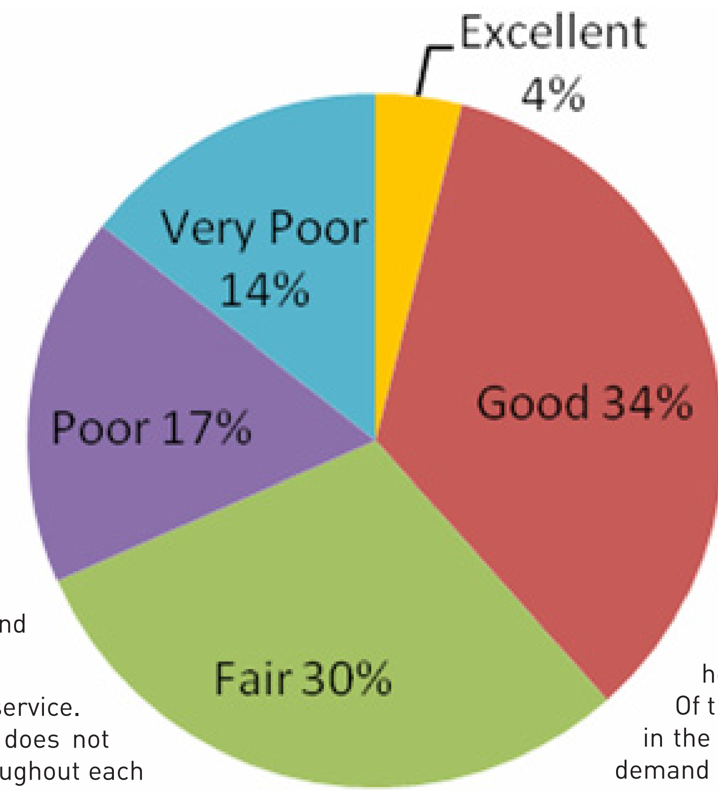

Figure 1-3 | Satisfaction with Bus Service Used on Day of Survey

Existing Transit Options

Existing transit options in Downtown Brooklyn include buses, subways, commuter rail, and commuter vans. A brief description of each of these transit options follows.

The Study Area is served by twenty bus routes, the vast majority of which offer 24-hour/7-day service. Only two routes, the B38 Limited and B51, are limited to weekdays, and one route B103 does not operate on Sundays. Scheduled service spans not only peak hours, but runs consistently throughout each day and week. These bus routes also offer service that is frequent enough throughout the Study Area to support choice and non-choice riders. The buses that service Downtown Brooklyn carry more than 187,000 passengers each weekday and approximately 108,000 passengers each day of the weekend. According to the New York City Transit (NYCT) Wait Assessment surveys, buses for three primary routes arrive on-time 80 percent of the time.

Of the 14 subway lines that serve Downtown Brooklyn, eight offer 24-hour/7-day service and 11 provide more than 12 consecutive hours of high frequency service every day. On average, NYCT reports these subways arrive on-time 85% of the time.

Downtown Brooklyn is also served by commuter rail, with the Long Island Rail Road (LIRR) operating out of Atlantic Terminal at Flatbush and Atlantic Avenues. LIRR offers service from Atlantic Terminal to Jamaica, Queens and points east, with connections available to all LIRR branches except the Port Washington Branch. Atlantic Terminal also offers bus and subway connections. Overall, the LIRR carries more than 270,000 passengers each weekday on ten branches serving 124 stations. An estimated 10 to 12 percent of all Downtown Brooklyn office commuters use the LIRR.

The final existing transit option in Downtown Brooklyn are commuter vans. A function of the market, these privately-owned vehicles, often referred to as "dollar vans", operate when formal public transportation services demands are unmet. In these areas, demand is significant enough to attract consistent, formalized operations with designated routes, stops, and fare structures. While these vans can be viewed as support services to the bus and subway services provided by the NYCT, Community Board 2 and local residents have expressed concerns about unsafe and aggressive driving. In addition, commuter vans often interfere with NYCT buses. Commuter vans also have been observed to use an excessive amount of horn honking when trying to get the attention of potential riders. Such activities damage the reputation of commuter vans, making them a less favorable form of transportation.

Future Demand

To analyze future conditions and the potential increase of surface transit demand in the Study Area, the planned location, type, and amount of future development was considered. The analysis was based on 87 development projects planned for Downtown Brooklyn. By 2015, Downtown Brooklyn could see an additional 9,300 residential units, 300,000 square feet of retail space, 1.4 million square feet of commercial office space, 204,000 square feet of community/institutional space, 930 hotel rooms, and 85 acres of publicly accessible open space as a result of these future projects.

This additional development will result in an increase in travel demand for the Study Area, including surface transit. Retail development more than other developments is expected to increase surface transit demand. Travel demand estimates indicate these future projects are expected to generate up to 10,654 AM peak hour transit trips, 10,473 midday peak hour transit trips, and 14,955 PM peak hour transit trips by 2015. Of these transit trips, bus trips will account for 1,386 (13 percent) in the AM peak hour, 2,692 (26 percent) in the midday peak hour, and 2,810 (19 percent) in the PM peak hour. While much of this increased travel demand will occur in core areas relatively well-served by surface transit, future growth is also projected for neighborhoods with fewer surface transit options, including Flatbush Avenue Extension between Willoughby and Nassau Streets, DUMBO, Brooklyn Heights, Columbia Street Waterfront, and Boerum Hill/Cobble Hill/Carroll Gardens.

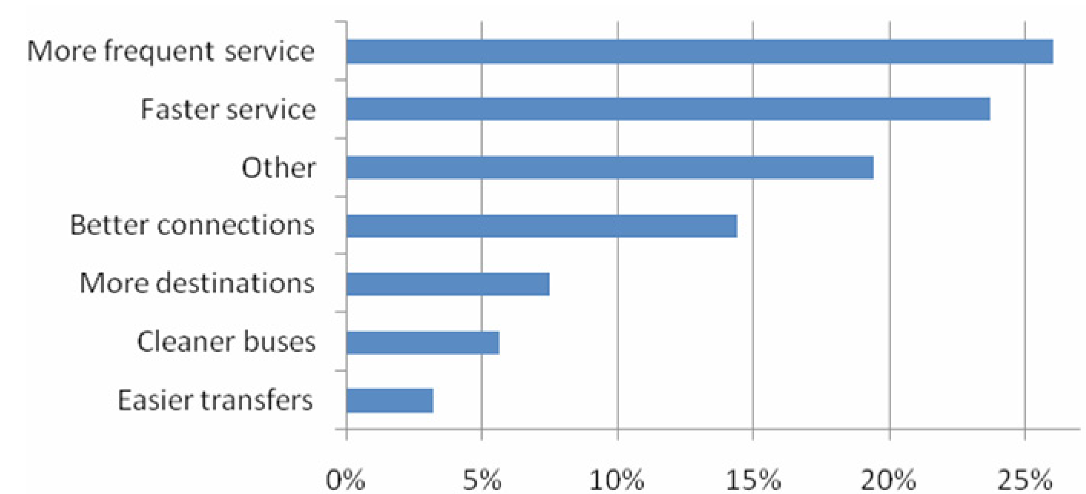

Figure 1-4 | Requested Improvements to Bus Routes

Passenger Experience

A series of surveys and focus groups identified priority origins and destinations of travelers within the Study Area, bus passenger experience, and suggested ways of improving surface transit. Two surveys: a bus rider survey and sidewalk intercept survey, were conducted during April and May 2009, collecting a total of 825 surveys (260 bus riders and 565 sidewalk intercepts). Bus riders were asked to rate service on the line they were waiting for and to pick their top choice from a list of preferred bus stop improvements. Sidewalk intercept surveys asked for pedestrian's trip origin, destination, and travel mode, as well as mode(s) typically used to travel to and from Downtown Brooklyn. Participants were also asked about their preferences for potential bus service improvements.

According to the survey results, bus riders were primarily traveling between work and home. These destinations represent just over 60 percent of origins and 58 percent of destinations. Additionally, 67 percent of survey participants were traveling within Brooklyn. More than one-third of bus riders walked from an origin point to reach a bus stop, while another third transferred from another bus route.

Table 1-1 | Mode Spilt for Sidewalk Survey

Mode	What mode will you use today?		What mode do you typically use?	
	Number	Percent	Number	Percent
Subway Line	223	36%	248	39%
Walk	182	29%	113	18%
Bus	125	20%	139	22%
Car	68	11%	79	12%
Other	16	3%	23	4%
Bike	6	1%	15	2%
Taxi	4	1%	16	3%
Commuter Van	3	0%	4	1%
Total	**627**	**100%**	**637**	**100%**

On a scale from Very Poor to Excellent, nearly two-thirds of survey participants rated their bus route satisfaction as "Fair" or "Good". Figure 1-3 shows a breakdown of responses. Bus customers were also asked which improvements they would most like to see, as shown in Figure 1-4.

Similarly to individuals traveling by bus, pedestrians participating in the sidewalk intercept surveys were mostly traveling between work and home. Additionally, 60 percent were traveling within Brooklyn. The subway was the preferred mode of transportation to final destinations (36 percent), followed by walking (29 percent), and the bus (20 percent). The complete breakdown of modes taken on the day of the survey is included in Table 1-1. When asked what factored into mode choice on the day of the survey, participants primarily cited speed and convenience. Common complaints against bus service were speed, frequency, and limited service areas.

Because public involvement is a key component of the DBSTCS, focus groups were held with Study Area stakeholders. These stakeholders were organized into two groups: residents and community groups; and employees and business owners/managers. The focus groups allowed stakeholders to identify and profile distinct travel experiences, perceptions, expectations, and preferences. Stakeholders requested implementing a Downtown Loop to provide service from offices to the shopping along Smith and Livingston Streets. Pedestrian improvements were also requested to assist travel between bus stops and points of origin or destination. Comments were incorporated in alternative design and recommendations.

CHAPTER 2
ISSUES + GOALS + OBJECTIVES

This chapter outlines the goals and objectives of the DBSTCS. These were developed through discussion with NYCDOT and the project's Steering and Stakeholder Committees, as well as field observations, focus groups, and analysis of existing conditions.

This chapter also identifies the surface transit issues within the Study Area, based on existing conditions data, field reconnaissance, public outreach through surveys and focus groups, discussions with NYCDOT and other transportation agencies, and a review of the previous studies presented in Chapter 1. Issues are organized into three categories – reliability, coverage, and passenger experience.

Reliability issues relate to bus service operations and include congested corridors, congested intersections, and long dwell times. Congested corridors and intersections were determined by level of service analysis, field observations, and focus groups. Long dwell times were determined through field observations, site investigations, boarding and alighting data, and public outreach.

Coverage issues include overlapping service and underserved neighborhoods. Bus routes travel from various locations in Brooklyn and converge in the downtown, which results in multiple buses operating along the same streets. Using field observation and GIS analysis, high-density overlapping service was identified. While transit service is generally available throughout the Study Area, some areas remain underserved. Focus groups, field observations, surveys, and GIS analysis identified these areas as well as growing neighborhoods in need of additional transit.

As for passenger experience issues, bus service is perceived as overcrowded, unreliable, and confusing, according to results of public outreach and focus groups. In addition, bus stops were described as uncomfortable and often unattractive.

Specific locations (or areas) are identified for each issue, and maps are used to identify geographic locations, including routes/corridors with reliability issues, problematic intersections, and underserved areas. Issues and locations are also presented in a tabular format, as shown in Table 2-1.

Table 2-1 | Surface Transit Issues in Downtown Brooklyn

RELIABILITY ISSUES	
Issue	Location
Congested Corridors	Flatbush Avenue
	Fulton Street/Livingston Street Corridor
	Jay Street/Adams Street/Cadman Plaza West Corridor
Congested Intersections	Atlantic Avenue, Flatbush Avenue, and 4th Avenue
	Fulton Street, Smith Street, and Jay Street
	Fulton Street and Boreum Place
	Livingston Street and Smith Street
	Livingston Street and Boreum Place
	Cadman Plaza West / Tillary Street (Bus Congestion)
Long Dwell Times	Study area wide

SERVICE COVERAGE ISSUES	
Issue	Location
Overlapping Service	Flatbush Avenue
	Fulton Street
	Livingston Street
	Cadman Plaza West
Underserved Neighborhoods	DUMBO
	Waterfront area (parallel to Brooklyn Bridge Park)

PASSENGER EXPERIENCE ISSUES	
Issue	Location
Rider Experience	Study area wide (i.e. lack of shelter, seating, or bus schedules, unsafe conditions, limited mobility information)

2.1 GOALS AND OBJECTIVES

The purpose of the DBSTCS is to analyze Downtown Brooklyn travel patterns and assess the surface transit circulation needs in the Study Area. Furthermore, the study seeks to identify users (and non-users) and forecast future surface transit demand. Based on the results of this analysis, reliability, service coverage, and passenger experience issues were identified. To address these issues, specific goals (project priorities) and objectives (measurable responses) have been identified. In addition to meeting Downtown Brooklyn's transportation needs, these goals and objectives are intended to foster economic activity and improve the quality of life for residents and non-residents alike.

The DBSTCS has three primary goals, each of which includes a corresponding objective:

Goal #1: Maximize effectiveness of the Study Area's surface transit network to provide improved access and mobility.

Objective: Reduce travel times and improve schedule reliability for bus users;

Improve inter modal connections between buses and other modes; and

Make bus service more comfortable and user-friendly.

Goal #2: Provide transit connectivity throughout the overall Study Area.

Objective: Maximize access to all significant trip generators throughout the Study Area.

Goal #3: Support the economic health of the overall Study Area.

Objective: Make transit improvements to increase economic attractiveness of commercial and tourism-based land uses.

2.2 RELIABILITY ISSUES

Congested Corridors

Significant surface transit service operates throughout the Study Area, with many routes running on frequent headways. These heavy bus volumes, vehicular traffic and conflicting curbside demands, hinder bus operations and result in degraded service reliability. Congestion is most evident in the Downtown Core, where vehicular traffic is particularly heavy and many bus routes converge. The following routes have been identified during field data collection and public outreach as least reliable: B25, B26, B37, B38 and B38 Limited, B41 and B41 Limited, B45, B51, B52, B54, B61, B67, and B103. Based on these unreliable routes three primary congested corridors were identified, as shown in Figure 2-1: Flatbush Avenue Corridor, Fulton Street Transit Mall/Livingston Street Corridor, and Jay Street/Adams Street/Cadman Plaza West Corridor.

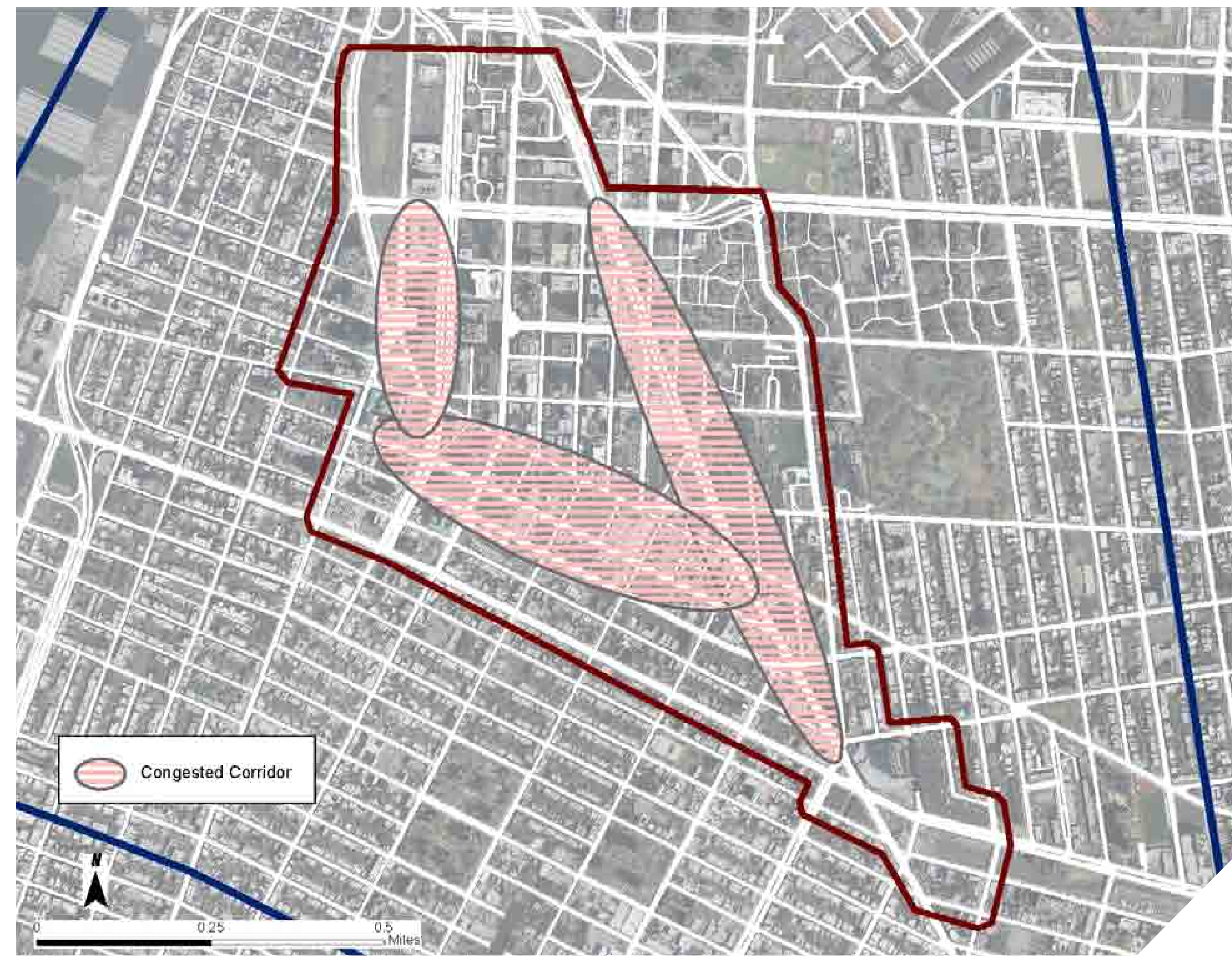

Figure 2-1 | Congested Corridors with the Downtown Core

Congested Intersections

One of the key issues raised in the research is the level of vehicular congestion at major intersections within the Study Area. Based on data collected from previous studies, there are a number of congested lanes and intersections within Downtown Brooklyn. Congestion at intersections hinders roadway operations and bus service performance. In addition, these intersections can be daunting and dangerous for pedestrians. Three areas in the Study Area have been identified as having intersections that are the most problematic to pedestrians, with potential bus riders stating they struggle to reach bus stops at these locations due to safety concerns. Intersection areas identified as having issues are shown in Figure 2-2 and described below.

The first area identified as being unsafe for pedestrians is around Cadman Plaza West and Tillary Street. Cadman Plaza West is the layover point for most bus routes that terminate in Downtown Brooklyn and numerous buses park there. This causes potential traffic interference and additional conflicts between buses and pedestrians.

The second area is the junction of Atlantic, Flatbush, and 4th Avenues. The atypical geometry here is complicated by heavy traffic, lengthy pedestrian crossings, and limited pedestrian refuge along Atlantic Avenue and Flatbush Avenue. The crossing distance for pedestrians across Flatbush Avenue can be as much as 115 feet and up to 130 feet across Atlantic Avenue. Atlantic Terminal, meanwhile, draws a significant number of pedestrians and the B41 bus stop in the middle of the intersection is one of the busiest in the area during both the AM and PM peak periods.

The final area identified as having pedestrian safety concerns is the series of intersections formed by Fulton Street, Smith/Jay Street, Adams Street/Boerum Place, Livingston Street, and Willoughby Street/Adams Street. This area is served by 15 bus routes, and bus boardings and alightings in this area are the highest in the entire Study Area in the AM and PM peak periods. In addition, traffic congestion along Livingston Street creates difficult crossings for pedestrians.

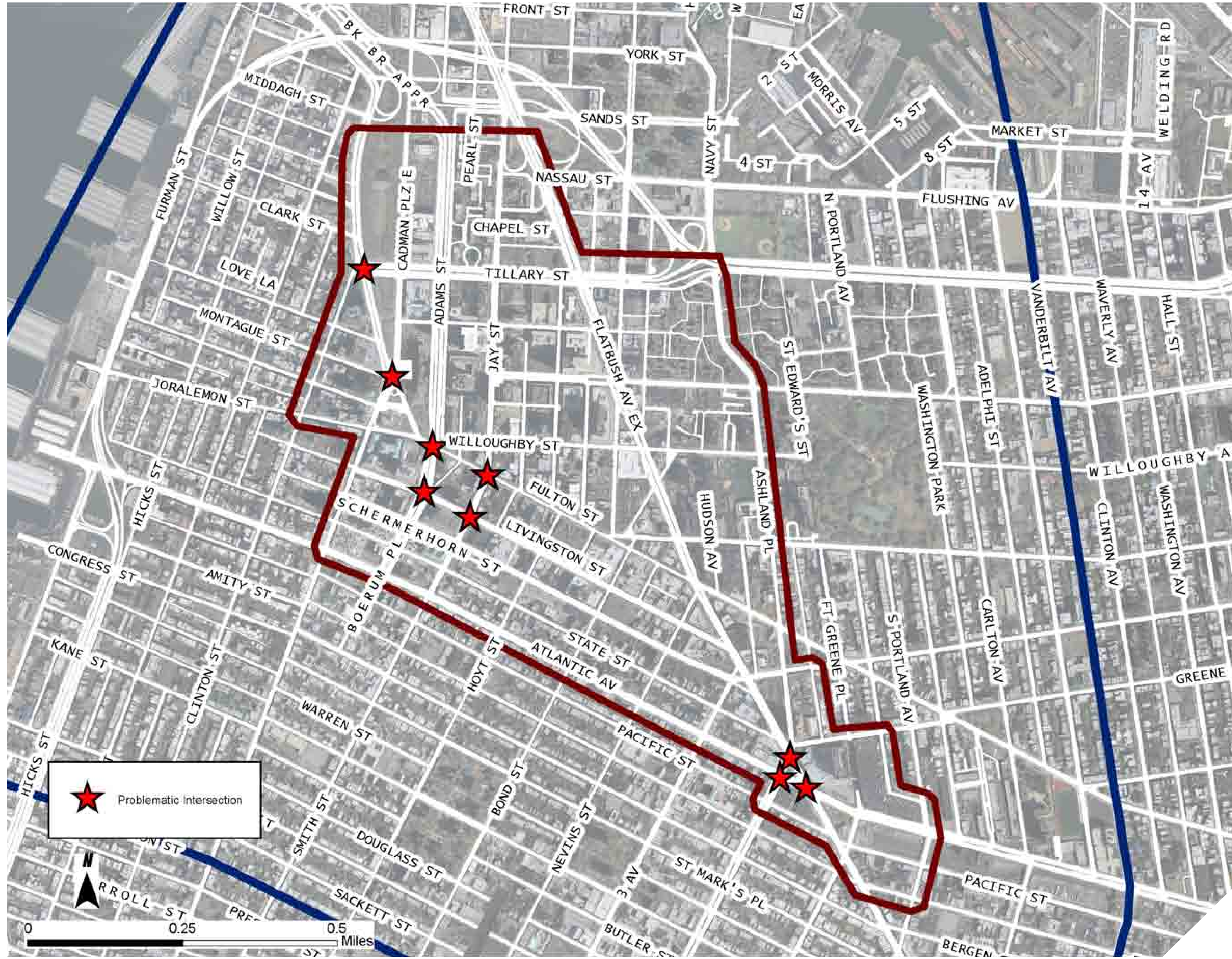

Figure 2-2 | Congested Intersections with the Downtown Core

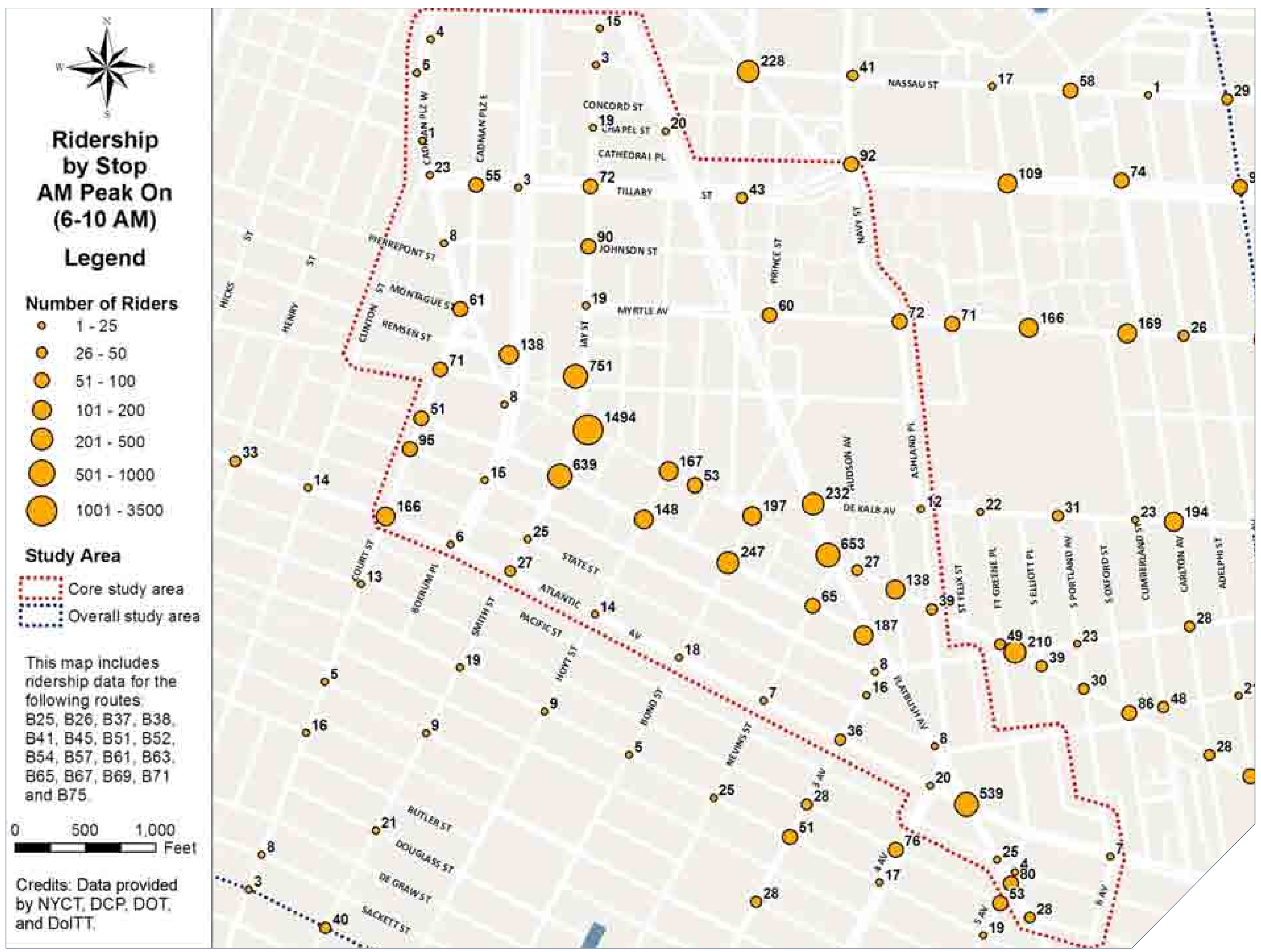

Figure 2-3 | Bus Boardings, AM Peak Period

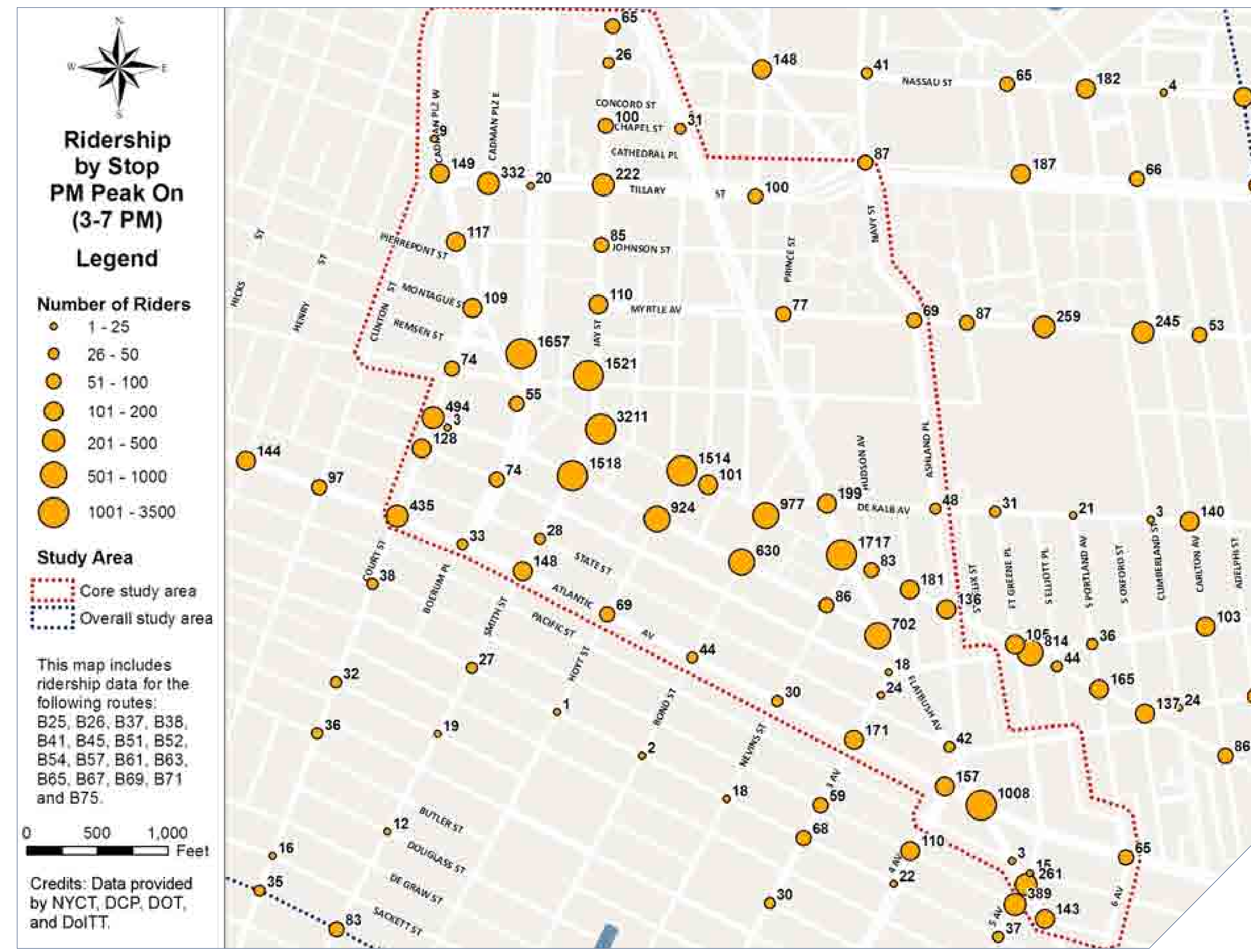

Figure 2-4 | Bus Boardings, PM Peak Period

Long Dwell Times

Field visits and focus groups raised concern over long dwell times due to on-board fare collection and MetroCard authentication, which is particularly problematic at high traffic bus stops. Figure 2-3 and Figure 2-4 show the number of boardings at bus stops throughout the Study Area during the AM and PM peak periods. Bus stops with the highest boardings can be assumed to have higher dwell times. The Jay Street, Fulton Street Transit Mall, Livin gston Street, and Flatbush Avenue Corridors show significant boardings during both peak periods, thus indicating higher dwell times.

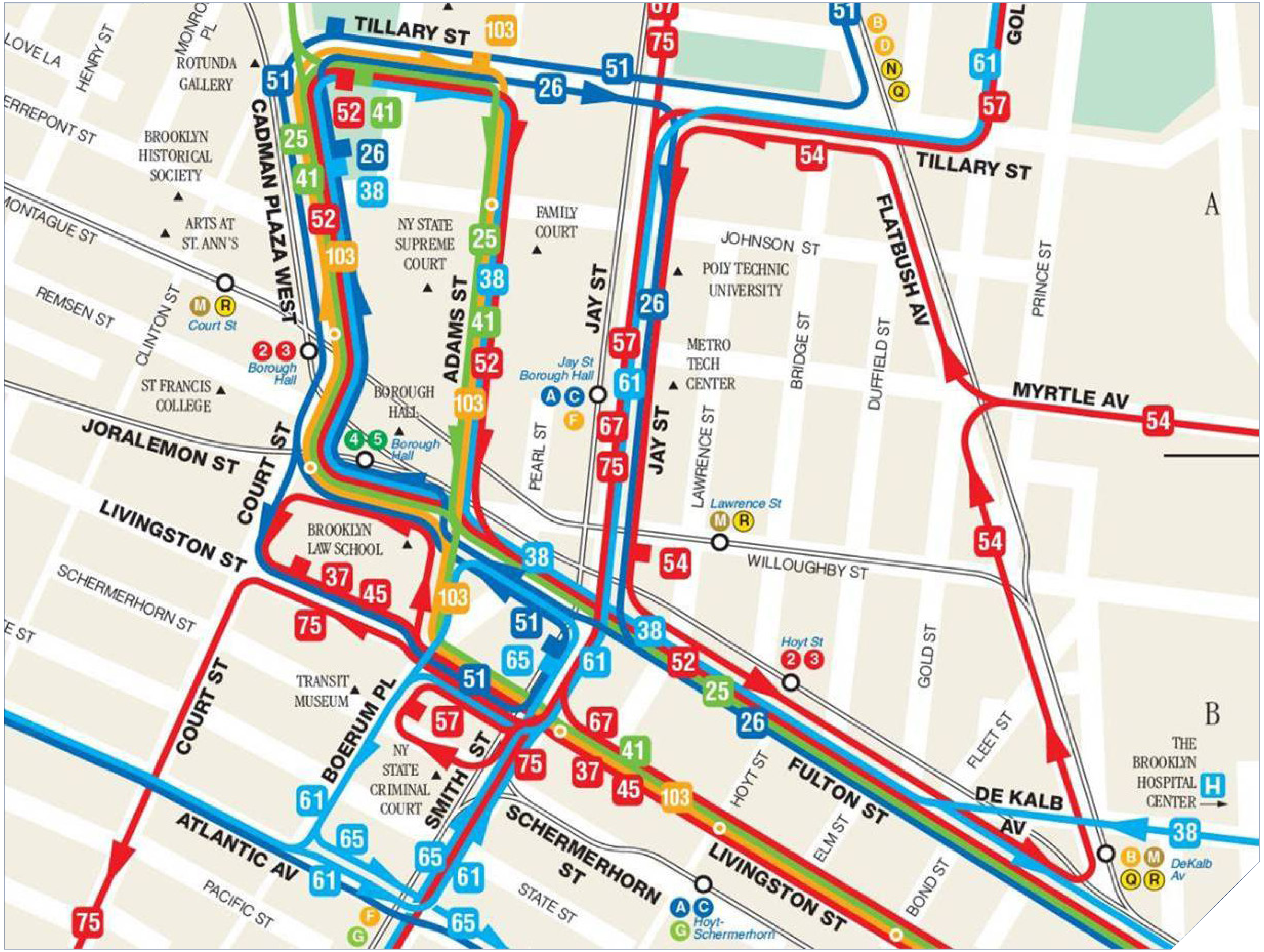

Figure 2-5 | Bus Boardings, AM Peak Period

2.3 SERVICE COVERAGE ISSUES

Overlapping Service

About twenty bus routes serve the Study Area. These bus routes serve a variety of neighborhoods throughout Brooklyn, expanding to almost 300 route-miles throughout New York City. Each route is important and necessary to serve the various neighborhoods in Brooklyn. However, problems arise when the many routes converge in the Downtown Core. As shown in Figure 2-5, there is a concentration of bus lines along Adams Street, Cadman Plaza West, Flatbush Avenue (south of Atlantice Avenue), Fulton Street, Jay Street, and Livingston Street, which is indicative of overlapping routes. Overlapping service is an issue for surface transportation because the many bus routes compete with each other, as well as other vehicles, for lane space. This leads to bus congestion, delays, and unreliable service. Increased bus congestion, coupled with narrow lanes, has a negative impact on the bike and pedestrian environment within Downtown Brooklyn. In addition, overlapping service increases rider confusion because several buses serve the same bus stops. Riders unfamiliar with the system might not be aware of the various transportation options.

Underserved Areas

Contrastingly, some areas within the Study Area are underserved. Focus groups, field surveys, and GIS analysis identified DUMBO (including the ferry landing), Flatbush Avenue north of DeKalb Avenue (near Fort Greene), and the waterfront area surrounding the new Brooklyn Bridge Park as areas that are underserved by surface transit. These areas are shown in Figure 2-6.

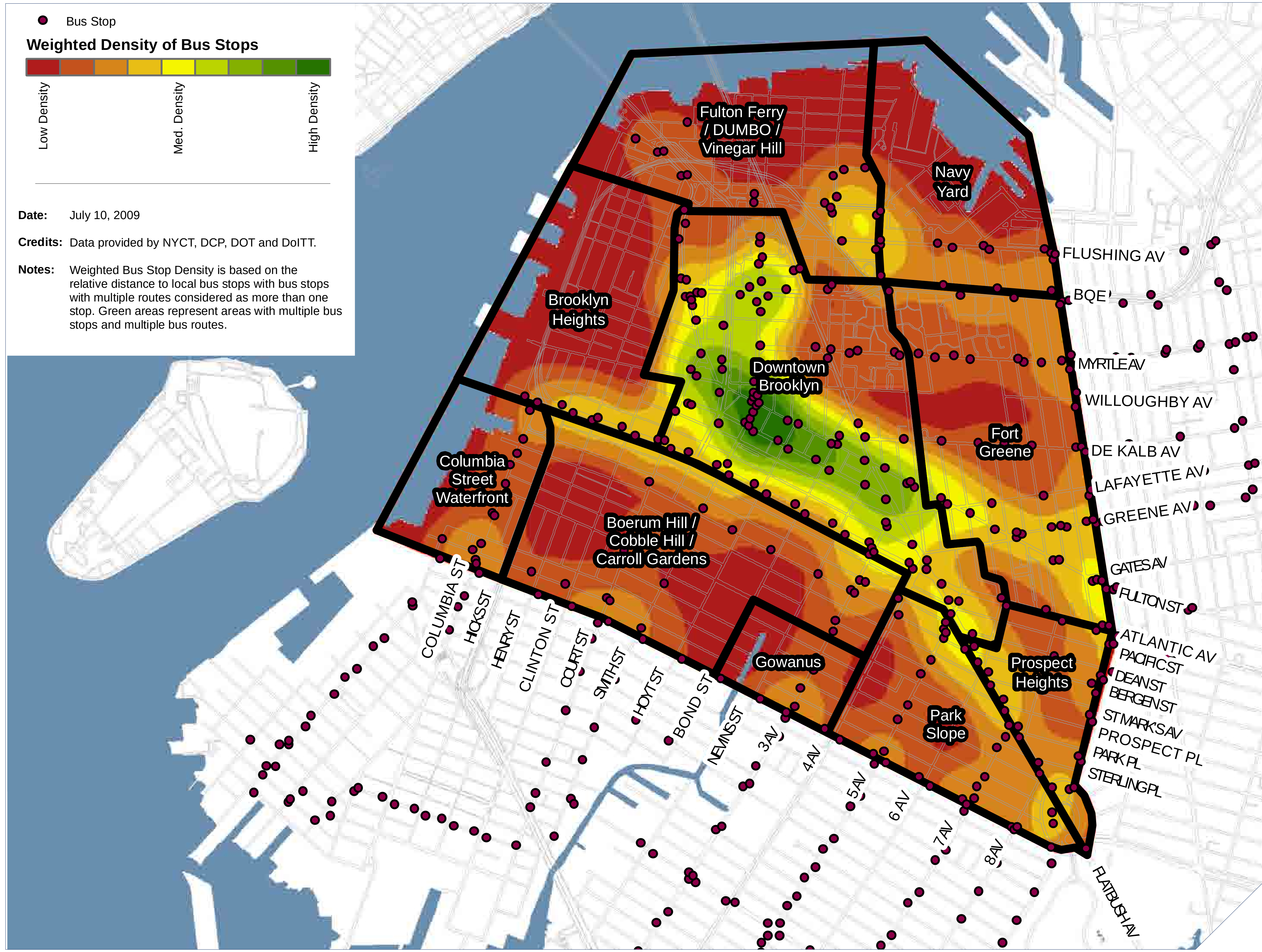

Figure 2-6 | Density of Bus Stops

2.4 PASSENGER EXPERIENCE ISSUES

Based on focus group meetings and surveys, surface transit is currently perceived by riders as overcrowded, unreliable, and confusing. Additionally, waiting conditions at bus stops were reported to be uncomfortable and difficult or unsafe to access because of a lack of bus stop infrastructure, adjacent roadway geometries, high vehicular traffic, or problematic intersections. The survey results are shown in Figure 2-7. Waiting area comfort and shelters were the most desired bus stop improvements.

Moreover, according to Census data, the Study Area's population includes a significant number of elderly residents (65 and older), who have unique travel needs. Bus transportation in Downtown Brooklyn is an important mode of transportation for the aging population. At the focus group meetings, elderly residents expressed a preference for the bus over other modes especially subway, as surface transit is easier to access than below-ground subway service. In addition, all bus stops and buses are compliant with the American Disability Act (ADA). For this large user population, improved bus stop amenities are particularly important.

In addition, a fare collection issue surfaced as part of the passenger experience: ticket vending machines (TVM) are primarely located below street level. Although MetroCards are available for purchase at nearby businesses, bus users are often unaware of these locations. As a result, potential riders are discouraged from using the surface transit system.

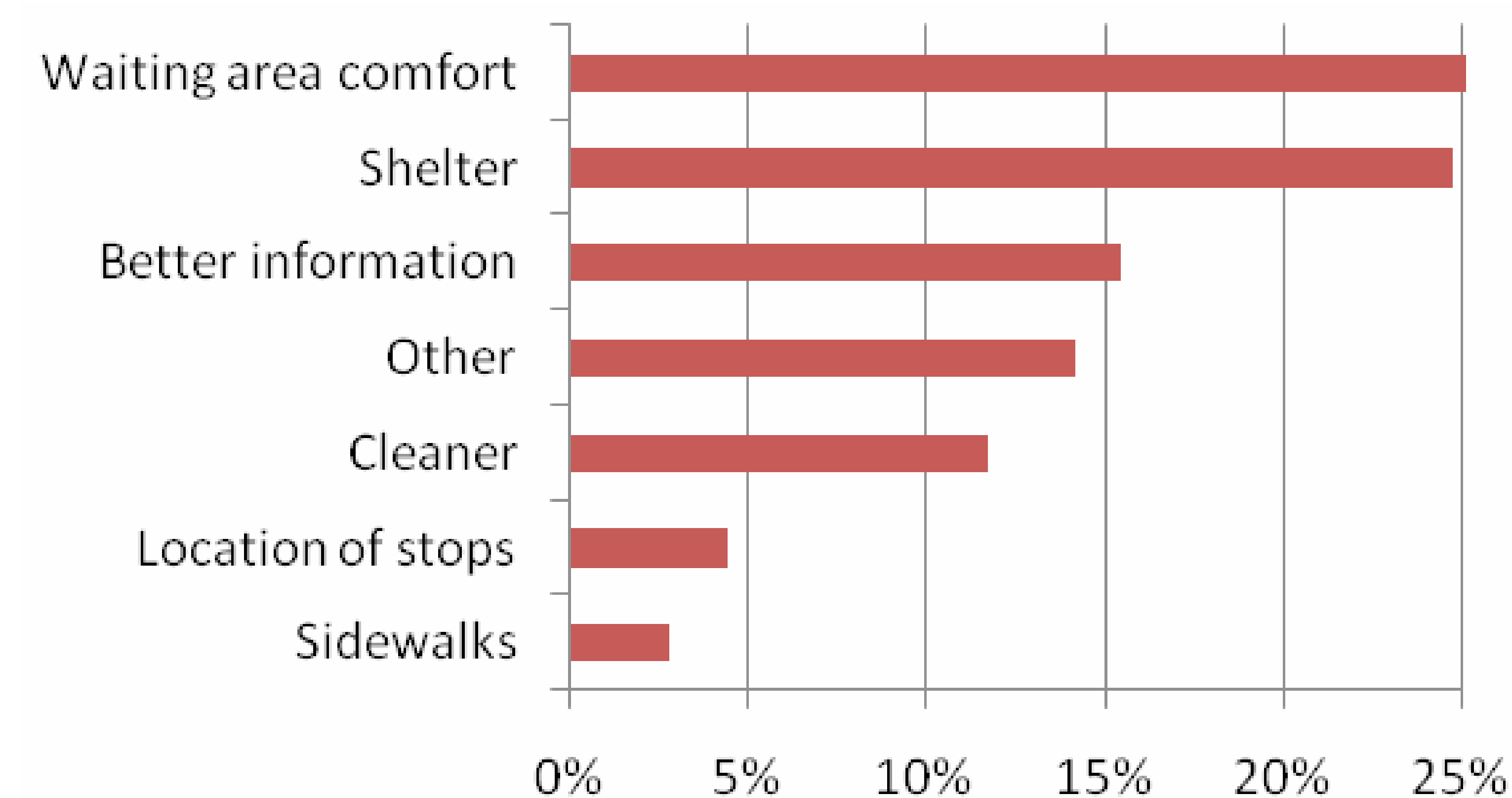

Figure 2-7 | Requested Improvements to Bus Stops

CHAPTER 3
PROPOSED ALTERNATIVES

3.0 INTRODUCTION

A number of alternatives to improve bus service and overall surface transit circulation in Downtown Brooklyn were developed based results of the Existing and Future Conditions Reports and survey findings. These alternatives address bus reliability, service coverage, and passenger experience.

3.1 ALTERNATIVES TO IMPROVE RELIABILITY

Proposed improvements to Downtown Brooklyn bus operations and reliability are in direct response to problems identified in the DBSTCS Existing Conditions Report, with many surface transit routes operating on frequent headways and often subject to constrained operations because of both bus and private automobile congestion. In addition, overlapping bus service in the Downtown Core Area complicates issues. Schedule reliability for three primary routes achieves 80% on-time rate, indicating potential for improvement. Specific corridors and intersections have been identified as problematic, and several alternative options could provide improvements. The Flatbush Avenue, Jay Street, and Fulton/Livingston Street corridors are primary corridors of concern. In all of these corridors, the vehicle Level of Service for one or more intersection approaches (a measure of traffic congestion grading conditions from A-F) were at failing or almost failing conditions during peak periods. Alternatives that were identified to improve the conditions for buses operating along these corridors include:

- Leading bus interval
- Traffic signal priority
- Extending bus only lanes/hours
- Bus stop consolidation
- Bus stop curb geometry
- Fare collection system
- Parking enforcement
- Splitting service

These alternative options are described in more detail below.

Figure 3-1 | Bus Only Lane / Leading Bus Interval, W 207th Street, Manhattan (Source: NYC Street Design Manual)

3.1.1 Leading Bus Interval

Definition

Leading Bus Intervals (LBI) offer a form of bus priority at intersections to give transit vehicles a green light before the rest of traffic. This allows transit vehicles to make difficult turns and merges without conflicting with automobiles. LBIs are currently in use in New York City. Figure 3-1 shows one such application on W. 207th Street in Manhattan.

Relation to Study Goals and Objectives

When implemented, LBIs directly improve the effectiveness of surface transit by reducing trip time of buses otherwise delayed behind general traffic. From a policy perspective, LBIs prioritize high capacity transit vehicles over general vehicles, supporting both the goals of this study and PlaNYC.

Needs and Benefits

According to the Bus Rapid Transit Practitioner's Guide, TCRP Report 118, application of queue jumpers (comparable to NYC's LBI's) has resulted in travel time savings of 5% to 15% for transit vehicles through intersections. This can also help to improve schedule reliability because of reduction of delay at signals.

Study Team Recommendation

Surface transit operations could benefit from the implementation of LBIs at two locations within the study area. First, difficult southbound to eastbound turns at Adams Street to Fulton Street would benefit from an LBI directly upstream of this location to allow buses using the Adams Street service road to more easily merge left in preparation for the left turn onto Fulton Street. With implementation of the Jay Street Transit Priority options (see Section 3.2.2), it would not be necessary to put an LBI here as the majority of the buses will be re-routed southbound to Jay Street, where the left turn onto Fulton Street is not as difficult. The second location where an LBI would provide a benefit to transit operations is at Livingston Street and Flatbush Avenue, specifically helping existing buses turn south onto Flatbush Avenue from Livingston Street and then Eastbound onto Lafayette Avenue ahead of vehicle traffic utilizing a right-turn bus-only lane. If the shuttle is implemented according to recommendations of Section 3.3.3, the shuttle would also directly benefit from an LBI at this location.

3.1.2 Traffic Signal Priority

Definition

Traffic, or transit signal priority systems adjust intersection traffic signal cycles with red truncation or green extensions to accommodate transit vehicle flow through the intersection. Red truncation terminates the cross traffic green phase early when a bus approaches the signal to allow the bus to proceed through the intersection without stopping. Green extensions hold current green phases so that buses can proceed on the extended green signal. Traffic signal priority require both a transponder in each transit vehicle and a wayside signal controller/receiver. New systems currently being developed use GPS devices on buses, which communicate with centralized signal control to provide either a red truncation or green extension. Figure 3-2 explains the two types of potential transit signal priority systems.

Relation to Study Goals and Objectives

Reductions in bus travel times and increased bus reliability help to maximize the effectiveness of the transit network to provide improved access and mobility.

Characteristics

A wide variety of transit signal priority systems are available for implementation at various levels of complexity. This would require additional studying and data collection efforts to determine the ideal system for Downtown Brooklyn, though the general concept of transit signal priority is used for the evaluation of appropriateness, below.

Needs and Benefits

Bus congestion in the Study Area is sometimes a result of delays at traffic signals and congested intersections. Transit signal priority systems can reduce such delays. Travel time reductions from 5 to 23 percent have been seen in applications of such systems (Transit Capacity and Quality of Service Manual p. 4-27). Recent implementation of the Victory Boulevard/Bay Avenue Corridor project in Staten Island included 14 signalized intersections and over 30 bus routes. 300 buses were fitted with emitters to communicate with these intersections. The final results indicated an overall time savings of 17 percent in the AM peak period (6am – 9am) and 11 percent in the PM peak period (4pm-7pm)

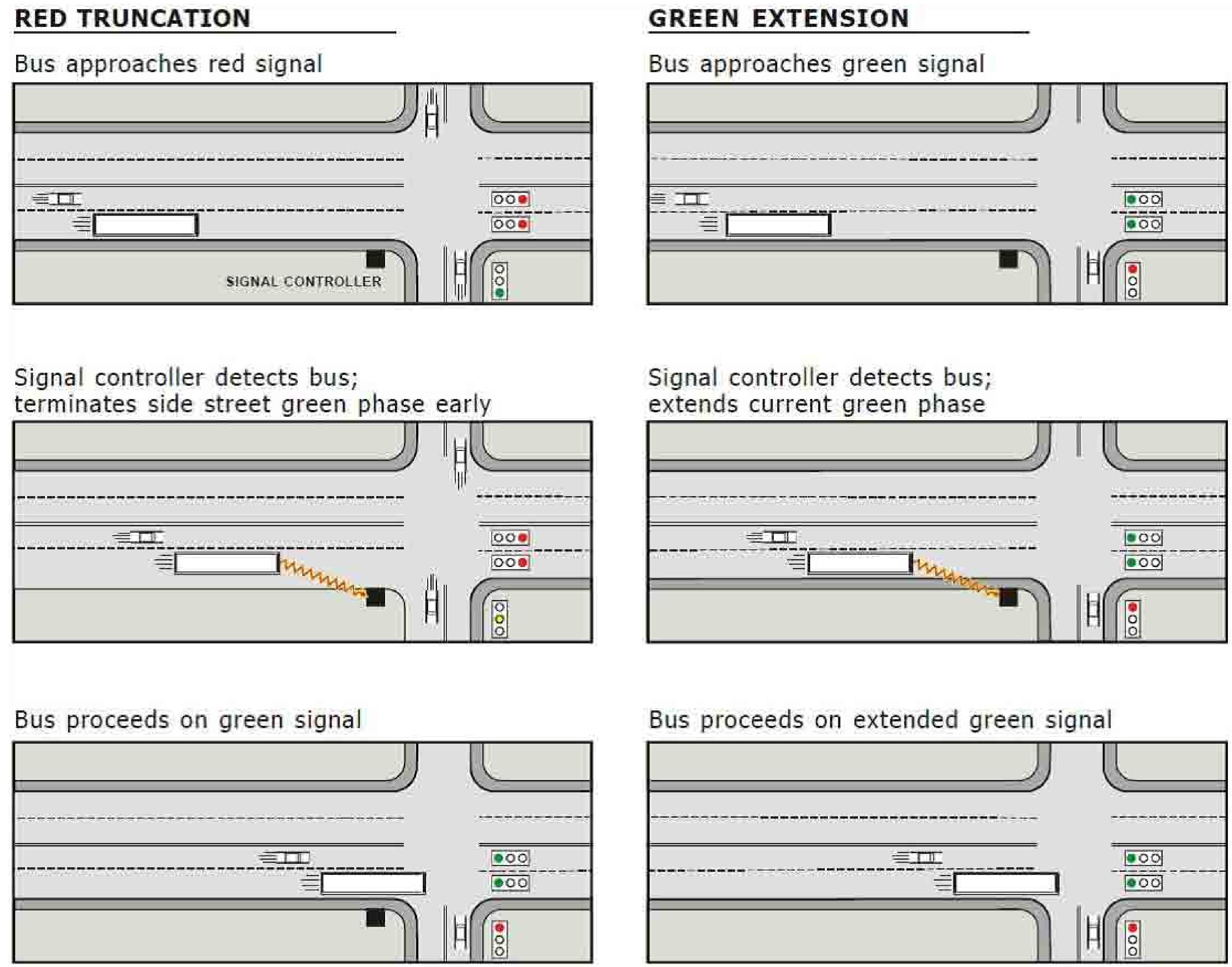

Figure 3-2 | Traffic Signal Priority (Source: Transit Capacity and Quality of Service Manual--2nd Edition p. 4-27)

Study Team Recommendation

Coordination within NYCDOT divisions and NYCT is necessary in order to implement such a system. In addition, detailed traffic analysis is required to understand the full impacts and benefits of transit signal priority. It is recommended that additional time be spent to study such systems along Fulton Street, Jay Street, and Livingston Street. Fulton Street and Livingston Street both have heavy bus traffic with bus priority lanes already in place. In addition, limited observed cross-traffic would make these streets ideal for additional priority. Jay Street has the potential to become a transit priority street (see section 3.2.2), which would also benefit from transit signal priority.

3.1.3 Extend Bus-Only Lanes/Hours

Definition

Bus-only lanes are the most widely used bus priority system already in use in the Study Area. Bus-only lanes allocate buses separate travel lanes, providing more attractive and reliable service. Full time bus-only lanes are currently in operation on Fulton Street, where automobile traffic is completely prohibited (except cross traffic). Livingston Street currently has peak-hour, peak-direction bus-only lanes. Effective enforcement for bus lane restrictions is necessary for maximum bus lane efficiency. See Section 3.1.7 for a detailed discussion of enforcement options.

Relation to Study Goals and Objectives

Enhancing the existing bus-only lane network would help to maximize the effectiveness of the Study Area's surface transit network in providing accessibility and mobility.

Needs and Benefits

The TCQSM recognizes the benefits of bus-only lanes on streets with high bus volumes and moderate to high traffic congestion. Livingston Street has approximately 70 buses per hour in the midday peak period. Due to the limited bus-lane operating hours, these buses are forced to travel with mixed traffic, providing no travel time savings.

Study Team Recommendation

Livingston Street is one of the most congested corridors within the Study Area and would benefit from extending the current bus-only lane operating hours and enhancing the existing pavement markings and signage. With the implementation of the shuttle (see Section 3.2.3), the impacts on parking could be minimized by simply extending the eastbound bus-only lane operating hours. The westbound bus-only lane could be eliminated and turned into a full day parking lane. Without the implementation of the shuttle, the bus volumes still warrant full day bus-only lanes in both eastbound and westbound directions, with parking impacts throughout the day. In addition, bus priority along Jay Street has potential to solve North/South bus movement problems in coordination with the implementation of the Jay Street Transit Priority (see Section 3.2.2).

Figure 3-3 | Bus Lane Signage

3.1.4 Bus Stop Consolidation

Definition

In general, having the same bus service stops that are close together results in increased delays for riders. Bus stops should be placed at a sufficient distance between each other to develop a compromise between providing adequate service for those one the bus and the most efficient distance to the areas that bus riders are interested in accessing. By consolidating close bus stops, travel time can be reduced and bus service can be improved.

Relation to Study Goals and Objectives

Consolidating bus stops has the potential to maximize effectiveness of the Study Area's transit network in providing improved access and mobility through decreased travel times.

Needs and Benefits

A analysis, using a geographic information system, of the placement of all bus stops within the study area was used to determine if bus service would benefit from consolidating bus stops. Using data provided by NYCDOT, the distance separating each bus stop was located and mapped. Based on NYCT guidelines, bus stops were flagged if they are within 750 feet, or three average city blocks, of another bus stop. Figure 3-4 shows the details of this analysis. Bus stops within this distance that accommodate less than 100 boardings or alightings in any peak period are considered opportunities for consolidation.

Four bus stops were found to fit the criteria:

- B25 at Cadman Plaza West north of Pineapple Street
- B38 at Dekalb Avenue and Ashland Place
- B63 and B65 at Atlantic Avenue and Nevins Street; Atlantic Avenue and Hoyt Street
- B63 and B65 at Atlantic Avenue and Hoyt Street

Study Team Recommendation

Analysis along selected corridors shows that bus stop consolidation would result in a limited decrease of dwell times. Existing riders may be inconvenienced, though none would need to walk more than the standard distance established by NYCT guidelines. Therefore, bus stops at the four determined locations are recommended for elimination, with information to riders indicating the location of the next closest bus stops.

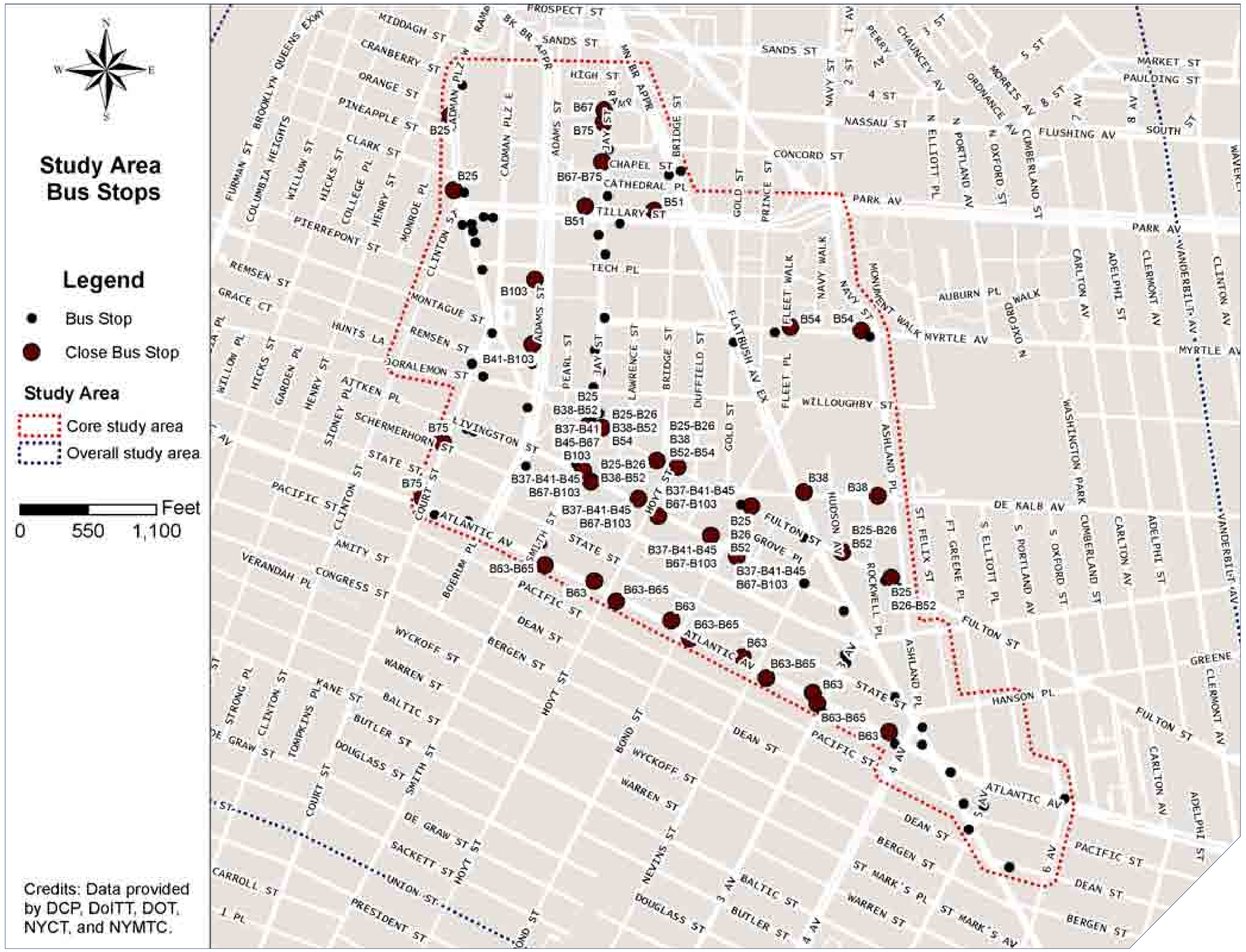

Figure 3-4 | Consolidated Bus Stop Analysis

3.1.5 Bus Stop Curb Geometry

Definition

Create additional bus bays by converting parallel bus stops into diagonal, sawtooth bus bays.

Relation to Study Goals and Objectives

Cadman Plaza West serves as a terminus for several routes, and layover space for the buses serving these routes. While the bus stops are designated as parallel spaces along the curb, the buses layover by double parking adjacent to legally parked vehicles. This double parking results in slower vehicle speeds and difficulty for pedestrians crossing the street.

Reconstructing the curb space into sawtooth bus parking could create additional space for layovers, potentially eliminating the double parking and creating a safer street environment.

Service Characteristics

Cadman Plaza West currently accommodates seven bus routes that terminate at two curbside bus stops just south of Montague Street. The routes start again at four curbside bus stops between Montague and Tillary Streets. In between, the 400 feet of curbside is used for parking for NYS Department of Justice (NYSJ)-permitted vehicles, while buses layover in the northbound right travel lane (with space for approximately 7 buses at a time). Through traffic travels in the left lane.

With 57 buses terminating at Cadman Plaza West in the peak hour, the two existing signed bus stops (approximately 100 feet) south of Montague Street each average a bus nearly every two minutes. The space is highly utilized, providing little excess space when multiple buses arrive at the same time.

Figure 3-5 | Saw Tooth Bus Stop - IKEA Plaza, Brooklyn

Needs and Benefits

For parallel parking along a flat curb, on a low speed street like Cadman Plaza West, a 40 foot bus requires nearly 50 feet of space. As currently utilized, the existing 100 feet of curb space accommodates two parallel bus stops.

A sawtooth bus bay requires approximately 35 feet of space plus an additional 10 feet of "flair space" to allow the buses to pull out without backing up. Therefore, the total curb space saved by converting the parallel bays to sawtooth bays is less than 10 feet. With 100 feet of curb space available along this segment of Cadman Plaza West, reconstructing would add less than one additional bay, providing minimal space for laying over.

An alternative option to providing additional layover space would be to re-dedicate some or all of the 400 feet of curb space north of Montague Street (currently being used for NYSJ placard parking). Converting the entire 400 feet from the existing bus stops to Tillary Street to sawtooth bus bays would create eight to nine bays. Reconstructing 315 feet of this space to sawtooth bus bays would provide sufficient space to accommodate the existing seven buses and still allow 4 parallel spaces for parked cars.

Study Team Recommendation

It is recommended that the first 315 feet of curb space on the east side Cadman Plaza West north of Montague Street be reconstructed to sawtooth bus bays to eliminate double parking during layovers. This will improve vehicle operations along Cadman Plaza West and improve the pedestrian environment.

Figure 3-6 | Off Board Fare Collection (Curitiba)

3.1.6 Fare Collection System

Field visits and focus group sessions raised concerns about existing fare collection methods within the DBSTCS Study Area. Transaction time to authenticate MetroCards aboard buses causes higher dwell times at high traffic bus stops. Fare collection policies and potential changes to fare collection methods are the responsibility of the MTA and outside of NYCDOT's jurisdiction. However, this study did identify and evaluate whether fare collection alternatives are worth considering within Downtown Brooklyn by the MTA as part of overall strategies to improve Downtown Brooklyn's surface transit operations. Fare collection alternatives that could address service reliability include the following:

- Smartcard
- Off-Board Fare Collection
- Fare free service
- Variable time pricing

These alternative options are discussed in greater detail below.

Smartcard

Definition

Smartcards are fare tickets with a semiconductor chip which needs only to be held within proximity of the farebox. Smartcard often saves time over magnetic strip cards (such as MetroCards) as the magnetic strip cards have to be dipped into the farebox requiring more time to process the transaction.

Relation to Study Goals and Objectives

Smartcards reinforce DBSTCS Study Goal #1 (maximize effectiveness of the surface transit network) and Goal #2 to provide improved "transit connectivity throughout the overall Study Area" by improving the ability to transfer.

Needs and Benefits

Travel experience and bus trip times stand to be improved with the implementation of the Smartcard system. With over 4,000 bus boardings in the Study Area during the PM Peak Hour, the potential cumulative savings in dwell time across all buses is about 50 minutes when compared to the current MetroCard system[1].

Study Team Recommendation

A change in the bus fare collection system would have to be system wide. The study team recognizes that a Smartcard is currently being investigated. It is recommended by this study team that the MTA continue to evaluate the feasibility of system-wide implementation.

Off-Board Fare Collection

Off-board fare collection methods have been employed on a number of fixed-guideway Light Rail Transit systems across the country, as well as for some Bus Rapid Transit systems. Their primary advantage is that they minimize boarding times (reduce dwell times) for heavily used routes.

There are currently no examples of off-board fare collection for conventional bus routes in North America, but several examples where the service is considered Bus Rapid Transit or Limited Stop service. MTA NYCT currently employs off-board fare collection along the Bx12 Select Bus Service (SBS) route from Bay Plaza Shopping Center, Bronx and Inwood, Manhattan, as well as along First and Second Avenues in Manhattan. Other SBS routes for NYCT are planned for the future.

Definition

Off-board fare collection requires passengers to pay prior to boarding; no fares are collected on the bus. Receipts are kept as proof-of-payment, and fare inspectors randomly check passenger receipts on-board.

Relation to Study Goals and Objectives

The off-board fare collection alternative responds primarily to DBSTCS Goal #1, to "maximize the effectiveness of the study's area's surface transit access to provide improved access and mobility."

Needs and Benefits

The primary benefit of off-board fare collection is the reduced boarding times that would result from passengers being able to board through both front and rear doors of buses without having to pay fares on the bus. This method is also sometimes referred to as "Self-Service, Barrier-Free Fare Collection." MTA NYCT states that this method, when combined with dedicated bus lanes and traffic signal priority, can result in faster service, and has shown a 20 percent increase in service levels for the Bx12 route during rush hour.

[1]Assuming passenger service times according to the Transit Capacity and Quality of Service Manual Exhibit 4-2 (4.2 seconds for MetroCard transactions and 3.5 seconds for Smart card transactions, assuming standees present, low-floor bus, and all transactions are card based)

Study Team Recommendation

Off-Board Fare Collection methods are effective for longer bus routes that operate with exclusive lanes in combination with traffic signal priority measures as part of an overall Bus Rapid Transit service. Within Downtown Brooklyn, given the short distances between stops, the lack of exclusive bus lanes over long distances, and the difficulty of establishing separate boarding areas for this type of service, off-board fare collection is not likely to be effective at improving travel times and could increase rider confusion at boarding areas in proximity to conventional bus service. If exclusive bus lanes were established throughout the Downtown Brooklyn, or SBS service extended into Downtown Brooklyn along prescribed routes with separate boarding areas, then this method could potentially improve travel times and result in overall bus service improvements. However, this method is not likely to improve service or reduce travel times for shorter trips within Downtown Brooklyn.

Fare Free Service

Definition

Fare free transit services implemented in downtown business districts have been shown to be an effective method of encouraging bus transit usage, particularly during the lunch hour time period. More than 20 bus systems across the U.S. employ fare free zones for bus service within the central business district.

Relation to Study Goals and Objectives

Fare free services have been demonstrated elsewhere to achieve elements of all three of the DBSTCS goals, particularly for downtown business districts: improved surface transit mobility and access, improved transit connectivity, and support of economic health of the Study Area.

Needs and Benefits

Central Business Districts using fare free services exhibited the highest fare elasticities, particularly when frequent fare free service is offered and trips are close to or under one mile in length. In other words, people who currently do not make the trip, or who currently walk, are attracted to fare free service in CBDs similar to Downtown Brooklyn. The difficulty of getting around Downtown Brooklyn, making trips of short duration within or across Downtown Brooklyn's Core Area, is one of the main challenges the DBSTCS has attempted to address. Adoption of a fare free service, in combination with a frequent, reliable downtown bus service aimed at improving downtown circulation in general, could be an effective surface transit service.

The adoption of fare free services is not without its cost. Lost farebox revenue, especially in a time of decreasing funding sources and nearly annual fare increases, has both policy and public relation implications. Adoption of a fare free services needs to be undertaken with full consideration of the entire MTA bus system for policy consistency, and the particular circumstance under which it would be implemented. Such programs have been shown to be most effective when the transportation need is most easily identifiable, the specific service area is well targeted, and travel distances are long enough to attract people who might otherwise not make that trip at all due to the distance and fare.

Study Team Recommendation

Implementation of a fare free service could have a positive impact for economic development in Downtown Brooklyn, if it is part of specific application for a targeted service within the Downtown Brooklyn Core Area. The Study Team recommends this alternative for consideration if implemented in combination with other alternatives, such as traffic signal priority and bus-only lanes, and potentially implementation of a downtown shuttle or circulator service.

Variable Time Pricing

Definition

In October 2009, MTA chairman Jay Walder proposed the possibility of transit time-of-day pricing to have lower fares during off-peak hours, similar to systems in place in Europe.

Relation to Study Goals and Objectives

Implementing variable time pricing would help to maximize the transit network's efficiency by shifting demand from peak times to times with available transit capacity in order to provide access and mobility around the Study Area all day.

Needs and Benefits

While data for this study was analyzed for the peak periods, it is well known that during off-peak times, transit utilization is considerably less; moving more people by transit by providing financial incentives could potentially reduce congestion at the highest volume times, and increase mobility in the Downtown Core Study Area. In addition, it would help to promote economic development by encouraging non-time sensitive trips all throughout the day.

Study Team Recommendation

A change in the fare schedule and structure would have to be system wide. The study team recognizes that time of day pricing is currently being investigated. It is recommended by this study team that the MTA continue to evaluate the feasibility of a system-wide implementation.

[2] TCRP Report 95: Chapter 12 – Transit Pricing and Fares: Traveler Response to Transportation, 2004.
[3] Ibid.
[4] TCRP Report 95: Chapter 10 – Bus Routing and Coverage: Traveler Response to Transportation, 2004
[5] Ibid.
[6] Ibid.

3.1.7 Parking Enforcement

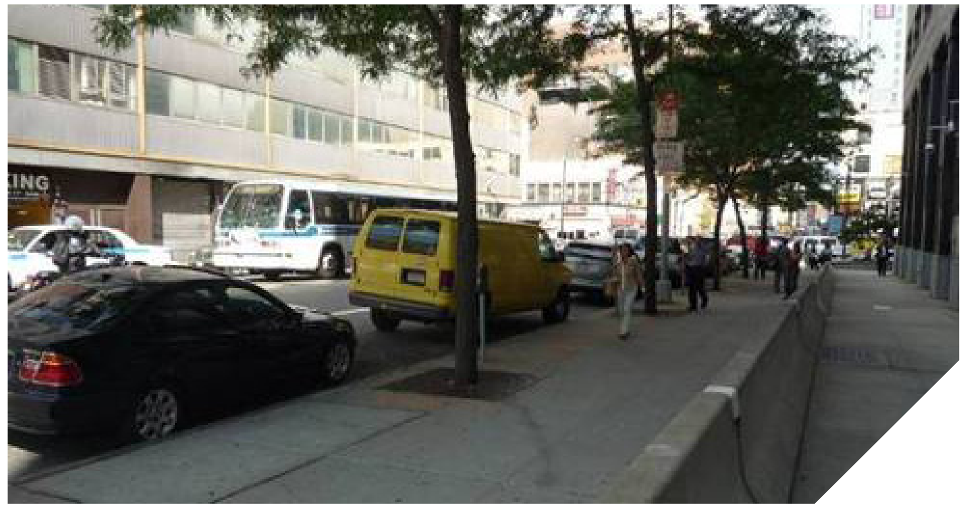

Figure 3-7 | Vehicle Parking in Bus Only Lane, Livingston Street between Boerum Place and Jay Street, 4:00 PM Weekday

Definition

Bus-only lanes are the most widely used bus priority system currently in use in the Study Area. Bus-only lanes allocate buses separate travel lanes, providing more attractive and reliable service. Livingston Street currently has peak-hour, peak-direction bus-only lanes. These lanes are used for parking during all other times. Parking, driving, and standing in bus-only lanes during bus-only times remains a serious problem and limits the effectiveness of these lanes. Parking (or more specifically, curb regulation) enforcement would reduce the ability of drivers to improperly block the bus-only lanes.

Relation to Study Goals and Objectives

Vehicles parked in bus-only lanes reduce the effectiveness of the priority intended for the surface transit system. Eliminating this delay would directly support one of the project's objectives, "Reduce travel times and improve schedule reliability for customers using buses."

Needs and Benefits

Ideally, drivers would obey bus-only designations and not park during regulated times due to the legal mandate. In reality, standing and parking in bus-only lanes is an on-going detriment to the effectiveness of the Study Area's transit system. Livingston Street between Boerum Place and Jay Street has been identified as a street segment where vehicles are frequently seen idling or parked, especially in the PM peak period, delaying buses entering this key east/west corridor.

Study Team Recommendation

While enforcement agents are dispatched during Bus Only periods to further support the operation of the bus-only lanes, it is fiscally impossible to post an enforcement agent on every block for every applicable period. Instead of personnel-based enforcement, physical improvements to the street are recommended. As recommended in the Fulton Street Transit Mall Reconstruction Alternative Analysis, the Study Team recommends restriping Livingston Street within its existing 50' cross section from four lanes to five lanes as follows (Figure 3-8):

- Eastbound Curb Lane – Parking and Bus stops
- Eastbound "Interior" Bus-Only Lane
- Eastbound Travel Lane
- Westbound Travel Lane
- Westbound Curb Lane – Parking and Bus stops

This redesign will allow for eastbound bus travel in a "moving" lane, providing separate space for vehicle to park. The result will be improved bus travel times along Livingston Street, not just during the PM peak period, but all day.

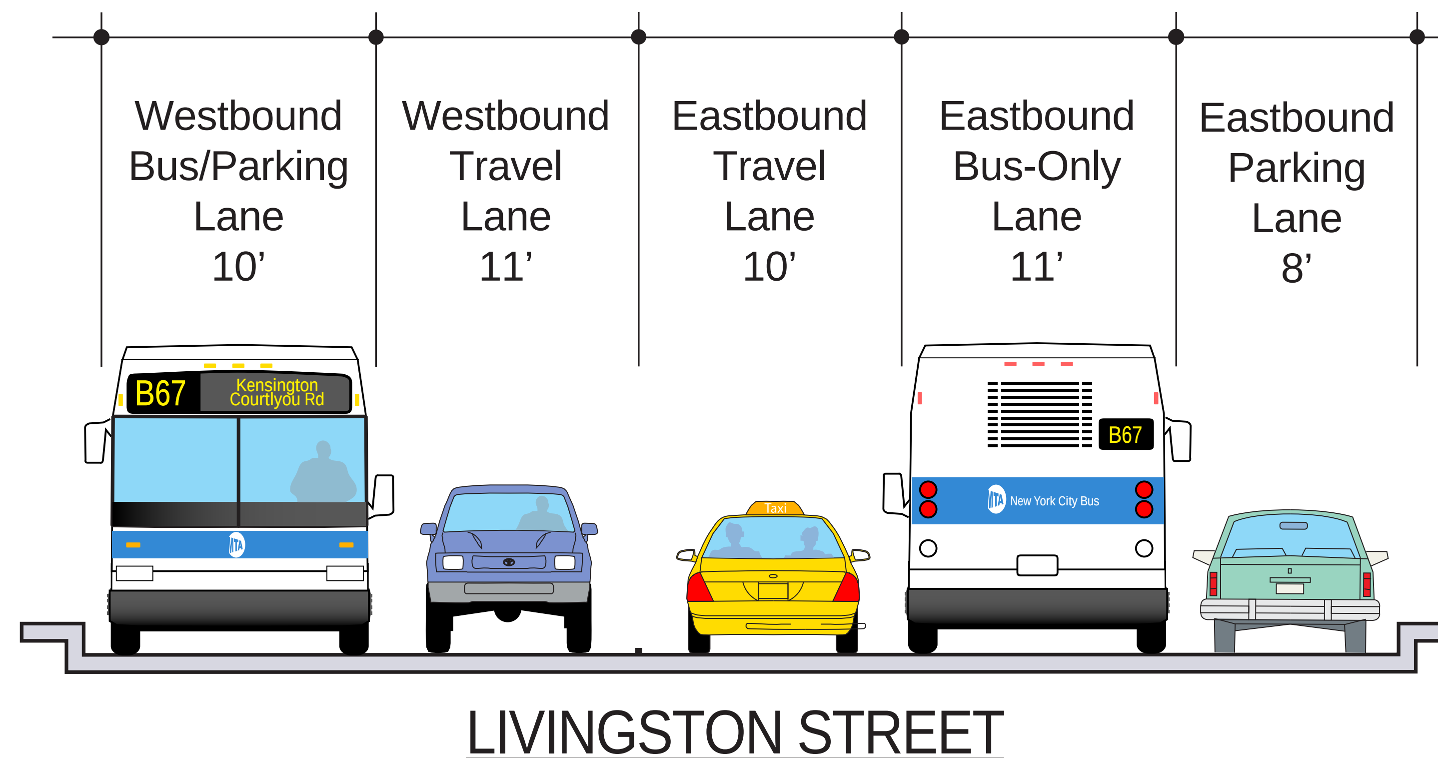

Figure 3-8 | Proposed Livingston Street Redesign Cross-Section

3.1.8 Splitting Service

Definition

Several routes traverse the Study Area and travel long distances outside the Study Area. There is greater potential for reliability issues and variances from scheduled times over longer distances. One potential solution for this problem is to restructure routes to shorten them and reduce time spent in congested intersections and corridors.

Relation to Study Goals and Objectives

Splicing service has the potential to maximize effectiveness of the Study Area's surface transit network to provide improved access and mobility by increasing the quality of transit service options.

Needs and Benefits

The majority of buses terminate in Downtown Brooklyn. Of those that do not (the B25 and B51), splitting the service has little added benefit. This is because the resulting segments would be either too short or would not serve any significant population.

Study Team Recommendation

The study team does not recommend the splitting of any additional routes beyond the B61, which was already restructured in January 2010.

3.2 ALTERNATIVES TO IMPROVE SERVICE COVERAGE

Service coverage improvements were considered in two ways for this study. First, in the Downtown Brooklyn Core Study Area, where abundant bus service already exists, improvements that would reduce or potentially eliminate impediments to existing access (and the resulting negative impacts to ridership) were considered. This included re-routing of buses to reduce overlapping service, improve travel times, and improve operating efficiency.

Second, focus groups, field surveys, and GIS analysis helped to identify several areas within the Study Area that have limited transit access and connectivity. Areas identified as being underserved by surface transit include DUMBO (including the ferry landing), the waterfront, and parallel to the new Brooklyn Bridge Park. Improvements that would extend service to these areas were considered.

The alternative options identified improving both existing surface transit access as well as increasing access to areas with limited or no surface transit service include: the extensions of routes, development of a new circulator route, and development of a downtown shuttle system.

3.2.1 Extension of Routes

Definition

Extending existing bus routes has the potential to provide access to otherwise underserved areas without significantly increasing operations or capital cost.

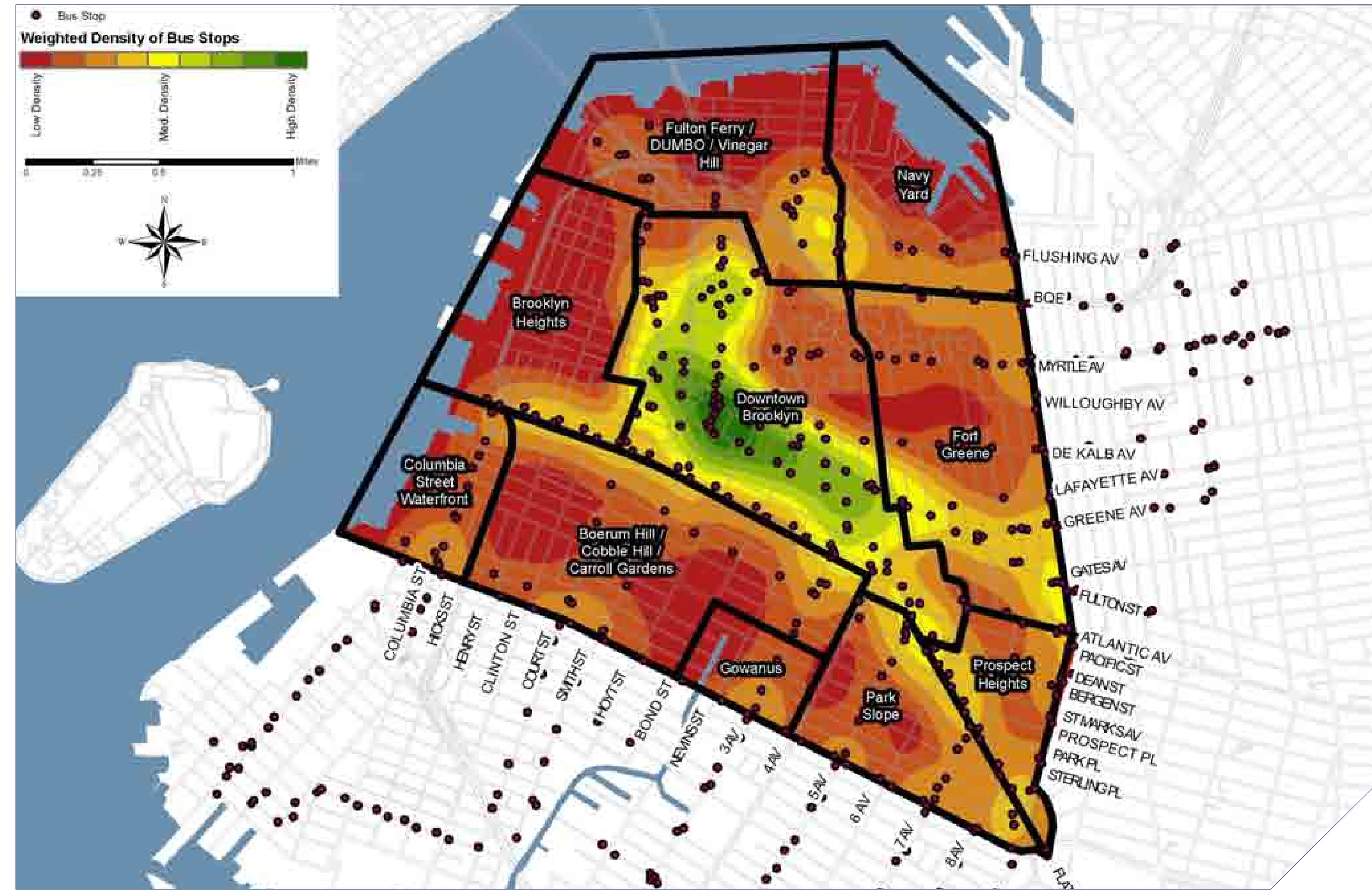

Figure 3-9 | Weighted Density of Bus Stops

Relation to Study Goals and Objectives

While bus accessibility is generally available throughout the Study Area, new developments projected to open in the near future which will also need transit service.

Maximize effectiveness of the Study Area's surface transit network to move people and improve connections between buses and intermodal connections between buses and other modes.

Needs and Benefits

The first sections of Brooklyn Bridge Park, Piers 1 and 6, opened in Spring 2010. As the number of visitors increases and progress on the next phases of the project continues, the park has become a key destination deserving of transit accessibility. According to the Brooklyn Bridge Park Project FEIS (2005), the park is projected to generate 719 bus riders in the weekday midday, 658 bus riders in the weekday PM peak, and 906 bus riders in the Sunday PM peak; these trips would be served by the B25, B61, and B63, though these routes do not directly access the park.

New residential developments are also planned along Flatbush Avenue north of Willoughby Street. As presented in Figure 3-9, this area is already served by bus service (specifically the B54); it is also a short walk from buses on Tillary Street and the DeKalb Avenue subway station. No additional service is recommended for this new development.

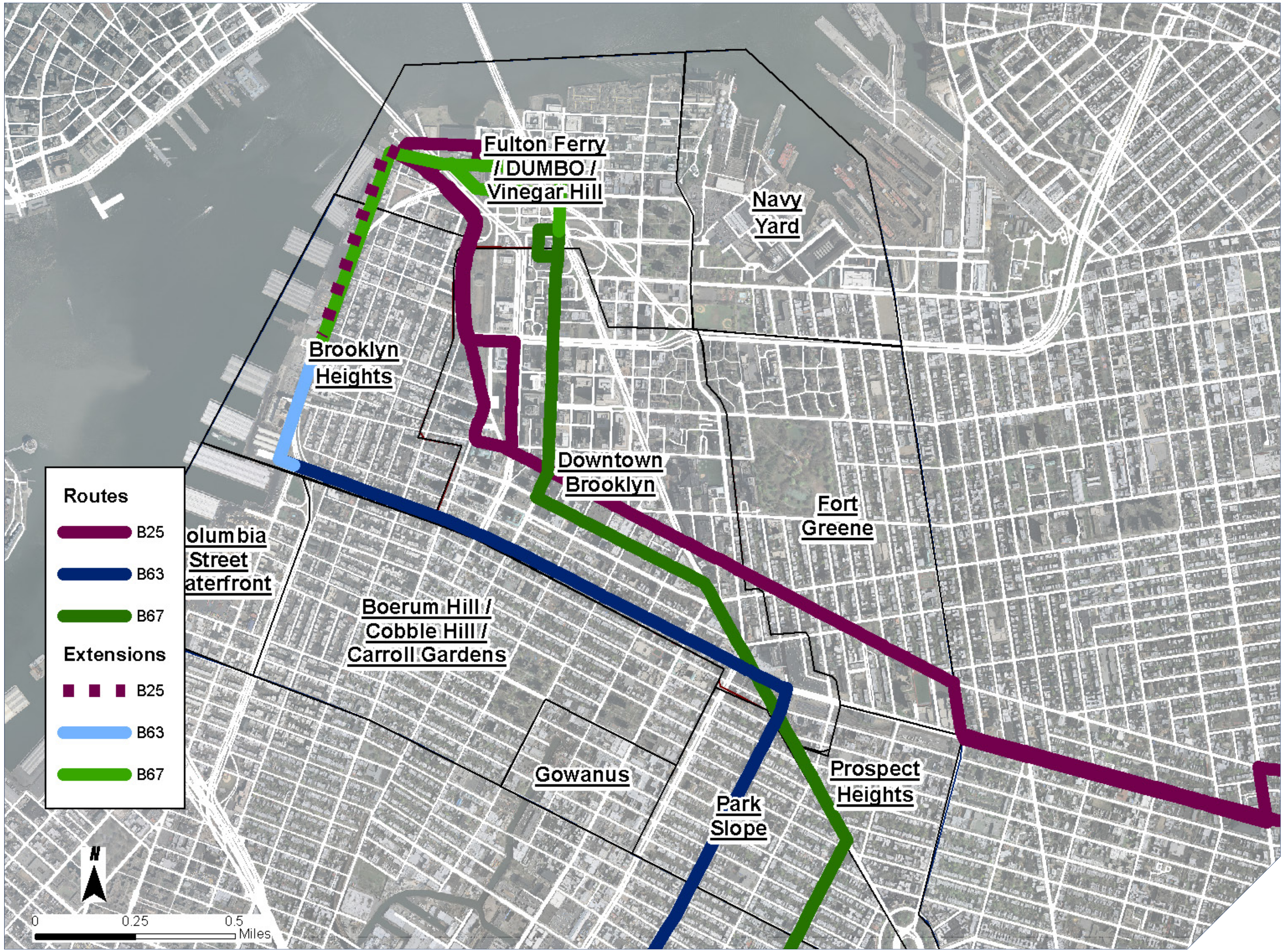

Figure 3-10 | Potential Bus Route Extensions

Study Team Recommendation

While origin data for anticipated park users is not available, the park will be a valuable resource, especially attractive to residents who live in areas without significant green space. Red Hook, Cobble Hill, and Boerum Hill are anticipated to be primary neighborhood trip generators. Connectivity between the park and the Borough Hall and High Street subway stations is also recommended. The following existing NYCT bus routes are recommended to be extended to connect the park with these trip generators (see Figure 3-10):

- Extension of the B25, B63 or B67 to Brooklyn Bridge Park via DUMBO. The route would return eastbound on Fulton Street. This would add approximately one mile to the route. At an average of 4 miles per hour, this extension would add approximately 15 minutes in each direction.
- Extension of the B63 which currently terminates at Sackett Street and Van Brunt Street north into Brooklyn Bridge Park via Furman Street. This route extension was also recommended in the Brooklyn Bridge Park Transportation and Access Study. As this extension would be solely to serve the park (as opposed to the B67 which would also serve DUMBO), this alternative may be more appropriate for seasonal or weekend service. Extending the B63 would add approximately 0.25 mile to the route. At an average of 4 miles per hour, this extension would add approximately 4 minutes in each direction.

Note: As the map indicates, all possible extensions will terminate at the MTA Fan Plant, as this was determined to be the easiest layover/turnaround point.

Note: Extension of these routes to Brooklyn Bridge Park are predicated upon conversion of Furman Street from existing one-way operations to a two-way street.

Note: Determination for all routing recommendations and location of bus stops is the sole purview of MTA New York City Transit.

3.2.2 Implementation of a Downtown Circulator System

Definition

A bus circulating through downtown would provide both tourists and employees surface transit access to areas within the downtown that are currently not directly covered by existing local bus service. Unlike the downtown shuttle alternative presented in this section, this likely privately-operated service would not necessarily require changing any existing NYCT bus routes, but would offer additional short trips with frequent headways.

Relation to Study Goals and Objectives

Providing a downtown circulator service has the potential to maximize effectiveness of the Study Area's surface transit network to provide improved access and mobility by increasing the quality of transit service options. The DBSTCS focus group and stakeholder interviews indicated a desire for a circulator to provide improved mobility with Downtown Brooklyn's core area.

Needs and Benefits

While the majority of NYCT Brooklyn bus routes terminate in Downtown Brooklyn, they serve primarily the Fulton Street, Livingston Street, Jay Street, and Cadman Plaza corridors. Several routes also provide service along Atlantic Avenue. Visitors and downtown workers looking to get around Downtown Brooklyn frequently decide to walk, due to lengthy waiting times and lack of short trip bus service that connects many downtown destinations without transfers. A circulator system could provide direct connections to many of these downtown destinations, while offering visitors a means of getting to tourist destinations, such as the Brooklyn Bridge, Atlantic Avenue or the anticipated new sports arena at Atlantic Yards.

Numerous downtown urban circulators are in service across the country. A study conducted for the Washington, D.C. Department of Transportation (D-DOT) in 2003 reviewed urban circulator systems in nearly a dozen cities across the United States. These cities included Los Angeles, CA, Miami and Orlando, FL, and Dallas and Austin, TX. The study resulted in implementation of a circulator in the U.S. capital, called the D.C. Circulator. Other cities continue to explore the feasibility of urban circulators, and a new one is planned to start this year in downtown Baltimore.

Typically, downtown circulators operate between the hours of 6AM and 10PM, with 10-15 minute headways and with either fare free zones or at reduced fares of $1 and under. The route length is generally between 1.5 and 3 miles. The D.C. study revealed costs to run the circulators, which nearly always featured low-floor transit vehicles, were between $38 and $72 per revenue vehicle hour (2003 dollars). The primary capital cost to establish a circulator system is associated with vehicles, which range in cost per vehicle from $250,000 to $600,000 or more, depending on size and type.

When considering a circulator system for Downtown Brooklyn, there are several factors that could significantly constrain the system's effectiveness. The first issue is the existing congestion and poor level of service at major intersections, as revealed in the DBSTCS Existing Conditions Report. The second factor would be the frequency of the service. If a circulator does not operate with frequent headway (3-4 minutes) then it is unlikely to attract many downtown workers, who would most likely use the service during lunch hours, breaks and after work. A third factor is the already abundant number of NYCT buses operating within Downtown Brooklyn. Addition of a circulator would only add to an already congested bus system, though this could be lessened if the circulator uses bus priority lanes along segments of the routes.

Study Team Recommendation

Further evaluation is required to determine how effective a downtown circulator could be, especially if additional on-street priority is provided.

3.2.3 Implementation of a Downtown Shuttle System

The primary purpose of the DBSTCS has been to evaluate how well the existing bus network provides for local circulation within the Downtown Core area, and to determine what transit enhancements can be implemented in response to existing and future mobility challenges. A key premise of the study is that while getting into and out of Downtown Brooklyn using transit is easily accomplished, getting around the Downtown Core area is often easier to accomplish by foot. Existing congestion has affected bus trip times, reliability, and overall attractiveness.

Several previous studies of the Downtown Brooklyn surface transportation network presented a shuttle, circulator service, or fixed route (light rail transit) alternative for the core area, dating back as far as 1985 with the Transit Antic Study prepared for the Brooklyn Economic Development Corporation. In the mid-1990s NYC Department of City Planning conducted a Downtown Brooklyn Transit Loop Study, which identified potential for nearly 100,000 daily riders of a loop or circulator service within the Downtown Core.

Definition of Alternative

Twenty different bus routes traverse Downtown Brooklyn, many with high frequency. These routes start in a variety of different neighborhoods throughout Brooklyn and Queens, and overlap in key segments within Downtown Brooklyn, including Livingston Street, Fulton Street, Flatbush Avenue, Adams Street, Jay Street, and Cadman Plaza. Reducing the overlapping services has the potential to improve surface transit in Downtown Brooklyn. This reduction of service does not have to mean a decrease in mobility or access to the study area or loss of access from outlying areas of Brooklyn. By implementing a shuttle service, routes could be terminated before entering the congested downtown area, and one streamlined shuttle service could provide downtown access at high frequency and reliability.

Relationship to Study Goals and Objectives

Overlapping routes reduce the effectiveness of the surface transit network to provide access and mobility around the Study Area. Overlapping routes increase bus congestion and rider uncertainty. Providing one shuttle service to operate in Downtown Brooklyn would reduce the total number of buses that have to enter the Core of Downtown Brooklyn. Reducing overlapping buses within Downtown Brooklyn would also improve schedule reliability for passengers traveling outside of the Study Area, as buses no longer need to traverse the heavily congested Downtown Core where they are frequently subject to delays. Shuttle routes would be optimized to maintaining existing connections to the other transit modes in the area, including subway and commuter rail.

In addition to maintaining transit connections, shuttle services can be extended at key times to maximize transit connectivity to all significant trip generators throughout the Downtown Core. This in turn can support the economic health of the study area. When combined with other alternatives, including an effective bus priority system and a faster fare collection system, a shuttle service has the potential to significantly reduce travel times for passengers in Downtown Brooklyn by addressing bus congestion issues and bus dwell times.

Needs and Benefits

For a downtown shuttle to be effective and maintain short headways consistently in the peak period, consideration needs to be given to a fare free shuttle operation within the service area. As mentioned earlier, fare free shuttles have been proven to promote quick and efficient boarding with the potential for significant reductions in dwell times. Transit studies and transit agency experience have shown that boarding times can decrease between 15% to 30%, with more dramatic results occurring typically on routes with high congestion and ridership. The fare free structure would only be implemented within the specific core area, such as the Downtown Brooklyn Core area, and only for the shuttle buses. Transfers onto the shuttle would occur at a Transit Center.

Denver RTD operates one of the most well known fare free shuttle services in the city's downtown core area, known as 16th Street Transit Mall. This fare free shuttle has daily ridership of approximately 46,000 passengers. Follow-up interviews with Denver RTD managers responsible for implementing and operating the 16th Street Transit Mall revealed that this system was created to improve service efficiency, reduce congestion and emissions, and promote economic health within the downtown. The Federal Transit Administration was a major supporter of the service from its outset.

The RTD MallRide Shuttle today is approximately 1.25 miles long connecting the state capital with Denver's Union Station. Three major Transit Centers are now located along the transit mall alignment, providing transfer points from approximately 20 different bus routes (routes with operating lengths similar to many of Brooklyn existing routes) as well as to new LRT and commuter rail services. Local downtown bus service continues to operate in one way pairs parallel to the Mall on 15th and 17th Streets (Figure 3-12). Several light rail lines also intersect the Mall. Initially, RTD operated 60-foot articulated buses along the transit mall; eventually, these buses were replaced with newer 45-foot High Capacity buses. This low-floor vehicle provides faster boarding and alighting as it features three wide doors and has capacity for up to 116 passengers.

The effectiveness of the Downtown Brooklyn shuttle can be significantly augmented with selection of a low-floor, high capacity bus similar to Denver's MallRide vehicles, particularly since multiple, wide doors on each vehicle greatly facilitate boarding and alighting. Shuttle vehicles with doors on both sides would speed up passenger boarding and alighting. A more detailed vehicle selection study would be required prior to implementation.

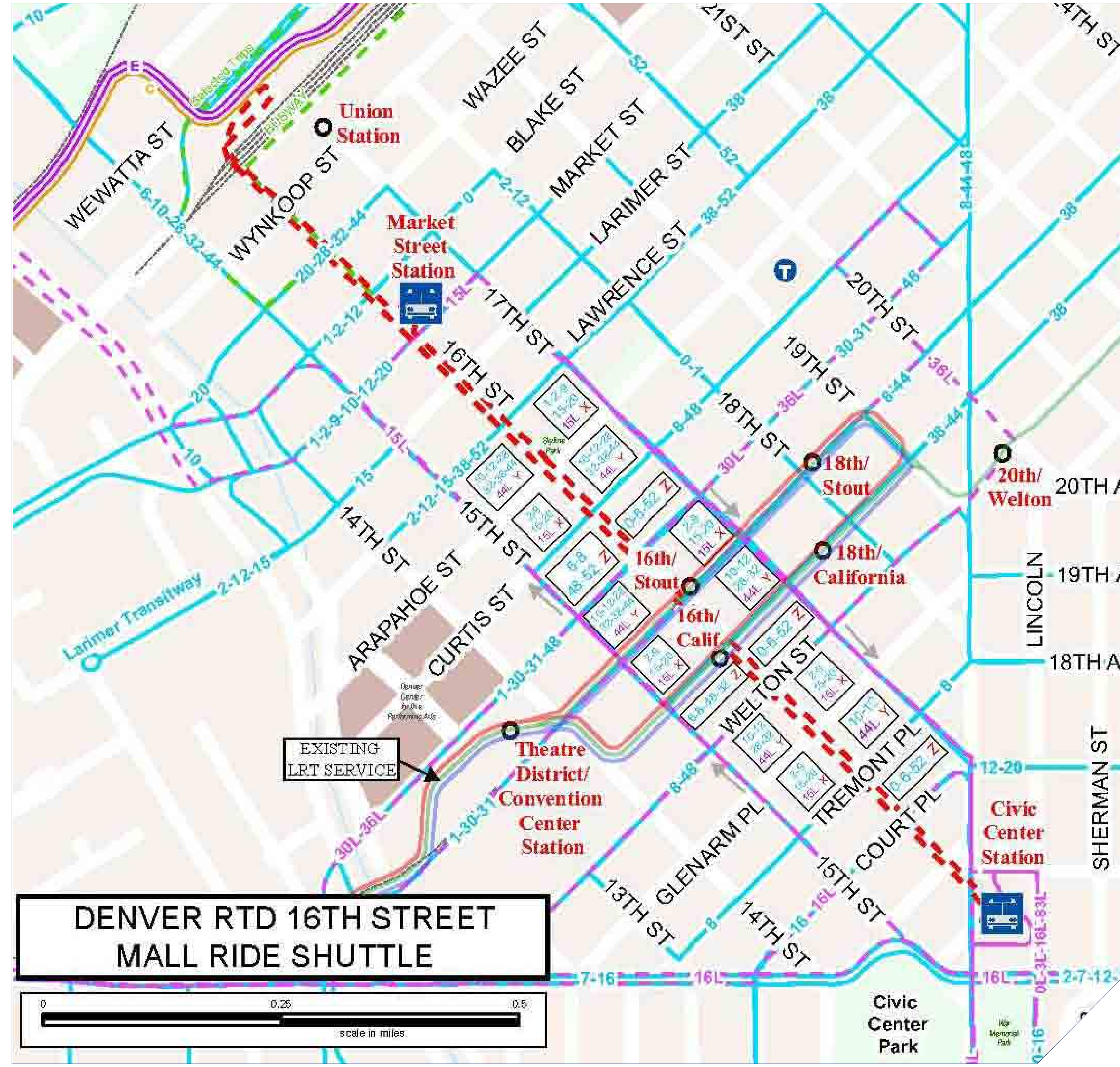

Figure 3-11 | RTD Map

Study Team Recommendation

Further evaluation is required to determine the effectiveness of a Downtown Brooklyn shuttle system.

3.3 ALTERNATIVE TO IMPROVE PASSENGER EXPERIENCE

Bus transportation is becoming an increasingly important mode of transportation for the aging population. During focus group sessions, the study team heard that transit riders prefer the bus over subway, walking, or biking, as it is often easier to access and all bus stops and buses are ADA compliant. However, surveys of bus users and non-users indicated that passenger experience needs to be improved. Buses are currently perceived by riders as overcrowded, unreliable, and confusing. Additionally, waiting conditions at bus stops were reported too often to be uncomfortable. Bus stops were also reported as being difficult or sometimes unsafe to access because of roadway geometries, high vehicular traffic, or other problematic intersections in Downtown Brooklyn. Pedestrian prioritization efforts, such as lead pedestrian intervals, long pedestrian phases, shorter pedestrian crossings, and pavement paintings are described in detail in this section. In addition, the bus stop environment and improvements to travel information including bus stop signage, improved schedule postings, bus arrival information, new mobility hubs, and improvements to physical environment, including shelters conditions, shelter placement, and seating.

3.3.1 Pedestrian Prioritization

Pedestrian prioritization is a set of physical and operational tools that are used to promote a safe pedestrian environment. In context of the study, there are several instances where access to transit services is limited by unsafe or unfriendly pedestrian environments. To overcome some of these issues, lead pedestrian intervals, longer pedestrian phases, shorter pedestrian crossing (using medians or closing travel lanes), and updating pavement markings can all be used.

- Lead Pedestrian Intervals – Allow pedestrians to begin to cross before vehicular traffic on the parallel street receives a green light;
- Longer Pedestrian Phases – Increase the amount of time pedestrians have to cross the street;
- Shorter Pedestrian Crossings – Adjust roadway geometries to reduce the cross distance, which can be done using:
  - Medians and pedestrian refuges;
  - Closing travel lanes – Reallocate vehicle space to pedestrian space;
- Pavement Markings – Ensure that all pavement markings are distinct and meet the latest standards.

Relation to Study Goals and Objectives

Providing better access to transit services helps to both maximize the effectiveness of the Study Area's surface transit network to provide improved access and mobility and provides transit connectivity throughout the study area.

Needs and Benefits

Pedestrian prioritization works to improve safety and work towards a complete streets design concept. Providing pedestrian prioritization in areas like Downtown Brooklyn, which are already heavily used by pedestrians and have strong pedestrian environments can provide additional benefits to pedestrian safety.

Study Team Recommendation

Several intersections and crossings in the Study Area have been identified through field work and public outreach as dangerous or difficult to navigate. The top two intersections include Atlantic Avenue/Flatbush Avenue and Smith Street/Livingston Street. While detailed signal timing, traffic volume, nor roadway geometry data was collected as part of the scope of this study, it is recommended that additional pedestrian prioritization measures be looked at for these two specific locations.

3.3.2 Bus Stop Environment and Improved Travel Information

Definition

The bus stop environment as well as information provided to bus riders has the potential to provide users with a positive experience when using the transit system, resulting in increased ridership. The bus stop environment is an important part of the transit system as time spent here is often perceived longer than actual time spent. In addition, it is important to provide adequate information at the bus stop in order for users to feel comfortable using the transit system. The following areas were identified for improvement:

- Bus Stop Signage – Examine the information presented at bus stops and the location of the stop signs;
- Bus Arrival Information – Provide real-time bus arrival information;
- Shelter Placement – Examine the location of shelters, with respect to distance from curb, and provide shelters at the busiest bus stops;
- Seating at Stops – Examine high traffic bus stops and ensure ample seating capacity;
- Posted Schedules – Verify the posted schedule at stops is accurate and up to date;
- New Mobility Hubs;

Relation to Study Goals and Objectives

Providing a comfortable bus stop environment and essential information at bus stops will help to maximize the effectiveness of the Study Area's surface transit network to provide improved access and mobility as well as increasing the knowledge of existing transit connections, and potential future connections throughout the Study Area. This is an objective specified by the project, "Make bus service more comfortable and user-friendly."

Needs and Benefits

A transit system is more than vehicles in motion. Bus stops that are easy to find and use are critical to passengers getting on and off the buses. Adequate pedestrian accessibility and enhanced passenger amenities at transit stops are critical to attracting people to transit. Provision of bus stop infrastructure is frequently tied to the number of riders who board and alight at each stop. The greater the number of riders, the greater the capital investment.

- All stops should have:
  - A level concrete pad;
  - Reliable pedestrian access;
  - Adequate lighting for safe and comfortable night use; and
  - Route and schedule information.
- Stops in the upper 50% of daily boardings (including transfers) should have:
  - Bus shelter with bench;
  - System map; and
  - Trash receptacles.
- Stops in the upper 10% of daily boardings (including transfers) should also have:
  - Super stop shelter (a large or double shelter and bench); and
  - Real time travel information.

Rider amenities should be added to routes where the highest number of boardings and alightings occur as funding becomes available.

These amenities support transit service by making the bus riding experience comfortable and convenient. As described in TCRP Report 46: The Role of Transit Amenities and Vehicle Characteristics in Building Transit Ridership, provision of certain physical amenities will draw more riders. The TCRP study was built around the Transit Design Game Workbook, a survey distributed to bus passengers in five cities: Rochester, New York; Ann Arbor, Michigan; Aspen, Colorado; Portland, Oregon; and San Francisco, California. The survey allowed people a budget of 12 to 18 points to spend on amenities, and also allowed the respondents to weigh spending money on amenities versus lowering the fare. Spending 18 points on amenities roughly equated to $450,000 in annualized costs for a 300-bus system and resulted in a 1.5 to 3 percent increase in ridership.

Another important component of bus stops is safety and security measures, which increase transit effectiveness. Safety and security requires transit operators to provide a predominantly controlled environment so riders perceive that the agency is protecting them. In addition, it also requires emergency planning for when uncontrolled events occur, so that responses are planned and procedures are in place to answer unforeseen incidents. These preparations provide riders with both an actual and perceived safe environment, preventing public concerns that would limit the effectiveness of the transit system.

Providing a safe and secure environment requires a combination of design features, response plans, evaluation of public perception, and coordination between the multiple transit services and levels of government. All bus stops should be well-lit and provide clear sight lines with no "blind spots." Placement of stops in view of active uses is recommended. Wherever possible, stations and stops should be accompanied by clearly marked crosswalks and traffic control devices to provide a safe, controlled roadway crossing.

Table 3-1 | Bus Shelters at Study Area Bus Stops

Rank	Intersection	Shelter
1	FULTON ST & JAY ST	No
2	FULTON ST & FLATBUSH AV EXT	No
3	ADAMS ST & BKLYN SUPREME COURT	Partial
4	JAY ST & WILLOUGHBY ST	No
5	LIVINGSTON ST & SMITH ST	Yes
6	FULTON ST & HOYT ST	No
7	ATLANTIC AV & FLATBUSH AV	No
8	FULTON ST & BOND ST	Yes
9	LIVINGSTON ST & HOYT ST	No
10	FULTON ST & LAFAYETTE AV	No

Study Team Recommendation

During focus group sessions and the public involvement process, a recurring theme among users was the desire for the creation of a sense of place at bus stops and clearer system information. This includes reliable posted schedules and real-time bus arrival information. In addition, people commented on the location and placement of shelters and seating. People requested that additional shelters to be placed at high volume locations. After reviewing the number of bus boarding per bus stop, it has been determined that high volume locations are along Livingston Street, Fulton Street, Jay Street, and Flatbush Avenue. Table 3-1 lists intersections with the most heavily used bus stops in the PM Peak Period and whether or not they have a shelter. Of the top ten intersections, only three have shelters. These remaining intersections should be analyzed and additional shelters should be placed if space warrants. In addition, comments from the public indicated that there is often not enough seating provided at bus stops, which should also be built with the shelters in high volume corridors, which is currently the standard practice for shelters installed by NYCDOT.

New Mobility Hubs

Definition

New Mobility Hubs are focused on providing transportation information at key "connecting" points in an urban transportation network in order to help travelers seamlessly connect from one point to another, from one transportation mode to another. New Mobility Hubs emphasize a multi-modal approach to travel in high density urban environments like Downtown Brooklyn. New Mobility and Sustainable Transportation are closely linked terms, as both focus on sustainability. However, New Mobility Hubs are designed to utilize transportation modes already in place (referred to as the supply side), with the goal of encouraging use of the most sustainable modes whenever possible.

Relation to Study Goals and Objectives

New Mobility Hubs in particular support DBSTCS Goal #1 – to "Maximize effectiveness of the Study Area's Surface Transit Network", particularly by facilitating improved intermodal connections between buses and other modes. This alternative also supports Goal #2, to"Provide Transit Connectivity throughout the overall Study Area."

Needs and Benefits

The concept of New Mobility Hubs was pioneered in Bremen, Germany by Michael Glotz-Richter and further developed in the U.S. and Canada by Susan Zielinski of the University of Michigan. "New Mobility," like "New Urbanism," grew out of a movement amongst planners to develop more sustainable and livable environments. "New Mobility" is focused on the complete transportation network. In addition to Bremen, Toronto, Canada, and Cape Town, South Africa, have developed networks of New Mobility Hubs throughout their city. Ford Motor Company has supported development of New Mobility Hubs through its sustainable transportation program, and is funding several projects around the world. New Mobility Hubs bring together surface transit, subway, bikes, carsharing, pedestrian walkways and taxis into one location, or hub, which is focused on connecting sustainable modes of transportation. Electronic kiosks are often used to provide detailed transportation information, such as information on different modes and fare options required to get from point A to point B, or ability to make carshare (e.g. Zip Car) reservations, or convenient access to Bike Share locations.

The DBSTCS Existing Conditions report revealed that surface transit information, maps, schedules, and overall visibility of information was deficient in the Downtown Brooklyn. Residents specifically cited high volume locations as priorities for improving these conditions. New Mobility Hubs address this need in a comprehensive approach that combines signage and wayfinding tools, trip planning, and multi-modal travel options.

"At your fingertips" wayfinding techniques can be delivered through cell phones or PDAs as well as simple public information kiosks, designed to be reflective of the neighborhood or surrounding environment. In Downtown Brooklyn, wayfinding kiosks have been developed for the Metro-Tech center, as an example. New Mobility Hubs would include this type of information and possibly this type of design. They could be combined potentially with electronic displays and linked to location of existing multi-modal connection points.

This approach can optimize a person's travel experience while at the same time preserve the environment by emphasizing the most sustainable transportation options throughout the trip. Essentially, New Mobility Hubs can be described as follows:

"The beauty of the Hub network is that you can transfer seamlessly from one mode of transportation to the other, informed of schedules and options all the way (either by public kiosks or through your cell phone, or even through better signage in areas which are not fully technologically served). The approach favours use of the best mode for the purpose, gaining access to car share at one hub, and dropping it off at another to pick up a waiting bus or train or bike. "

For anyone traveling into Downtown Brooklyn, their journey to work, shopping, the courts, recreation or other destination typically involves a series of transportation modes, from walking or biking, or multiple transit modes (van, bus, commuter rail,

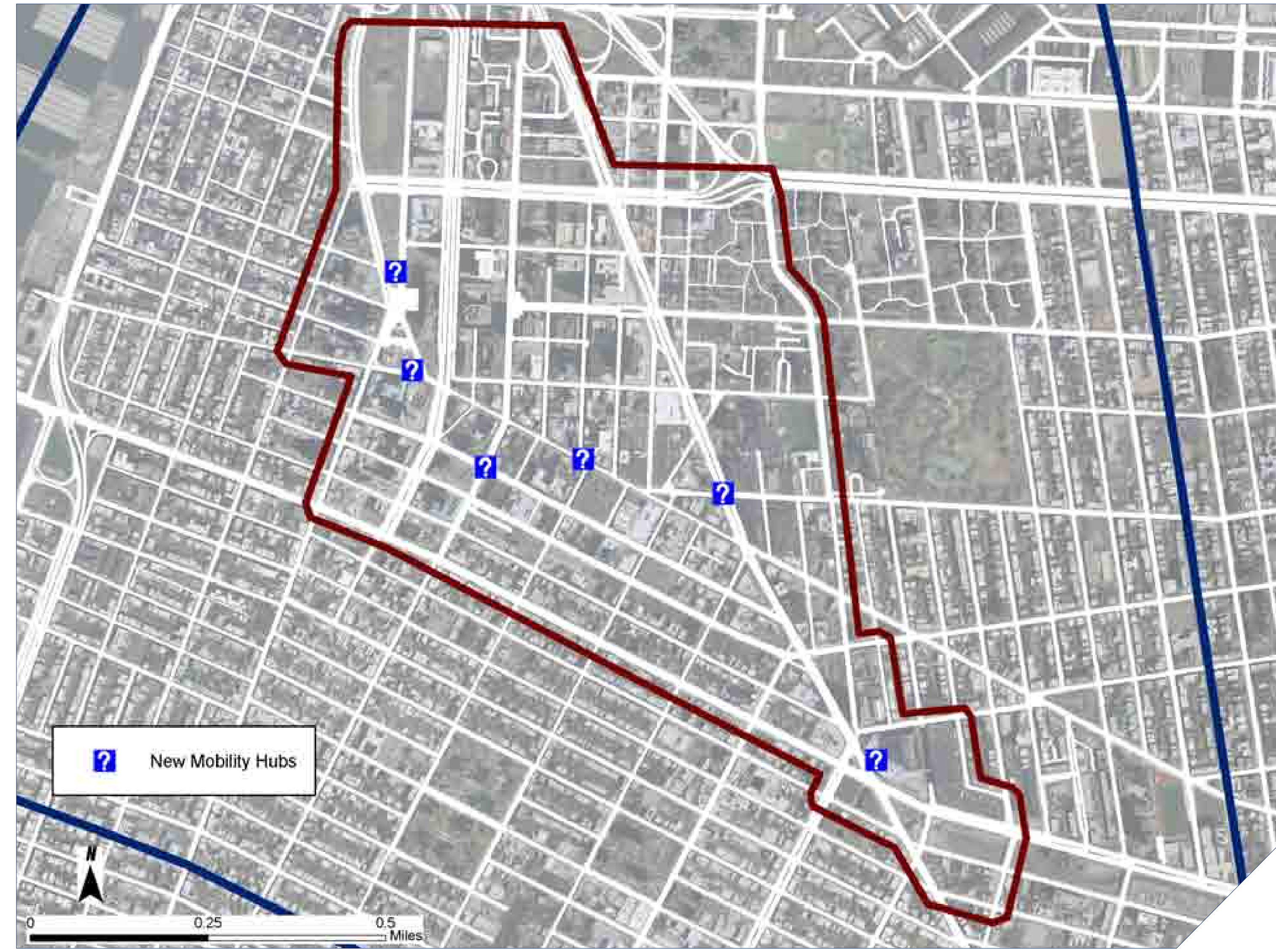

Figure 3-12 | Potential New Mobility Hubs

subway), or possibly car sharing (e.g. ZipCar), car pooling, or taxi- sharing. New Mobility Hubs would serve to integrate and link these modes wherever possible.

Potential Location and Application of New Mobility Hubs in Downtown Brooklyn

Figure 3-12 provides the proposed location of potential New Mobility Hubs in Downtown Brooklyn. Several applications of New Mobility Hubs could have beneficial impacts for Surface Transit. Two key locations stand out for potentially effective New Mobility Hubs. These are:

1. Borough Hall Area: Establish New Mobility Hub in the vicinity of Borough Hall, where the majority of NYCT routes serve and with significant passenger activity This location is particularly well suited for connecting bus to pedestrian and potentially future bike share opportunities. Information at the Hub on key destinations, such as Brooklyn Bridge Park, Brooklyn Bridge, municipal buildings, and other relevant destinations

2. Atlantic Terminal Area: Atlantic Terminal is a major multi-modal transportation center and is ideally suited for the location of a New Mobility Hub, which could provide detailed information on ways to travel to major destinations in Downtown Brooklyn.

3. Other locations: Livingston Street / Smith Streets, along Fulton Street Transit Mall, and Flatbush Avenue / DeKalb Avenue. Coordination with the Downtown Brooklyn Partnership and NYCT is recommended prior to making final decisions on locations of new mobility hubs.

[11] "New Mobility Solutions for Urban Transportation," by Susan Zielinski and David Berdish, in the Journal of the International Institute, Vol. 16, No. 1, Fall 2008, Ann Arbor, MI: Scholarly Publishing Office, University of Michigan Library, p. 2.

Study Team Recommendation

The Study Team recommends that New Mobility Hubs be included for further evaluation as part of the preferred improvement alternatives that have high potential for improving effectiveness of the surface transit network as well as connectivity throughout the overall Study Area.

3.3.3 FARE COLLECTION

Field visits and focus group sessions raised concerns about existing fare collection methods within the DBSTCS Study Area. These concerns include the locations of ticket vending machines for bus users – they are not readily available on street level or in proximity to bus stops. Fare collection alternatives that could address issues raised in the study that impact the passenger's experience include the following:

- On-Street Ticket Vending Machines (TVMs);
- Information About Nearby MetroCard Vendors

These alternative options are discussed in greater detail below.

MetroCard Purchasing: On-Street TVM's

Definition

TVMs are the easiest way to obtain MetroCards. It is important to provide access to ticket vending machines near surface transit facilities.

Relation to Study Goals and Objectives

Providing access to TVMs helps to maximize the effectiveness of the Study Area's surface transit network to provide improved access and mobility.

Needs and Benefits

Throughout the public involvement process, the study team heard that the lack of MetroCard purchasing options at bus stops was a deterrent to use the existing bus network. TVMs are only available in subway stations, which are sometimes inaccessible to people with disabilities and difficult for the elderly to access. By providing TVMs at street level at key bus stops and locations, additional fare purchasing options become available to bus riders.

TVMs are a significant capital expenditure. The typical cost for a single TVM is well above $50,000 (TCRP Report 80, Toolkit for Self-Service, Barrier-Free Fare Collection published in 2002 cited $55,000 for one TVM).

Figure 3-13 | MTA's MetroCard Merchant Locator

Study Team Recommendation

High volume bus stops and heavily used corridors are perfect candidates for on-street TVMs. This includes the area around Borough Hall, Livingston Street, Fulton Street, and Flatbush Avenue. Given cost considerations, where there may exist multiple TVMs at existing subway stops in Downtown Brooklyn, MTA NYCT could consider re-locating one of these to a surface location in proximity to both the subway entrance and bus stop.

Table 3-2 | Reliability Issues

RELIABILITY ISSUES		PROPOSED ALTERNATIVES TO ADDRESS RELIABILITY						
Issue	Location	Leading Bus Interval	Traffic Signal Priority	Bus-Only Lanes/Hours	Bus Stop Reconfiguration	Fare Collection System	Parking Enforcement	Splitting Service
Congested Corridors	Flatbush Avenue	✓	✓	✓	✓	✓	✓	✓
	Fulton/Livingston Corridor	✓	✓	✓	✓	✓	✓	✓
	Jay/Adams/Cadman Plaza West Corridor	✓	✓	✓	✓	✓	✓	✓
Congested Intersections	Atlantic Avenue, Flatbush Avenue, and 4th Ave.		✓				✓	✓
	Cadman Plaza West / Tillary Street		✓	✓			✓	✓
	Fulton Street and Boreum Place		✓				✓	✓
	Fulton Street, Smith Street, and Jay Street		✓	✓			✓	✓
	Livingston Street and Boreum Place		✓	✓			✓	✓
	Livingston Street and Smith Street		✓				✓	✓
Long Dwell Times	Study area wide					✓		

MetroCard Purchasing: Information About Nearby Vendors

Definition

In addition to purchasing MetroCards at TVM's, there are numerous authorized MetroCard merchants within the Study Area. The location of these merchants might not be widely known. Signage at local merchants can provide riders with valuable information on purchasing a MetroCard.

Relation to Study Goals and Objectives

Riders unwilling or unable to access ticket vending machines in subway stations can use local merchants at street-level. Providing access to transit fare media for all helps to maximize the effectiveness of the study area's surface transit network.

Needs and Benefit

Throughout the public involvement process, the study team heard that the lack of MetroCard purchasing options significantly reduces the number of people who utilize the existing bus network. TVMs are only available in subway stations, sometimes inaccessible to people with disabilities and difficult for the elderly to access. Based on this input, the Project Team concluded that the MetroCard authorized merchant program is not well known to riders.

Study Team Recommendation

Information about nearby merchants who sell MetroCards should be placed at key locations and bus stops throughout the area. Maps, or lists, of nearby merchants can be incorporated with the New Mobility Hub concept (see Section 3.3.2). Current programs, such as the mobile device interface on the MTA's website should also be promoted, as this can be used by anybody with an internet-enabled phone, and not just at bus stops.

Figure 3-14 | Potential Locations for Leading Bus Intervals

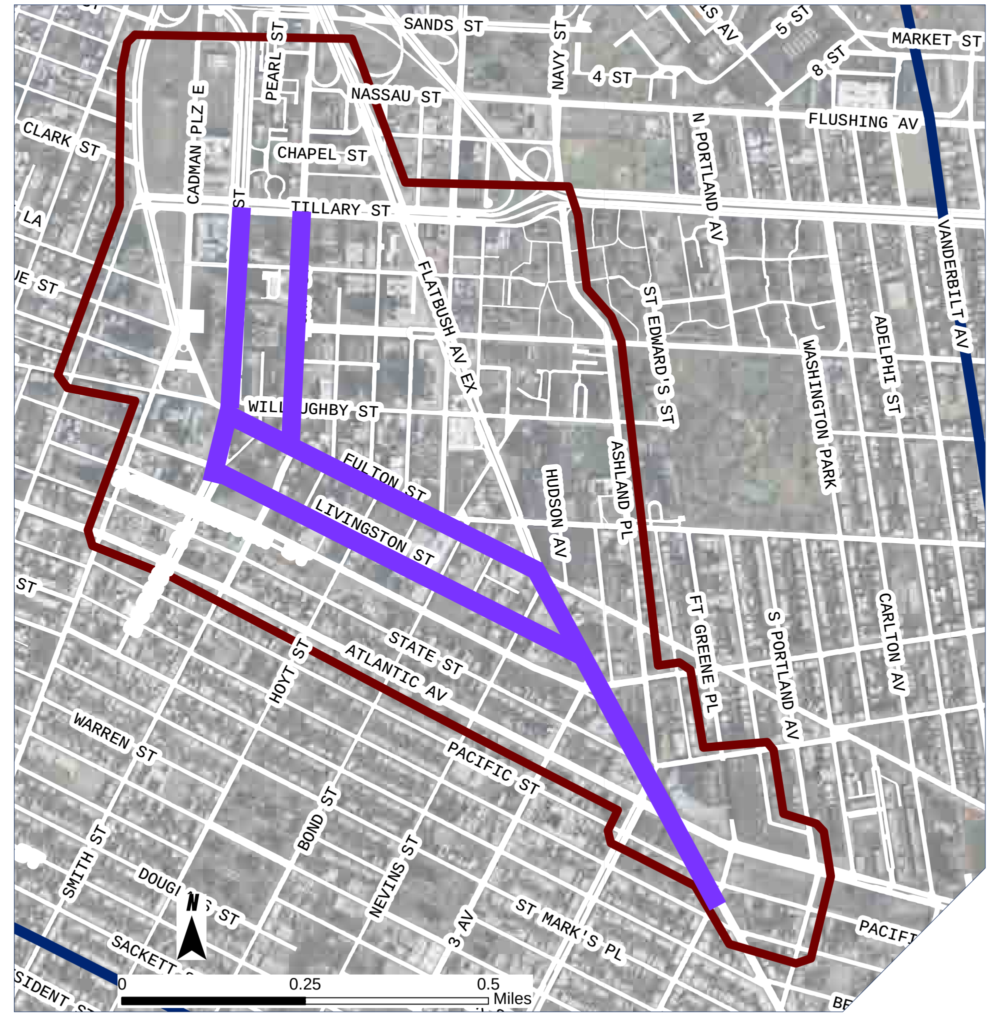

Figure 3-15 | Potential Corridors for Traffic Signal Priority

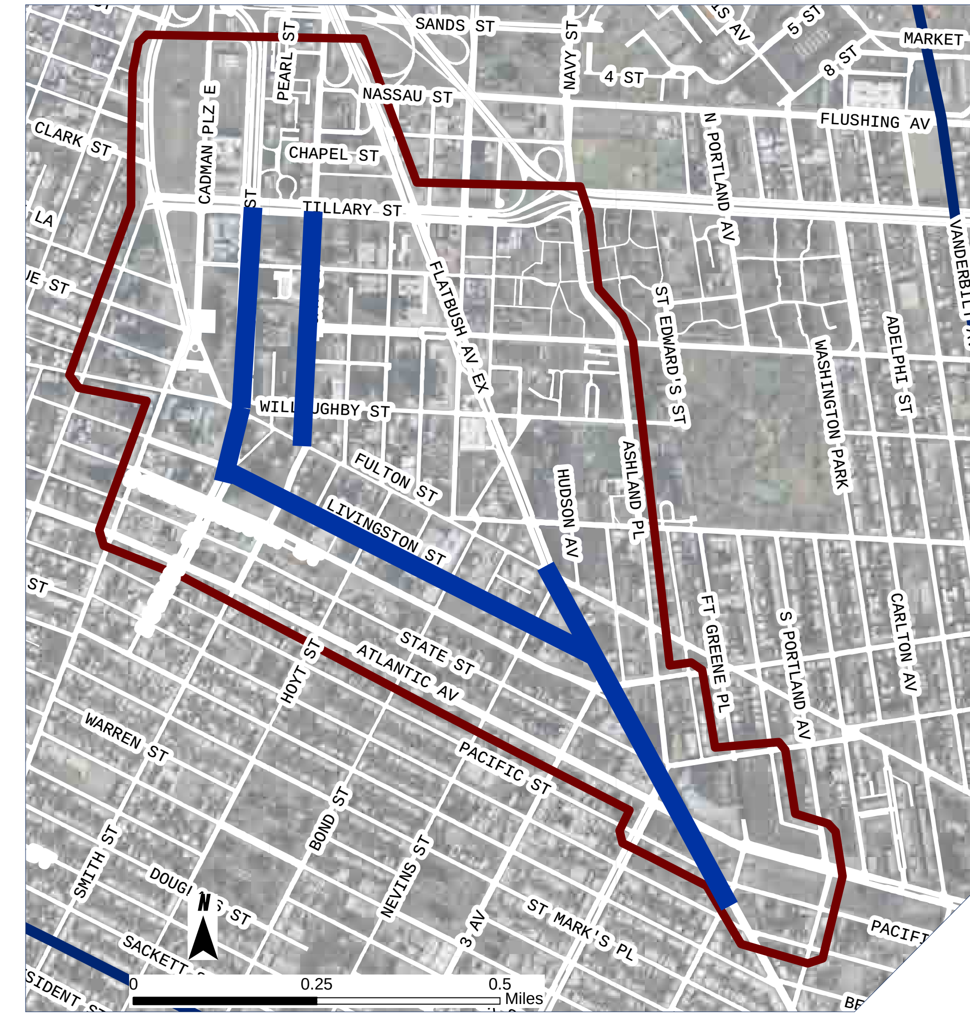

Figure 3-16 | Expansion of Bus-Only Lanes and/or Extension of Operating Hours

3.4 LINKING ISSUES AND ALTERNATIVES

General implementation locations have been mentioned throughout this chapter, this section will detail the implementation of each alternative at proposed location and explain how each will address the identified issue.

Proposed Alternatives to Address Reliability Issues

Table 3-2 (Page 3-16) shows the connection between reliability issues and their proposed alternatives.

Leading Bus Interval (LBI)

The green areas in Figure 3-14 show the recommended locations to implement a leading bus intervals to help buses avoid vehicular congestion along Flatbush Avenue, Livingston Street, and the Adams Street corridors. First, difficult southbound to eastbound turns from Adams Street to Fulton Street would benefit from an LBI directly upstream of this location. This would allow buses using the Adams Street service road to more easily merge left in preparation for a left turn onto Fulton Street. The second location, Livingston Street and Flatbush Avenue would benefit travel for buses on both the Livingston Street corridor and the Flatbush Avenue corridor, specifically helping existing buses turn south onto Flatbush Avenue from Livingston Street and then Eastbound onto Lafayette Avenue ahead of vehicle traffic utilizing a right-turn bus-only lane. Impacts to traffic along Flatbush Avenue would be limited by taking green time from Livingston Street, instead of Flatbush Avenue. In these locations, leading bus intervals would improve bus travel times and allows buses to avoid some congestion-related reliability issues.

Traffic Signal Priority

The purple areas of Figure 3-15 represent potential implementation locations for traffic signal priority for buses. These corridors have high bus volumes and vehicular congestion. Providing buses traffic signal priority in these would improve transit reliability, even though it may degrade general vehicle level of service for cross-traffic.

Bus-Only Lanes/Hours

The blue areas of Figure 3-16 could benefit from the expansion of the bus-only lane network or the extension of the operating hours. Current bus-only lanes along Livingston Street between Adams Street and Flatbush Avenue could be extended to 12 hours or even 24 hours per day. Southbound Adams Street between Tillary Street and Livingston Street could also benefit from the addition of bus-only lanes on the service road. In addition, southbound Jay Street between Tillary Street and Fulton Street Transit Mall could also benefit from the addition of bus-only lanes. Bus-only lanes are the most commonly used method of giving buses priority. Doing so will improve reliability and relieve congestion for buses along the currently congested corridors and intersections.

Specific implementation of the bus-only lanes, and various other improvements for Jay Street is described in the next section.

Table 3-3 | Jay Street Peak Hour Through Volumes

Location	Direction	AM Peak Hour Volume	Midday Peak Hour Volume	PM Peak Hour Volume
Jay Street/ Fulton Street	NB	684	307	526
	SB	446	492	649
Jay Street/ Willoughby Street	NB	559	266	510
	SB	377	422	558
Jay Street/ Metrotech Plaza	NB	737	477	634
	SB	407	429	608
Jay Street /Tech Street	NB	632	411	554
	SB	387	376	586
Jay Street/ Tillary Street	NB	250	91	202
	SB	64	49	161

Jay Street Transit Priority

The Jay Street southbound general travel lane between Tillary Street and Schermerhorn Street could be converted to a Bus Only lane. Reroute Jay Street northbound bus routes to alternate streets.

Existing Conditions

Jay Street is approximately 50' wide, comprised of four lanes in the following configuration:

- Southbound Curb Lane – Parking and Bus stops
- Southbound Travel Lane
- Northbound Travel Lane
- Northbound Curb Lane – Parking and Bus stops
- According to the NYCDOT Streets Design Manual, the existing Jay Street northbound bicycle lane is a "standard lane." The southbound bicycle facility is a "buffered lane."

The following MTA-NYCT routes serve Jay Street between Tillary Street and Atlantic Avenue:

- Southbound Buses: 26, 54, 57, 62, 67, 75
- Northbound Buses: 57, 61 (Atlantic to Fulton), 67, 75

These routes combine to operate approximately 450 buses in each direction throughout the day along Jay Street. During the peak hours (7:30AM-8:30AM; 5PM-6PM), these routes combine to operate approximately 27 buses in each direction, or approximately one bus every two minutes in each direction. The buses operating along these routes are frequently delayed along Jay Street due to significant vehicle volumes, vehicles illegally parked along the curb and double parked in the travel lanes, and a signed and striped, but not physically separated bicycle route.

According to NYCDOT (September 2007), 746 bicycles were observed riding along Jay Street between Myrtle Avenue and Tech Place between 7:00AM and 7:00PM, with 83 in the peak hour (5:30PM-6:30PM).

Table 3-3 presents the peak hour through volumes at intersections along Jay Street between Fulton Street and Tillary Street (except Johnson Street).

Table 3-4 | Proposed Reconfiguration of Jay Street

Jay Street Segment	Lanes from West to East
Sand Street to Johnson Street	• Bike lane (bi-directional, protected) • Parking (eliminate existing bus stop) • Southbound travel lane (all non-local traffic turns at Johnson Street) • Northbound travel lane • Parking
Johnson Street to Marriott Hotel access lane	• Bike lane (bi-directional, protected) • Southbound bus island with bus stops (no parking) • Southbound travel lane (bus and local traffic to Marriott/parking only) • Northbound travel lane • Parking
Marriott Hotel access lane to Parking Facility south driveway	• Southbound parking facility access (no on-street parking and all vehicle traffic must turn into parking facility) • Southbound bus only lane • Bike lane (bi-directional, protected) • Northbound travel lane • Parking
Parking Facility south driveway to Livingston Street	• Southbound bus stops • Southbound bus only lane • Bike lane (bi-directional, protected) • Northbound travel lane • Parking
Livingston Street to Schermerhorn Street	• Extended sidewalk • Bike lane (bi-directional, protected) • Northbound left turn lane • Northbound travel lane • Parking

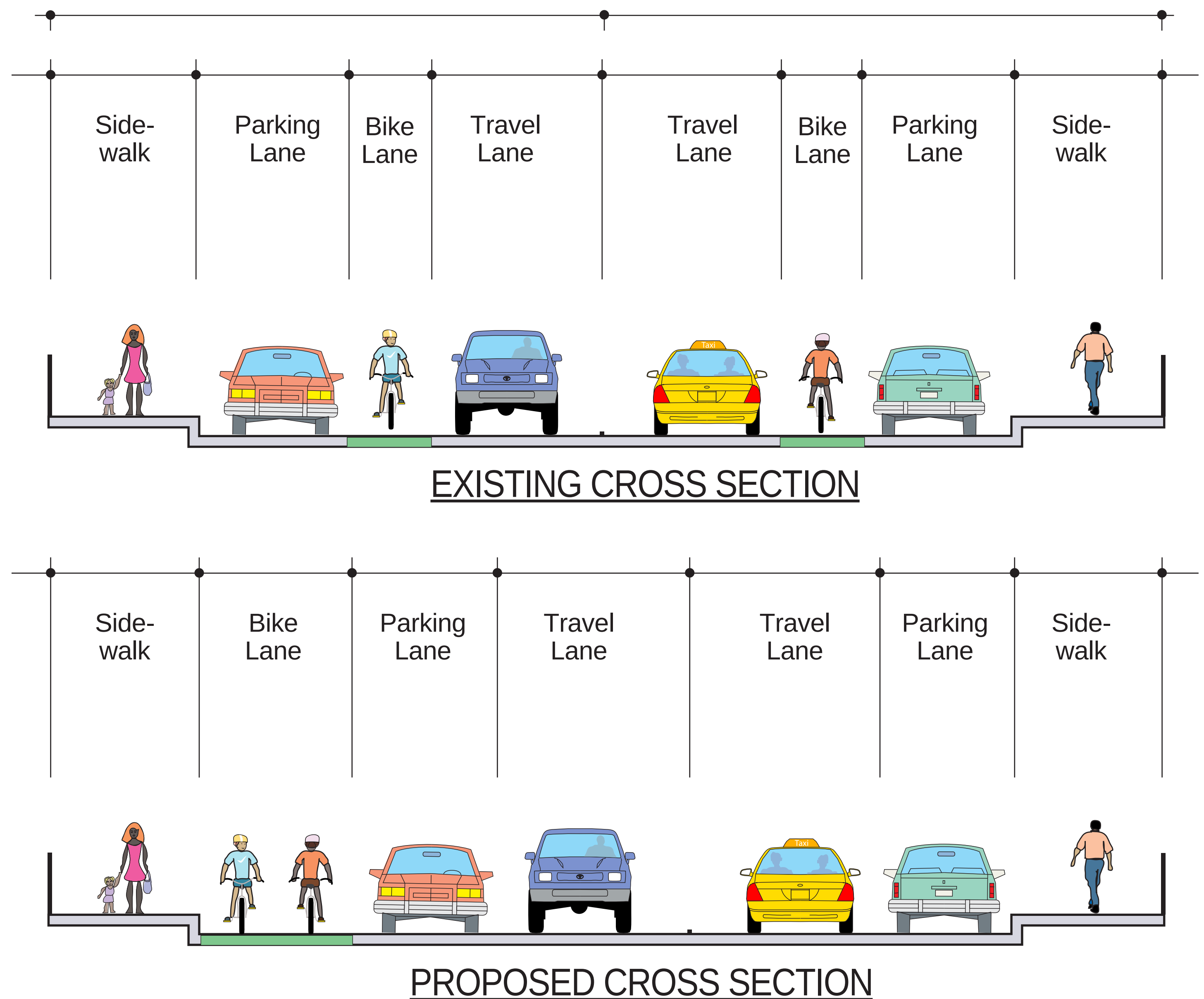

Figure 3-17 | Jay Street Cross Section (Johnson-Tillary)

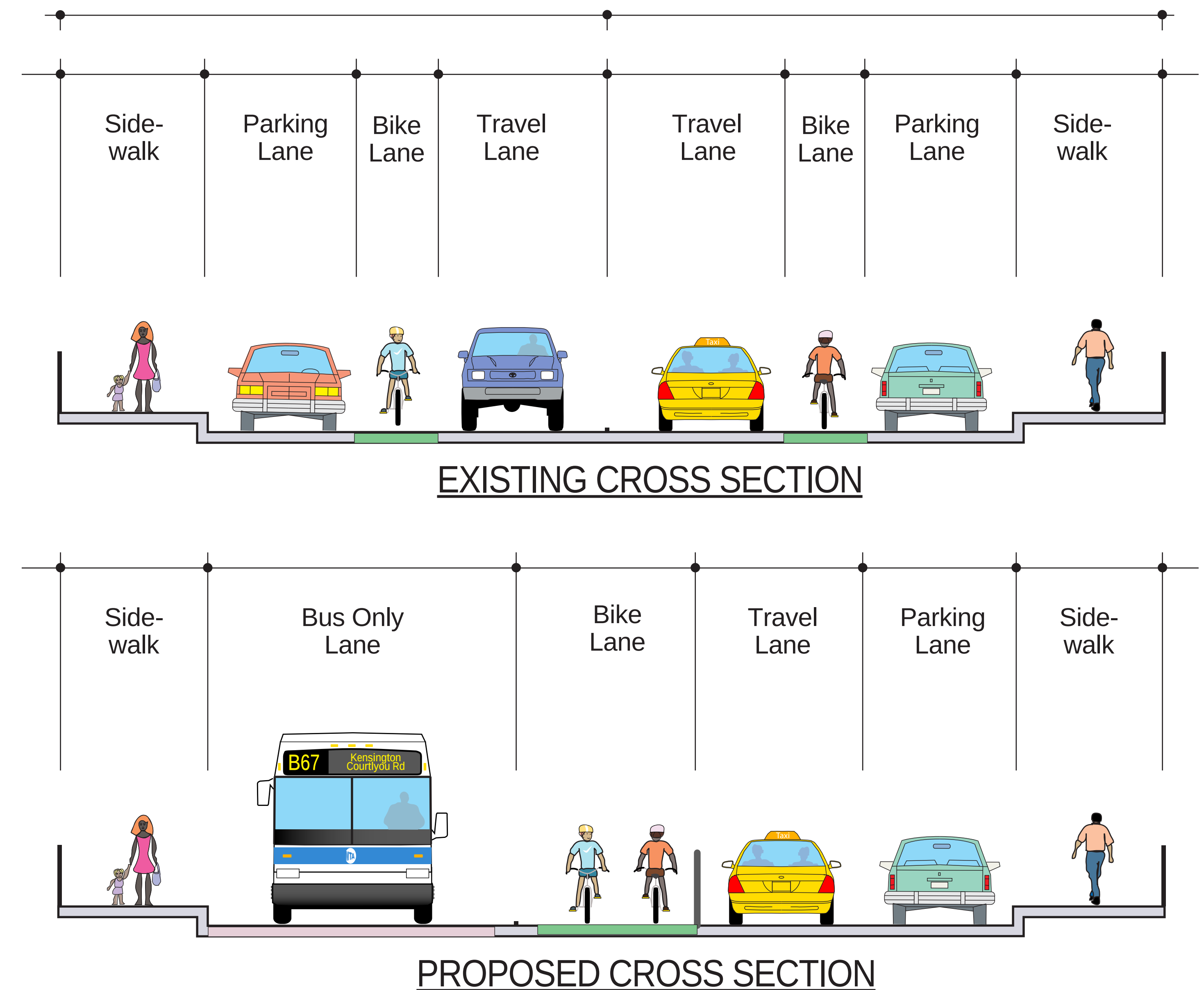

Figure 3-18 | Jay Street Cross Section (Johnson-Livingston)

Proposed Alternative

This alternative to reconfigure Jay Street is proposed in Table 3-4, with specific cross sections in Figures 3-21 and 3-22:

This configuration would result in high frequency south- and east-bound bus service on Jay Street and eliminate both conflicting vehicle volumes and parked (and double-parked) autos. This alternative would also improve bicycle priority in both directions along Jay Street. The proposed street operations and bus operations are presented in Figure 3-23 and Figure 3-24, respectively.

The 25, 38, and 52 south- and east-bound routes would shift to Jay Street and no longer travel along Adams Street. This would eliminate the difficult east-bound left turns at Fulton and Schermerhorn Streets, allow the median on the north side of the intersection to be widened, signal cycle time to be reallocated for northbound left turns, and potentially increase pedestrian crossing time. These changes would improve pedestrian safety at this key intersection. (The 41 and 103 would remain on Adams Street to continue south and turn east onto Livingston Street.)

The 57, 67, and 75 north- and west-bound routes would shift from Jay Street to Adams Street between Livingston Street and Fulton Street, and Cadman Plaza West north of Joralemon Street. Bus riders traveling north- and west-bound would generally have access to the same locations as the current routes, but the routes would terminate, layover, and start again at Cadman Plaza West. This alternative would add approximately 16 buses to the Cadman Plaza West bus stops during the peak hour. Cadman Plaza West currently has space designated for two buses to park curbside south of Montague Street; this space is currently accommodating 57 buses during the peak hour. Each of the two bus stops would have to accommodate eight additional buses per peak hour, reducing the time each bus can stop to less than two minutes. While this is still operationally feasible, the first 50 feet of curbspace north of Montague Street, which is currently used for placard parking, should be converted to bus stop space.

(Concurrent with the reprioritization of southbound Jay Street, the B-54 is recommended to be rerouted to operate clockwise on Jay Street, Joralemon Street, Cadman Plaza West, and Tillary Street.)

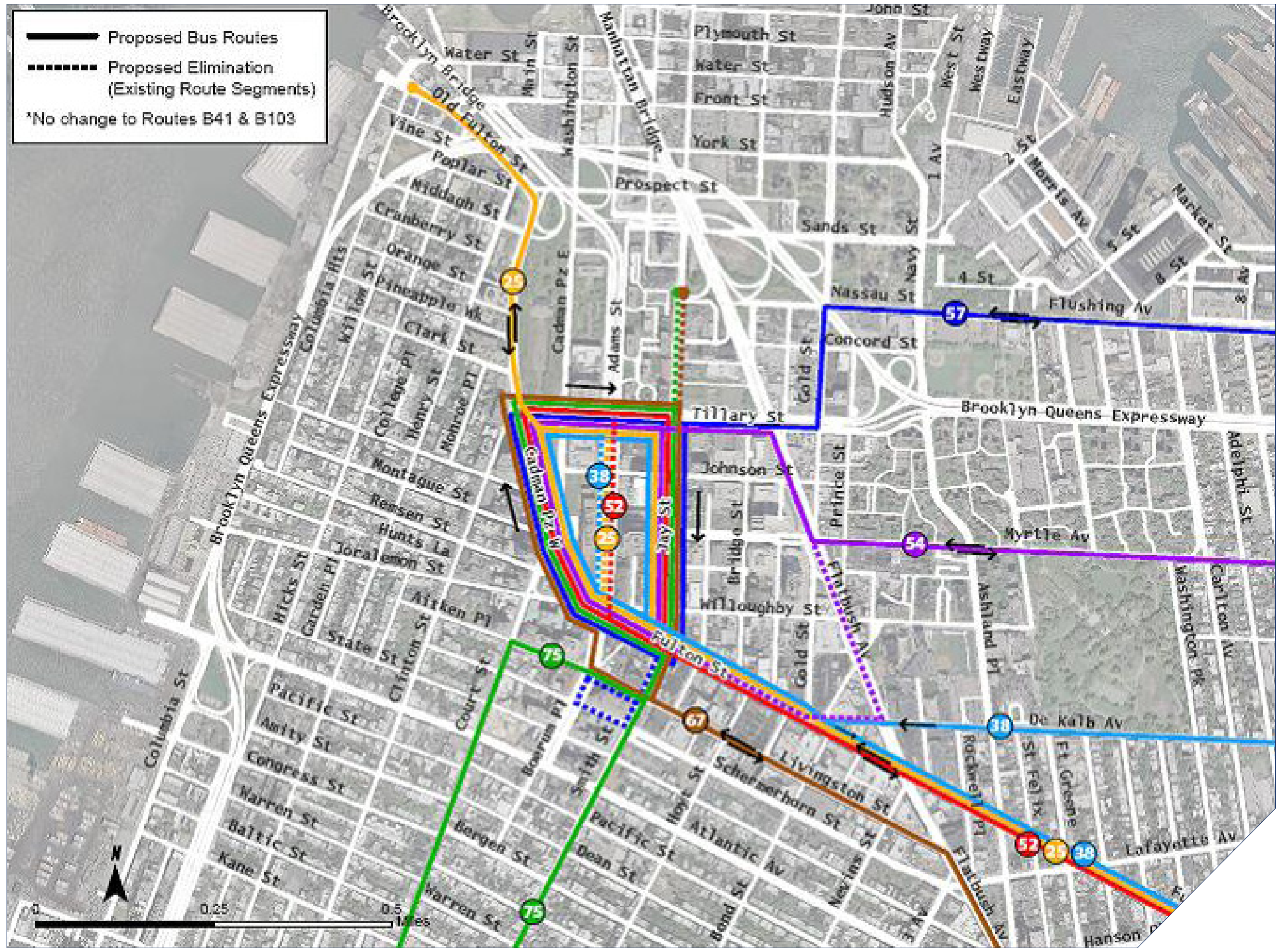

Figure 3-19 | Jay Street Transit Priority Alternative Proposed Bus Operations

The proposed bicycle facility would be a 2-way path that would be physically separated from motor vehicle traffic through the entirety of the facility. The facility could be designed like the Sands Street bike path, which is grade separated, or the Tillary Street bike path that is separated by barriers. At a minimum, flexible, reflective bollards should line each side of the facility at spacings of 5' apart.

The proposed Jay Street northbound travel lane would be 11' wide to accommodate trucks.

Relation to Study Goals and Objectives

- Goal to be Addressed: Maximize effectiveness of the Study Area's surface transit network to move people.
- Objective to be Addressed: Reduce travel times and improve schedule reliability for customers using buses.

Needs and Benefits

Existing bus service through the Study Area is hindered by high traffic volumes and conflicting curbside demands. Bus operations are significantly slowed along Jay Street due to significant volumes of autos, buses, and bikes. A secondary issue is the difficulty of buses traveling southbound on Adams Street, turning east from the Service Road onto Fulton Street.

Currently, many riders heading east- and south-bound walk to Adams Street instead of boarding at Cadman Plaza West to avoid buses laying over. Shifting the routes to Jay Street may result in more passengers boarding at Cadman Plaza West. To improve the boarding experience for these riders, the reconstructed Cadman Plaza West boarding area should be reenvisioned to include multiple bus shelters with complete transit and walking information about the area (including bus and are destination, bus schedules, and wayfinding signage to key destinations and subway stations).

Figure 3-20 | Jay Street Transit Priority Alternative: Proposed Street

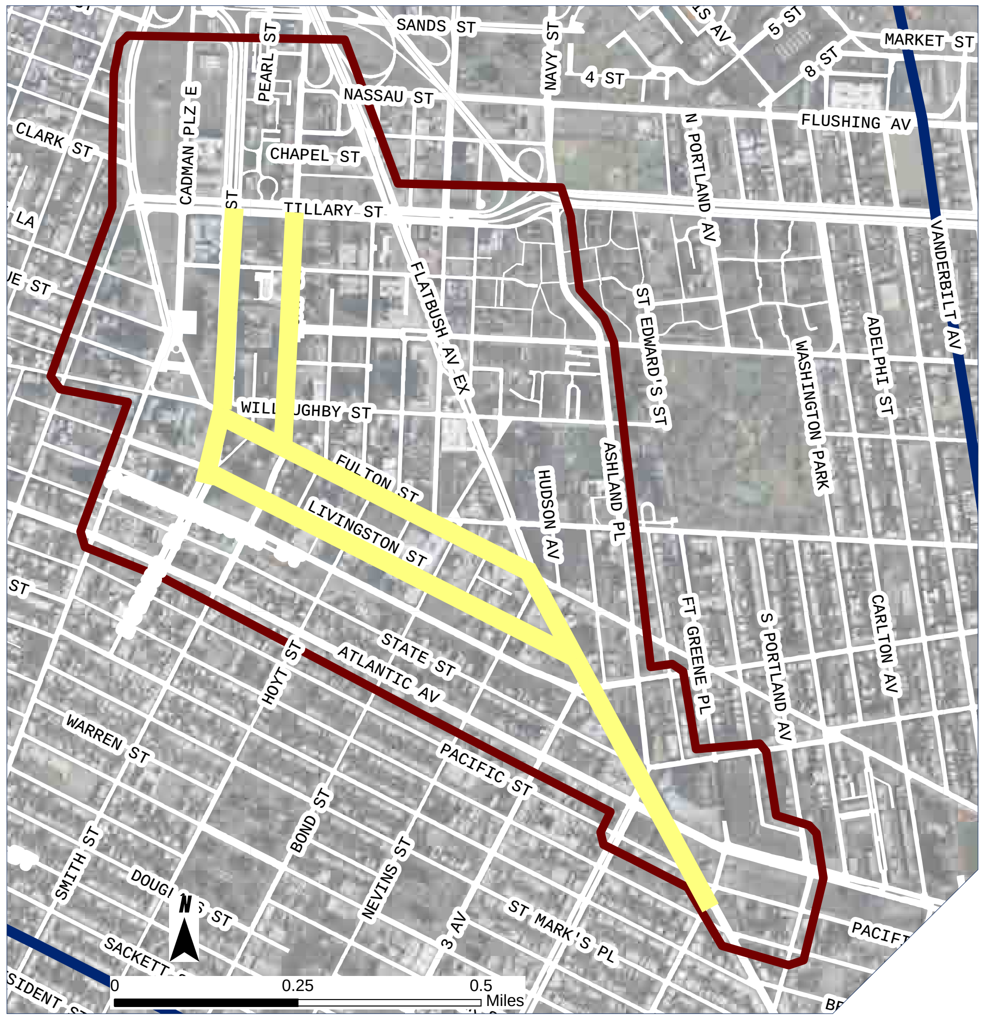

Figure 3-21 | Locations of Fare Collection System Improvement Options

This alternative would also provide an opportunity to improve pedestrian safety with construction of neckdowns at the subway entrances near the Myrtle promenade, at Willoughby Street, on the northeast and southeast corners, and at Fulton Mall on the northeast and southeast corners.

This alternative would result in a slight decrease in parking spaces as a result of eliminating all parking along Jay Street (southbound south of Johnson Street) and adding parking spaces at eliminated bus stops Jay Street (northbound) and Adams Street (southbound).

Study Team Recommendation

1. Key issues for further analysis for this alternative include vehicular operations at:
   - Jay Street at Fulton Street (due to additional southbound buses turning left);
   - Tillary Street at Jay Street (due to additional eastbound buses turning right); and
   - Joralemon Street between Adams Street and Court Street (due to additional bus volumes).
2. Other Options for Consideration with NYCT
   - Maintain existing Jay Street northbound routes (B57, B67, B75) to operate in mixed traffic on Jay Street northbound instead of rerouted to Cadman Plaza West.

Table 3-5 | Does the Proposed Alternative Address Service Coverage Issues and Meet the Goals and Objectives?

SERVICE COVERAGE ISSUES		PROPOSED ALTERNATIVES TO ADDRESS SERVICE COVERAGE		
Issue	Location	Route Extensions	Circulator System	Shuttle System
Overlapping Service	Cadman Plaza West			✓
	Flatbush Avenue			✓
	Fulton Street			✓
	Livingston Street			✓
Underserved Neighborhoods	DUMBO	✓	✓	
	Waterfront area (parallel to Brooklyn Bridge Park)	✓	✓	

✓ Indicates the proposed alternative could address the identified issue and meet the DBSTCS goals and objectives.

3. Eliminate on-street parking on Jay Street southbound from Sand Street to Johnson Street (reduces double parking delays to buses in mixed traffic segment).

Bus Stop Reconfiguration

The bus stops around Cadman Plaza West, between Johnson Street and Tillary Street could potentially be redesigned to accommodate saw-tooth bus parking. In addition, four bus stops can be consolidated (see Figure 3-4 on Page 3-4):

- B25 at Cadman Plaza West, north of Pineapple Street
- B38 at DeKalb Avenue and Ashland Place
- B63 and B65 at Atlantic Avenue, Nevins Street, and Hoyt Street
- B63 and B65 at Atlantic Avenue and Hoyt Street

These consolidations would improve conditions along congested corridors by keeping buses moving and minor reductions in average travel times due to reduced number of stops. These improvements were not found to directly influence reliability along the identified congested corridors; however, still improve travel time and reliability throughout the entire study area.

Fare Collection System

The most congested and used bus corridors are candidates for improvements to the fare collection system to address congestion issues and long dwell times. This includes the implementation of a smartcard system, off-board fare collection, and fare free service. The implementation of smartcards and a fare-free service reduces dwell times throughout the study area by reducing the transaction time for fare collection. In addition, variable time pricing address reliability by addressing congestion during the peak period. Changing the fare pricing according to time of day rewards people for traveling outside of the congested peak period. This both reduces congestion during the peak period and forces more people to travel during a time when reliability is presumably higher.

Parking Enforcement

Parking enforcement of the bus lanes and bus stops can be carried out wherever there are bus lanes (currently only on Fulton Street Transit Mall and Livingston Street, and proposed on Jay Street) or in the no standing zones of bus stops, throughout the entire study area. This will directly address issues of congestion along these corridors by returning priority to buses along these congested corridors.

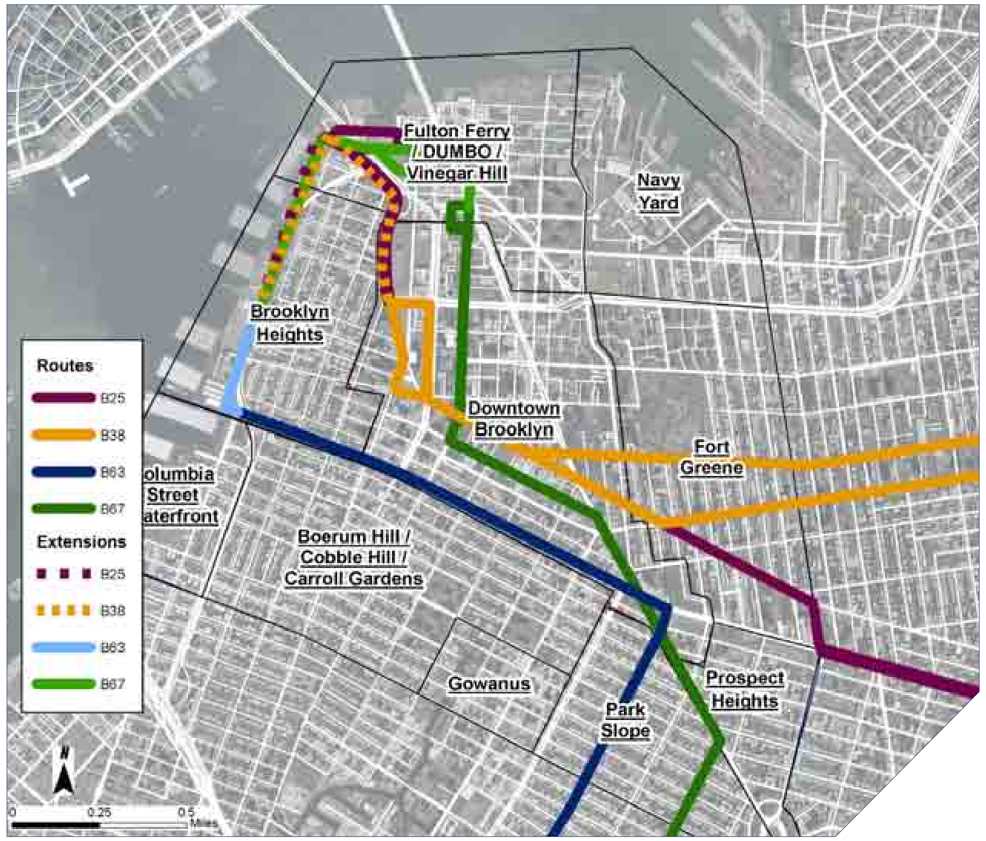

Figure 3-22 | Potential Bus Route Extensions

Figure 3-23 | Potential Circulator, Route 1

Figure 3-24 | Potential Circulator, Route 2

Proposed Alternatives to Address Service Coverage

Table 3-5 shows the connection between service coverage issues and their proposed alternatives.

Route Extensions

Future development within the study area will create the need for additional transit service to areas, which are currently not served. The two primary areas identified are the Brooklyn Bridge Park along the waterfront and DUMBO. Existing transit demand along the waterfront is limited, especially with only part of the Brooklyn Bridge Park open. As additional demand develops, a phased extension of routes is suggested.

- Extension of the B25 from existing terminal on Old Fulton Street onto Furman Street and into Brooklyn Bridge Park. This would add approximately 0.5 miles to the route. At an average of 4 miles per hour, this extension would add approximately 8 minutes in each direction.
- Extension of the B67 to York Street, west to Old Fulton Street, and south along Furman Street into Brooklyn Bridge Park via DUMBO. The route would return eastbound on Fulton Street This would add approximately one mile to the route. At an average of 4 miles per hour, this extension would add approximately 15 minutes in each direction.
- Extension of the B63 which currently terminates at Sackett Street and Van Brunt Street north into Brooklyn Bridge Park via Furman Street. This route extension was also recommended in the Brooklyn Bridge Park Transportation and Access Study. As this extension would solely serve the park (as opposed to the B67 which would also serve DUMBO), this alternative may be more appropriate for seasonal or weekend service. Extending the B63 would add approximately 0.25 miles to the route. At an average of 4 miles per hour, this extension would add approximately 4 minutes in each direction.
- Extension of the B38 from the existing terminal at Cadman Plaza to Brooklyn Bridge Park along Furman Street via DUMBO. This extension would add approximately one mile to the route. At an average of 4 miles per hour, this extension would add approximately 15 minutes in each direction.

Note: Extension of these routes to Brooklyn Bridge Park are predicated upon conversion of Furman Street from existing one-way operations to a two-way street and determination for all routing recommendations and location of bus stops is the sole purview of MTA NYCT.

Circulator System

Several previous studies of the Downtown Brooklyn surface transportation network presented a circulator service, or fixed route (LRT) alternative for the core area, dating back as far as 1985 with the Transit Antic Study prepared for the Brooklyn Economic Development Corporation. In the mid-nineties NYC Department of City Planning conducted a Downtown Brooklyn Transit Loop Study, which identified potential for nearly 100,000 daily riders of a loop or circulator service within the Downtown Core.

During the DBSTCS focus group meeting with downtown retail merchants, the concept of a circulator serving downtown workers and tourists was also identified, and a route was sketched out based on their input.

Two alternative route options are presented in Figure 3-23 and Figure 3-24.

Study Team Recommendation

Further development of a circulator system is not recommended at this time, as there are elements of it which overlap with the potential Downtown Brooklyn Shuttle system. A stand alone circulator system, with no changes to existing route termination points, would do little to improve mobility for tourists or workers within Downtown Brooklyn, giving existing congestion, overlapping bus routes, and lengthy travel times for short distances.

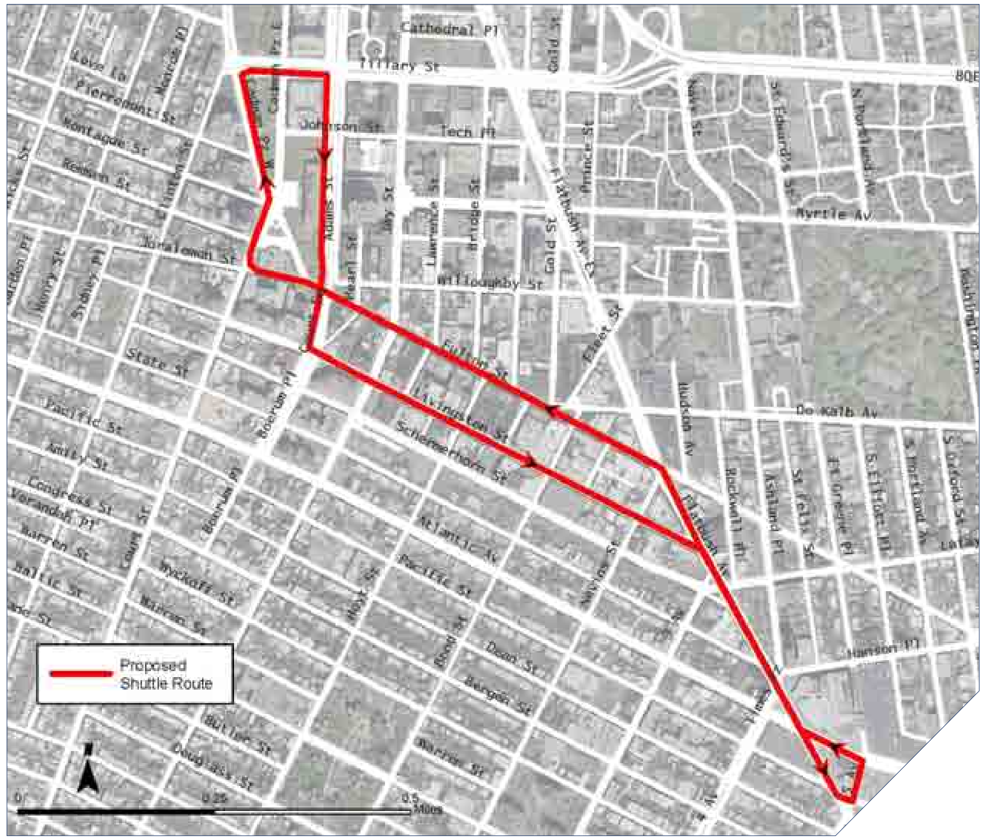

Figure 3-25 | Route 1

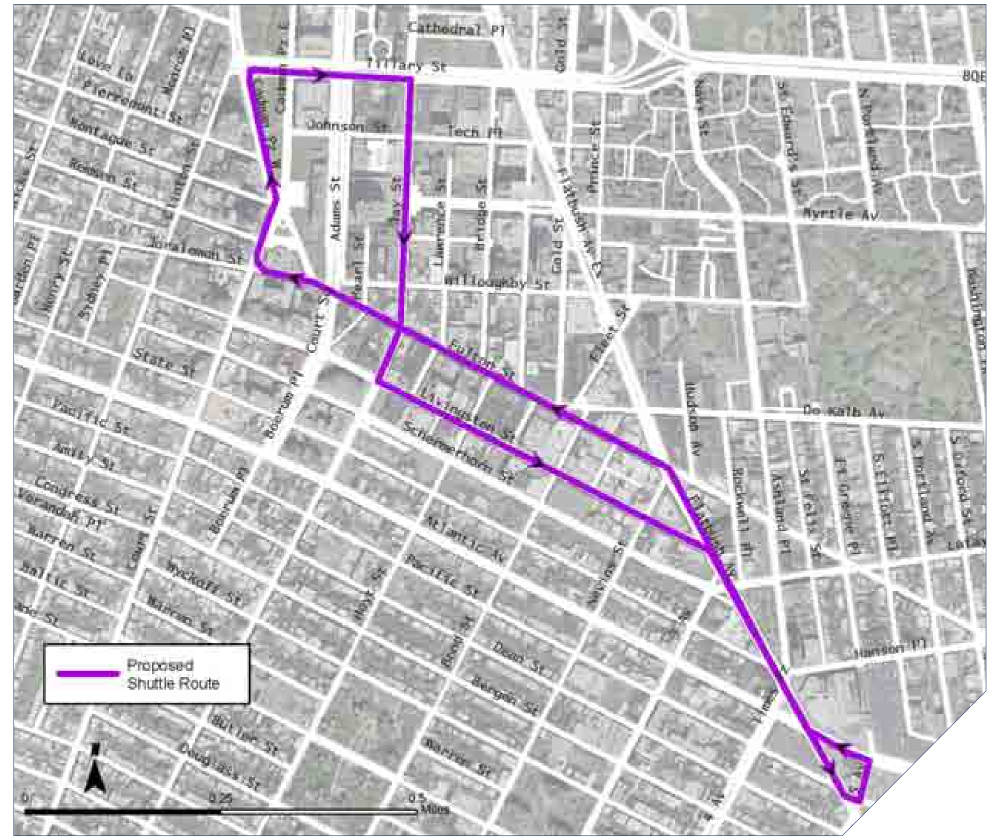

Figure 3-26 | Route 2

Figure 3-27 | Route 3

Figure 3-28 | Route 4

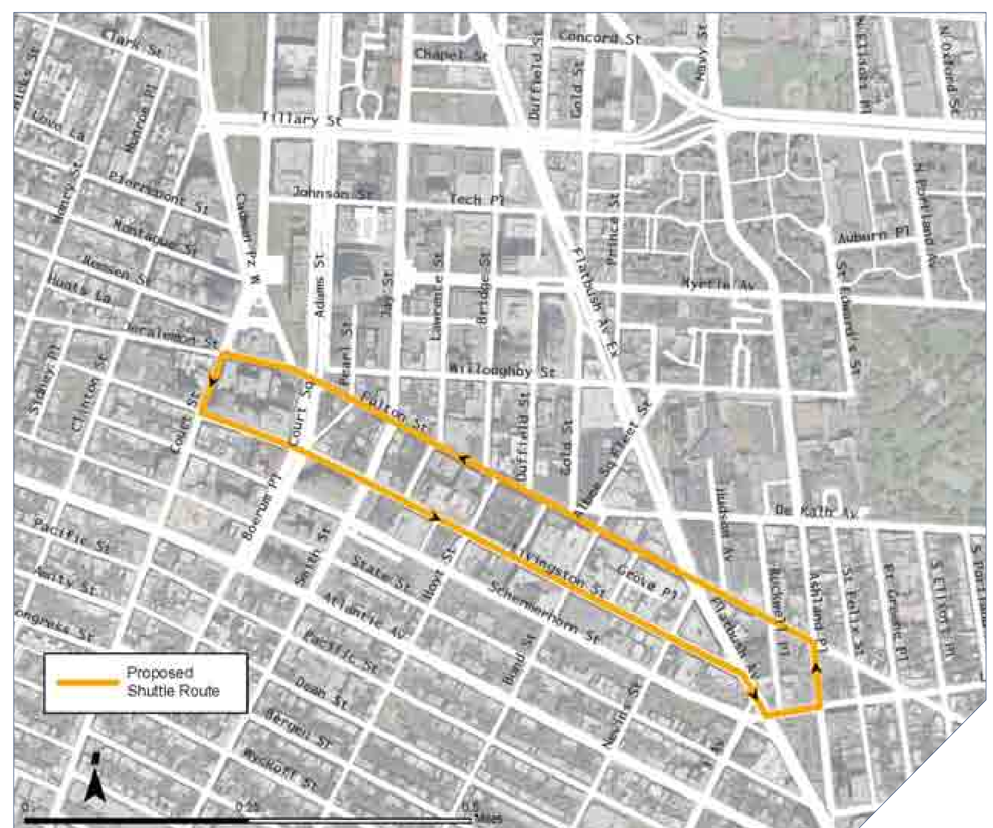

Figure 3-29 | Route 5

Figure 3-30 | Route 6

Potential Shuttle Routes

Downtown Brooklyn Shuttle

The first level of screening of the Downtown Brooklyn Shuttle alternative revealed that it provides many positive impacts for surface transit access in Downtown Brooklyn. Specific elements of this option, including potential routes and location of potential transfer points were further developed. These details are presented below:

Six alternative shuttle routes were developed based on several criteria. This includes the need to maximize existing, or planned bus priority systems and maintain access and mobility around Downtown Brooklyn. Routes are limited by the potential to locate a transit center (transfer facility) to connect existing bus lines to the new shuttle service. Potential routes are summarized in Table 3-6 and detailed in Figure 3-29 to 3-34.

Current routes in Downtown Brooklyn would be analyzed and re-routed to the appropriate transit center based on the selected route. Re-routings will be discussed later in more detail; however, routings around the transit centers are currently for conceptual purposes only, specific routes would have to be incorporated with the final chosen transit center location.

All routes contain common attributes. All routes take advantage of the bus facilities currently in place in Downtown Brooklyn, which include the Fulton Street Mall and the bus-only lanes on Livingston Street. Alternative Routes 1, 2, and 3 require a transit center, or off-street layover location, at Flatbush Avenue and Atlantic Avenue, near Atlantic Yards, while Routes 4, 5, and 6 require a transit center near Ashland Place and Fulton Street. Exact Transit Center locations and potential properties are outside of the scope of this project, and will have to be looked at in more detail if this alternative is to proceed.

Route 1 and Route 2 are similar except for the southbound street that is used. Route 2 would be preferred over Route 1 if the Jay Street Transit Priority Alternative (see section 3.2.2) also proceeds. These routes face congestion along Flatbush Avenue and could potentially have left turn issues from Flatbush Avenue to Fulton Street Mall. Route 3 is based on feedback from focus group sessions, which includes connections to Fulton Ferry Landing and extends towards the shops on Atlantic Avenue. This part of the route could potentially be viewed as a detour for peak-hour trips from Cadman Plaza / Adams Street to Atlantic Terminal to connections elsewhere. Routes 1, 2, and 3 are assumed to capture the Fulton Street bus routes, requiring major re-routings outside of the study area. This would require additional planning and implementation measures.. Routes 4 and 5 are similar, with Route 4 connecting to Cadman Plaza, while Route 5 is shorter, and cuts out Cadman Plaza and Adams Street. Route 6 follows Route 4, but utilizes Jay Street for southbound movements. Route connections to area attractions and other transportation access points are summarized in Table 3-7. Only transit one-way couplets were considered for potential routes as it simplifies route turnaround.

Table 3-9 details those routes recommended to be re-routed to the transfer facility, including an estimated number of daily buses that are currently entering the study area.

Table 3-6 | Route Alternatives

Route	Route Name	Route Length (miles)	Transfer Facility Location
1	Cadman Plaza / Adams Street	2.8	Atlantic Avenue / Flatbush Avenue
2	Cadman Plaza / Jay Street	2.8	Atlantic Avenue / Flatbush Avenue
3	Fulton Ferry	4.2	Atlantic Avenue / Flatbush Avenue
4	Cadman Plaza / Adams Street	2.2	Ashland Place / Fulton Street
5	Fulton Mall / Livingston Street	1.7	Ashland Place / Fulton Street
6	Cadman Plaza / Jay Street	2.2	Ashland Place / Fulton Street

Table 3-7 | Route Connections

Route	LIRR	Cadman Plaza / Courts	MetroTech (Jay Street)	LIU	2-3-4-5* (Borough Hall)	A-C-F*
1	X	X	-	-	X	X
2	X	X	X	-	X	X
3	X	X	-	-	X	X
4	-	X	-	X	X	X
5	-	-	-	X	X	X
6	-	X	X	X	X	X

* Route considered to serve subway station if it passes within 100ft of subway entrance

Service Characteristics

Primary service characteristics of the shuttle include short headways, the number of vehicles required during each period, the operating hours of the shuttle service, and the fare collection system.

Potential weekday headways are calculated based on the number of people boarding and alighting within the study area on the routes which would be replaced by the shuttle bus. These headways are based on a maximum load of 50 people per bus. For the morning peak period, it is assumed that the peak load point will be the new terminal, and headways should be designed around this. For the evening peak, a conservative estimate will calculate the number of riders boarding buses on any of the re-routed routes and will remain on the bus until reaching the Transit Center. At the same time, an attractive shuttle service could potentially increase the number of riders that are not traveling to the Transit Center (internal Downtown Core trips), particularly if a no-fare zone is implemented. During the remaining periods, the maximum loading was used to calculate headways; as this was calculated to be a conservative estimate for headways. The results are shown in Table 3-10. Weekend data was not available to calculate weekend headways.

As the additional transfer is expected to add travel time to some trips, a portion of existing riders are anticipated to change to a different mode, or walk to their final destination from the transfer point. Table 3-11 details the headways, assuming that 15% of the current riders will find another mode. Both analyses are rough estimates, and a more detail analysis will have to be conducted prior to implementation of this alternative.

The shuttle bus will need to operate 24 hours a day; seven days a week, as the majority of bus routes currently operate 24 hours a day (operating every 60 minutes overnight). 24 hour connectivity needs to be maintained.

Table 3-9 | Total Number of Buses Entering Downtown

Bus	Daily Buses
B25	143
B26	125
B37	66
B38	105
B38 LTD	106
B41	166
B41 LTD	153
B45	114
B52	159
B67	87
B103	100
11 Routes	**1324 Buses / Day**

Table 3-8 | Comparison of Downtown Brooklyn Shuttle Route Options

Route Option	Length	Annual Potential Operating Cost*	Potential Issues
Route 1 –Atlantic Terminal area to Cadman – Adams	2.8 miles	$2.96 Million	• Atlantic Avenue/Flatbush Avenue intersection congestion issues • Left turn from Flatbush Avenue to Fulton Street
Route 2 – Atlantic Terminal area to Cadman – Jay	2.8 miles	$2.96 Million	• Atlantic Avenue/Flatbush Avenue intersection congestion issues • Left turn from Flatbush Avenue to Fulton Street
Route 3 – Atlantic Terminal area to Ferry Landing	4.2 miles	$3.11 Million	• Atlantic Avenue/Flatbush Avenue intersection congestion issues • Left turn from Flatbush Avenue to Fulton Street • Extension to Ferry Landing extends travel time of shuttle and reduces service area around courts and Metro-Tech
Route 4 – Ashland – Cadman	2.2 miles	$2.89 Million	• Requires crossing Flatbush Avenue • Does not serve LIRR
Route 5 – Ashland to Fulton to Livingston loop	1.7 miles	$2.84 Million	• Does not serve Cadman Plaza area • Requires crossing Flatbush • Does not serve LIRR
Route 6 – Ashland – Cadman – Jay	2.2 miles	$2.89 Million	• Requires crossing Flatbush Avenue • Does not serve LIRR

* Calculated using the 1995 DOT Formula, where Annual O&M Costs = 25.7 * Annual Vehicle Hours + 2.14 * Annual Vehicle Miles + 24600 * Number of Vehicles During Peak Period

Common Advantages of all routes:

- Potential ridership for all routes is expected to be approximately 35,000 with differences based on specific length of route.
- Removes as many as 729 buses per day entering downtown, with a reduction of up to 260 vehicle hours.
- Utilizes bus-only priority, such as existing facilities on Fulton Street and future Eastbound Bus lanes on Livingston Street

Needs and Benefits

Replacing existing buses routes with a shuttle route would reduce the number of buses that travel in the Downtown Core area and replace it with higher average ridership per vehicle. The resulting decreases in bus volumes are shown in Table 3-12. The net result would be a reduction of approximately 629 buses per day for the conservative headways, and 831 buses per day for the reduced headways, all providing the same level of service, with frequent weekday headways.

Using the scheduled length of time that the buses travel in the Downtown Core, we can estimate the reduction in vehicle hours. The scheduled times (per September 2008 timetables) for all buses which current enter Downtown, and are expected to be re-routed to the new terminal are used to calculate the current vehicle hours traveled by each bus in Downtown Brooklyn. The total number of buses from the schedules is used to then calculate the current vehicle hours for the entire day by all buses. Using the shuttle headways (Table 3-10 and Table 3-11) and an assumed route-trip time of twenty-two minutes for all five routes, the number of vehicle hours for shuttle operation is calculated. The subtraction of these two yields the decrease in vehicle revenue hours traveled in Downtown Brooklyn. The simplifying assumption of 22 minutes for all five routes is based on an average current scheduled times for buses in Downtown. Each route would have a slightly modified reduction in vehicle revenue hours. Table 3-13 presents the reduction in vehicle revenue hours broken down by peak period. The total weekday decrease in vehicle hours would be about 223 vehicle hours for the conservative headways, and 300 vehicle hours for the reduced headways.

In addition to a decrease in vehicle revenue hours, a shuttle service would provide streamlined bus service in the Downtown Core. It would provide one bus which would operate on low headway times and be easy to use. These aspects increase overall customer satisfaction. In addition, the new Transit Center could also provide an opportunity for additional development on-site or within proximity of its location.

Constraints of the Shuttle Alternative

Implementing the Downtown Brooklyn Shuttle alternative poses several constraints. First, passengers accustomed to a one-seat ride on existing local bus service will be required to transfer to the shuttle, thereby losing some direct local bus-subway connections. Second, there will be an increase in pedestrian activity, both at the transfer station site as well as crossings of Flatbush Avenue. This will require careful planning and attention to safety issues. It is likely that local developers may oppose use of prime developable land for a bus facility. This could be lessened by developing a transit center that allows for private development as part of the final plan.

The implementation of the shuttle option cannot capture all of the bus routes that enter and leave Downtown Brooklyn, but would aim to capture a majority of them in order to provide a more efficient surface transit service downtown. Certain routes, such at the B51, B61, and B62 would continue routing through Downtown Brooklyn.

The entire shuttle implementation project would fall under the responsibility of MTA NYCT as a capital project, potentially an FTA funded project (New Starts or Small Starts). Given the demands for federal funds, this option will need to be evaluated by MTA within the context of other capital project priorities system wide.

Table 3-10 | Conservative Headway Estimate

Peak Period	Potential Riders / Hour	Headway
AM (6am – 10am)	2080	85 seconds
Mid-Day (10 am – 3pm)	1903	95 seconds
PM (3pm – 7pm)	2774	65 seconds
Evening (7pm – 11pm)	1147	2.5 minutes
Overnight (11pm – 6am)	115	*

* Overnight headway should be determined based on service level.

Table 3-11 | Reduced Headway Estimate

Peak Period	Potential Riders / Hour	Headway
AM (6am – 10am)	1456	2 minutes
Mid-Day (10 am – 3pm)	1332	2.25 minutes
PM (3pm – 7pm)	1942	90 seconds
Evening (7pm – 11pm)	803	3.75 minutes
Overnight (11pm – 6am)	81	*

* Overnight headway should be determined based on service level.

Table 3-12 | Net Decrease in Buses Entering Downtown

Period	Net Decrease in Buses (per hour) – Conservative Headways	Net Decrease in Buses (per hour) – Reduced Headways
AM (6am – 10am)	-53	-59
Mid-Day (10 am – 3pm)	-31	-36
PM (3pm – 7pm)	-28	-36
Evening (7pm – 11pm)	-27	-30
Overnight (11pm – 6am)	-6	-7
Total (Daily)	**-629 Daily Buses**	**-729 Daily Buses**

Table 3-13 | Net Decrease in Vehicle Hours

Period	Net Decrease in VRH (per hour) - Conservative Headways	Net Decrease in VRH (per hour) – Reduced Headways
AM (6am – 10am)	-20	-22
Mid-Day (10 am – 3pm)	-11	-13
PM (3pm – 7pm)	-10	-13
Evening (7pm – 11pm)	-9	-10
Overnight (11pm – 6am)	-2.5	-3
Total (Daily)	**-223 VRH / Day**	**-260 VRH / Day**

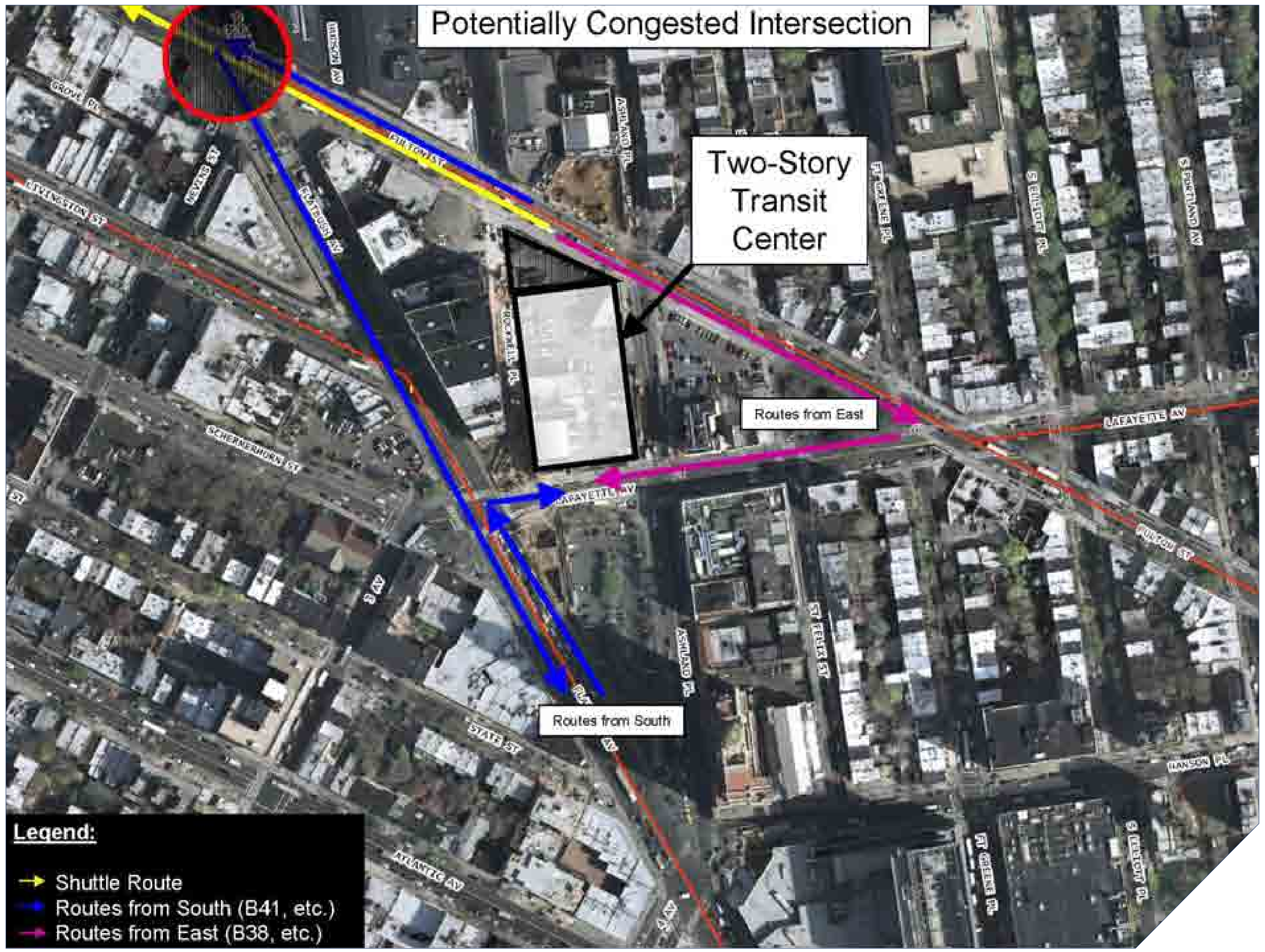

Figure 3-31 | Transit Center Alternative 1

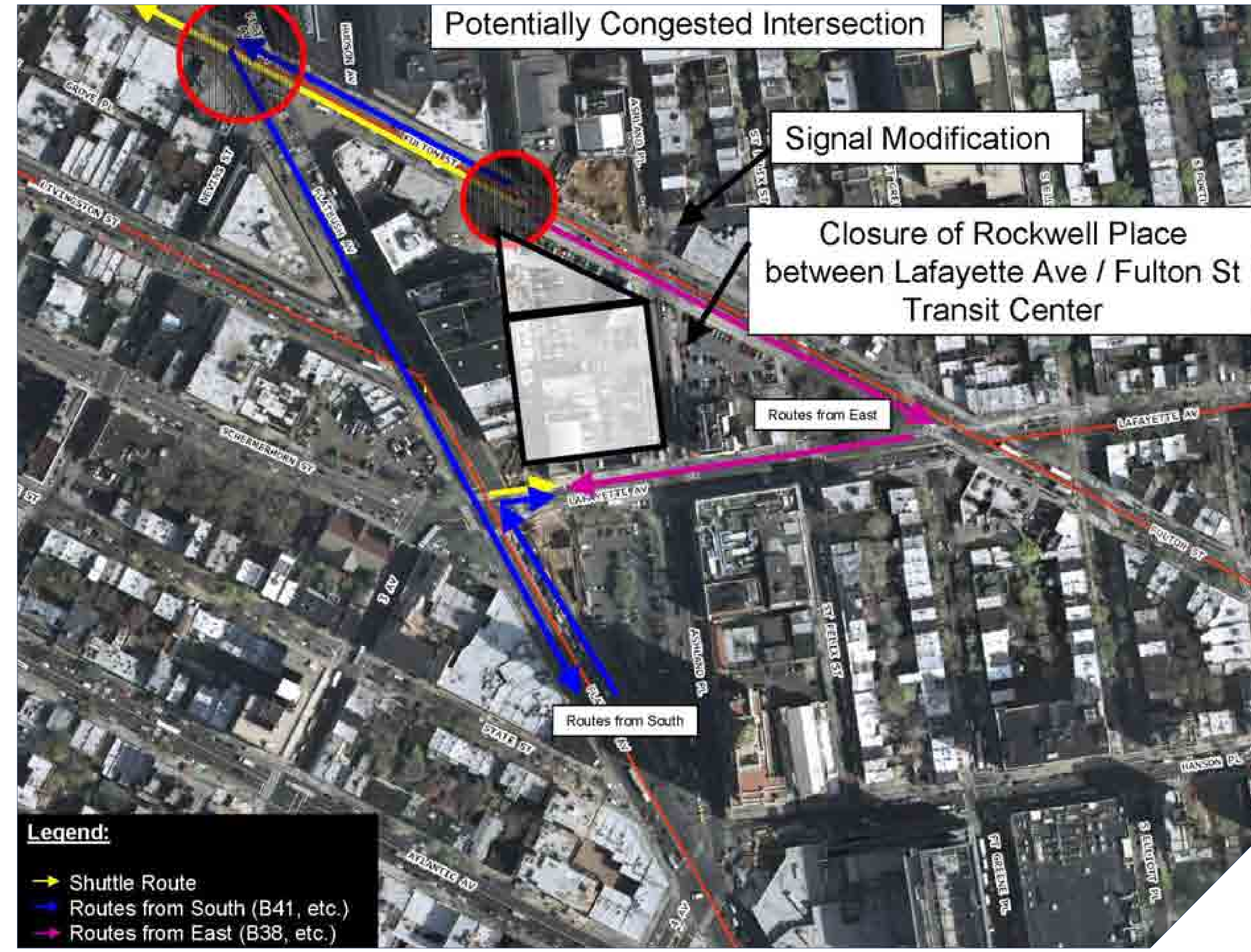

Figure 3-32 | Transit Center Alternative 2

Comparison of Transit Center Options

Land requirements vary for transit centers depending on the number of buses per hour and typical transit centers range from 1 to 3 acres. A site at Atlantic Terminal was originally considered and has been mentioned by NYCT; however, the project indicated that this property is currently not available for a bus transit center. The study team recommends that this location be reconsidered in the event that this alternative proceeds.

Alternative 1 would utilize the current parking lot near Ashland Place and Fulton Street, as seen in Figure 3-31. NYC digital tax maps list the owners as the City of New York / Brooklyn Academy of Music. The City of New York is looking at developing a mixed used building in this area, the transit center would have to incorporate this. The site is narrow and would therefore require a two-level transit center to handle the between 130 and 140 buses per hour using the transit center in the PM peak period. A two-level facility would allow shuttles to arrive on the lower level and require riders to complete a vertical transfer to the routes servicing the rest of Brooklyn. A vertical transfer is not ideal for customer satisfaction. It would also increase the operating costs of the transit center, requiring elevators and escalators to be ADA compliant.

Additional space is needed to maintain a one-story transit center. Closing Ashland Place between Lafayette Avenue and Fulton Street could provide this additional space for the transit center; however, it is not likely that the city would agree to such a closure. Additional investigation is needed to determine a more optimal solution such as closing Rockwell Place. As seen in Figure 3-32, Alternative 2 utilizes Ashland Place, thereby eliminating the needs for the two-story transit center. In addition, transit signal priority could be established at Ashland Place and Fulton Street, to allow buses to merge onto Fulton Street. Impacts to auto movements, however, would need to be reviewed and analyzed. Both Alternative 1 and 2 create a potentially congested intersection at Flatbush Avenue and Fulton Street, where the shuttle bus would be required to cross Flatbush Avenue. Existing signal timings cannot be modified to provide priority to crossing buses, as Flatbush Avenue is an important corridor to access the Manhattan Bridge. Further, recently started construction of the Theater For A New Audience on Ashland Place between Lafayette Avenue and Fulton Street now precludes both Alternatives 1 and 2.

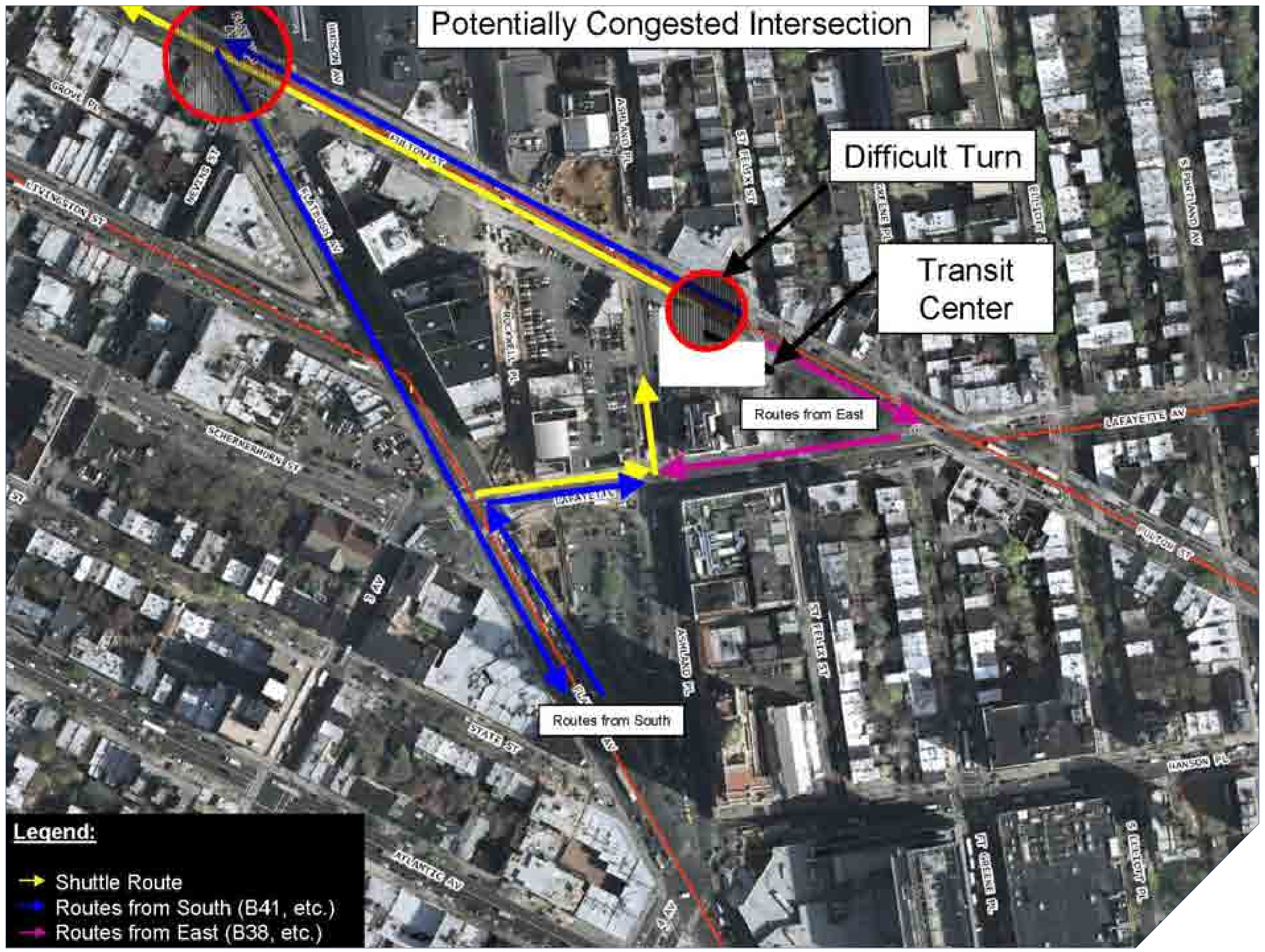

Figure 3-33 | Transit Center Alternative 3

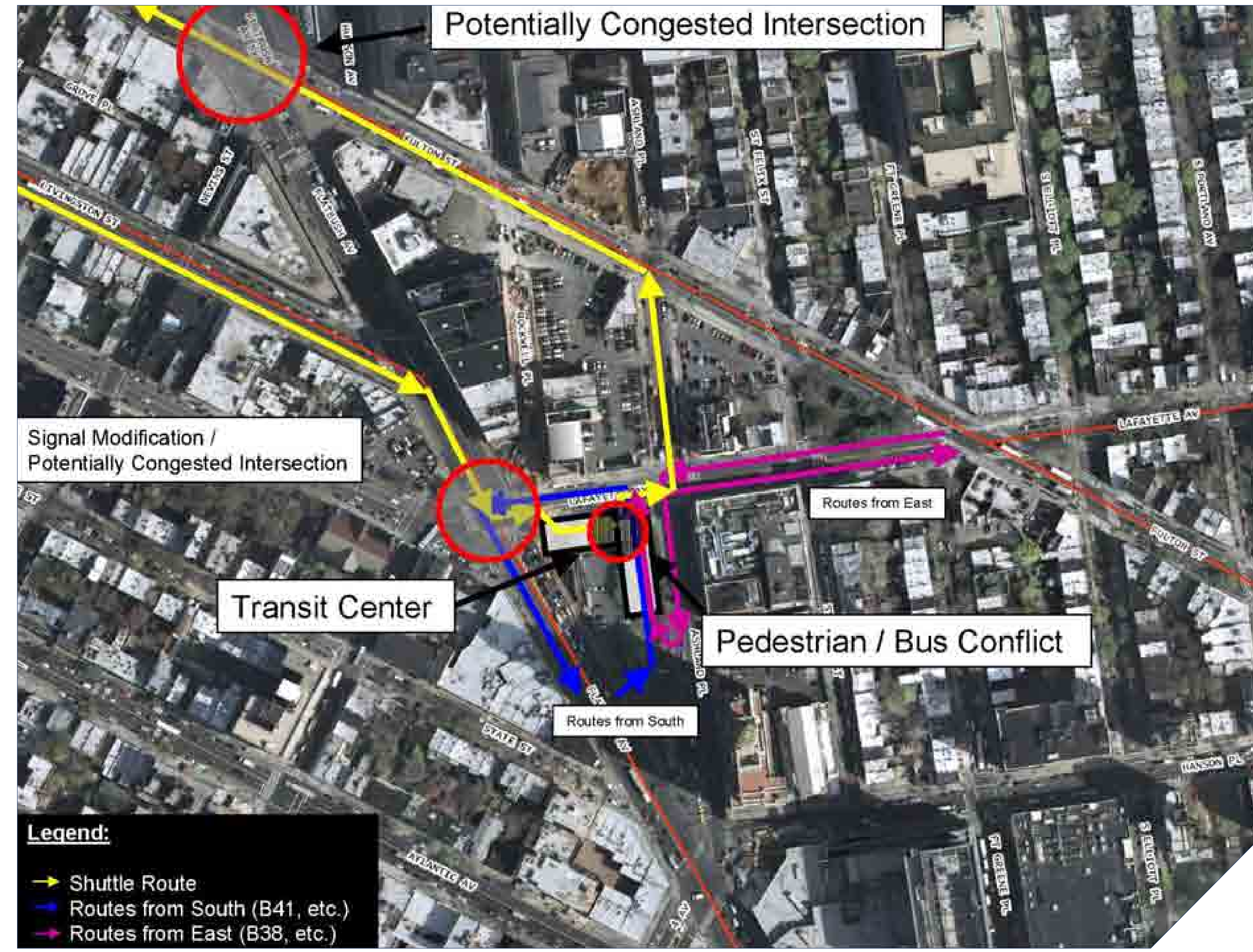

Figure 3-34 | Transit Center Alternative 4

Alternative 3 utilizes the parking lot to the east of Ashland Place, just south of Fulton Street, see Figure 3-36. This alternative allows buses to exit traffic off Ashland Place and pull through the transit facility, then exit at Fulton Street. This alternative also may cause operational problems with the intersection at Flatbush Avenue and Fulton Street. In addition, potential conflicts arise with buses pulling out of the transit center onto Fulton Street, as there is no traffic signal. Additional, NYC digital tax maps indicate that there is a private owner for this property, increasing the difficulty of obtaining this property for public use.

Alternative 4 utilizes the parking lot in the triangle south of Lafayette, East of Flatbush Avenue and west of Ashland Place, see Figure 3-34. For this alternative, Lafayette Avenue, which is currently a one-way eastbound street, will have to be changed to two directions between Fulton Street and Ashland Place, in order to allow buses from the south to exit the facility. This alternative creates two potentially congested intersections with Flatbush Avenue, at Lafayette Avenue and Fulton Street, where high volumes of buses will have to cross Flatbush Avenue. Signal timing modifications will have to be made at Lafayette Avenue and Flatbush Avenue to account for the new two-way operation of Lafayette Avenue. It is understood that the city plans to develop this site as a "Grand Plaza" at the surface with an underground parking garage, which could potentially be modified to include a transit center.

Further investigation of transit center sites is need prior to making a recommendation. Several alternatives are worthy of further investigation for feasibility.

Table 3-14 | Summary Comparison of Downtown Brooklyn Shuttle –Transit Center Options

Transit Center Location	Property Size	Advantages	Disadvantages
Atlantic Terminal Yard	2.85 Acres*	• Potential for additional economic development in conjunction with planned development at Atlantic Terminal Yard; • Ease of entry/exit for existing routes on Flatbush Avenue; • Avoids congestion and property configuration issues of locating a Transit Center in Downtown Core Area	• Pending redevelopment plans for the site; • Difficult to re-route buses from East (B38 etc.); • Requires shuttle to cross Atlantic Avenue/Flatbush Avenue intersection; • Congestion issues and left turn from Flatbush Avenue to Fulton Street
Ashland /Rockwell Place Parking Lot	1.58 Acres	• Site within Downtown Core Area; • Avoids operating the shuttle south of Atlantic Avenue/Flatbush Avenue intersection	• Property in use; • Constraints with size of parcel requires two story facility and potential transfer from one level to another – passenger inconvenience; • Turn at Fulton Street requires signal
Ashland Place Between Lafayette and Fulton	1.95 Acres	• Site within Downtown Core Area; • Provides adequate space for Transit Center; • Ease of access for buses both from the south and east; • Uses a potentially underutilized street; • Can use existing signal at Ashland Place and Fulton Street for bus signal priority to turn onto Fulton Street	• Closure of street; • Operational constraints with passenger transfer from right side of existing buses to shuttle; • Potentially increases congestion at Fulton Street and Flatbush Avenue
Ashland/Fulton Parking Lot	0.46 Acres	• Site within Downtown Core Area; • Avoids operating the shuttle south of Atlantic Avenue/Flatbush Avenue intersection; • Ease of access for buses from both the south and the east	• Property in use requires crossing Flatbush Avenue; • Property size constrained may require two-story transit center with inconvenient passenger transfer; • Difficult left turn on Fulton Street for buses exiting facility.

Proposed Alternatives to Address Passenger Experience

Table 3-15 shows the connection between passenger experience issues and their proposed alternatives.

The proposed alternatives to address the passenger experience are designed to enhance the rider experience within the study area. These options, pedestrian prioritization, the bus stop environment, improved travel information, and fare collection system could be implemented system-wide; however, emphasis should be placed on high volumes bus stops and corridors. This includes the corridors of Livingston Street / Fulton Street Transit Mall, Flatbush Avenue, and Jay Street / Adams Street.

Table 3-15 | Does the Proposed Alternative Address Passenger Experience Issues and Meet the Goals and Objectives?

PASSENGER EXPERIENCE ISSUES		PROPOSED ALTERNATIVES TO ADDRESS PASSENGER EXPERIENCE			
Issue	Location	Pedestrian Prioritization	Bus Stop Environment	Improved Travel Information	Fare Collection System
Rider Experience	Study area wide	✓	✓	✓	✓

✓ Indicates the proposed alternative could address the identified issue and meet the DBSTCS goals and objectives.

CHAPTER 4

EVALUATION OF PROPOSED ALTERNATIVES

This chapter will evaluate the proposed alternatives outlined in Chapter 3 and identify which alternatives are most suitable and implementable for Downtown Brooklyn. To accomplish this, a detailed evaluation and screening process was established to assess how well the proposed alternatives address the surface transit issues, meet the goals and objectives, as outlined in Chapter 2.

Proposed improvements to Downtown Brooklyn bus operations and reliability are in direct response to problems identified in the DBSTCS Existing Conditions Report. Significant surface transit service operates throughout the Study Area, with many routes operating on frequent headways and often subject to constrained operations because of both bus and private automobile congestion. Overlapping bus service in the Downtown Core Area further complicates this issue. The alternatives identified to improve the conditions along these corridors include the following: leading bus interval; traffic signal priority; extending bus only lanes/hours; bus stop consolidation; bus stop curb geometry; fare collection system; parking enforcement; and splitting service.

All of these alternatives are proven methods of improving surface transit, as has been demonstrated in numerous cities across the United States. In many instances, these alternatives have been employed in various parts of the MTA New York City Transit bus system, but not yet in Downtown Brooklyn. As such, to identify the solutions that are feasible and optimal for Downtown Brooklyn, the following evaluation process was utilized.

4.1 METHODOLOGY

To evaluate the alternatives presented in Chapter 3, various performance measures were selected as shown in Table 4-1. These performance measures were developed to evaluate the proposed alternatives consistent with the goals and objectives identified in Chapter 2. These measures are generally qualitative and allow for a comparison of the order of magnitude benefits and detriments of each proposed alternative. In certain cases, one performance measure correlates to multiple project objectives, and certain objectives have been defined by more than one performance measure. Table 4-1 shows the goals and objectives and the corresponding performance measures for the forthcoming evaluation of proposed alternatives.

Using the performance measures, each proposed alternative was rated based on a range of high to low performance. Point values were assigned for the respective ratings of each performance measure. A description of how these point values were applied to each performance measure is provided in Table 4-2.

Table 4-1 | Performance Measures

Goal and Objective	Performance Measure
Maximize effectiveness of the study area's surface transit network	
Improve Surface Transit	Travel time (bus service)
	Dwell time
	Traffic congestion
	Service reliability
	Vehicle hours traveled
More Comfortable and User Friendly Bus Service	Bus rider information
	Bus stop environment
	Perceived passenger safety
Implementation Factors	Capital cost
	Operating and maintenance posts
	Interagency cooperation
Provide overall transit connectivity through the study area	
Improve Intermodal Connectivity	Intermodal transfers
Improve Pedestrian Safety	Bike and pedestrian modes
Support economic health of the study area	
Improve Connectivity to Existing and Future Development	Capacity
	Future TOD potential
Maintain Existing Vehicle Access	Parking impact
	Delivery impact
Avoid Property Acquisition	Property requirements

Table 4-2 | Evaluation Methodology

Performance Measure	Basis for Scoring		
	10	5	0
Travel time (bus service)	Reduces bus service travel time	No change in bus service travel time	Increases bus service travel time
Dwell time	Results in reduced dwell times	No change in dwell times	Increases dwell times
Traffic congestion	Reduces traffic congestion	No change in traffic congestion	Increases traffic congestion
Service reliability	Improves service reliability	No change in service reliability	Reduces service reliability
Vehicle hours traveled	Reduce vehicle hours traveled	No change in vehicle hours traveled	Increases vehicle hours traveled
Bus rider information	Improves bus rider information	No change in bus rider information	Reduces bus rider information
Bus stop environment	Improves bus stop environment	No change in bus stop environment	Worsens bus stop environment
Perceived passenger safety	Improves passenger safety	No change in passenger safety	Reduces passenger safety
Capital cost	Requires minimal capital cost	Requires some capital cost	Requires higher capital cost
Operating and maintenance costs	Requires minimal O&M cost	Requires some O&M cost	Requires higher O&M cost
Interagency cooperation	Requires coordination	Requires minimal interagency coordination (less than three agencies)	Requires more interagency coordination (more than three agencies)
Intermodal transfers	Improves intermodal transfers	No change to intermodal transfers	Reduces intermodal transfers
Bike and pedestrian modes	Improves connections to bike and pedestrian modes	No connections to bike and pedestrian modes	Reduces connections to bike and pedestrian modes
Bus capacity	Increases bus capacity	No change in bus capacity	Reduces bus capacity
Future TOD Potential	Increases the potential for future TOD	No change in the potential for future TOD	Reduces the potential for future TOD
Parking impact	Reduces parking impacts	No change to parking impacts	Increases parking impacts
Delivery impact	Reduces interference with deliveries	No change in inference with deliveries	Increases interference with deliveries
Property requirements	Requires no property acquisition	Requires minimal property acquisition (one owner)	Requires property acquisition of more than one owner

Total Rating

The scores of each performance measure were totaled to determine a final rating of low, medium, or high. Proposed alternatives with scores of 95 or lower were given a 'low' rating. Total scores greater than 95, but less than 110 were given a 'medium' rating, and scores greater than 110 were given a 'high' rating. The scores allocated to each alternative for each performance measure are included in Appendix A.

Feasibility and Timeframe

In addition, each proposed alterative was evaluated in terms of feasibility and timeframe to implement. Proposed alternatives that are not feasible in Downtown Brooklyn were eliminated for further consideration. Tables 4-3, 4-4, and 4-5 depict this evaluation process for reliability issues, service coverage issues, and passenger experience issues, respectively. In addition, Tables 4-3, 4-4, and 4-5 include the rating score, as determined above, and included in Appendix A.

4.2 NEXT STEPS

Based on this evaluation process, proposed alternatives can be prioritized. Some alternatives are important to implement in the short-term, and others can be considered over the long-term as Downtown Brooklyn continues to develop. The implementable short- and long-term improvements are identified and further discussed in Chapter 5.

RELIABILITY ISSUES						
Issue	Location	Proposed Alternative	Description	Is it Feasible? (1)	Timeframe (2)	Rating (3)
Congested Corridors	Flatbush Avenue	Leading Bus Interval	Eastbound direction (Livingston Street) to facilitate turning along Flatbush Avenue	👍	⇨	●
		Traffic Signal Priority	Additional coordination/analysis necessary	Unknown; additional analysis recommeded		
		Bus-Only Lane/Hours	Add bus lanes *NOT RECOMMENDED - high vehicular traffic*	👎		
		Bus Stop Reconfiguration	Consolidation *Study area wide (less than 750 feet)*	👍	⇨	◐
		Fare Collection System	Smartcard *System wide*	👍	⇨ ⇨ ⇨	◐
			Off-Board Fare Collection	👍	⇨ ⇨ ⇨	◐
			Fare Free Service *Targeted service*	👍	⇨ ⇨ ⇨	●
			Variable Time Pricing *System wide*	👍	⇨ ⇨	○
		Parking Enforcement	Enforcement of bus lane parking regulations *NOT NECESSARY - lack of bus lanes*	👎		
		Splitting Existing Routes	Split service routes *NOT RECOMMENDED - short routes with downtown terminus*	👎		
	Fulton/Livingston Corridor	Leading Bus Interval	Eastbound direction (Livingston Street) to facilitate turning along Flatbush Avenue	👍	⇨	●
		Traffic Signal Priority	Additional coordination/analysis necessary	Unknown; additional analysis recommeded		
		Bus-Only Lane/Hours	Extend current bus-only lane operating hours	👍	⇨	●
		Bus Stop Reconfiguration	Consolidation *Study area wide (less than 750 feet)*	👍	⇨	◐
		Fare Collection System	Smartcard *System wide*	👍	⇨ ⇨ ⇨	◐
			Off-Board Fare Collection	👍	⇨ ⇨ ⇨	◐
			Fare Free Service *Targeted service*	👍	⇨ ⇨ ⇨	●
			Variable Time Pricing *System wide*	👍	⇨ ⇨	◐
		Parking Enforcement	Enforcement of bus lane parking regulations	👍	⇨	●
		Splitting Existing Routes	Split service routes *NOT RECOMMENDED - short routes with downtown terminus*	👎		

(1) 👍 – Yes, 👎 – No, Unknown=additional analysis necessary to determine feasibility

(2) ⇨ – Short term, ⇨ ⇨ – Mid term, ⇨ ⇨ ⇨ – Long term

(3) Rating is determined by how well the alternative meets the goals and objectives

○ Lowest performing

● Highest performing

Table 4-3 | Evaluation Process

RELIABILITY ISSUES

Issue	Location	Proposed Alternative	Description	Is it Feasible? (1)	Timeframe (2)	Rating (3)
Congested Corridors	Jay Street/ Adams Street/ Cadman Plaza West Corridor	Leading Bus Interval	Adams Street in the Southbound direction would have a left hand turn priority onto Fulton Street	👍	⇨	●
		Traffic Signal Priority	Additional coordination/analysis necessary	Unknown; additional analysis recommeded		
		Bus-Only Lane/Hours	Jay Street - Southbound lane between Tillary Street and Schermerhorn Street	👍	⇨	●
		Bus Stop Reconfiguration	Consolidation *Study area wide (less than 750 feet)*	👍	⇨	◐
			Curb Geometry *Saw Tooth Bus Stop*	👍	⇨ ⇨	◐
		Fare Collection System	Smartcard *System wide*	👍	⇨ ⇨ ⇨	◐
			Off-Board Fare Collection	👍	⇨ ⇨ ⇨	◐
			Fare Free Service *Targeted service*	👍	⇨ ⇨ ⇨	●
			Variable Time Pricing *System wide*	👍	⇨ ⇨	◐
		Parking Enforcement	Enforcement of bus lane/bus stop parking regulations	👍	⇨	●
		Splitting Existing Routes	Split service routes *NOT RECOMMENDED - short routes with downtown terminus*	👎		

(1) 👍 – Yes, 👎 – No, Unknown=additional analysis necessary to determine feasibility
(2) ⇨ – Short term, ⇨ ⇨ – Mid term, ⇨ ⇨ ⇨ – Long term
(3) Rating is determined by how well the alternative meets the goals and objectives

○ Lowest performing
● Highest performing

Table 4-3 | Evaluation Process

RELIABILITY ISSUES						
Issue	Location	Proposed Alternative	Description	Is it Feasible? (1)	Timeframe (2)	Rating (3)
Congested Corridors	Atlantic Avenue, Flatbush Avenue, and 4th Avenue	Traffic Signal Priority	Additional coordination/analysis necessary	Unknown; additional analysis recommeded		
		Parking Enforcement	Enforcement of bus lane parking regulations *NOT NECESSARY - lack of bus lanes*	👎		
	Cadman Plaza West	Traffic Signal Priority	Additional coordination/analysis necessary	Unknown; additional analysis recommeded		
		Parking Enforcement	Enforcement of bus lane/bus stop parking regulations	👍	⇨	●
		Bus Stop Reconfiguration	Curb Geometry *Sawtooth bus stop/parking regulations*	👍	⇨ ⇨	◖
	Fulton Street and Boreum Place	Traffic Signal Priority	Additional coordination/analysis necessary	Unknown; additional analysis recommeded		
		Parking Enforcement	Enforcement of bus lane parking regulations	👍	⇨	●
	Fulton Street, Smith Street, and Jay Street	Traffic Signal Priority	Additional coordination/analysis necessary	Unknown; additional analysis recommeded		
		Bus-Only Lane/Hours	Extend current bus-long lane operating hours	👍	⇨	●
		Parking Enforcement	Enforcement of bus lane parking regulations	👍	⇨	●
	Livingston Street and Boreum Place	Traffic Signal Priority	Additional coordination/analysis necessary	Unknown; additional analysis recommeded		
		Bus-Only Lane/Hours	Extend current bus-long lane operating hours	👍	⇨	●
		Parking Enforcement	Enforcement of bus lane parking regulations	👍	⇨	◖
	Livingston Street and Smith Street	Traffic Signal Priority	Additional coordination/analysis necessary	Unknown; additional analysis recommeded		
		Bus-Only Lane/Hours	Extend current bus-long lane operating hours	👍	⇨	●
		Parking Enforcement	Enforcement of bus lane parking regulations	👍	⇨	●
Long Dwell Times	Study area wide	Fare Collection System	Smartcard *System wide*	👍	⇨ ⇨ ⇨	◖
			Off-Board Fare Collection	👍	⇨ ⇨ ⇨	◖
			Fare Free Service *Targeted service*	👍	⇨ ⇨ ⇨	●

(1) 👍 – Yes, 👎 – No, Unknown=additional analysis necessary to determine feasibility

(2) ⇨ – Short term, ⇨ ⇨ – Mid term, ⇨ ⇨ ⇨ – Long term

(3) Rating is determined by how well the alternative meets the goals and objectives

○ Lowest performing

● Highest performing

Table 4-4 | Evaluation Process

RELIABILITY ISSUES						
Issue	Location	Proposed Alternative	Description	Is it Feasible? (1)	Timeframe (2)	Rating (3)
Overlapping Service	Cadman Plaza West	Adding a Shuttle System	Downtown core	👍	⇨ ⇨ ⇨	●
	Flatbush Avenue	Adding a Shuttle System	Downtown core	👍	⇨ ⇨ ⇨	●
	Fulton Street	Adding a Shuttle System	Downtown core	👍	⇨ ⇨ ⇨	●
	Livingston Street	Adding a Shuttle System	Downtown core	👍	⇨ ⇨ ⇨	●
Underserved Neighborhoods	DUMBO	Extending Existing Routes	Extending existing routes to underserved areas	👍	⇨ ⇨ ⇨	◐
		Adding a Circulator System	Connecting underserved areas	👍	⇨ ⇨ ⇨	○
	Fort Greene (Flatbush Avenue - north of DeKalb Avenue)	Extending Existing Routes	Extending existing routes to underserved areas	👍	⇨ ⇨	◐
		Adding a Circulator System	Connecting underserved areas	👍	⇨ ⇨ ⇨	○
	Waterfront Area (Brooklyn Bridge Park)	Extending Existing Routes	Extending existing routes to underserved areas	👍	⇨ ⇨	◐
		Adding a Circulator System	Connecting underserved areas	👍	⇨ ⇨ ⇨	○

(1) 👍 – Yes, 👎 – No, Unknown=additional analysis necessary to determine feasibility

(2) ⇨ – Short term, ⇨ ⇨ – Mid term, ⇨ ⇨ ⇨ – Long term

(3) Rating is determined by how well the alternative meets the goals and objectives

○ Lowest performing

● Highest performing

Table 4-5 | Evaluation Process

RELIABILITY ISSUES						
Issue	**Location**	**Proposed Alternative**	**Description**	**Is it Feasible? (1)**	**Timeframe (2)**	**Rating (3)**
Rider Experience	Study area wide	Pedestrian Prioritization	Improve safety, complete streets design concept *Atlantic Avenue and Flatbush Avenue, Smith Street and Livingston Street* Additional analysis necessary	Unknown; additional analysis recommeded		
		Bus Stop Environment	Creation of sense of place *High volume bus stops*	👍	⇨ ⇨	◐
		Improved Travel Information	New Mobility Hubs *Cadman Plaza West, Atlantic Avenue Terminal, Borough Hall, Livingston Street and Smith Street, Fulton Street Transit Mall, Flatbush Avenue and DeKalb Avenue*	👍	⇨	●
		Fare Collection System	On-Street TVMs *Key locations and high volume bus stops*	👍	⇨ ⇨ ⇨	◐
			MetroCard Vendor Information *Key locations and high volume bus stops*	👍	⇨	◐

(1) 👍 – Yes, 👎 – No, Unknown=additional analysis necessary to determine feasibility

(2) ⇨ – Short term, ⇨ ⇨ – Mid term, ⇨ ⇨ ⇨ – Long term

(3) Rating is determined by how well the alternative meets the goals and objectives

○ Lowest performing

● Highest performing

CHAPTER 5
RECOMMENDATIONS

Recommendations to improve surface transit and overall circulation within Downtown Brooklyn were developed based on results of the alternatives evaluation process described in Chapter 4, the direction of the study's Steering Committee, and input received from the public, through surveys and public workshops, throughout the study. These recommendations highlight feasible short and medium-term solutions, as well as identify longer term options. The table below summarizes these recommendations:

RELIABILITY ISSUES

Issue	Recommendation
Congested Corridors	*Short-Term*
	Implement Jay Street Bus Only Lane
	Implement Fulton and Livingston One Way Pair With Bus Only Lane
	Introduce new fare collection methods
	Long-Term
	Downtown Brooklyn Bus Priority Loop
Long Dwell Times	*Short-Term*
	Fare collection methods

SERVICE COVERAGE ISSUES

Issue	Recommendation
Congested Corridors	*Long-Term*
	Downtown Brooklyn Shuttle
	Short-Term
	Document demand for new bus service to underserved areas
Long Dwell Times	*Long-Term*
	Extend B63/B67 to Brooklyn Bridge Park

PASSENGER EXPERIENCE ISSUES

Issue	Recommendation
Rider Experience	Short-Term
	Install new bus shelters
	Install New Mobility Hub network and Mobility Hub kiosks at four locations
	Pilot automated schedule system
	Publicize vendors

GOVERNANCE

Issue	Recommendation
Agency Coordination	*Short-Term*
	Continue Steering Committee meetings on a quarterly basis

Short-Term: Immediately to 2 years

Medium-Term: 2 to 3 years

Long-Term: 3 to 5 years

5.1 IMPROVING BUS RELIABILITY

To improve surface transit through the congested corridors identified in the study area and shown in Figure 5-1 (Flatbush Avenue; Fulton Street/Livingston Street; and Jay Street/Adams Street/Cadman Plaza West), the study team recommends implementation of both short and long term measures that will give bus service priority wherever feasible. In the short term, this would include the addition of a Bus Only Lane on Jay Street and continuation of the Bus Priority Lane configuration for Livingston Street. In the long term, the Study Team recommends development of a "Bus Priority Loop" throughout the study area, as identified in Figure 5-2.

A **Downtown Brooklyn Bus Priority Loop** would ideally include the existing Fulton Street Mall Corridor and the continuation of Livingston Street as a one-way pair with permanent bus priority. In addition, a Bus Only Lane on Jay Street between Tillary and Schermerhorn would be added, along with a Bus Priority Lane within the Flatbush Avenue Corridor from the Atlantic Avenue/ Flatbush intersection to Fulton Street.

Adding a bus priority lane along Flatbush Avenue; however, presents a challenge. Given the current importance of Flatbush Avenue for vehicular traffic to the Manhattan Bridge, a bus priority lane on any section of Flatbush Avenue is currently not feasible. A comprehensive traffic network analysis would be necessary to determine the feasibility of adding bus priority on Flatbush Avenue between Atlantic and the Manhattan Bridge, as the roadway is at capacity.

In the interim, a Bus Only Lane could be developed on Jay Street between Tillary and Schermerhorn. Figure 5-3 shows a typical conceptual plan for a Jay Street Bus Only Lane. This short-term recommendation would accomplish the following:

- Increase southbound bus capacity, which would allow the removal of buses from Adams Street, eliminating the poor connection to Fulton Street;
- Provide bus priority in a congested corridor, while still allowing access to Manhattan-bound bridges for northbound vehicle traffic;
- Reduce bike/bus and bike/vehicle conflicts; and
- Strengthen the regional bike network by providing connections to the Brooklyn Bridge, Manhattan Bridge, and Downtown Brooklyn.

There are several steps that need to be reviewed prior to implementation of the **Jay Street Bus Only Lane**. First, signal re-timing would be required at several intersections, including Tillary Street, Fulton Street, and Livingston Street. In addition, this new configuration would restrict access to businesses such as the Marriott hotel along southbound Jay Street. However, access to these businesses could be provided by other streets.

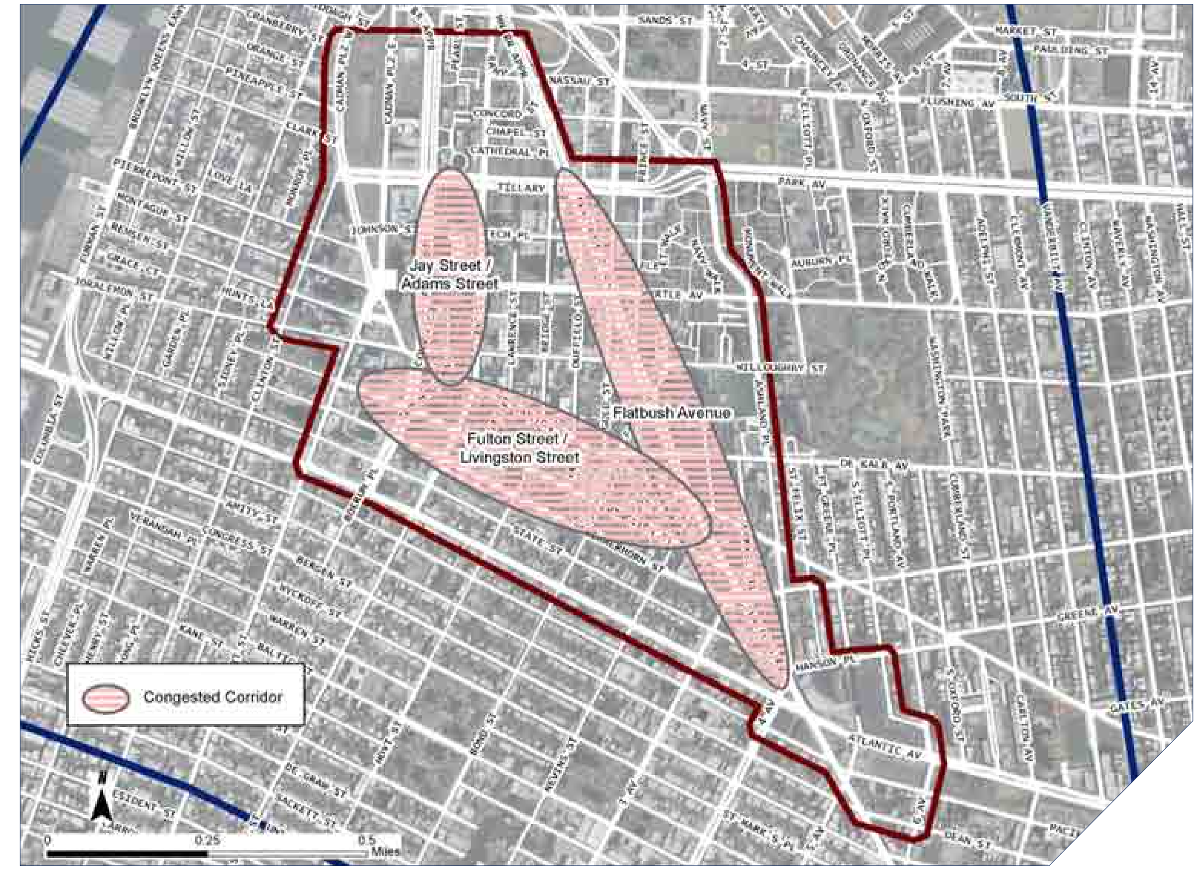

Figure 5-1 | Congested Corridors

Figure 5-2 | Bus Only Lane Network

As another short term recommendation, Livingston Street should be a one-way Bus Only Lane paired with Fulton Mall. For the **Livingston Bus Only Lane / Fulton Mall**, Westbound Fulton Street buses would remain on Fulton Street, as it operates today, and all buses that currently operate along Livingston Street would remain on Livingston Street. In addition, the eastbound Fulton Street Mall buses would be re-routed to eastbound Livingston Street. Re-routing buses in the eastbound direction presents fewer operational impacts than in the westbound direction. Moreover, this alternative eliminates the need to accommodate buses turning left from Fulton Street onto Flatbush Avenue and buses turning right from Flatbush Avenue to Livingston Street.

The **Livingston Bus Only Lane / Fulton Mall** alternative incorporates several operational improvements:

- Optimizes signal timings along Livingston Street to facilitate east-west vehicle movement;
- Prohibits all traffic except buses from using the Livingston Street eastbound bus-only lane between Nevins Street and Flatbush Avenue;
- Incorporates a "leading bus interval" at the eastbound approach to the intersection of Livingston Street and Flatbush Avenue to facilitate the southbound left turn at the intersection of Flatbush Avenue and Lafayette Street; and
- Elongates the traffic signal time allocation for the southbound left turn approach of the intersection of Flatbush Avenue and Lafayette Street.

Also included in the efforts to improve service reliability are measures for **Improved Fare Collection**, as on-board fare collection contributes to longer dwell times and service delays. Two fare collection measures are recommended to improve service reliability.

As a first step, MTA NYCT should undertake a public relations campaign that identifies vendors in Downtown Brooklyn who currently sell Metro-Cards. Based on passenger surveys undertaken as part of this study in April and May 2009, many survey respondents and focus group participants are not aware that MetroCards are sold at locations other than MTA facilities. Better outreach is needed to improve public awareness.

A second step to improve fare collection is the addition of Ticket Vending Machines (TVM) at the street level. Based on the feedback and concerns of existing bus riders, access to TVMs is limited or restricted to subway stations only. Adding TVMs at the street level could be coordinated through the Downtown Brooklyn Partnership with the participation of the NYCDOT and MTA NYCT. Corridors, that would be ideal for TVM placement are shown in Figure 5-4.

Figure 5-3 | Typical Conceptual Plan for Jay Street Transit Priority

Third, consideration should be given to off-board fare collection on a route-by-route basis. As a demonstration for Brooklyn bus routes, off-board fare collection should start with the B41 Limited. This route is currently under evaluation by MTA NYCT. Other potential off-board fare collection candidate routes include the B38, B45, and B54, given the high number of boardings within the study area.

The implementation of the **Downtown Brooklyn Shuttle**, while an attractive option that could reduce the number of buses circulating in the Downtown Core and provide greater service efficiencies, cannot move forward in the short term for a number of reasons. First, there is no available parcel of land with adequate space for a bus transfer facility within the Study Area. Second, for this option to be effective, the **Downtown Brooklyn Bus Priority Loop** would need to be implemented, but this alternative has its own limitations and requires additional traffic analysis, as described above. Last, this option requires the addition of new bus equipment, which would put demands on the MTA's capital budget at a time when the system is forced to make cutbacks.

The Study Team recommends that the **Downtown Brooklyn Shuttle** be reconsidered once a system of Bus Only Lanes and a **Downtown Brooklyn Bus Priority Loop** is established. Similarly, as parcels are redeveloped in the Study Area and/or property becomes available, this recommendation may prove feasible.

5.2 EXPANDING SERVICE COVERAGE

The study identified several areas that are currently underserved by surface transit, especially in comparison to other areas in Downtown Brooklyn. Surface transit is a mode that is particularly important to senior citizens, as was mentioned repeatedly in the surveys of passengers conducted in the study. While it may be correct to state that a neighborhood is served by transit if it has a subway stop, the lack of bus routes poses an impediment to the use of transit for those residents who have physical difficulties maneuvering through the underground labyrinth of a subway system.

As shown in Figure 5-5, several steps can be taken to expand surface transit coverage in the short or long term: **Extend the B63** bus north from Atlantic Avenue to Brooklyn Bridge Park via Furman Street; and **Extend the B67** bus North from Jay Street to Brooklyn Bridge Park via DUMBO. Additionally, the B25 and B38 is also a potential candidate for extending into Brooklyn Bridge Park, as shown in Figure 5-5. These extensions can be done in phased implementation as demand grows along the waterfront.

Given the 2009-2010 MTA budget crisis and service cutbacks, a critical first step would be documentation of demand in neighborhoods identified as underserved. This can be done by performing origin and destination surveys. Once this is completed, the service extensions recommended as part of this study should be given full consideration and implemented as soon as funding is available.

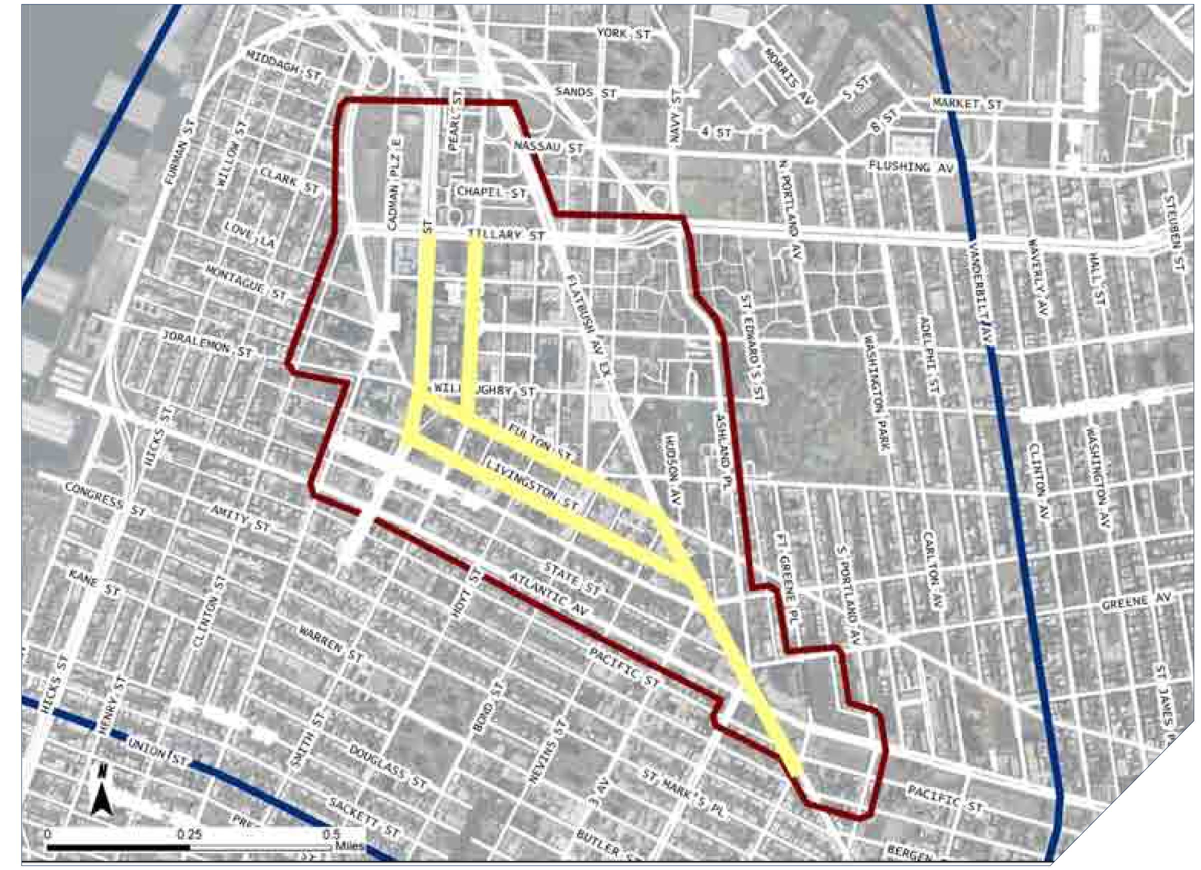

Figure 5-4 | Potential Corridors for TVM Placement

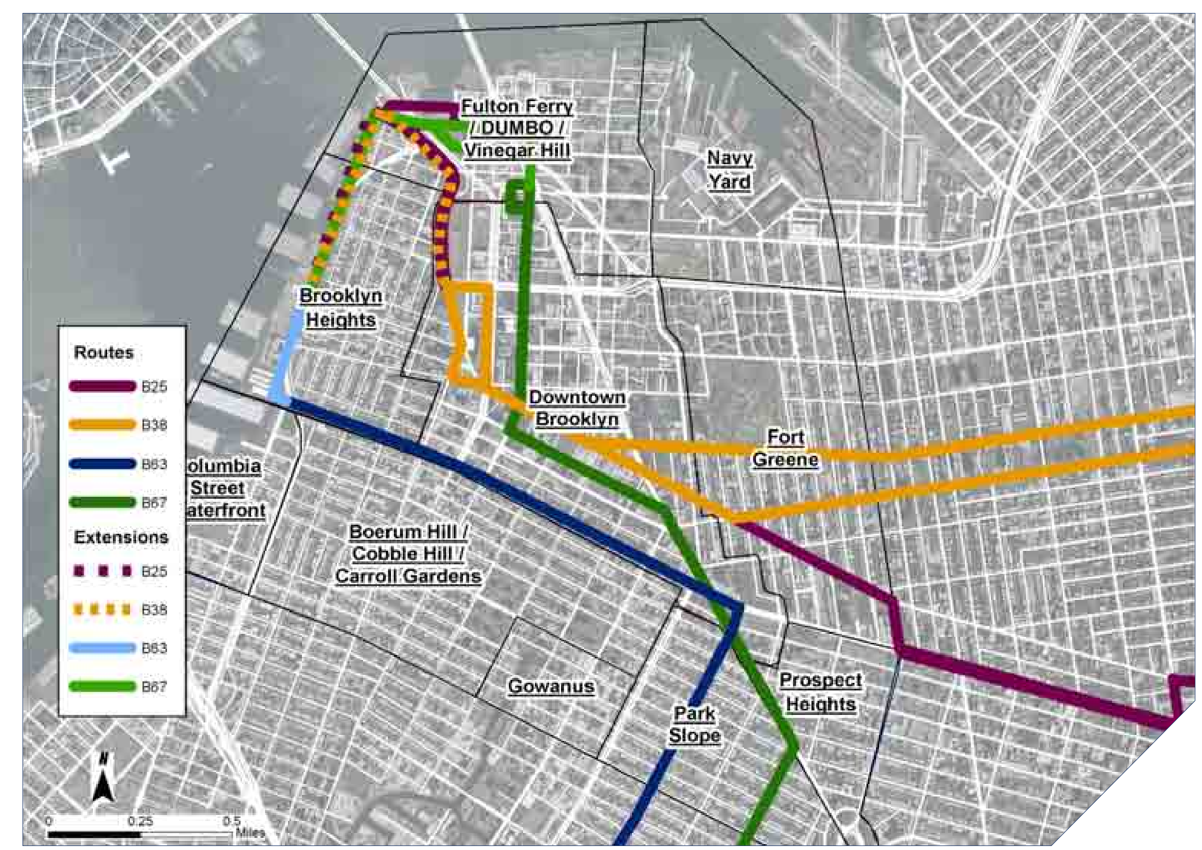

Figure 5-5 | Route Extensions

To improve the overall passenger experience in the Study Area, the study team recommends several courses of action, including two-short term and one long-term solutions.

Bus shelters should be added wherever possible to improve passenger waiting comfort. These New Shelters and a Pilot-Automated Schedule System respond specifically to the almost 25 percent of survey respondents who said shelters are the most important improvement to bus stops. The priority locations are:

Intersection
FULTON ST & JAY ST
FULTON ST & FLATBUSH AV EXT
ADAMS ST & BKLYN SUPREME COURT
JAY ST & WILLOUGHBY ST
FULTON ST & HOYT ST
ATLANTIC AV & FLATBUSH AV
LIVINGSTON ST & HOYT ST
FULTON ST & LAFAYETTE AV

In addition, while it would not be possible or financially feasible to provide system-wide bus schedules updates, a pilot program demonstrating an automated schedule system should be installed at key locations throughout Downtown Brooklyn. This system would provide real time information on bus arrivals and departures and respond to the need to provide passengers with up-to-date schedule information.

In combination with the addition of bus shelters, a pilot automated bus schedule system, and the city's efforts to develop a bike share program, Downtown Brooklyn should serve as a demonstrator program for a New Mobility Hub Network. For this demonstrator program, the initial placement of four hubs within the Study Area is recommended. Each of these hubs would include a bike share component; a real-time information kiosk with linkage to smartphones; MetroCard and fare information; neighborhood and block information highlighting retail and institutional services; and details on bus, subway, and commuter rail services. Figure 5-7 depicts what a New Mobility Hub Network could look like in the vicinity of Borough Hall.

Figure 5-7 | New Mobility Hub

To fund the pilot New Mobility Hub Network, the NYCDOT should consider funding such as the Section 5316 Jobs Access and Reverse Commute Grant from the Federal Transit Administration. Since re-authorization of the Safe, Accountable, Flexible Transportation Equity Act – A Legacy for Users (SAFETEA-LU) has not yet occurred, additional potential funding sources should be continually monitored.

5.3 GOVERNANCE

During the course of this Study, the Project Steering Committee met periodically to discuss improvement options, share perspectives on issues related to surface transit throughout the study area, and provide input on the specific policies and practices of their respective organizations. Led by NYCDOT, the Steering Committee should continue to meet on a regular basis, perhaps quarterly, to share ideas and issues related to Downtown Brooklyn surface transit and circulation issues. This will provide a forum for specific problems to be addressed, and a means for advancing recommendations from this report into the implementation stage.

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