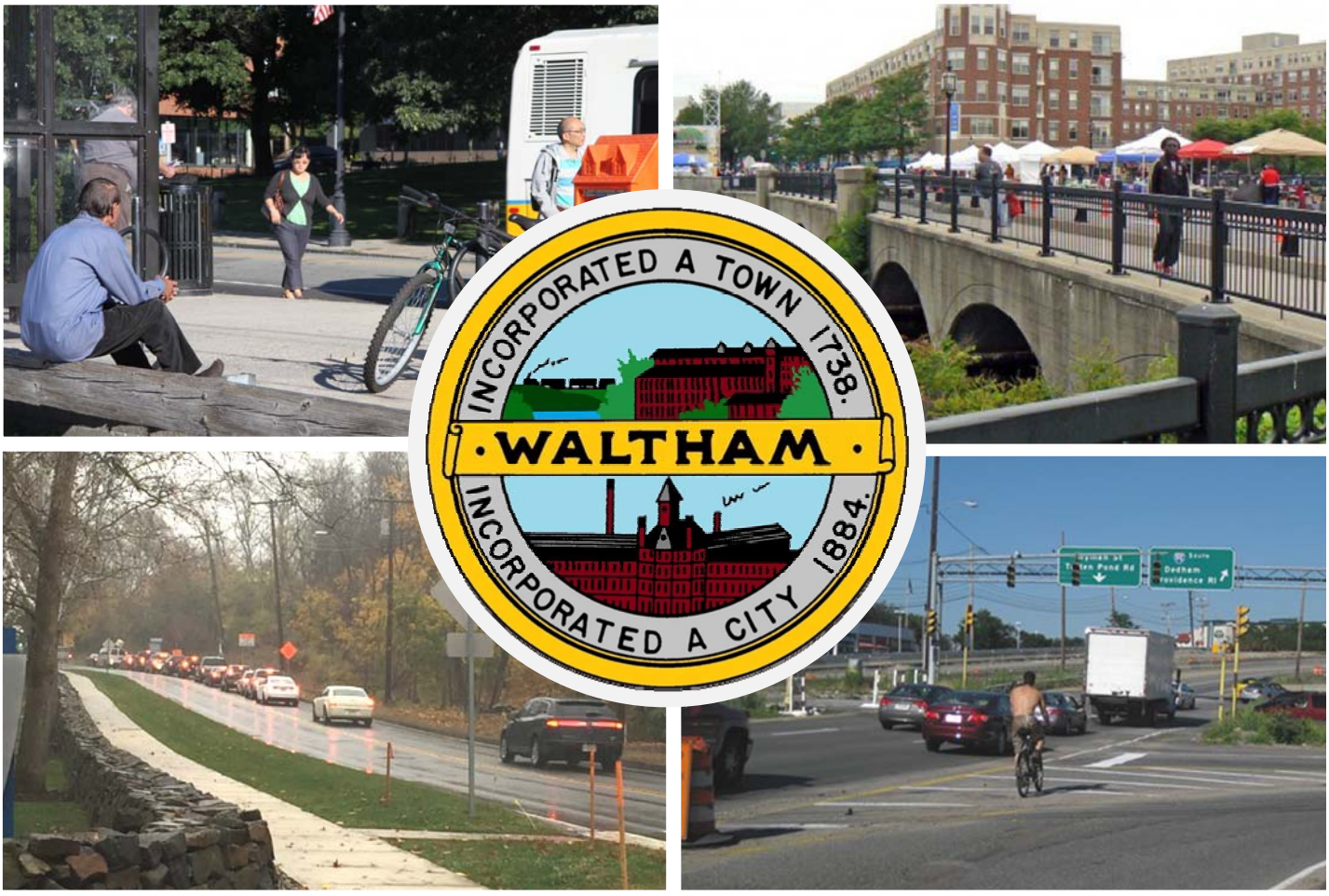
City of Waltham
Transportation Master Plan

Prepared for

City of Waltham



Prepared by

McMAHON
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1. Overview

A. Introduction

The City of Waltham has undertaken a Transportation Master Plan (TMP) to map out the City's transportation future. Given the size of Waltham, the intensity of the roadway system with a range of classifications, the diverse land uses being served including two major universities and the presence of a well-established MBTA Bus Service/Commuter Rail, the TMP addresses many aspects and assists the City in addressing transportation issues.

The initiation of this TMP is reflective of the City's proactive approach to dealing with transportation issues that affect the City's residents, workers, and visitors. The City's forward thinking and strategic approach to address the City's transportation issues will serve as a valuable framework for decision making.

Taking a multi-modal approach, the TMP focuses on all modes of transportation including vehicles, pedestrians, bicyclists and transit users, supporting the implementation of the City's Complete Streets Policy. This policy was established in 2014 and requires that projects be designed, operated, maintained and enforced to provide safety and accessibility for all users including motorists, pedestrians, bicyclists and transit riders of all ages and abilities. Furthermore, the City recognizes that the current traffic congestion experienced in Waltham threatens the quality of life for those who live and work in the City. The traffic congestion is reflective of many factors both regionally and locally and cannot be easily fixed by simply adding infrastructure. Today's transportation solutions involve both policy and infrastructure changes. In addition to implementing physical improvements, easing today's congestion and minimizing the congestion encountered in the future will require mode shift, smart land use planning, and mitigation on the state, City and private partnership level.

The TMP focuses on the entire City with specific detail given to major corridors, transit routes and over 90 key intersections. The TMP also includes a parking evaluation of the downtown area.

The TMP offers strategies for operating, managing, and financing the transportation network. The Plan provides recommendations for high level citywide transportation policy as well as specific improvements for four corridors, 20 key intersections, one major bus route, and parking strategies for downtown. Implementation of the improvement strategies will involve partnerships with federal and state agencies, private developers, and coordination within the City's internal departments.

The TMP was developed through a robust public process, has been built with general consensus, is easily understandable and will serve as a living document evolving over time to reflect future changes in land use, priorities, and the surrounding regional transportation network.

B. Background

With a population of 63,378[1] residents, an employment base of more than 52,000 employees, and a total area of 13.6 square miles, the City of Waltham is a desirable city in which to live, work, shop, study and play. The city's diverse location and uses, urban downtown, growing innovation center on Routes 128/I-195, and access to open space makes Waltham strong in terms of residential, commercial and institutional land uses. From a transportation perspective, Waltham provides excellent regional connections due to its close proximity to Boston and to major interstates including I-95/Route 128 and I-90 (Massachusetts Turnpike), as well as being located on the Massachusetts Bay Transit Authority (MBTA) Fitchburg/Boston Commuter Rail line. The regional roadway and transit connections offer great development opportunity within Waltham, as is already evident in the development that exists along the I-95 corridor and in close proximity to the transit stations. In addition, Waltham is home to two higher educational facilities, both of which are the city's top employers; Bentley University and Brandeis University, whose combined enrollments total over 11,000 students. Waltham is also home to several other large commercial employers located along the Route 128 corridor. In addition, there are several large developments on the horizon that have been recently approved at the local and state level. The development potential coupled with Waltham's connections to the regional transportation network present a challenge for the City to mitigate the transportation growth associated with the development. Similarly, to retain the City's vibrant residential and business communities, the City is challenged to manage the existing transportation network so as to protect appropriate areas from induced traffic congestion, to offer transportation options, to improve connectivity, and to maintain the existing network.

C. Study Purpose

The purpose of this project is to articulate the City's desired transportation vision and outline how to best manage traffic to protect residential neighborhoods, promote business in designated areas, improve safety, offer mode choice and ensure quality of life for residents. The TMP offers a long range plan to guide the City and developers on the investment of transportation infrastructure. Strategies and prioritization are outlined in the form of short and long term improvements, with estimated costs and potential funding sources identified.

This TMP was developed in coordination with the City of Waltham Traffic Engineering Department, as well as the Traffic Commission, the Planning Department and the Police Department. It will serve as a living document for capital planning and budgeting needs for potential future short term and long term transportation improvement projects. The process for the TMP has included the following tasks:

Task 1: Existing Inventory and Data Collection

Task 2: Evaluate Existing and Future Conditions

Task 3: Identify Issues/Deficiencies and Develop Action Plan

Task 4: Transportation Master Plan Report

Task 5: Stakeholder Coordination

[1] American Community Survey 2015 Population estimate.

Goals and Objectives

The goal of this Transportation Master Plan report is to identify existing transportation issues, develop strategies to address transportation issues, and to recommend specific solutions and an action plan for realistic future transportation improvements and initiatives within the city. The action plan will identify multi-modal improvements that will increase safety and circulation for motorists, pedestrians, bicyclists and public transit users and help accommodate future growth concerns.

Goals for a balances transportation system:

- Improve, or at a minimum maintain quality of life for residents and businesses while supporting economic vitality.
- Increase the number of trips made by carpooling, transit, bicycling and walking to help reduce overall congestion.
- Identify specific capital improvements each with clear implementation strategies, including possible funding sources.
- Promote more communication and education about transportation options and easy ways to get around
- Make downtown parking easier.
- Protect resident neighborhoods from overflow business parking.
- Increase economic vitality of downtown with more on-street parking turnover.
- Improve transit customer experience by making it easier to understand and use. This could include: better connectivity of schedules, improvements to pick up/drop off points, clear/visible information on fares and schedules.
- Support employer/university programs to increase transit trips.
- Encourage more trips by bicycle by expanding facilities both on and off road.
- Advance bicycle plan into a criteria for facilities.
- Define implementation criteria to improve pedestrian crossings.
- Establish safe walking routes near schools for parents and children to use.
- Identify missing links in the pedestrian network and prioritize locations for capital improvements.

D. Public Outreach and Process

Stakeholder coordination was a primary task throughout the development of the Waltham TMP. Stakeholder coordination included public outreach, agency coordination, and educational institution outreach, as well as consistent internal team coordination meetings with City officials. Table 1-1 provides a summary of the project meetings with specific details such as the comment periods for each public meeting.

A robust public outreach plan was conducted throughout the development of the Waltham TMP. Outreach was conducted through a public survey and in a series of public meetings held at strategic points in the TMP development.

Table 1-1: Summary of Project Meetings

Public Survey	19-Nov-15 through 31-Dec-15	To gain additional prospective on issues within the City of Waltham from people who live, work, and go to school in Waltham.
Kick-Off Public Meeting	18-Nov-15	Project overview & Schedule, existing transportation and parking conditions. A 30 day comment period was associated with this PM.
Comment Period	19-Nov-15 through 09-Dec-16	The presentation was posted on the City's website for review and comment. Feedback on the material was encouraged in a 30 day comment period.
Public Meeting 2	17-May-16	Project findings, parking and transit recommendations, 26 concept plans for corridor and intersection improvement. The meeting format included an open house before and after the formal presentation. A 58 day comment period followed this PM.
Waltham Traffic Commission	19-May-16	Summary of project recommendations
Comment Period	20-May-16 through 20-Jun-16	The presentation was posted on the City's website for review and comment. Feedback on the material was encouraged in a 30 day comment period.
Draft Document	04-Nov-16	Draft of the transportation master plan showing recommendations after public comment
Comment Period	05-Nov-16 through 06-Dec-16	The draft report will be posted on the city's website for additional revew and comment. Feedback on the material was encouraged in a 30-day comment period.
Final Plan Presented	TBD	Final recommendations for the transportation master plan

Public Survey

A public survey was offered online and on paper to gain additional prospective on issues within the City of Waltham from people who live, work, and go to school in Waltham. The survey period started on November 19, 2015 and was open through the end of 2015. Public participation in the survey was encouraged at public meetings and through social media and local media. The City of Waltham had copies of the survey available in the Traffic Engineer's office and the Library, plus it was posted on the home page of the City website. The survey provided questions on a wide range of transportation modes including vehicle, pedestrian, bicycle, and transit usage. Participants were asked what areas of the city they are most likely to travel through, what areas are in greatest need of improvement, and what improvements they would like to see implemented. Over 3,400 responses were recorded.

The survey results revealed that driving is the predominant mode of travel in Waltham. The majority of respondents were those who work in Waltham, followed by residents, and a small number of students. The need for roadway improvements and the location of the most congested areas were fairly evenly spread throughout the areas of the city surveyed, with the exception of the fewest responses in the Brandeis/Roberts and Bentley/Fernald neighborhoods. The areas reported as in most need of roadway improvements and having frequent congestion are in the northwestern area of Waltham where there is a predominance of business parks. These results may show the prevalence of respondents' familiarity and concern over this area of the city more so than others. The most desirable improvements are the addition of left turn lanes and traffic signalization, with the least desirable being reducing the number of traffic lanes.

From the survey results we can also conclude that significantly more respondents use a personal vehicle to commute to work than public transit, walking, and biking. The majority of those who do walk or bike do so for recreational purposes. The majority of transit riders, both bus and commuter rail, do so to commute to work. Some of the major obstacles to transit, bicycle and walking include convenience, comfort, and safety. Top ranked obstacles include the perception that public transportation is not as convenient as a personal car, the need for better sidewalk maintenance, and the desire for more off-road bike paths or trails, specifically the Wayside Trail (also called Mass Central). A detailed summary report on the survey results and the survey itself are included in Appendix A.

Public Meetings (PM)

A kick-off public meeting was held on November 18, 2015 at Waltham Government Center to discuss the project with members of the public and solicit feedback from attendees. The presentation covered the following topics:

- Project overview and the expected project schedule
- Existing transportation network conditions for the City of Waltham including, traffic volumes, crash analysis for study area intersections and corridors
- Analysis on existing parking conditions,
- Existing healthy transportation facilities including pedestrian, bicycle, and transit
- Existing traffic operations analysis for each study area intersection
- Next steps in the Transportation Master Plan process.

The presentation was posted on the City's website for review and comment. Feedback on the material was encouraged in a 30 day comment period. The presentation is provided in the Appendix B of this report.

A second public meeting took place on May 17, 2016 at Waltham Government Center to discuss the analysis findings and recommended mitigation for the City as a whole as well as five corridors and 20 study area intersections that were identified for specific improvements. The recommendations presented were concepts and public feedback was encouraged. The meeting consisted of an open house to view and discuss the concepts with the project team, followed by a formal presentation of the recommendations and an additional open house following the presentation. A comment period was open to the public to solicit additional feedback from May 3-June 30, 2016. The content of the presentation was available online for interested individuals who were not able to attend the meeting. The presentation was posted on the City's website with links to the presentation itself; prior presentations and links to each of the 26 concept plans for corridor and intersection improvements. The presentation was also available in the Traffic Engineer's office for review and comment by anyone unable to attend the meeting. The presentation has been included in the Appendix B of this report.

A third public meeting was held on May 19th, 2016 at the City of Waltham Traffic Commission to present the analysis findings and recommended mitigation for the City and select corridors and study area intersections.

E. Study Area

The study area was developed by the City of Waltham and includes 92 intersections that cover the city's major corridors and areas of concern for safety and traffic operations. As seen in Figure 1-1, the study area covers key intersections over the entire city. A complete listing of the 92 intersections is provided in Appendix C.

Of the 92 intersections, 73 intersections are signalized, 18 intersections are stop-controlled, including both two-way and all-way stop conditions, and one intersection is a roundabout. The selection of the 92 intersections was based upon the traffic operation and safety data available, knowledge of planned and potential development and the insight of City officials.

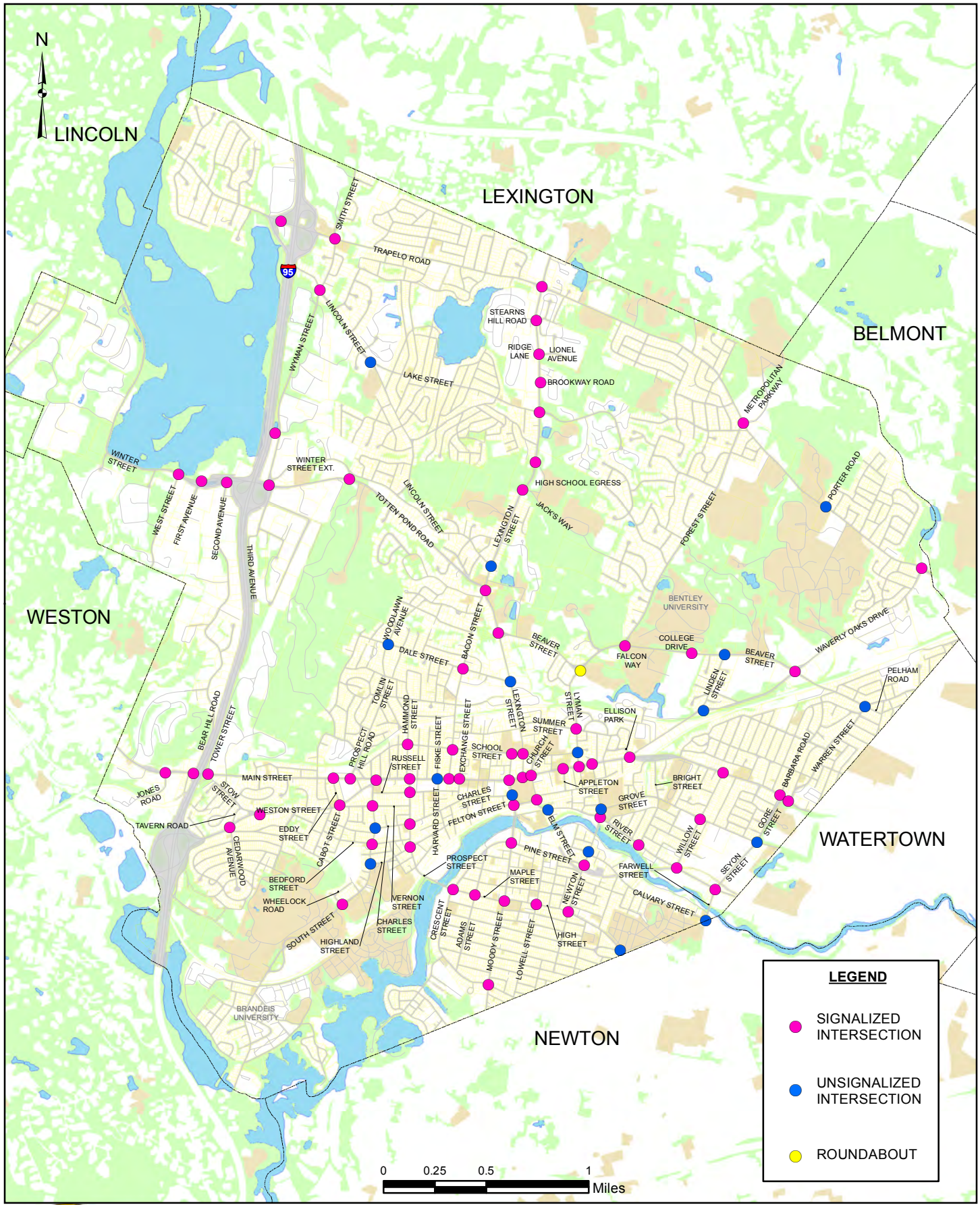

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Figure 1-1
Study Area Map
Transportation Master Plan
Waltham, Massachusetts

2. Existing Conditions

A. Introduction

To gain an understanding of the current conditions within the City of Waltham, the existing transportation network conditions were reviewed. This review included the following:

- An inventory of existing roadway, pedestrian, bicycle, and transit facilities
- Detailed crash analysis at both the study area intersections and along major corridors
- A review of city demographics
- An analysis of public transportation
- An analysis of existing parking throughout the City
- Capacity analysis for the study area intersections

B. Traffic Conditions

Data Collection

An extensive inventory of existing conditions was performed during July and August of 2015 while traffic counts were conducted in November 2014. The inventory included a collection of intersection characteristics including lane, sidewalk, and shoulder measurements, an inventory of traffic controls including sign and signal placement as well as traffic signal timings, and photographs documenting issues at each study area intersection.

To facilitate the field reconnaissance process, a program called Traisr™ was used. Traisr™ is a Geographic Information System (GIS) based asset and infrastructure management program developed by McMahon to help users in local agencies manage their assets more efficiently. A detailed spreadsheet was developed for the program that allowed the field reconnaissance team to input data directly into Traisr™ using a tablet in the field. Information such as traffic signal plans and other record plans were attached to each intersection within the program and could be accessed in the field by the user.

Vehicles

Manual Turning Movement Counts (MTMCs) were conducted by the City of Waltham in November 2014 at each of the 92 intersection locations to capture the peak time of year for traffic within the city when schools are in session. The counts were conducted during both the weekday morning peak period from 7:00 AM to 9:00 AM and during the weekday afternoon peak period from 4:00 PM to 6:00 PM to coincide with peak commuter traffic operations. The MTMCs collected included an inventory of MBTA buses, pedestrians, bicycles, and heavy vehicles and served as a basis for our analysis of these intersections. Traffic counts were also conducted in August 2014 as summer month counts often provide conservative traffic counts. November proved to be the higher count month, however, likely due to school operations within the City. The manual turning movement counts are shown in detail for each intersection during the weekday morning and weekday afternoon peak hours in Appendix D. The traffic count data is summarized in Figure 2-1 and Figure 2-2 below for major corridors during the weekday morning and weekday afternoon peak hours, respectively.

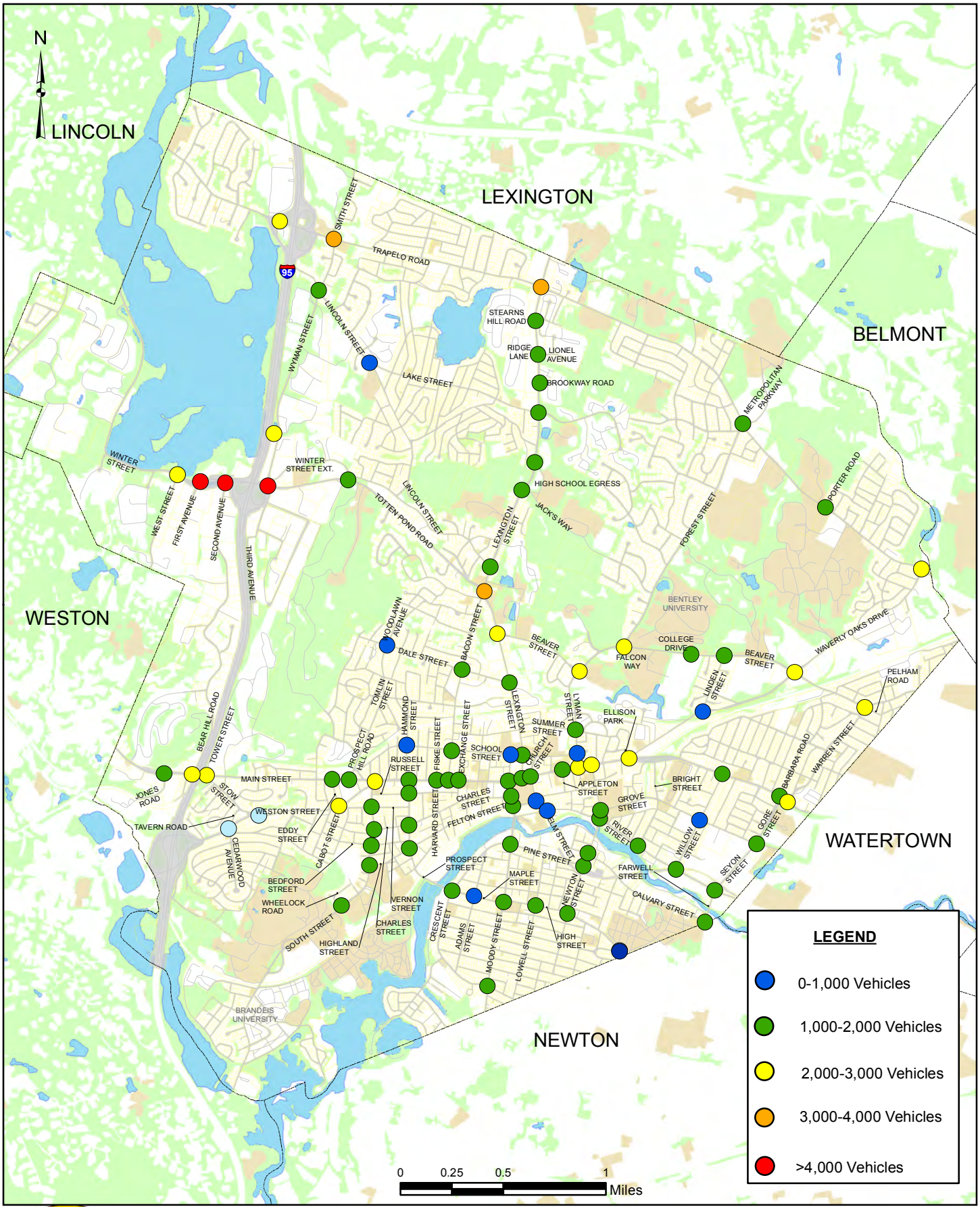


Figure 2-1
Weekday Morning Peak Hour Traffic Volumes
Transportation Master Plan
Waltham, Massachusetts

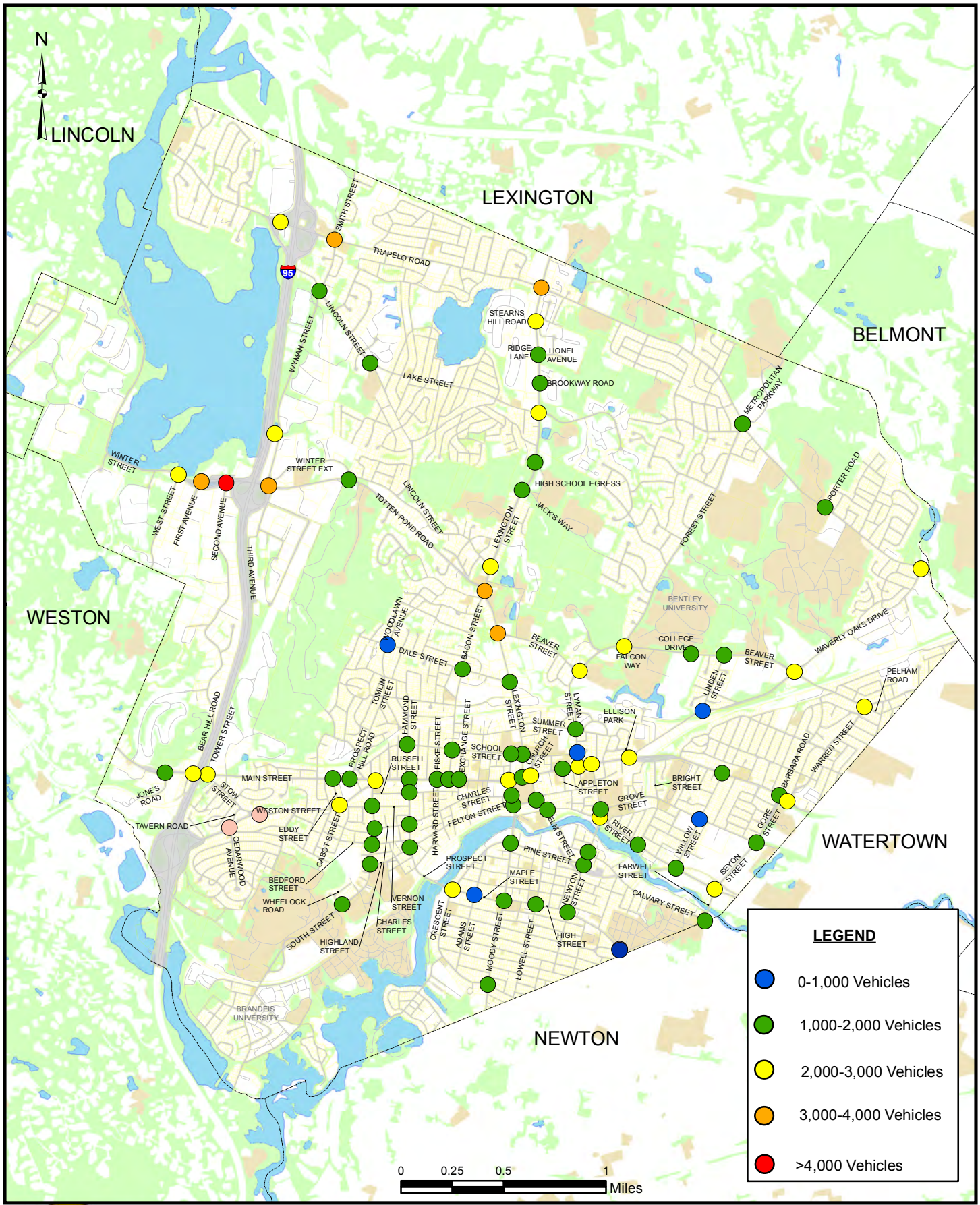


Figure 2-2
Weekday Afternoon Peak Hour Traffic Volumes
Transportation Master Plan
Waltham, Massachusetts

In addition, 48-hour automatic traffic recorder (ATR) counts were conducted in November 2015 at nine locations, summarized in Appendix E.

Pedestrian Facilities

An inventory of pedestrian facilities was conducted throughout the city. Pedestrian facilities in the form of sidewalks and crosswalks were observed in most locations. The City has recently undertaken a sidewalk improvement project, including locations on Trapelo Road, Moody Street, and Main Street. The improvements are still on going in some locations and include sidewalk replacement and ADA compliant curb ramp installation.

Curb ramp replacement ongoing at various locations.

Relative to crosswalks, the general finding of the inventory was that where crosswalks are provided, the crossing is wider than the minimum standard, allowing additional space for pedestrians to cross.

While ADA compliant sidewalks, crosswalks, and curb ramps are available in much of the city, there are areas observed where deficiencies exist including missing sidewalk or sidewalk in poor condition, obstructions on sidewalks, missing crosswalk links, and missing ADA compliant curb ramps.

Sidewalk obstructions limiting accessibility.

The Department of Conservation and Recreation (DCR) Riverwalk also provides a connection for pedestrians as well as cyclists through Waltham and connects to downtown Boston. There are four at-grade crossings within the city for the Riverwalk, including crossings as Prospect Street, Moody Street, Newton Street and Farewell Street.

In a review of the traffic count data collected, the majority of pedestrian activity is located around the downtown Main Street area, Moody Street, South Street adjacent to Brandeis University, and the intersections adjacent to Bentley University including Forest Street and Beaver Street. Pedestrian volumes are highest during the weekday afternoon peak hour. Pedestrian volumes for the weekday morning and weekday afternoon peak hours are shown in Figure 2-3 and Figure 2-4 below.

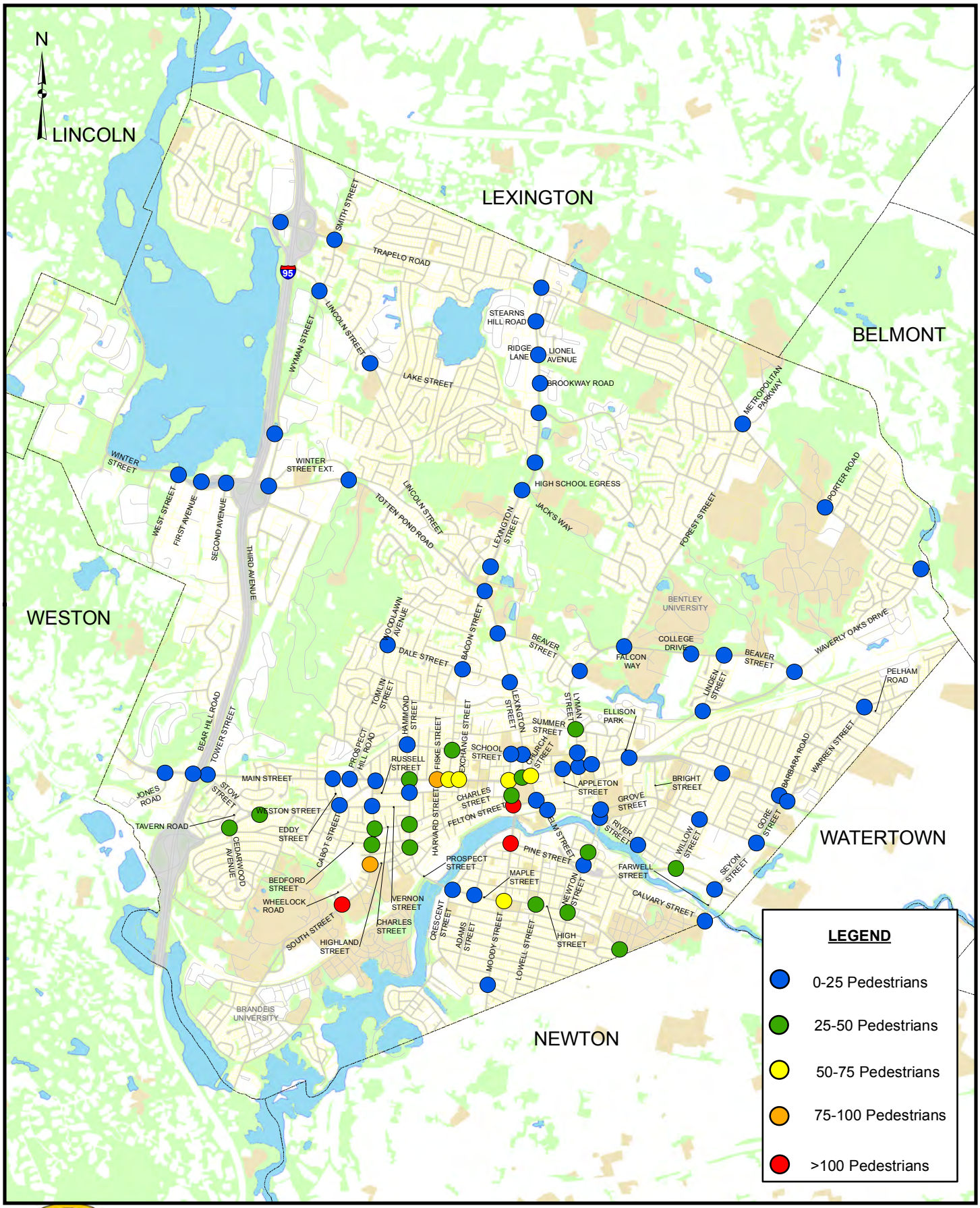


Figure 2-3
Weekday Morning Peak Hour Pedestrian Volumes
Transportation Master Plan
Waltham, Massachusetts

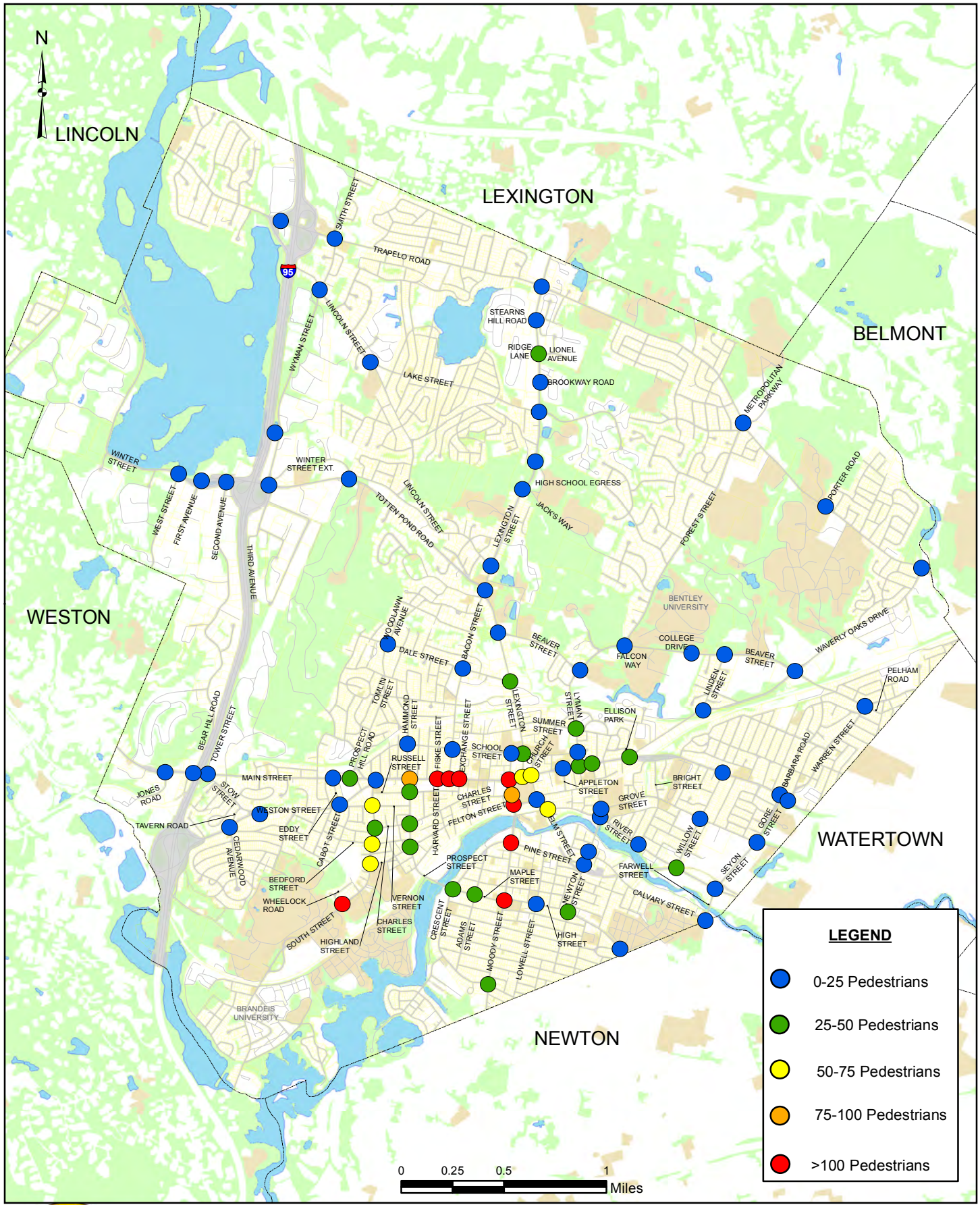


Figure 2-4
Weekday AfternoonPeak Hour Pedestrian Volumes
Transportation Master Plan
Waltham, Massachusetts

Bicycle Facilities

Bicycle facilities were inventoried throughout the City. The results revealed limited facilities that include sharrows, bicycle lanes, and bicycle shoulder signage. Many of the roadways within the city had on-street parking that poses a dooring risk to bicyclists, particularly in downtown Waltham.

Sharrows on four lane roadway.

The DCR Riverwalk Reservation Multi-use path in Waltham serves as a major transportation connection from Waltham to downtown Boston and adjacent communities. This corridor also provides a key connection from Waltham's neighborhoods to Moody Street.

In a review of the traffic count data collected, the majority of bicyclist activity is on Main Street, Moody Street, South Street adjacent to Brandeis University, and the intersections adjacent to Bentley University, similar to the pedestrian data. The lack of bicycle facilities may reduce numbers due to safety concerns. Bicycle volumes for the weekday morning and weekday afternoon peak hours are shown in Figure 2-5 and Figure 2-6 below.

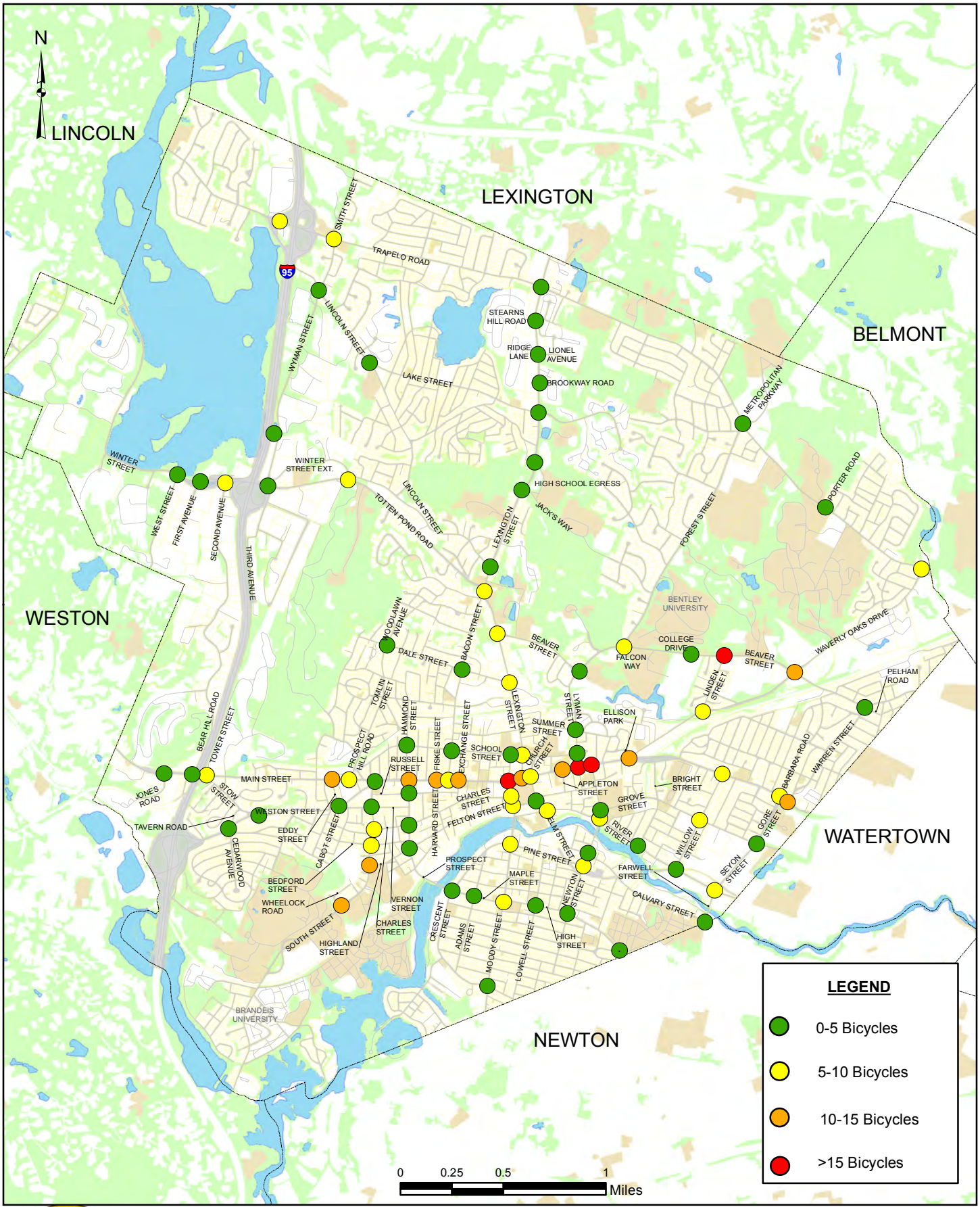


Figure 2-5
Weekday Morning Peak Hour Bicycle Volumes
Transportation Master Plan
Waltham, Massachusetts

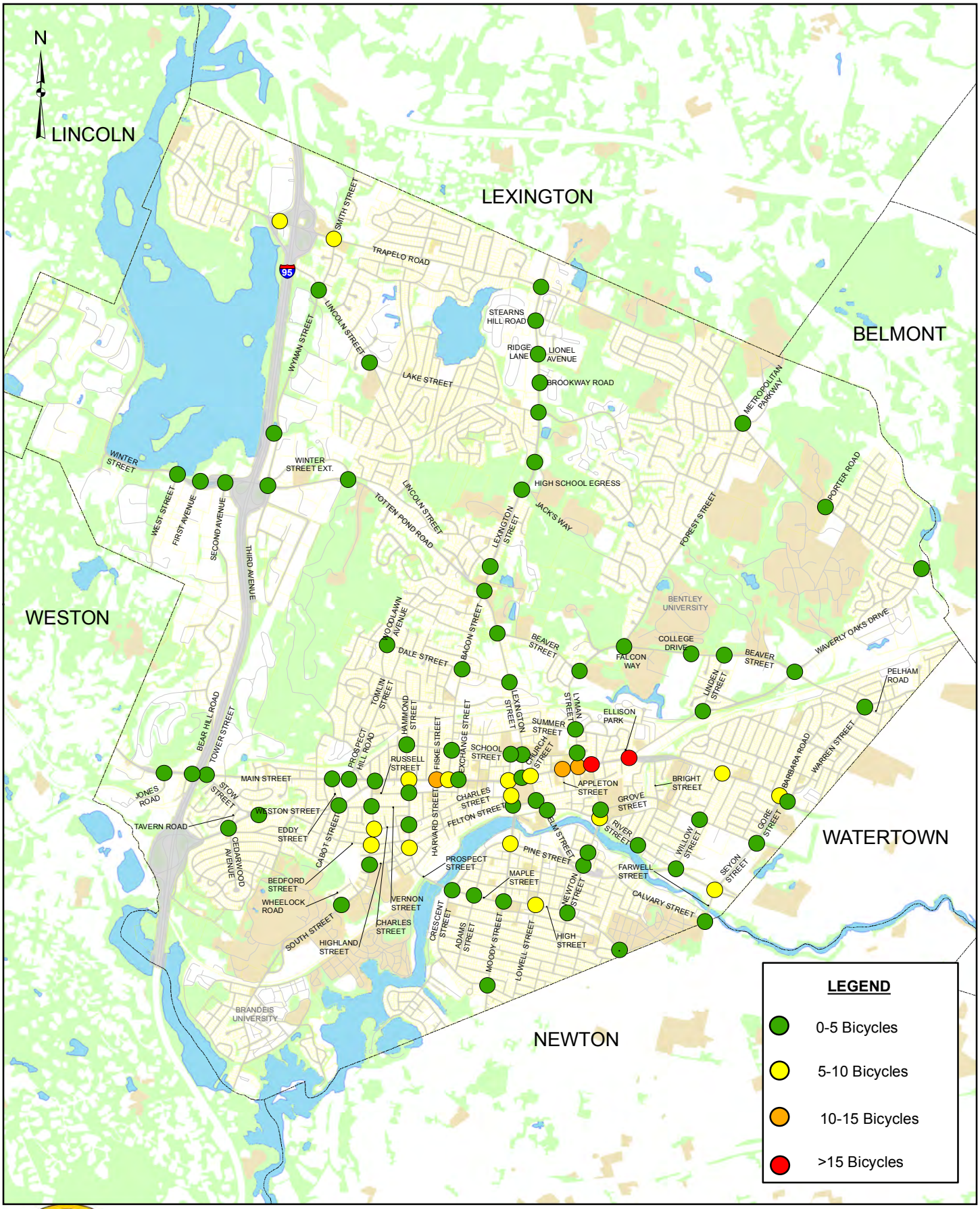


Figure 2-6
Weekday Afternoon Peak Hour Bicycle Volumes
Transportation Master Plan
Waltham, Massachusetts

C. Crash Analysis

MassDOT Data

Crash data was obtained from MassDOT for a recent three year period (2011-2013) for the City of Waltham. Additional crash information from the City was not obtained as part of this project. The MassDOT Crash Rate Worksheet was used to determine whether the crash frequencies at the study area intersections were unusually high given the travel demands at each location. The MassDOT Crash Rate Worksheet calculates a crash rate expressed in crashes per million entering vehicles (MEV). The calculated crash rate was then compared to the average crash rate for signalized and unsignalized intersections. Waltham is located in MassDOT District 4. For comparison, the statewide and District average crash rates are shown below:

Average Crash Rates	Signalized intersection	Unsignalized intersections
MassDOT District 4	0.77 accidents per MEV	0.58 accidents per MEV
MassDOT Statewide	0.80 accidents per MEV	0.60 accidents per MEV

Of the 92 intersections analyzed, 29 intersections have crash rates above the state average. A detailed analysis of each intersection is provided in Appendix F.

A coordination meeting was held with the City of Waltham Police Department on September 9, 2015 to discuss traffic safety issues throughout the City. The City police department also is proactive in working with City officials to provide specific data as needed for crash analysis. Various areas and issues were noted to have safety concerns by the police department including:

- Banks Square – difficult to regulate traffic through this downtown area
- Piety Corner – noted for its confusing lane configuration and was a major safety concern to town officials
- Winter Street at 2nd Avenue – noted to have issues with congestion as well as a confusing lane configuration
- Eddy Street at Weston Street – has a history of red light running
- Stow Street – A popular cut-through and truck route
- Main Street at Newton Street – Noted for congestion issues aiding to driver frustration and ultimately a safety concern
- Grove Street at Gore Street/Seyon Street – high volume of complaints received for this intersection.

Top 20 List

The top 20 highest crash locations have been identified based on a crash rate and are shown in Table 2-1 below.

Table 2-1: Top 20 Vehicular Crash Locations

Crash Ranking	Intersection		Total Crashes	Ped	Bike	Crash Rate*
1	Main St	Moody St	50		1	1.95
2	Felton St	Moody St	35	3	1	1.75
3	Main St	Friske St	34	2	1	1.54
4	Trapelo Road	Lexington Street	56	1		1.41
4 (tie)	Lexington Street	Totten Pond Rd/ Bacon St	60	1		1.41
6	Main St	Weston St	38			1.39
7	Lyman St	Main St	32		1	1.34
7 (tie)	Moody	Crescent St/Pine	23		1	1.34
9	Lexington Street	Main Street	31	1		1.33
10	River St	Seyon St	33	1	1	1.30
11	Charles St	Moody St	21			1.24
12	High St	Lowell St	18		1	1.22
13	South Street	Vernon St	18			1.21
14	Bacon St	School Street	23			1.20
15	Lyman St	Summer St	20			1.18
16	South Street	Bedford St	20			1.14
17	Moody St	Maple St	23			1.12
18	Prospect St	Russell St	16			1.07
18 (tie)	Warren St	Main St	27			1.07
20	Lexington Street	Beaver St	40			1.02

Pedestrian Crashes

Figure 2-7 below shows the number of crashes at the 92 study area intersections that had a crash involving a pedestrian. This evaluation focused on the 92 intersections studied and did not review additional roadway segments throughout the City. As shown, the majority of intersections had no crashes involving a pedestrian and of the intersections that did, the majority experienced only an isolated incident. The following three intersections, however, had multiple pedestrian related crashes:

- Main Street at Prospect Street
- Main Street at Fiske Street/Harvard Street
- Moody Street at Felton Street/Carter Street

Based on the traffic volumes collected, these three intersections experience high usage by pedestrians. Overall at the intersections reviewed, there were a total of 27 crashes that involved pedestrians.

Bicycle Crashes

Of the crashes that occurred at the 92 study area intersections throughout the City of Waltham over the three year study horizon, a total of 17 bicycle related crashes were recorded, as shown in Figure 2-8.

Several major corridors were also reviewed to determine crash clusters through the city beyond the 92 intersections previously shown. As shown in Figure 2-9 below. Crashes are displayed in the number of crashes per mile and do not account for traffic volume data.

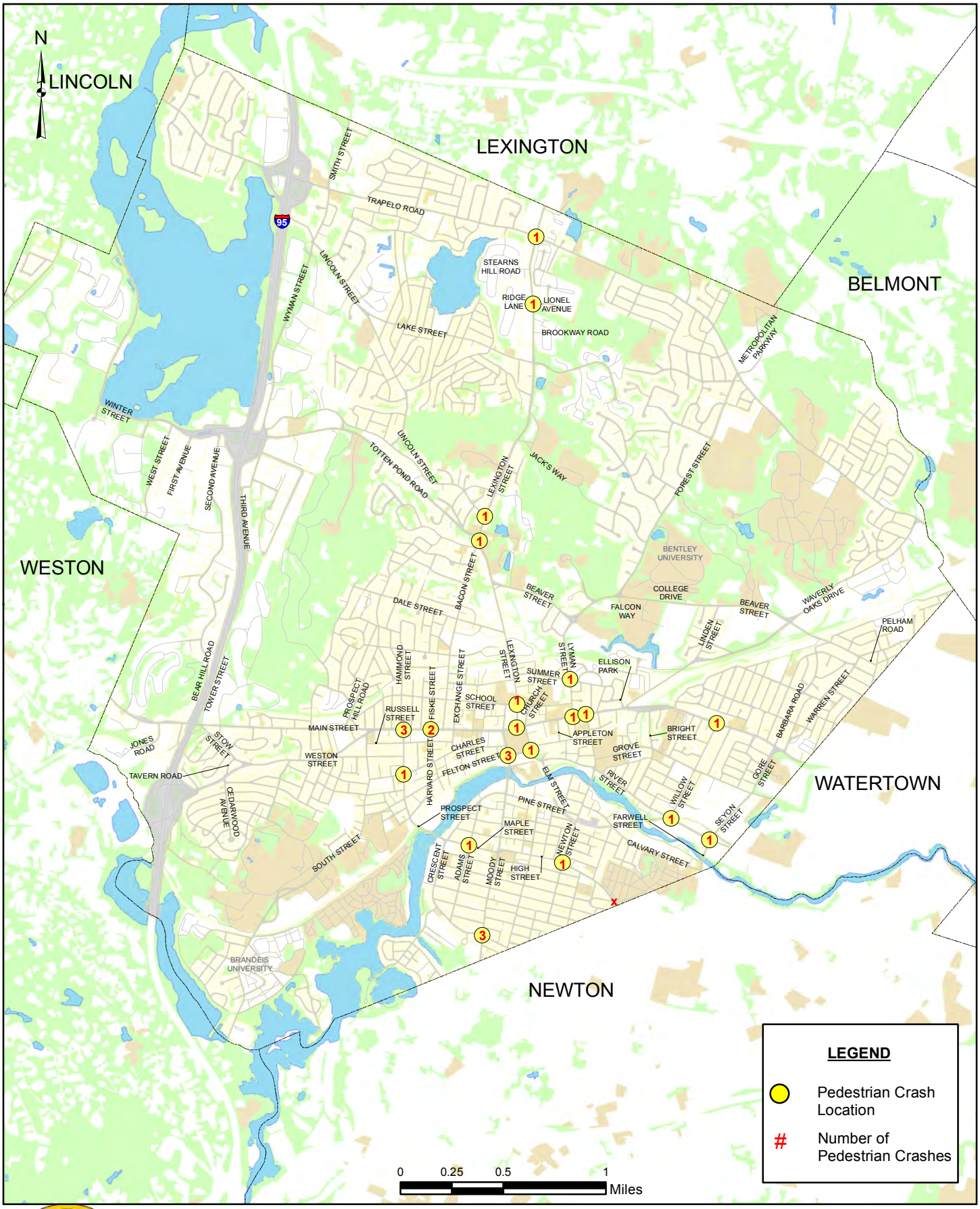


Figure 2-7
Study Area Intersection Pedestrian Crashes 2011-2013
Transportation Master Plan
Waltham, Massachusetts

Figure 2-8
Study Area Intersection Bicycle Crashes 2011-2013
Transportation Master Plan
Waltham, Massachusetts

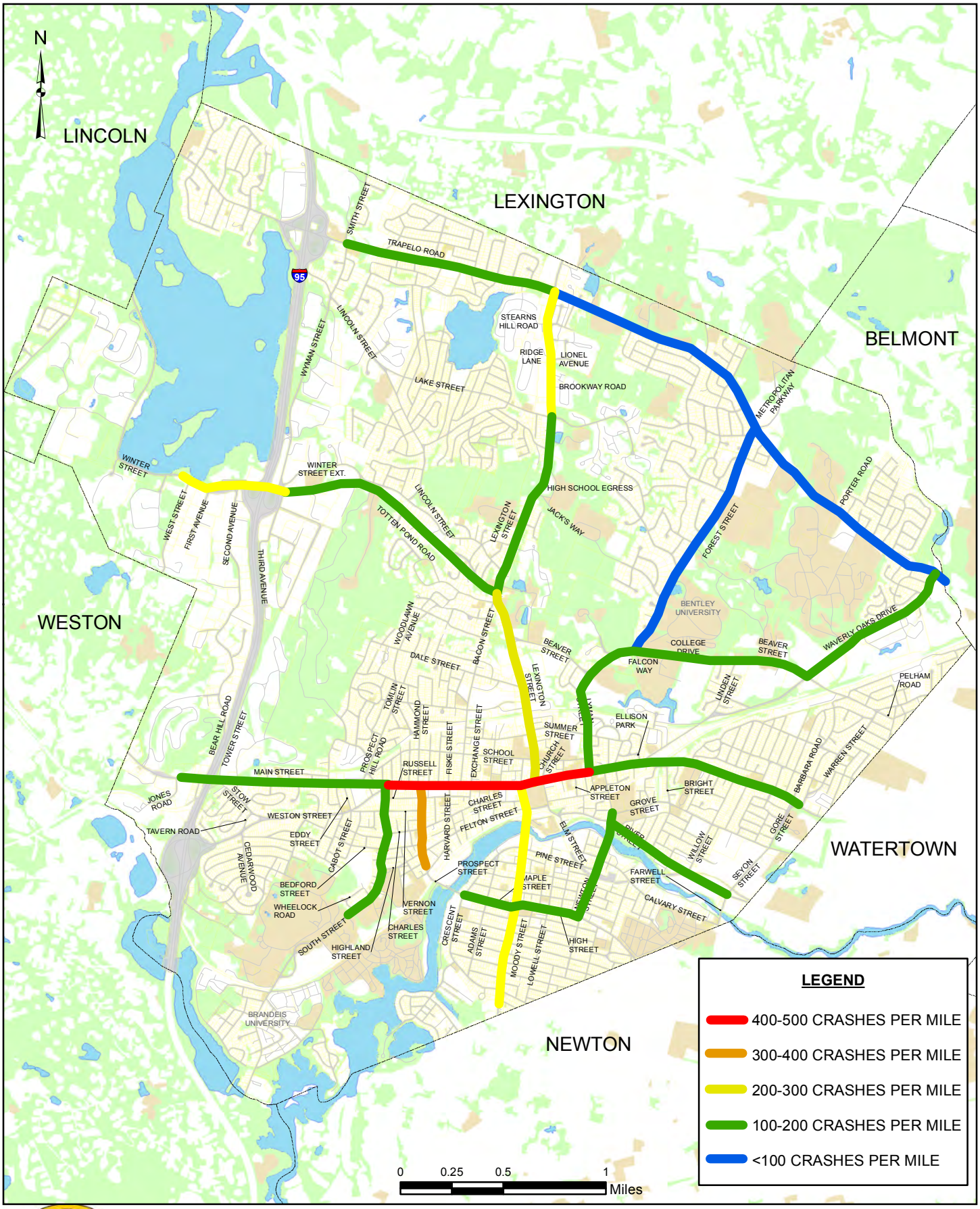


Figure 2-9
Study Area Crash Clusters 2011-2013
Transportation Master Plan
Waltham, Massachusetts

D. Existing Traffic Operations

A detailed capacity and level-of-service analysis was performed for each of the 92 study area intersections during the weekday morning and weekday afternoon peak hours based on procedures contained in the *Highway Capacity Manual* (HCM), a national standard for traffic analysis. The methodologies employed and analysis results are described in detail below.

Vehicular Intersection Capacity Analysis

At unsignalized intersections, the methodology for evaluating the operations of intersections controlled by stop or yield-signs has been developed, and is based on several assumptions, including:

- Major street flows are not affected by the minor (stop-sign controlled) street movements.
- Left turns from the major street to the minor street are influenced only by opposing major street through and right traffic flow.
- Minor street left turns are impeded by all major street traffic plus opposing minor street traffic.
- Minor street through traffic is impeded by all major street traffic.
- Minor street right turns are impeded only by the major street traffic coming from the left.

The concept of stop-controlled or yield-controlled intersection analysis is based on the estimate of average delay on minor streets. The methodology of analysis relies on three elements: the size and distribution of gaps in traffic on the major (higher volume) roadway, the usefulness of these gaps in traffic on the minor (lower volume) roadway, and the relative priority of the various traffic patterns at the intersection. The results of the analysis provide an estimate of average total delay for the various critical unsignalized movements. Correlation between average total delay and the respective level-of-service are provided for unsignalized intersections below in Table 2-2.

Table 2-2: Level-of-Service Criteria for Unsignalized Intersections

Level-of-Service	Control Delay Per Vehicle (seconds)
A	0 to 10
B	>10 to 15
C	>15 to 25
D	>25 to 35
E	>35 to 50
F	> 50.0

Highway Capacity Manual (2010)

At signalized intersections, level-of- service is based primarily on the average control delay per vehicle for various movements within the intersection. Volume-to-capacity relationships also affect level-of-service. Thus, both volume/capacity and delay must be considered to evaluate the overall operation of a signalized intersection. Correlation between average delay per vehicle and the respective level-of-service are provided for signalized intersections in Table 2-3 as follows:

Table 2-3: Level of Service Criteria for Signalized Intersections

Level-of-Service	Control Delay Per Vehicle (seconds)
A	0 to 10
B	10.1 to 20.0
C	20.1 to 35.0
D	35.1 to 55.0
E	55.1 to 80.0
F	> 80.0

Highway Capacity Manual (2010)

Operating levels of service (LOS) are reported on a scale of A to F with A representing the best conditions (with little or no delay) and F representing the worst operating conditions (long delays). In urban areas, LOS D is typically considered adequate. The LOS summary for the 2015 existing conditions is shown in Figure 2-10 and Figure 2-11 for the weekday morning and weekday afternoon peak hours, respectively. Detailed capacity analysis is provided in Appendix G for the 2015 Existing weekday morning and weekday afternoon peak hours. As shown in the figures below, a total of 13 intersections operate at LOS F during the weekday morning peak hour and 12 intersections operate at LOS F during the weekday afternoon peak hour.

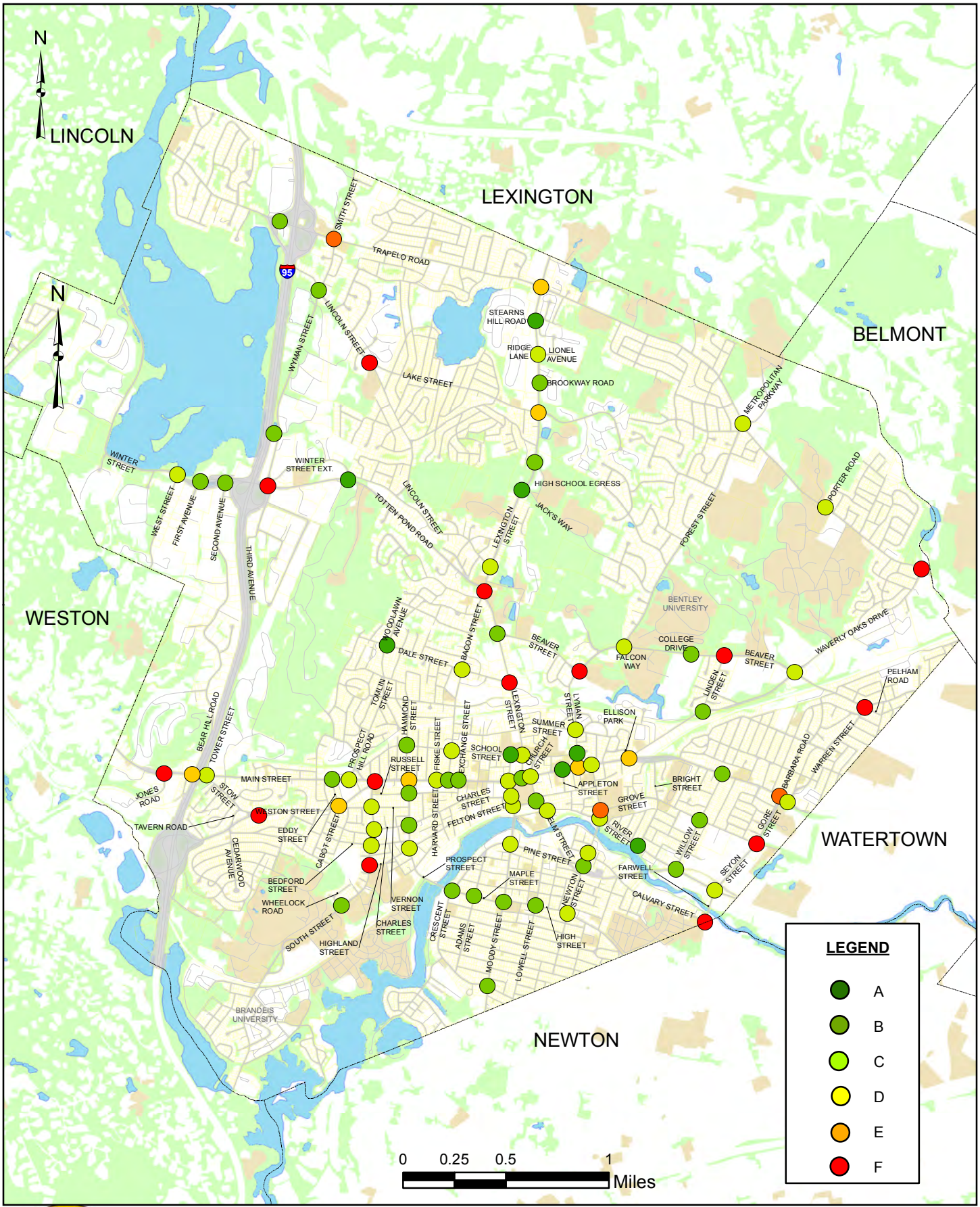


Figure 2-10
2015 Existing Weekday Morning
Peak Hour LOS Summary
Transportation Master Plan
Waltham, Massachusetts

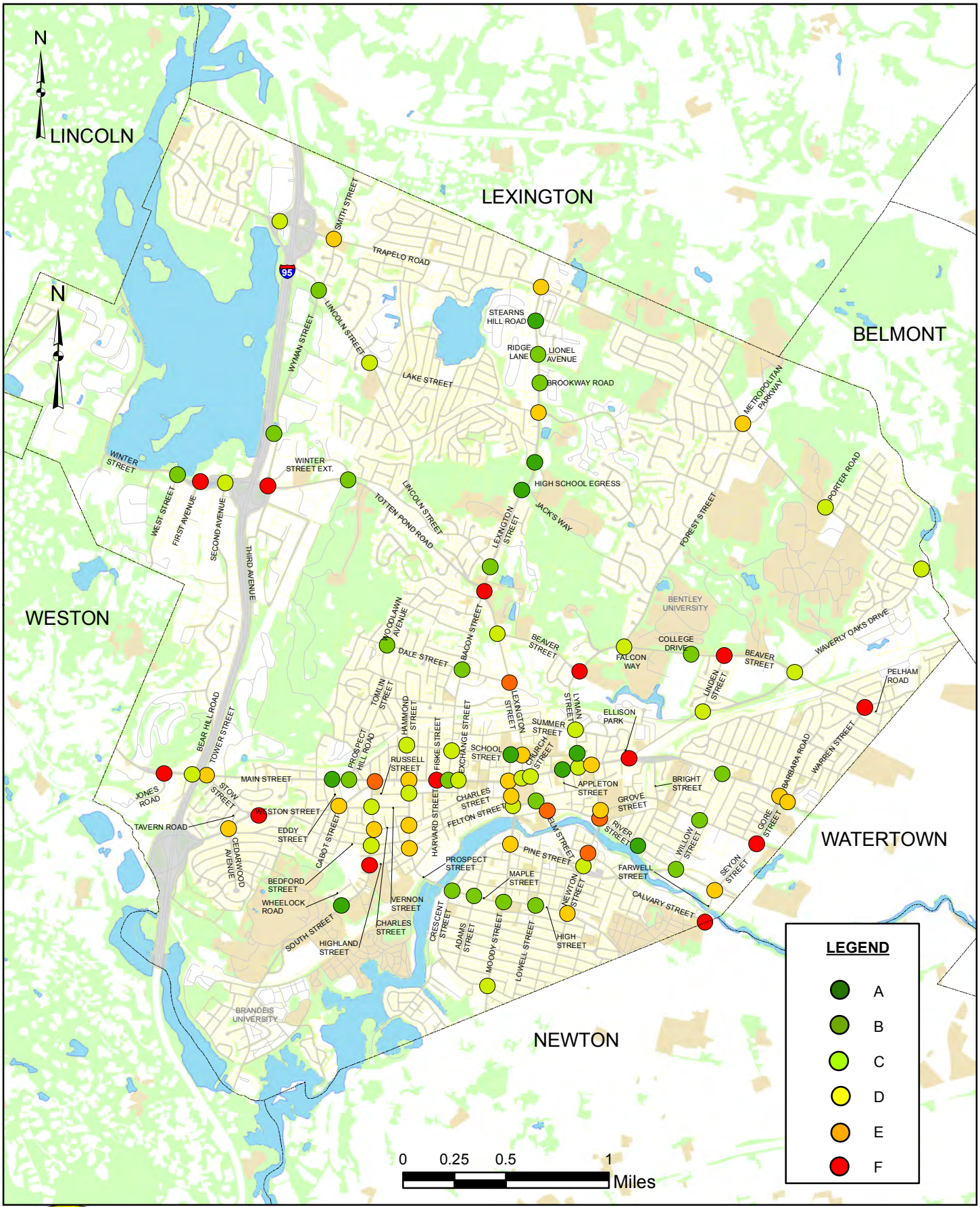


Figure 2-11
2015 Existing Weekday Afternoon
Peak Hour LOS Summary
Transportation Master Plan
Waltham, Massachusetts

E. Demographics

An evaluation of the demographic information is important for understanding the transportation needs within the community and specific neighborhoods.

Population

The estimated 2015 population for the City of Waltham is 63,378 people, and is expected to grow by approximately 1% per year over the 10 year study horizon (10% over 10 years) to an estimated 2025 population of 69,610 people [2].

Figure 2-12 below shows the population density for each census tract within the City of Waltham, based on the 2010 US Census. As shown, the neighborhoods surrounding Main Street and Moody Street are the most populated areas. The southern neighborhood district has some of the most populated areas with high walkability scores and good access to transit. The northern neighborhood district has some of the least populated areas, especially surrounding Route 128/I-95 and on either side of Trapelo Road, as these areas are mainly business-oriented with lower walkability scores and limited access to transit. Brandeis University and Bentley University both have on campus students, adding additional population to these areas when school is in session.

[2] American Community Survey 2015 Population estimate.

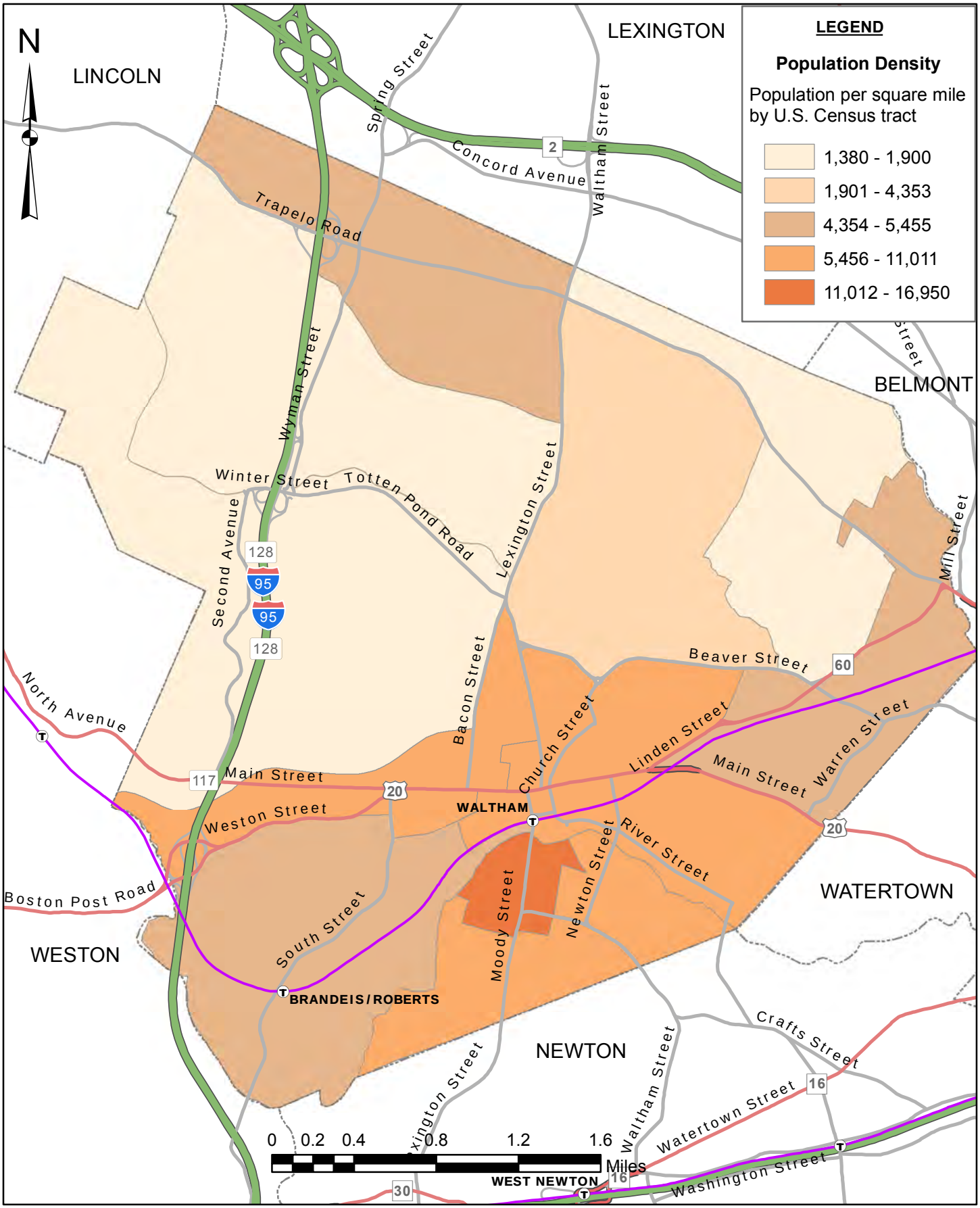


Figure 2-12
Population Density
Transportation Master Plan
Waltham, Massachusetts

Employment

The City acts as a major employment center for the region. Waltham holds a larger number of employees (approximately 53,000) than residents who are part of the workforce (approximately 46,500, or 77% of total residents). Employees in Waltham include both City residents and residents of several other surrounding communities (ACS 2013 5-year estimates).

Employment is concentrated in northern Waltham around Route 128/I-95 where there are several business parks, as well as in downtown Waltham and southern Waltham near Brandeis University and the Boston Children's Hospital campus. As noted earlier, households are concentrated in downtown Waltham, making this area the most diverse, offering both housing and employment.

Land Use

As shown in Figure 2-13 below, there is a large amount of industrial and commercial land use along the Route 128/I-95 corridor including various office parks, hotels, and adjacent retail space that serves the Route 128 business corridor. Institutional uses in Waltham include Bentley University located on Forest Street, Brandeis University located on South Street, as well as a branch of the Boston Children's Hospital located on South Street. Main Street and Moody Street are the major locations within the city for mixed land uses that include both residential and retail. The majority of other areas within Waltham serve residential land uses and open space.

Major Employers in Waltham

AstraTech

Astra Zeneca

Bentley University

Brandeis University

Fresenius Medical Care

Immunogen

Intuit

Mass Medical

MultiPlan

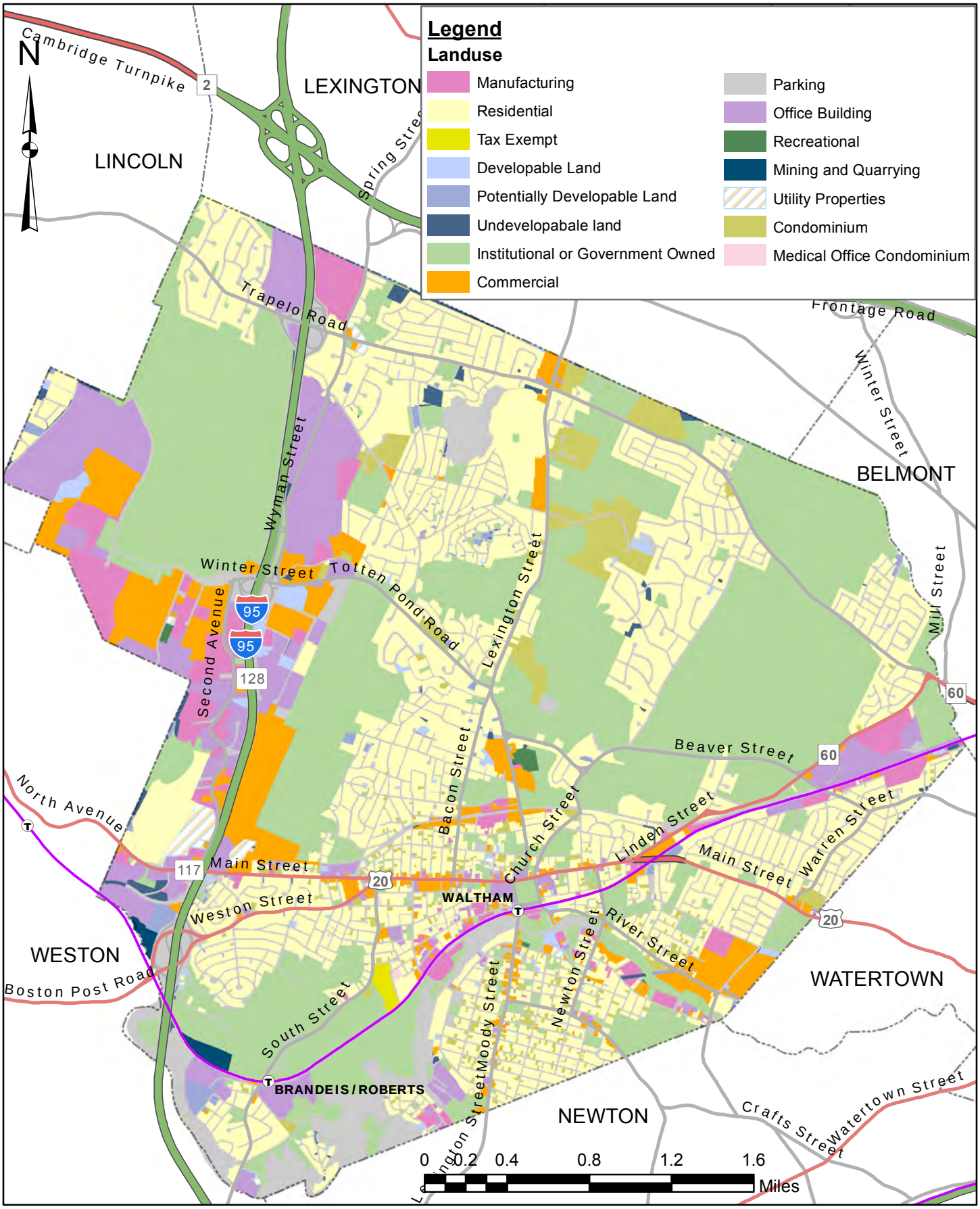
National Grid

Perkin Elmer

QuinetiQ/North America

Westin Waltham Hotel

Source: MAPC 128 Corridor Report



City of Waltham Land Use GIS, October 4, 2016

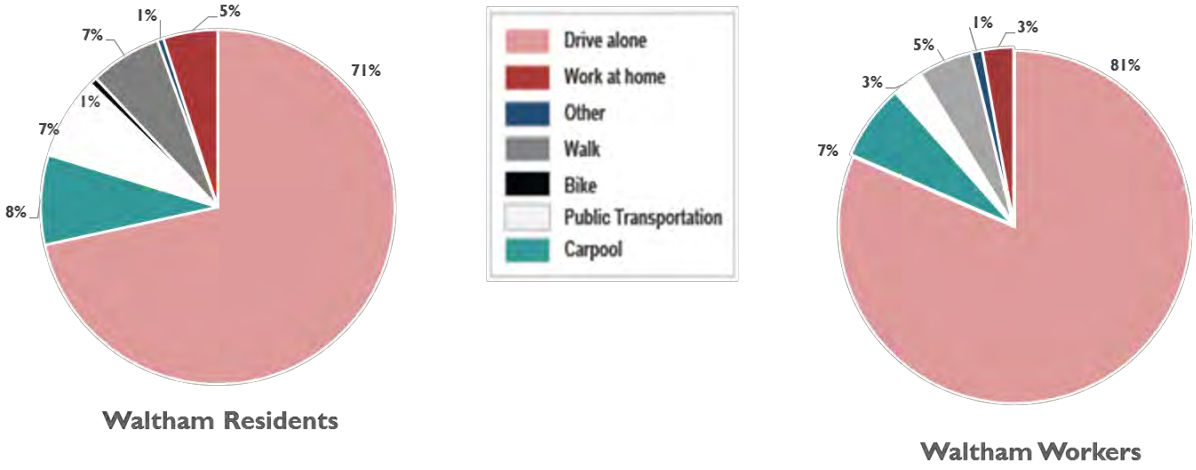
Figure 2-13
Existing Land Use
Transportation Master Plan
Waltham, Massachusetts

Mode Split

The vast majority of City residents are dependent on a personal vehicle as their primary means of transportation, with approximately 70% driving alone to commute to work. There are only approximately 8% of households in Waltham without access to a vehicle[3].

While approximately 70% of Waltham's population uses a personal vehicle to commute to work, approximately 80% of those commuting to Waltham for work use a personal vehicle. This may show a greater lack of public transportation usage to Waltham rather than from Waltham to other locations, such as Cambridge and Boston. Approximately 7-8% of both residents and workers commuting to Waltham carpool to work. Even fewer people use public transit, walk, or bike as a primary means of travel, as shown in Figure 2-14.

Figure 2-14: Mode share of Waltham Residents and Workers

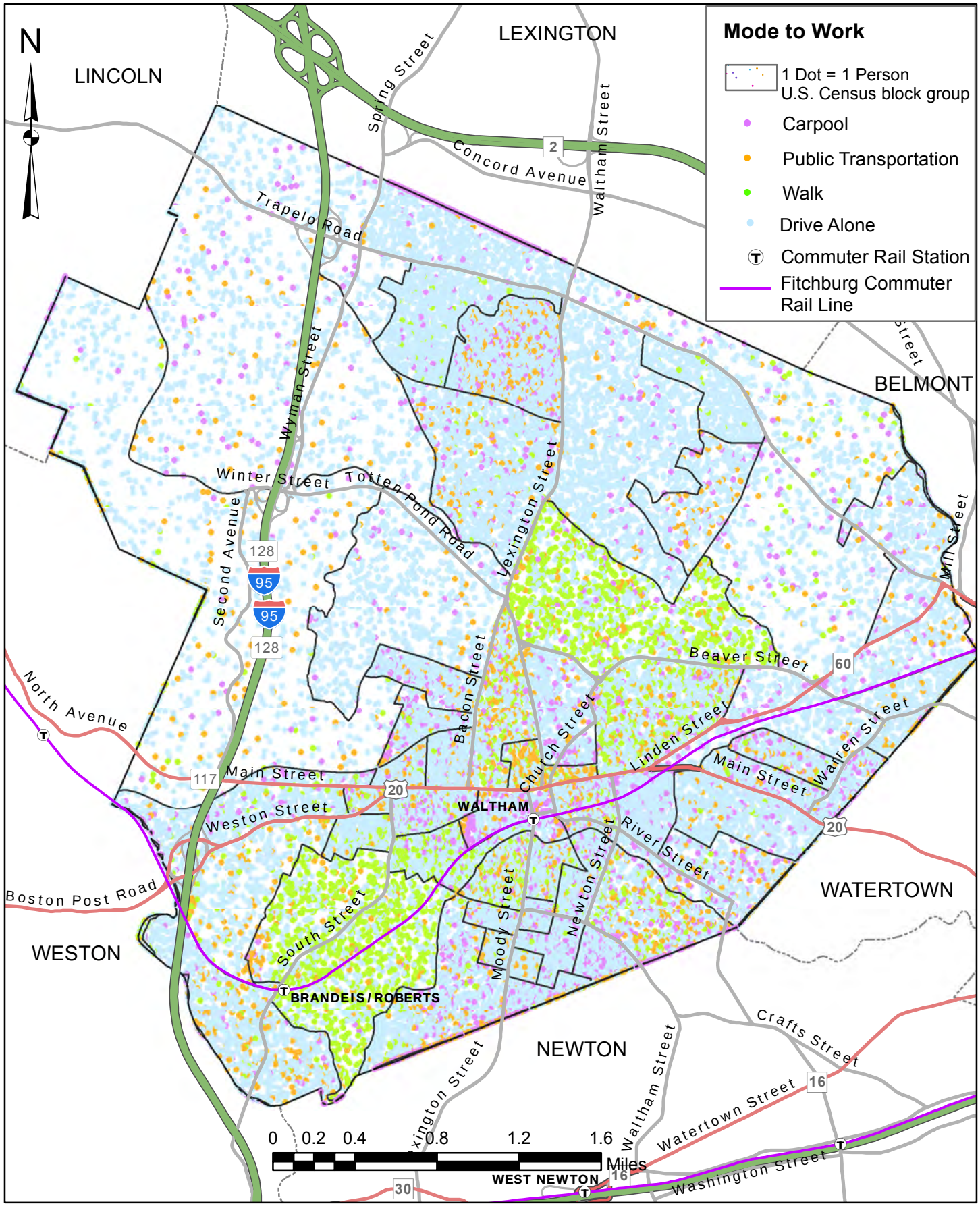


Source: American Community Survey 2013 5-year estimate

The 7% of residents that walk to work in Waltham are concentrated around Bentley University and Brandeis University. Walk scores to determine a community's walkability can be evaluated by zip code[4]. Within the city of Waltham, the zip code capturing the downtown area and Brandeis University (02453) has the highest walk score of 66, meaning this area is somewhat walkable. The remaining areas in Waltham have significantly lower walk scores and are considered vehicle dependent.

The majority of public transit users live in downtown Waltham, as would be expected by its availability of access to several transit options as compared to the rest of the City. Residents who carpool and drive to work are scattered throughout the City, with those who drive alone representing the largest group of residents. These trends are illustrated in Figure 2-15.

[3] American Community Survey 2013 5-year estimate
[4] Walkscore.com



American Community Survey 5-Year Estimates, 2013

Figure 2-15
Mode to Work for Residents in Waltham
Transportation Master Plan
Waltham, Massachusetts

F. Public Transportation

The City of Waltham is served by eight MBTA bus routes and one commuter rail line, as well as university and Route 128 business Council shuttle service. Bus and commuter rail services provide access to both downtown Boston and Cambridge, while the TMA 128 Business Council provides additional service between major employers in the Route 128 region and Alewife Station on the MBTA Red Line. Waltham is home to Bentley and Brandeis universities, which both provide shuttle services serving local destinations in Waltham, as well as intercity connections to Harvard Square and downtown Boston. Public transportation in Waltham is summarized in Figure 2-16.

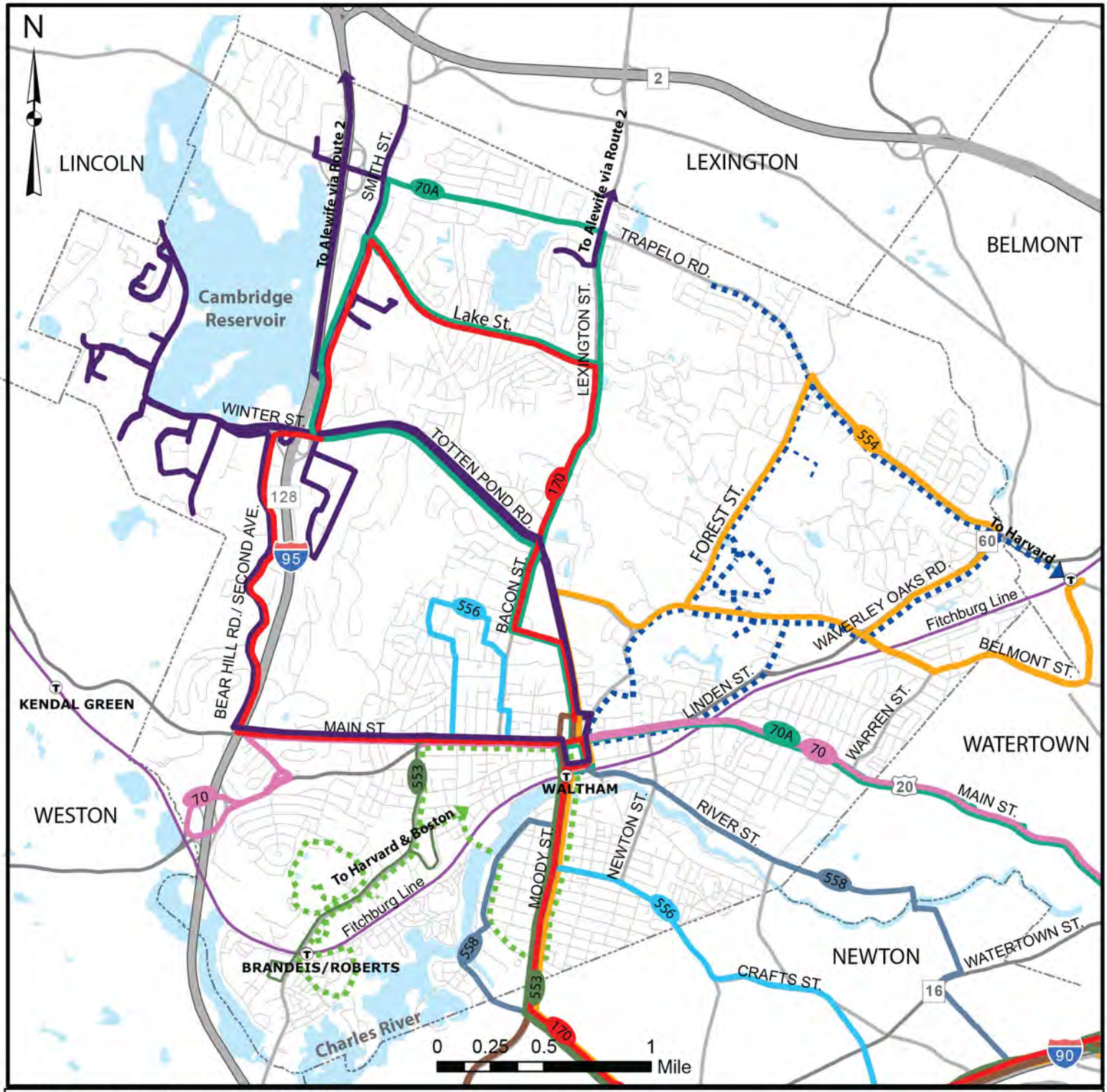
MBTA Commuter Rail

Waltham is served by the MBTA Fitchburg Commuter Rail Line at two stations – Waltham Station, in downtown Waltham, and Brandeis/Roberts, at the southern edge of Brandeis University Campus. Both stations are located within fare Zone 2, and are approximately 1.5 miles apart.

Waltham Station is located off Carter Street, south of Waltham Common, but the station itself spans across Moody Street to Elm Street, and therefore can be accessed from multiple points from Moody Street, Carter Street and Elm Street. The station has a single platform on the north side of the single track system, for service in both directions, and is accessible to persons with disabilities. One shelter is provided adjacent to the platform, west of Moody Street, two additional shelters are provided at the eastern end of the station. The three shelters are part of the JCDecaux (formerly CEMUSA) shelter program, and have been provided by and are maintained by JCDecaux through an agreement with MBTA. A covered ramp system is provided at the east end of the station, also providing shelter on the platform. As of April 2013, the average daily boardings at the station is 610, ranking 52 out of 133 systemwide.

The station is serviced by 16 inbound and 16 outbound trips each weekday, of which 5 trips operate in each direction during the peak period, and 8 trips in each direction on the weekends. On-time performance on the line was 81% in June 2015, ranking second to last system-wide (average was 87%).Bus connections can be made to/from eight MBTA bus routes – 70, 70A, 170, 505, 553, 554, 556 and 558. Inbound and outbound bus stops for these routes are located on Carter Street, directly north of the station. MBTA-owned bus shelters are provided at both stops. There are 50 car parking spaces at the station (33 are angled parking spaces directly abutting the platform, west of Moody Street; and 52 are located in an off-street parking lot between the platform and Carter Street), including 4 accessible spaces. Parking is provided, operated and maintained, by the City of Waltham and available for a daily fee of $2 per day. Parking is generally available in this lot, especially after 5:00 PM. About 12 covered bike parking spaces are also provided.

Brandeis/Roberts Station is located off Sawyer Street, east of South Street. Station access is provided from Sawyer Street and a private parking lot off South Street to the north of the station. Both an inbound and an outbound platform are provided, one for each track, and the station is accessible to persons with disabilities. Covered ramp systems are provided on both platforms, also providing shelter on a section of the platform. As of April 2013 the average daily boardings at the station is 437, ranking 71 systemwide.



MBTA Bus Routes

- 70
- 70A
- 170
- 505
- 553
- 554
- 556
- 558

LEGEND

- MBTA Commuter Rail Station
- MBTA Commter Rail Line
- 128 Business Council Route
- Bentley University Shuttle Route
- Brandeis University Shuttle Route

Note: Routes for Brandeis shuttles are approximate

(Employers noted are the top ten employers in Waltham Bureau of Labor Statistics)

Source: MassGIS MBTA Bus Routes, 128 Business Council Shuttle Schedules, Bentley University Shuttle Schedule, Brandeis University Van and Shuttle Service

WALTHAM · INCORPORATED A TOWN 1738 · INCORPORATED A CITY 1884 ·

McMAHON TRANSPORTATION ENGINEERS & PLANNERS

Figure 2-16
Existing Transit Service
Transportation Master Plan
Waltham, Massachusetts

The station is serviced by 15 inbound and 15 outbound trips each weekday, of which 4 trips operate in each direction during the peak period. Four trips overall are flag service, where passengers must flag to the conductor that they wish to board or alight the train. There are 8 trips in each direction on the weekends and all operate as flag service. Bus stops for Route 553 are located on South Street at Sawyer Street. There are 24 parking spaces, including 3 accessible parking spaces, adjacent to the southern (inbound) platform, accessed via Sawyer Street. Parking is provided by the MBTA for $4 per day. Parking for 12 bicycles is also provided on uncovered bike racks.

Information on ridership and trips at both stations is summarized in Table 2-4.

Table 2-4: Commuter Rail Ridership and Trips

Station Name	Average Daily Boardings	Percent of Total Line Ridership	Trips per Weekday
Waltham	610	6%	16
Brandeis/Roberts	437	4%	15

MBTA Bus

There are eight MBTA bus routes that service Waltham – Routes 70, 70A, 170, 505, 553, 554, 556 and 558. The frequency of service was determined from Fall 2015, although Routes 70 and 70A were updated in Winter 2016. Ridership data is from MBTA's Fall 2014 APC data and on-time performance information is from April-June 2015.

Routes 70 and 70A are local service routes providing connections between Central Square/University Park in Cambridge and Cedarwood/Market Place Drive (Route 70)/North Waltham (Route 70A). The variation of Route 70 to service Market Place Drive was recently created in Winter 2016. Route 70A operates a circuitous and duplicative routing through North Waltham, which changes at approximately 12:00 PM daily, in order to service the direction for the peak demand, as shown in Figure 2-17. In the morning the route serves Totten Pond Road and Wyman Street outbound, and then makes a loop around Lincoln/Lake Streets, Lexington Street, Trapelo Road, and Smith Street, before returning to Lincoln/Lake Streets again, and turning onto Lexington Street on inbound trips. In the afternoon/evening the route serves Lexington Street, Lake/Lincoln Streets, Smith Street, Trapelo Road, Lexington Street, and Lake/Lincoln Streets, once again in the outbound direction, and then Wyman Street and Totten Pond Road inbound. This route serves three additional municipalities, Watertown, Boston and Cambridge, and therefore provides numerous important connections and transfer points such as at Watertown Square (Key Bus Route 71, among other routes), and Market Street/Western Avenue in Brighton, before reaching Central Square in Cambridge.

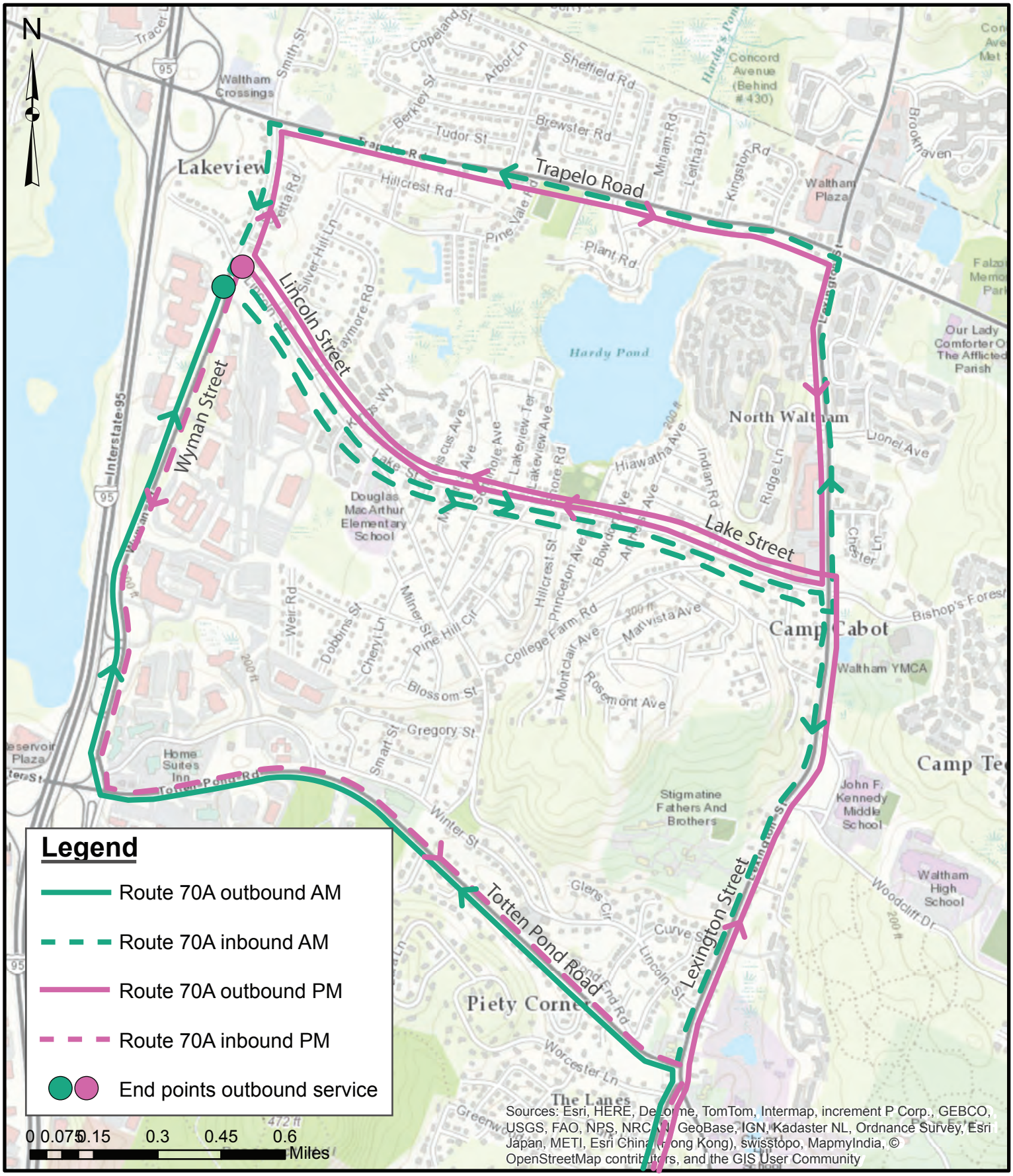


Figure 2-17
Summary of MBTA Bus Route 70A
Transportation Master Plan
Waltham, Massachusetts

Route 170 is a limited express weekday peak direction only service between Central Square in Waltham and Dudley Station in Boston, via the Masspike. Two trips operate outbound to Waltham in the morning (at 6:15 a.m. and 6:40 a.m.) and two trips operate inbound from Waltham in the evening (at 3:55 p.m. and 4:55 p.m.). The average daily ridership is 183. On-time performance for the route was 58%.

Route 505 is commuter express weekday peak period only service between Central Square, Waltham, and downtown Boston, via West Newton and the Masspike. Service generally runs from 6:00 a.m. to 8:00 p.m. every 10 minutes. The average daily ridership is 1,928. On-time performance for the route was 55%.

Route 553 is an all-day express route between Roberts and downtown Boston, via Central Square, Newtown Corner and the Masspike. Service generally operates every hour on weekdays and Saturdays, from 6:00/7:00 am to 7:30 p.m. There is no service on Sundays. The average daily ridership is 1,753. On-time performance for the route was 47%.

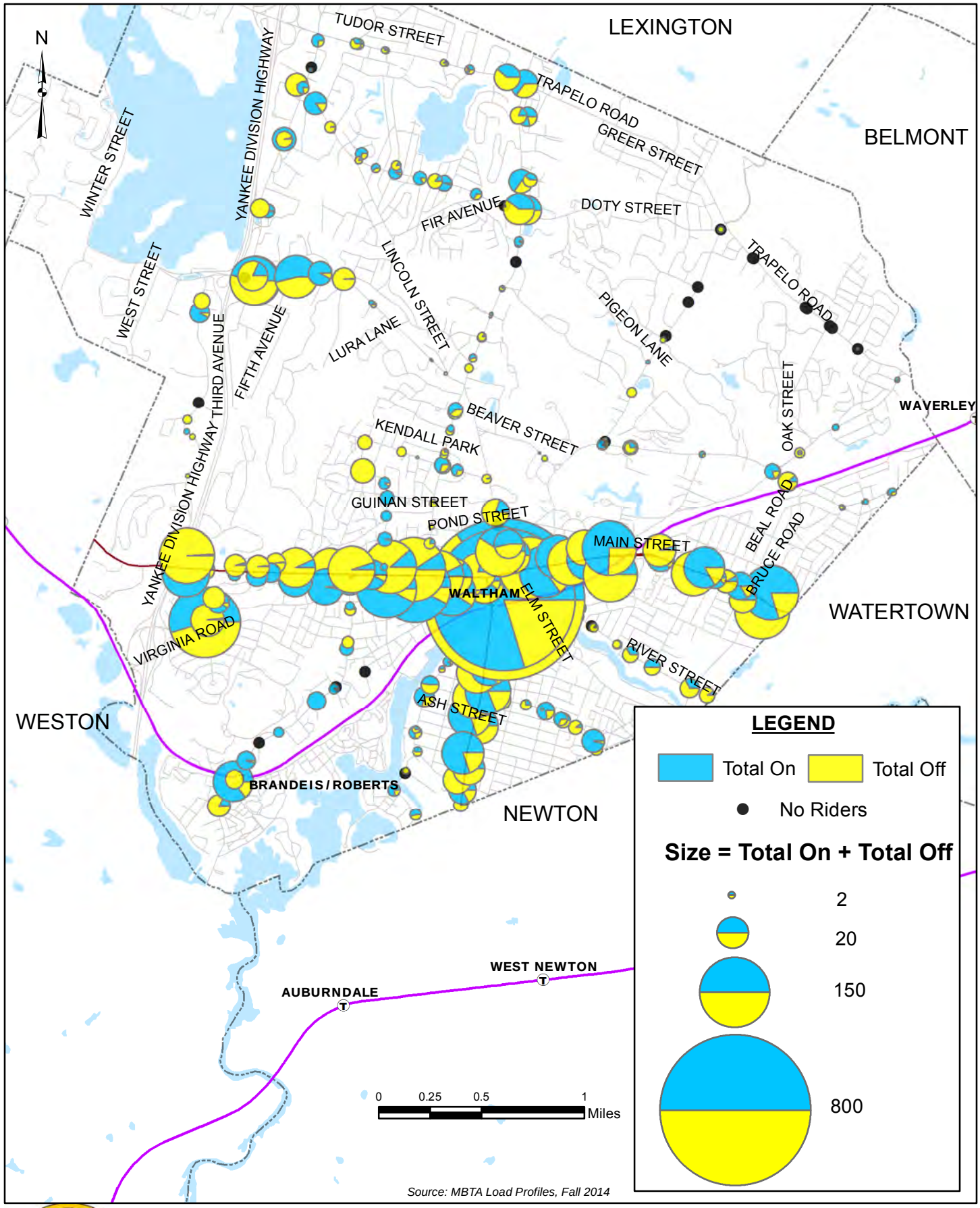
Route 554 is an all-day express route between Waverley Square in Belmont, and downtown Boston, via Central Square, Newtown Corner and the Masspike. Service generally operates every hour on weekdays and Saturdays, from 6:00/7:00 a.m. to 8:00 p.m. Note AM/PM trips via Trapelo Road. There is no service on Sundays. The average daily ridership is 1,339. On-time performance for the route was 48%.

Routes 553 and 554 overlap between Central Square and Downtown Boston and therefore the combined frequency of these routes between Central Square and Downtown Boston is approximately every 30 minutes.

Route 556 is an all-day express route that operates on weekdays only, between Waltham Highlands, and downtown Boston, via Central Square, Newtown Corner and the Masspike. Service generally operates every hour from 6:15 a.m. to 7:15 p.m. The average daily ridership is 1,084. On-time performance for the route was 51%.

Route 558 is an express route that operates almost all-day on weekdays only (there is a four-hour gap in service in both directions after the morning peak and midday), between Riverside, and downtown Boston, via Central Square, Newtown Corner and the Masspike. Service generally operates every hour from 6:30 a.m. to 7:00 p.m. The average daily ridership is 822. On-time performance for the route was 54%.

There are currently approximately 274 MBTA bus stops (MassGIS MBTA data) within the city, covering 130 miles of unique bus routes. Some bus stops are very heavily utilized, especially in the downtown area. The Central Square stops on Carter Street have a total ridership of 1,486 (combined for all routes) and ranks 118th highest of bus stops serviced by the MBTA. Bus stops at and opposite the Waltham Commuter Rail Station each have 685 and 801 average weekday boardings. Stop ridership is also displayed in Figure 2-18.



Source: MBTA Load Profiles, Fall 2014

Figure 2-18
Average Daily Ridership at MBTA Bus Stops
Transportation Master Plan
Waltham, Massachusetts

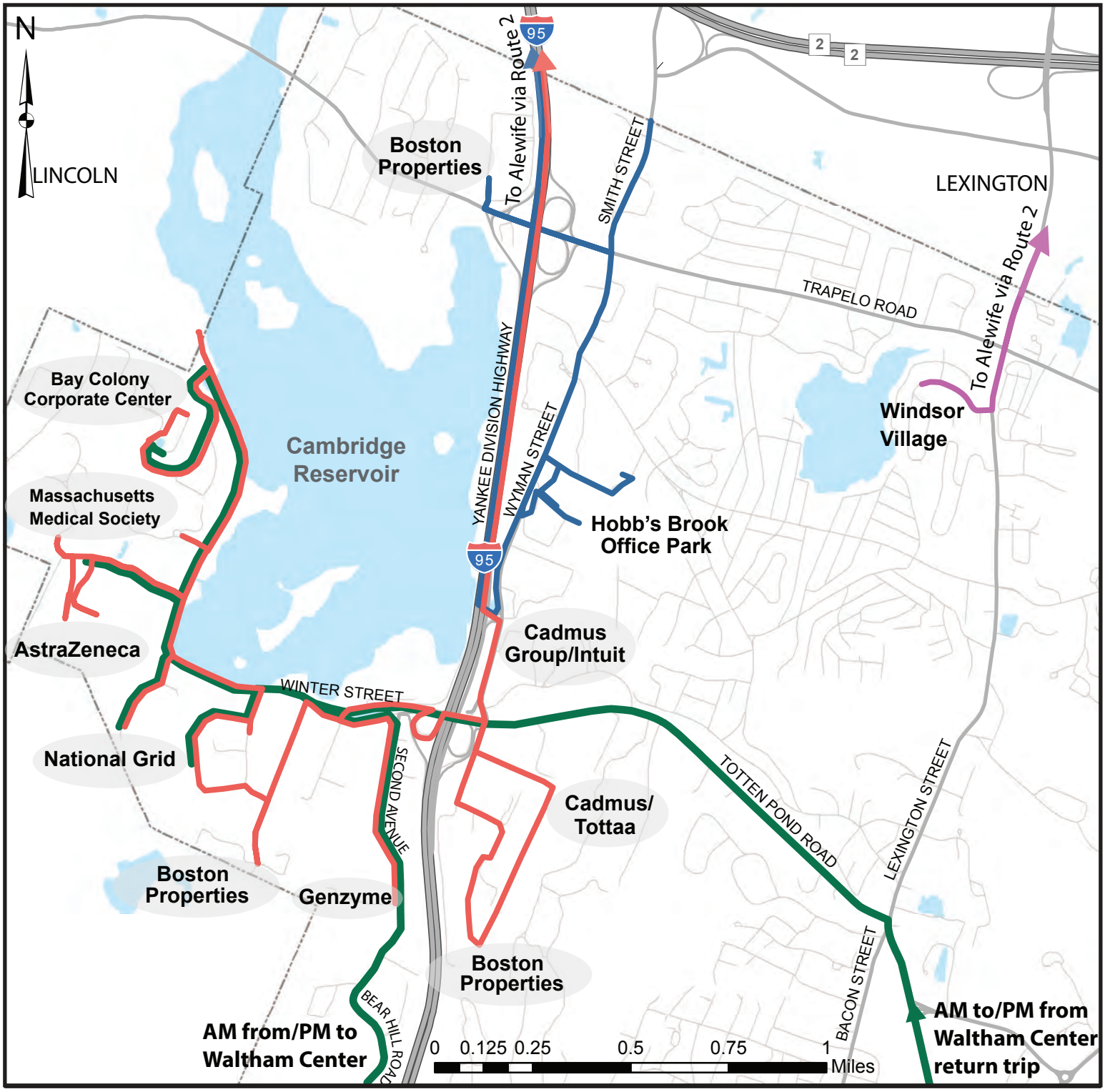
Shuttle Routes

Shuttle bus services are provided by 128 Business Council, Bentley and Brandeis Universities, Boston Children's Hospital and several hotels.

The 128 Business Council is a Transportation Management Association (TMA) that provides transportation assistance for numerous employers in the city of Waltham located around the commercial catchment area along the Route 128 corridor. They service about 480 riders (a mix of members and non-members) on a typical weekday (as of the week of March 23-27, 2015) and operate four routes as follows and shown in Figure 2-19.

- Alewife Routes A and B carry about 260 average weekday ridership and provide service to/from the Alewife MBTA Station in Cambridge, which connects to the MBTA Red Line.
    - Alewife Shuttle A stays on the east side of Route 128 serving businesses off Wyman Street, including Cadmus Group/Inuit and Hobbs Brook Office Park.
    - Alewife Route B serves businesses to the west of Route 128 off Winter Street, including the Bay Colony Corporate Center, Massachusetts Medical Society, AstraZeneca, National Grid, Boston Properties, and Genzyme.
- The Windsor Business shuttle provides a commuting service for residents to and from Alewife Station. Average daily ridership is about 170.
- The Waltham Center shuttle provides service via Totten Pond Road between the office parks located off Winter Street, and the Waltham Commuter Rail Station, and services about 50 riders on a typical weekday.
- The Tick-Tock Trolley operates on Thursdays, Fridays, and Saturday between 6:00PM and 11:00PM and connects parking around City hall to retail land uses on Moody Street to mitigate parking availability on Moody Street. The route loops around the Waltham Common and Central Square Parking Deck and travels the length of Moody Street to Crescent Street with several trolley stops along the corridor.

The shuttles run during morning and evening commuting hours, between approximately 6:00 AM and 10:00 AM, and 4:00 PM and 8:00 PM.



LEGEND

128 Business Council Shuttle Routes

- Alewife Route A
- Alewife Route B
- Waltham Center
- Windsor Village

Source: 128 Business Council Shuttle Schedules

Figure 2-19
Existing 128 Business Council Shuttle Routes
Transportation Master Plan
Waltham, Massachusetts

Shuttle services provided by *Brandeis University* are private and only available to Brandeis students, faculty, and staff. Ridership data is not collected by the University but they report that the service is consistently utilized during the academic year when services are available. The university runs five shuttle routes, two of which provide service around campus, two provide service to/from Waltham Center via Moody Street, and one that provides service to/from Harvard Square and Boston (Commonwealth Avenue and Massachusetts Avenue). The campus shuttles run daily every 15 minutes, Waltham Center shuttles run daily every 30-40 minutes, and the Boston/Cambridge shuttle runs Thursday to Sunday every 90 minutes.

Shuttle services provided by *Bentley University* are private and limited to use by students, staff and faculty only. Ridership information was not available. *Bentley University* runs three routes: one that makes a loop around campus, one that provides service to Waltham Station, and a third that provide service to Harvard Square. All buses run Monday to Sunday, with the campus loop running every 20 minutes and Route 200 shuttle to Carter Street every 60 minutes from 6:50 AM to 11:00 AM and 2:30 PM to 11:00 PM, with some intervals of two hours between trips. The Harvard shuttle runs every 60 minutes on weekdays and every 30 minutes on weekends.

Boston Children's Hospital operates a shuttle between its Waltham campus and the Longwood Medical Area primary facility. The shuttle operates every 40-60 minutes Monday through Friday, from 5:30 AM to 9:00 AM and 3:00 PM to 7:10 PM. The shuttle carries about 100 riders to Waltham, and about 50 riders from Waltham, according to ridership data provided for the week of May 11 through 15, 2015.

Several of the hotels in the business center of Waltham, around the Route 128/Winter Street area, including the Holiday Inn, Hyatt Waltham, Embassy Suites, and Hilton Garden provide complimentary shuttle services. Service is generally for hotel guests between the hotel and nearby corporate offices, the conference center at Waltham Woods, and Forefront Conference Center. Some services are limited to morning and evening peak periods only. Shuttle service to/from Logan Airport is generally available, with prior arrangements for a fee.

G. Parking

Study Overview

Parking plays an important role in the context of Waltham's multi-modal transportation master plan. The focus of the parking study is in downtown Waltham along Moody Street and Main Street. Downtown Waltham was chosen for the parking study over several other areas as it represents the heart of the city, providing residents with many retail and business destinations and transportation options. Evaluating parking in this area will inform Waltham's desire to accommodate growth, balance commuter rail parking needs with local parking needs, and manage parking supply to better accommodate demand.

Parking management can provide downtown Waltham with multiple benefits, ranging from economic benefits to safety benefits. When parking is managed to ensure there is an appropriate amount, the turnover of cars supports business accessibility, the presence of on-street parking provides traffic calming to increase pedestrian safety, the reduction of vehicles searching for parking improves traffic circulation, and parking near transit stations increases

transit use. The most efficient use of parking in a typical downtown area is 85% utilization, as this means it is well utilized while also providing space for those seeking parking.[5]

Downtown parking in Waltham was evaluated by conducting a parking count and analyzing utilization rates within two defined study areas.

- The Moody Street area of downtown Waltham consists of 1,330 public parking spaces, 290 of which are on-street and 1,040 of which are in off-street lots and garages. This area is bounded by Dexter Street to the south and School Street to the north. It includes all on-street parking spaces on Moody Street; and spaces in the vicinity of the Common including 10 on Main Street, 11 on Lexington Street, 6 on Church Street, 16 on Elm Street, and 8 on Felton Street. Off-street parking lots off Moody Street and Main Street were included as well.
- On-street parking spaces along Main Street in downtown Waltham, from Weston Street to Lyman Street, were also counted to provide a broader context for the downtown parking supply as a whole.

The data collection effort was guided by McMahon with the City of Waltham on the ground collecting parking utilization data street by street. The spaces in the Moody Street area were counted hourly on Friday, September 25, 2015 from 10:00 AM to 8:00 PM. A Friday was selected to represent the highest demand for both daytime and evening uses, such as the businesses, commuter rail parking, restaurants, and entertainment found downtown. The spaces in the Main Street area were counted on Friday March 18, 2016 every two hours from 10:00 AM to 8:00 PM to confirm parking trends along this corridor of the downtown. A Friday was selected to provide consistency with the data collection methodology used for the Moody Street study area.

Parking Regulations

As displayed in Figure 2-20, all on-street parking is free. Off-street parking is 50 cents an hour until 6:00 PM with a maximum of $2.00 a day.[6]

On-street parking time restrictions range from 15 minutes to four hours. Off-street parking is either two or 12-hour parking.

The Main Street study area includes only on-street parking, which is free. Some of the segments, notably between Common Street and Spring Street were once metered. On-street parking along Main Street is generally free with a two-hour time limit, except for a few spaces in front of the post office with a 30-minute time limit.

[5] Donald Shoup, High Cost of Free Parking
[6] City of Waltham Pay-by-Space Parking Meter Brochure, 2013

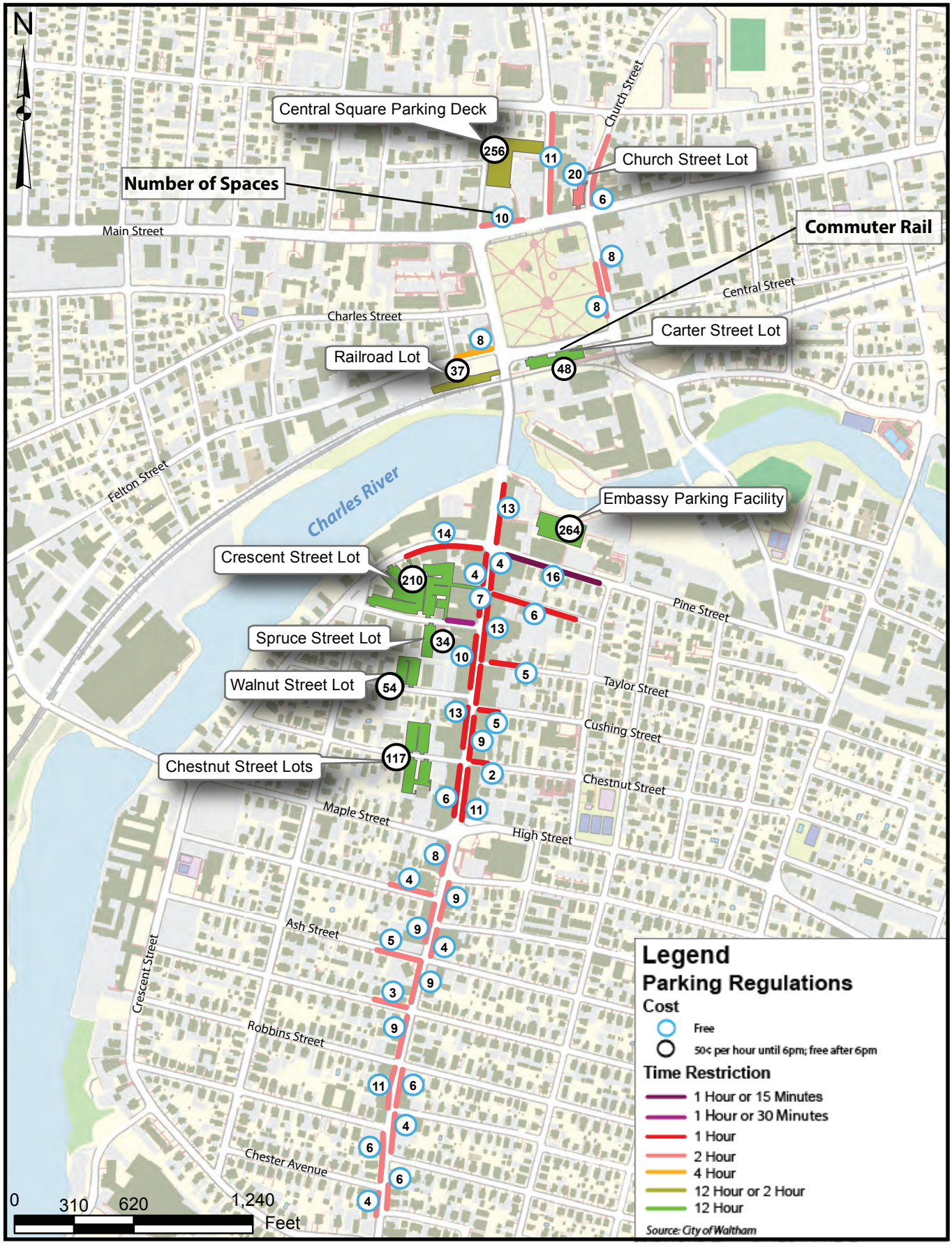


Figure 2-20
Parking Restrictions Map
Transportation Master Plan
Waltham, Massachusetts

General Trends

Moody Street

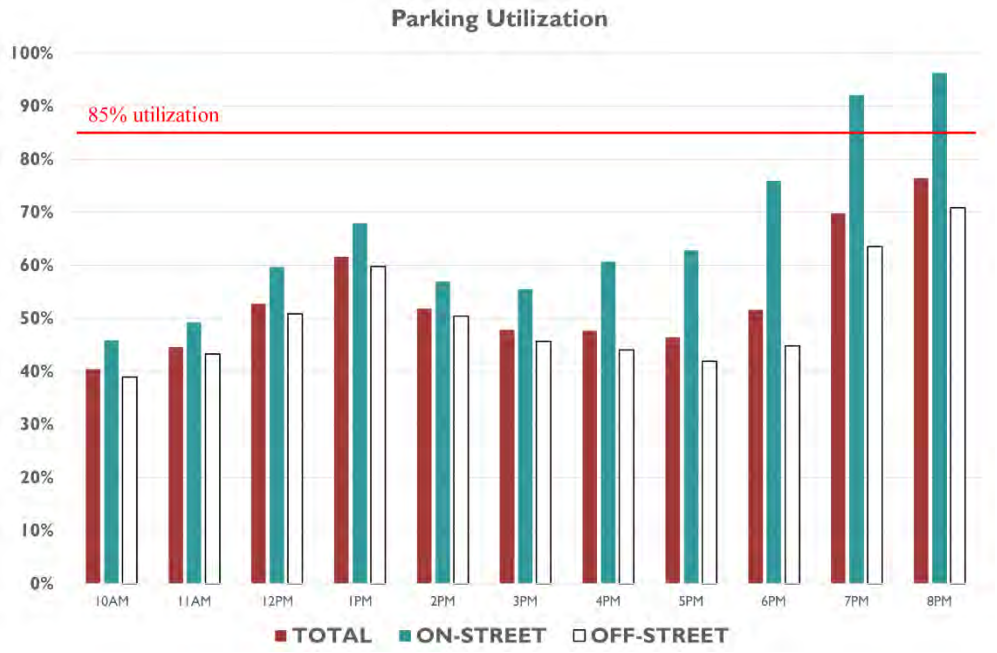
As shown below, weekday utilization in the Moody Street study area peaks at 8:00 PM for both on and off-street spaces. On-street spaces reach a peak use of 96% and off-street spaces reach a peak use of 71%. On-street parking spaces are consistently more utilized than off-street spaces throughout the day. This is a likely trend due to convenience and cost:

- On-street parking is convenient to a destination's front door.
- On-street parking is free, compared to the fee for of off-street parking.

Total parking peaks at 76%, and does not reach 85% utilization on the date of data collection. There is a high demand for on-street parking, especially in the evening hours, but the analysis indicates parking demand does not exceed total supply within the overall study area.

Throughout the day on-street parking ranges from 46% utilization at 10:00 AM to 96% utilization at 8:00 PM. Before 6:00 PM on-street parking in the southern end of the study area is underutilized, with the majority of street spaces less than 75% full. On-street parking after 6:00PM is well utilized, ranging from 76% to 96% utilization. On-street parking north of the Charles River does not display a clear pattern, with some blocks up to 100% full and some less than 50% full throughout the day. Maps displaying utilization rates for the entire study area are located in Appendix H.

Off-street parking ranges from 39% utilization at 10:00 AM to 71% utilization at 8:00 PM. The utilization of off-street parking varies by location, as described in the sub-area section below. Generally, off-street parking north of the Charles River is more utilized during the day, and off-street parking off Moody Street south of the Charles River is more utilized in the evening. The utilization patterns for both on-street and off-street parking throughout the study area are depicted in Appendix H.

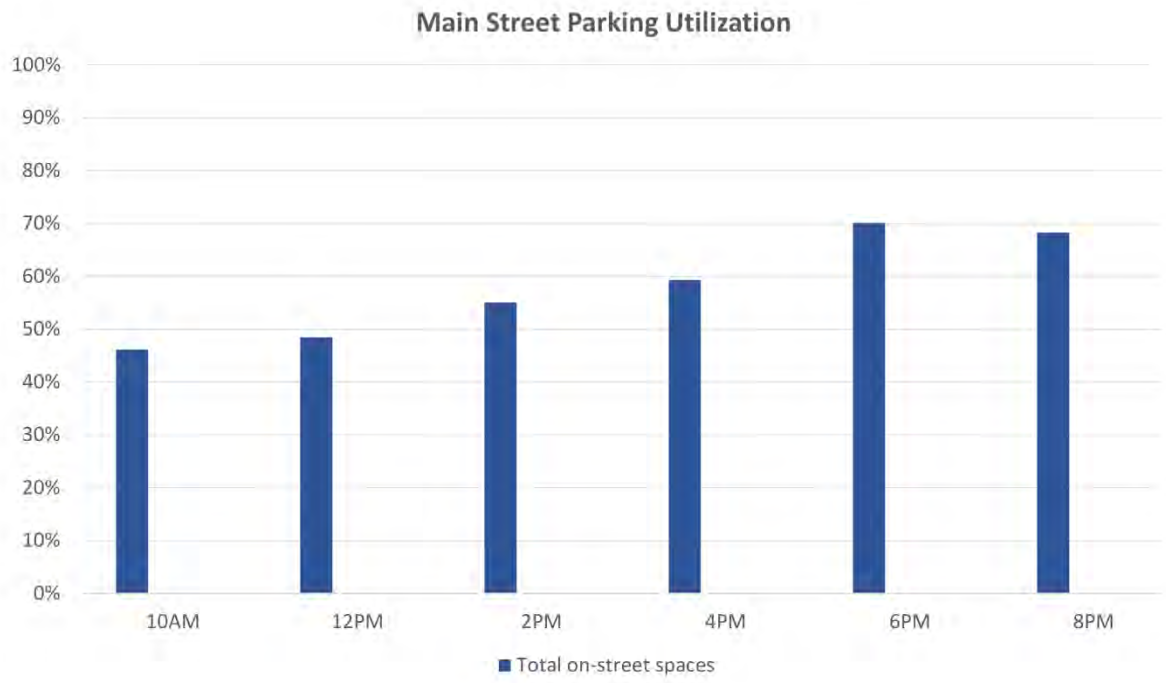


Moody Street Parking Utilization

Main Street

The data for Main Street was collected by segments, as shown in Figure 2-21. The segments provide a way to understand the catchment areas along Main Street and the different land uses that may be driving parking demand at different times of day. For example, the segment west of the Common between Fiske Street and Howard Street is mainly restaurants and bars, while east of the Common closer to Newton Street are businesses and retail with private off-street parking lots and residences.

The Main Street parking count also depicts higher utilization in the evening, from 6:00 PM to 8:00 PM, as shown below. However, the Main Street segment from Weston Street to Newton Street peaks at 70% utilization at 6:00 PM, illustrating that there is less on-street parking demand on Main Street than Moody Street at this time, when the demand for parking Moody Street is highest.



Main Street Parking Utilization

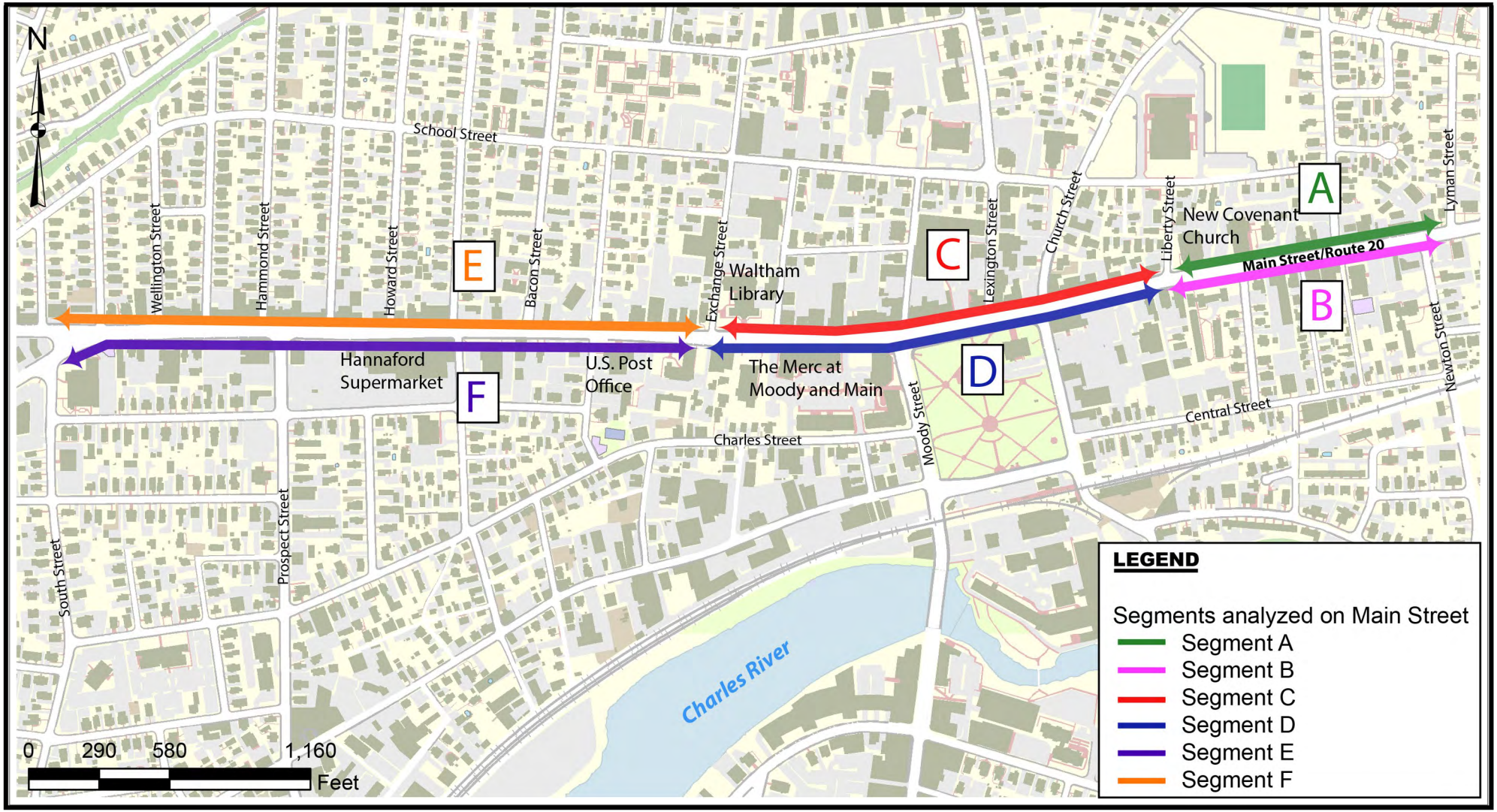


Figure 2-21
Main Street Parking Segments
Transportation Master Plan
Waltham, MA

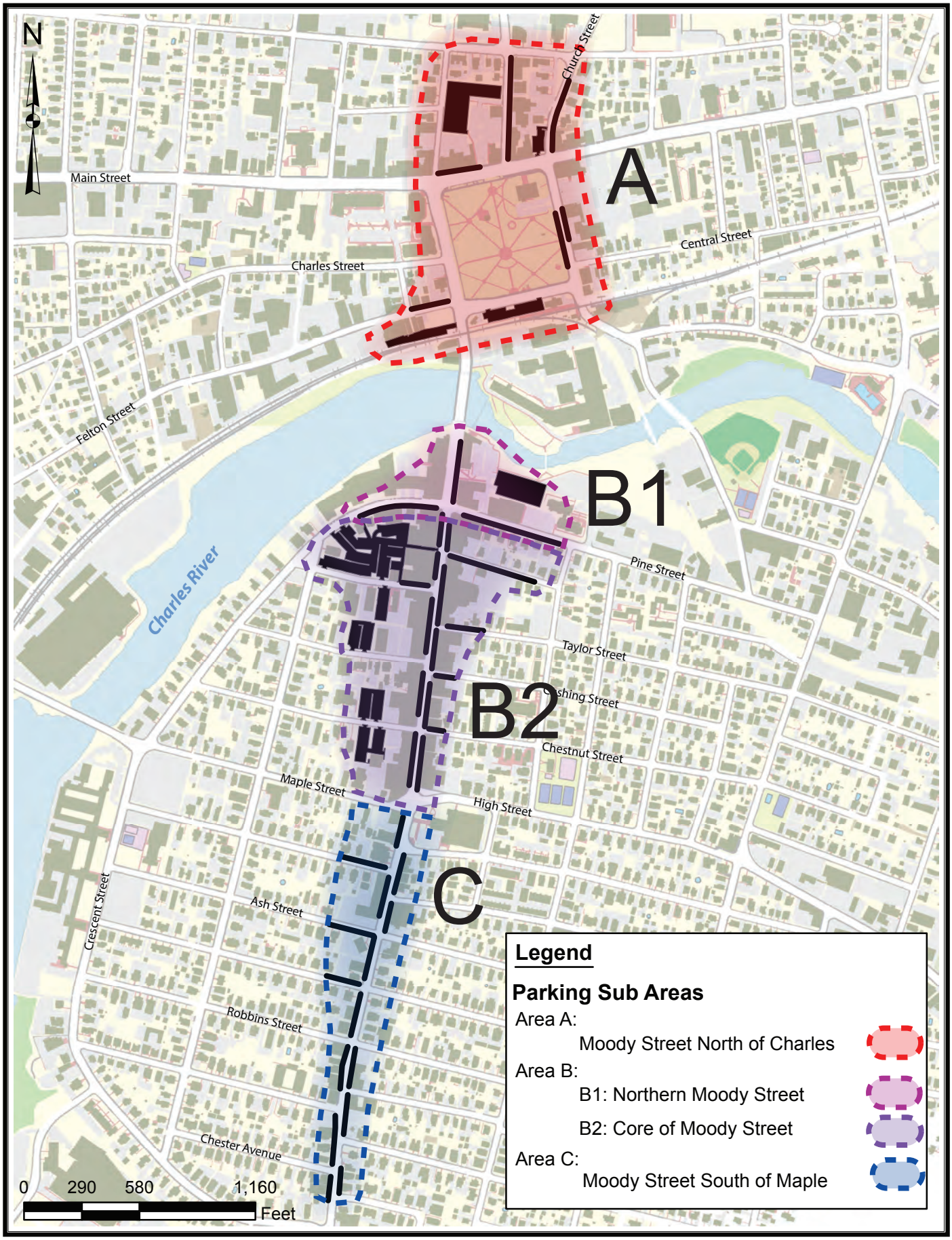
Moody Street Sub-Area Analysis

To better understand varying utilization patterns by location, the Moody Street study area was divided into three areas, as shown in Figure 2-22. These areas were selected based on the supposed catchment areas for likely drivers of parking demand. Demand for parking north of the Charles River is expected to be influenced by demand for parking near the commuter rail station, located on Carter Street south of the Common. This is defined as Area A. Area B is comprised of Moody Street south of the Charles River down to Maple Street, as this represents the core of downtown business, retail, and entertainment. Area B is further divided into sub-areas B1 and B2, as demand for parking in sub-area B1 is suspected to be heavily influenced by the Embassy Cinema and the Cronin's Landing Apartments. These uses would lead to more demand in the evening and night. Area C is defined as Moody Street south of Maple Street, which contains a mix of commercial and residential uses.

Area A: Moody Street North of the Charles River

Demand for parking in Area A, Moody Street North of the Charles River, is influenced by access to the commuter rail station. Parking is more utilized during the day, with a peak at of 74% at 1:00 PM and gradually falling afterwards to its lowest utilization of 38% at 8:00 PM, as illustrated below.

Area A Total

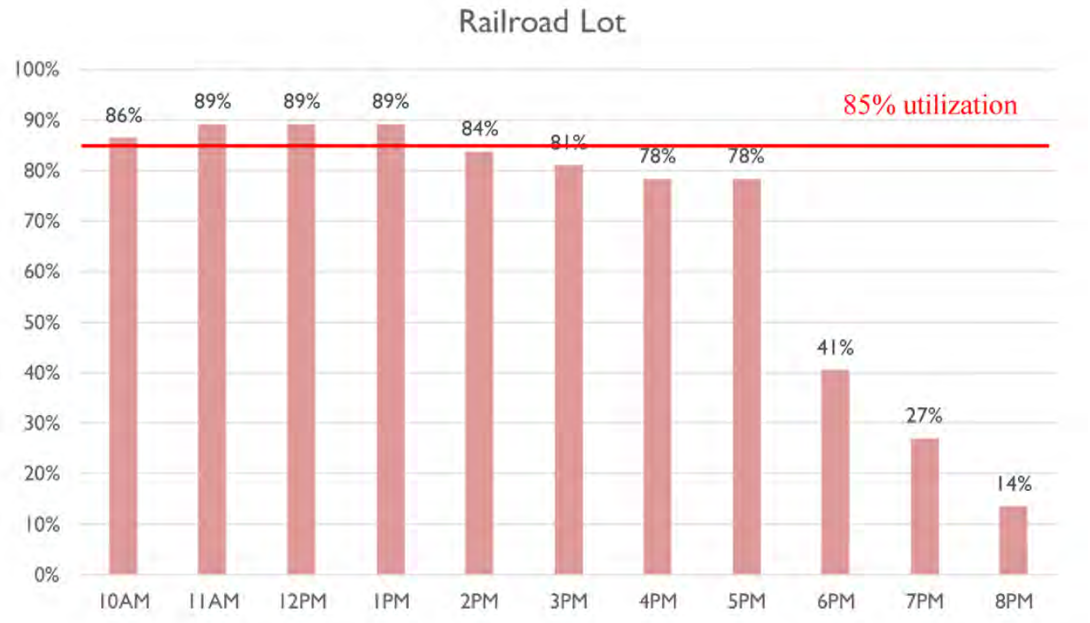


WALTHAM
INCORPORATED A TOWN 1738
INCORPORATED A CITY 1884

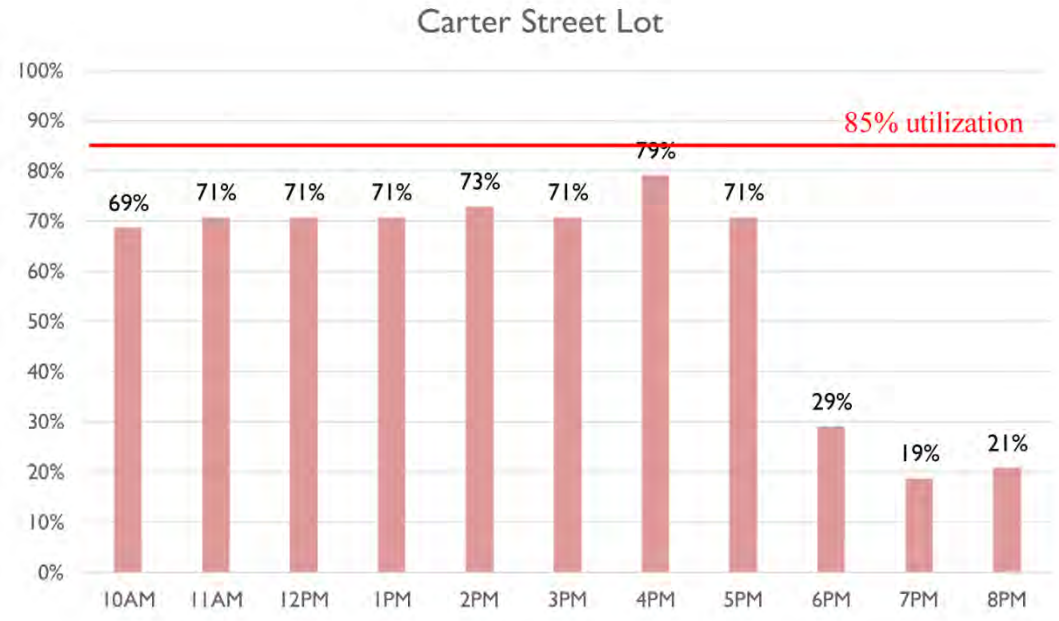
McMAHON
TRANSPORTATION ENGINEERS & PLANNERS

Figure 2-22
Parking Sub Areas
Transportation Master Plan
Waltham, Massachusetts

Utilization is highest during the day due to the proximity of the area to the commuter rail station. The Railroad Lot, which provides access to the Waltham Station outbound platform, is highly utilized during the day, with 89% utilization at 12:00 PM, but drops to only 14% utilization at 8:00 PM. Similarly, the Carter Street Lot, which provides access to the Waltham Station inbound platform, is between 69% and 79% utilized from 10:00 AM until 5:00 PM, and then drops to between 19% and 29% utilization from 6:00 PM until 8:00 PM. The utilization of these lots illustrates the pattern in Area A of high daytime utilization and evening under use, as shown in Figure 2-23.



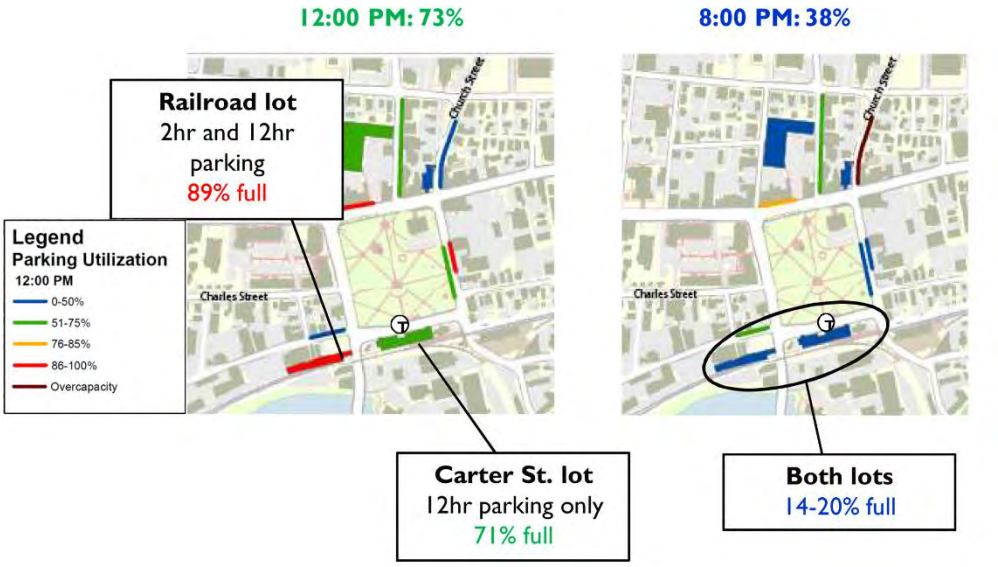
Railroad Lot Utilization



Carter Street Lot Utilization

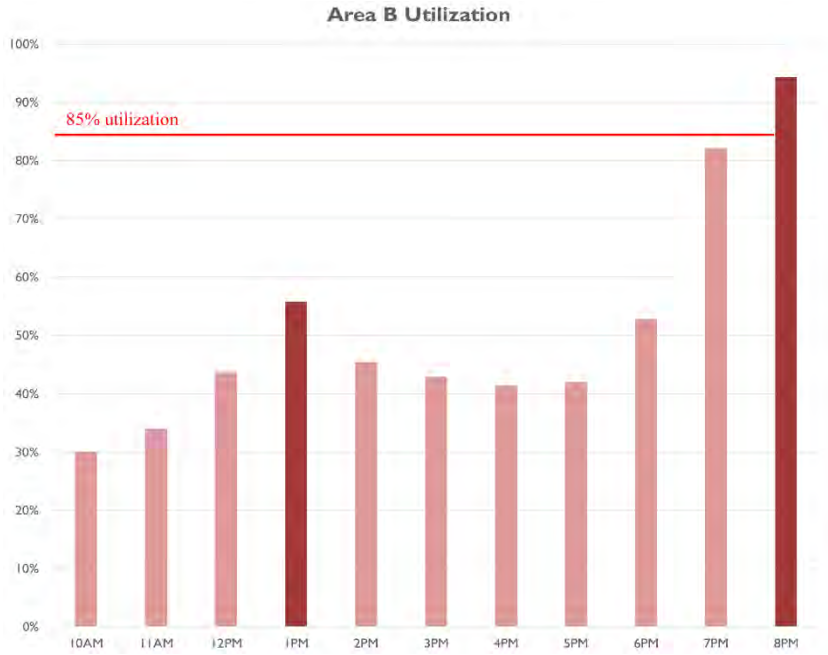
Commuters into Boston may prefer to park closer to the outbound platform, in the Railroad Lot, where they will exit on their return trip and have more direct access to their vehicles.

Figure 2-23: Area Utilization Maps



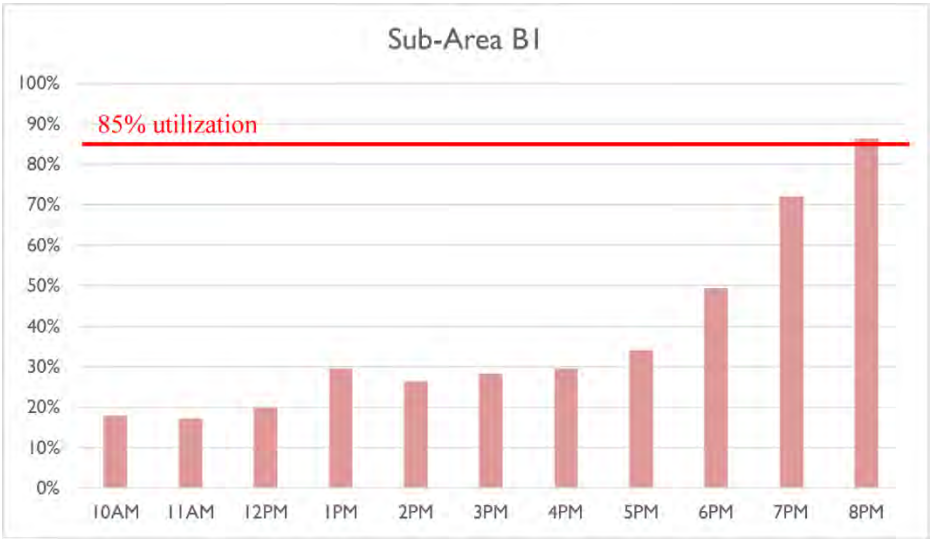
Area B: Core of Moody Street

Demand for parking in Area B, the Core of Moody Street, is driven by the business activity and entertainment on Moody Street. Utilization is highest in the evening, with over 80% of the parking utilized from 7:00 PM to 8:00 PM. There is also a rise in utilization at 1:00 PM during lunch time, relative to other times during the day, as shown below.

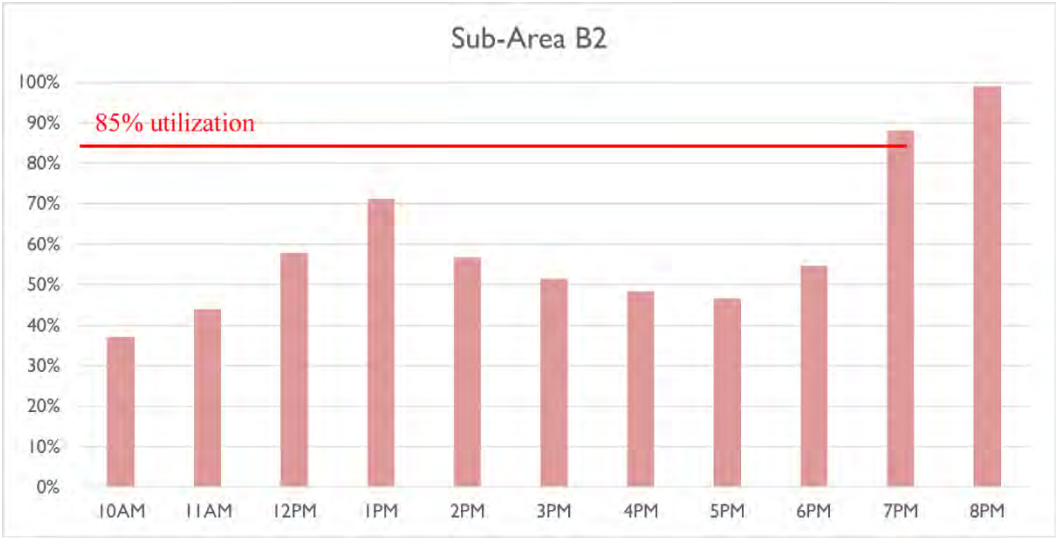


Area B Utilization

Area B is divided into sub-areas B1 and B2 as there are two distinct generators of demand for these areas. Sub-area B1 is north of B2 and includes on-street parking along Crescent/Pine Street, which runs west to east across Moody Street and is the northern most cross street with Moody Street before the Charles River. Sub-area B1 also includes parking along Moody Street north of Crescent/Pine Street and the Embassy Parking Facility. Demand for parking in sub-area B1 rises in the evening due to the Embassy Cinema. The on-street parking along Crescent Street west of Moody Street and Moody Street north of Crescent Street appears to accommodate spillover parking from nearby residential facilities (Cronin's Landing Apartments), which also increases evening utilization. In its entirety, B1 is notably less utilized during the day than B2, which is why it is important to view these areas separately to understand the heightened demand for B2.



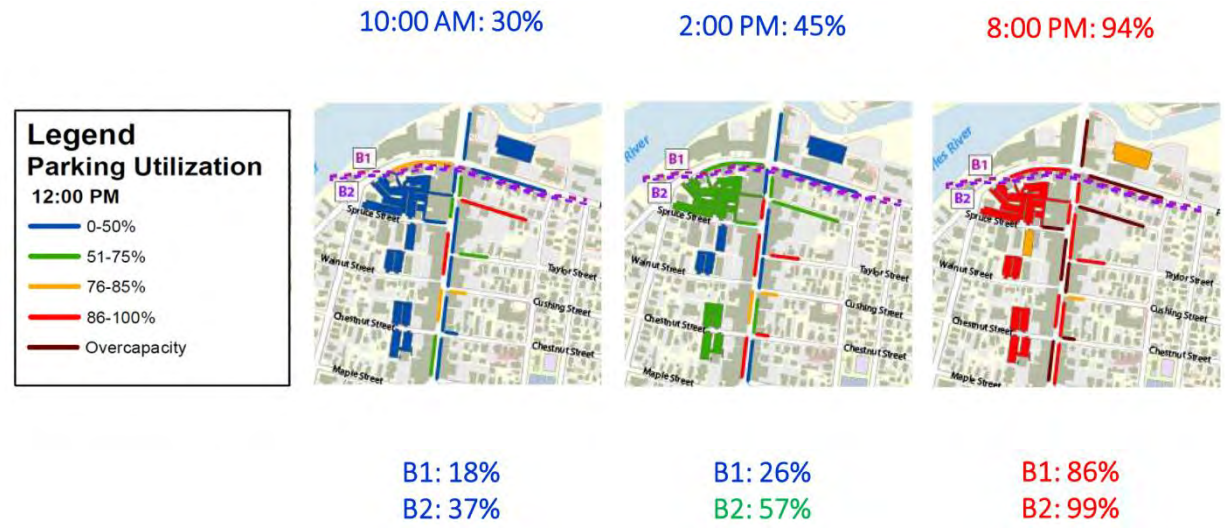
Sub-Area B1 Utilization



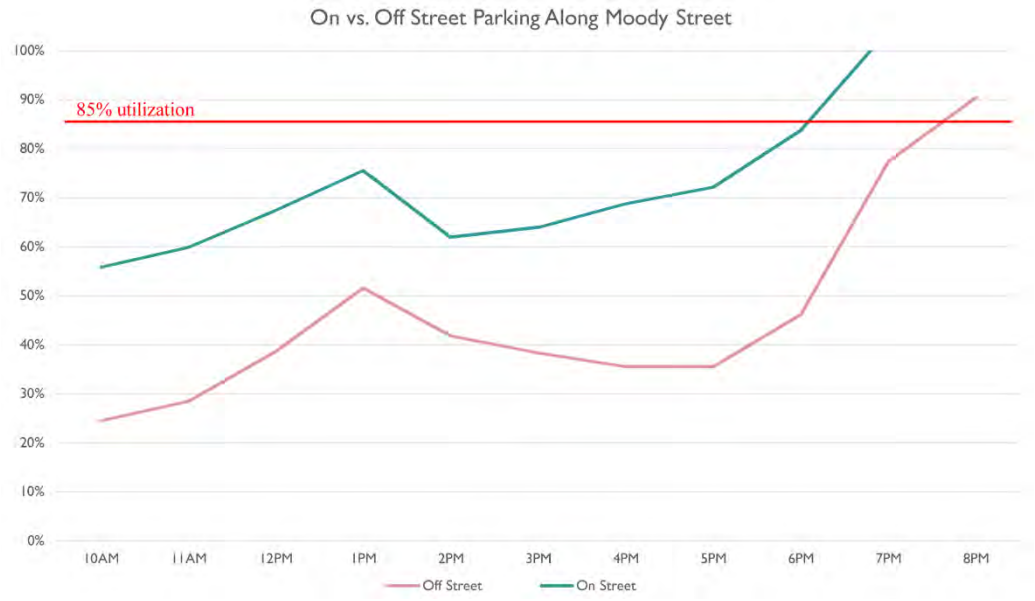
Sub-Area B2 Utilization

The section of Moody Street in B2 contains the majority of business and entertainment destinations. These generate demand for parking in both the day and evening. Destinations include small retail stores, food markets, and restaurants. Parking in B2 peaks at 8:00 PM at 99% utilization, and also is highly utilized (71%) at 1:00 PM relative to other hours of the daytime, which suggests there is increased activity during the lunch hour. These trends are seen in Figure 2-24.

Figure 2-24: Sub-Area B Utilization Area



Although there is consistent demand for parking in sub-area B2 throughout the day, there is not equal demand for on-street and off-street parking, as shown below. Even when on-street spaces are highly utilized, all of the off-street lots in this area are under 75% utilized up until 8:00 PM. It is not until 8:00 PM until both on- and off-street spaces are both highly utilized. The Crescent Street lot is the most used off-street lot in the study area, with a peak usage of 95% at 8:00 PM.

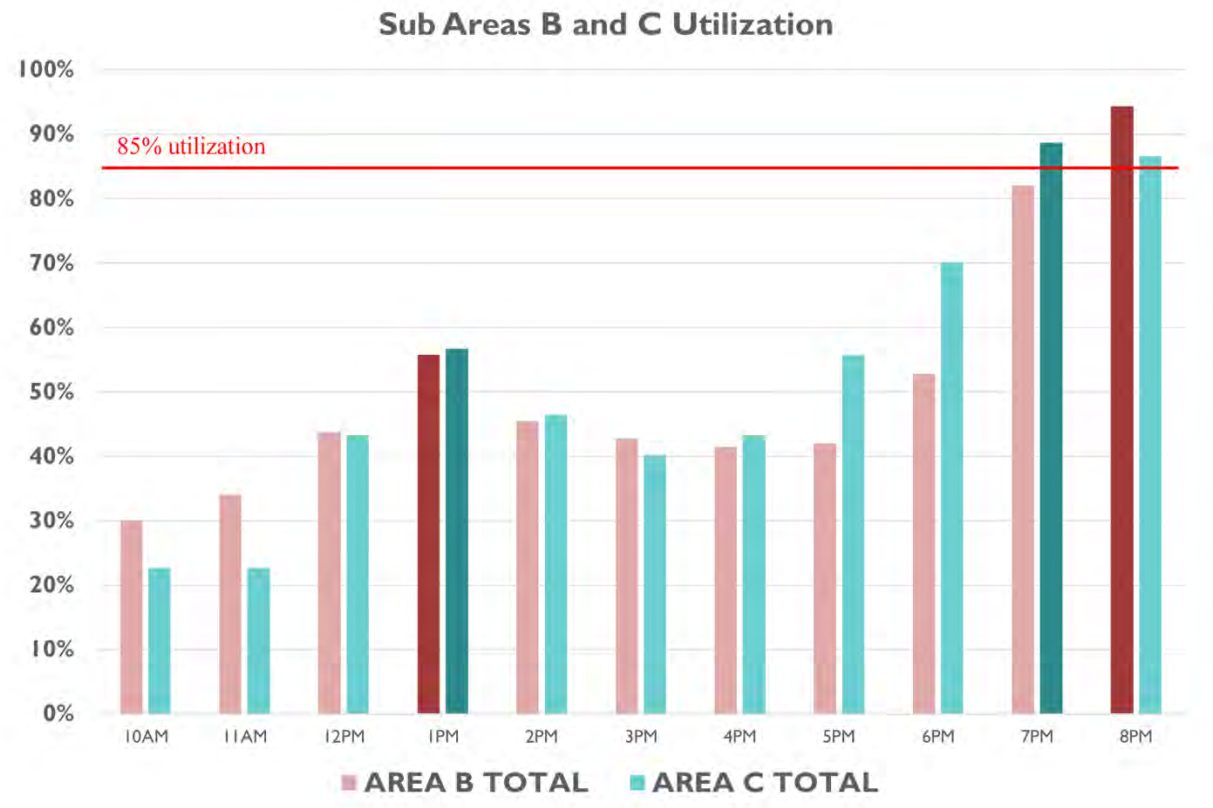


Area C On vs. Off Street Parking on Moody Street

At this time, the Walnut Street and Chestnut Street lots are 95% and 98% as well. The increased utilization of these lots at 8:00 PM may illustrate a preference of parking on-street closer to destinations fronting Moody Street, and a shift over to off-street lots only when on-street spaces are full and off-street lots become free (after 6pm).

Area C: Moody Street South of Maple Street

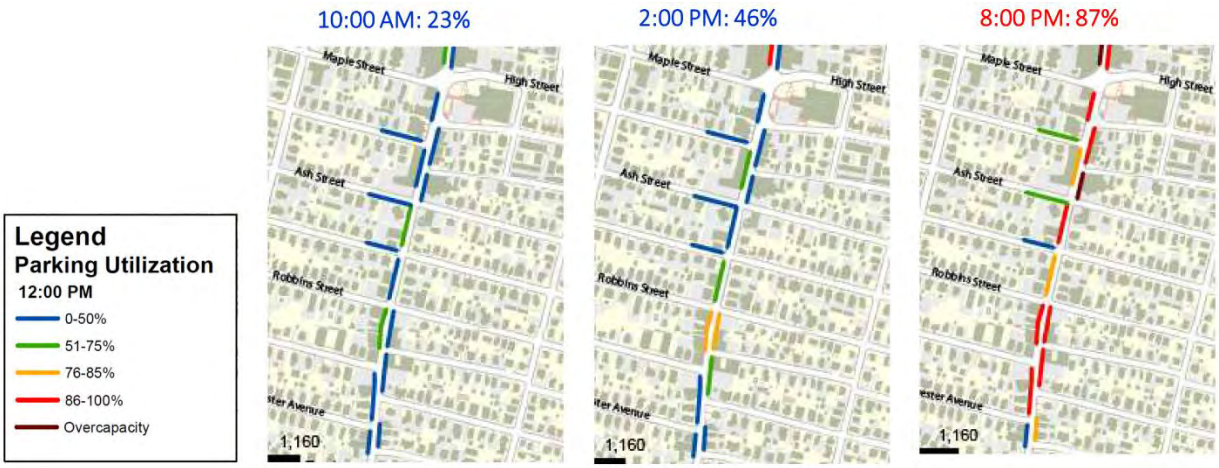
Area C, Moody Street South of Maple Street, follows a similar utilization pattern to Area B. South of Maple Street, Moody Street transitions into a more residential area scattered with convenience stores, take-out restaurants, and some businesses. There is also a church and community center in the northern segment of Area C. Unlike from Area A to B, there is not a distinct barrier like the Charles River dividing the two areas; however, Maple Street, running east and west across Moody Street serves as a transitional street between these two areas. At the intersection of Moody Street and Maple Street is the Waltham Community and Cultural Center, which is distinct from the retail and entertainment land uses in Area B, and provides a break in building form that transitions the neighborhood into one of more residential character with scattered commercial uses.



Sub Areas B and C Utilization

The demand for parking in Area C may be primarily residents or from those making short-term trips to banks or take-out restaurants. There are also several churches, which may generate parking demand on Sundays. The community center may generate additional demand during the day and on weekends. Area C may also accommodate parkers seeking destinations in Area B, as these two areas have similar utilization patterns, shown in Figure 2-25. Parking spaces in the southern end of Area C are approximately a ¼ to ½ mile walk from Area B, illustrating that it is reasonable to walk between these two areas.

Figure 2-25: Sub Areas B and C Utilization

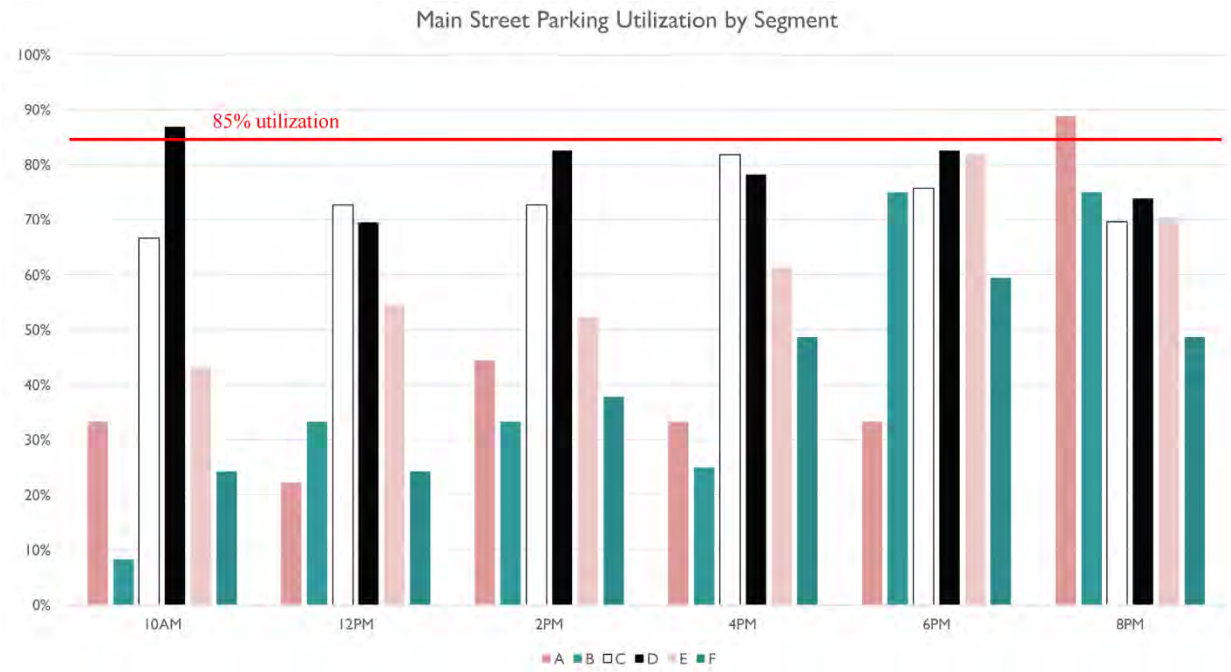


Main Street Analysis

Overall, Main Street between Weston Street and Newton Street does not have a parking shortage, as parking utilization did not exceed 85% during the study period. Parking along Main Street is increasingly more utilized as the day progresses from 10:00 AM to 6:00 PM, and peaks at 6:00 PM. This is notably later than Area A in the Moody Street area, which overlaps with the Main Street area and peaks midday at 1:00 PM.

Main Street Parking Utilization

The majority of uses along the studied portion of Main Street are retail and businesses like banks, hair salons, and convenience stores. There are also City Hall, a post office, and library. The segment of Main Street between Fisk Street and Howard Street houses several restaurants and bars, which may generate more demand for on-street parking. The figure below illustrates parking utilization by segment A through F. It is clear that daytime demand is highest in segments C and D, alongside the Common, while utilization on segments A, B, E, and F is generally higher in the evening.



Main Street Parking Utilization by Segment

Conclusions

Demand for parking in both the Moody Street and Main Street study areas, as a whole, does not exceed parking supply. Parking exists but is largely underutilized and does not reach the 85% threshold for an efficient use of parking in a downtown area throughout most of the day and in most areas. The only areas and times of day where parking utilization reaches or exceeds 85% utilization are Moody Street Areas B and C after 7:00 PM. Area B is closest to having demand outweigh supply at 8:00 PM, when utilization is at 94% (99% in B2), but at this time there is currently still available parking within the study area as a whole, with Area C at 87% utilization and Area A only at 38% utilization.

There are two distinct drivers of parking demand within the Moody Street study area: the commuter rail station north of the Charles River and business and entertainment activity south of the River. This leads to daytime demand for parking in Area A and evening demand for parking in Areas B and C. The Main Street corridor sees a mix of drivers of parking demand, including daytime businesses, City Hall, the library, restaurants, and residences.

Sub Area Comparison

If parkers are willing to park further from their destinations at either time of day, they are highly likely to find available parking in downtown Waltham on a typical Friday. Similarly, if some parkers are willing to park in off-street lots when on-street parking is in high demand, they are likely to find available parking. Barriers to either of these alternatives are the presence of the Charles River, which may discourage parkers in the core of Moody Street from wanting to walk to a destination on the opposite side of the river due to comfort or perceived safety concerns, as well as the price of parking or time restrictions in some of the off-street lots. Providing better parking management can help address these parking imbalances downtown. Additionally, the Tick-Tock Trolley may encourage Moody Street patrons to park around City Hall and utilize the trolley to reach Moody Street. The trolley loops around Waltham Common and the Central Square parking deck and then connects that parking to Moody Street. The trolley runs Thursday, Friday and Saturday from 6PM to 11PM to capture the restaurant peak.

3. Future Year Projections

A. Introduction

The transportation master plan projects a 10-year study horizon from existing year 2015 to future year 2025. Traffic volumes on the roadways in 2025 are assumed to include all existing traffic, as well as new traffic resulting from general growth in the study area and from planned development projects.

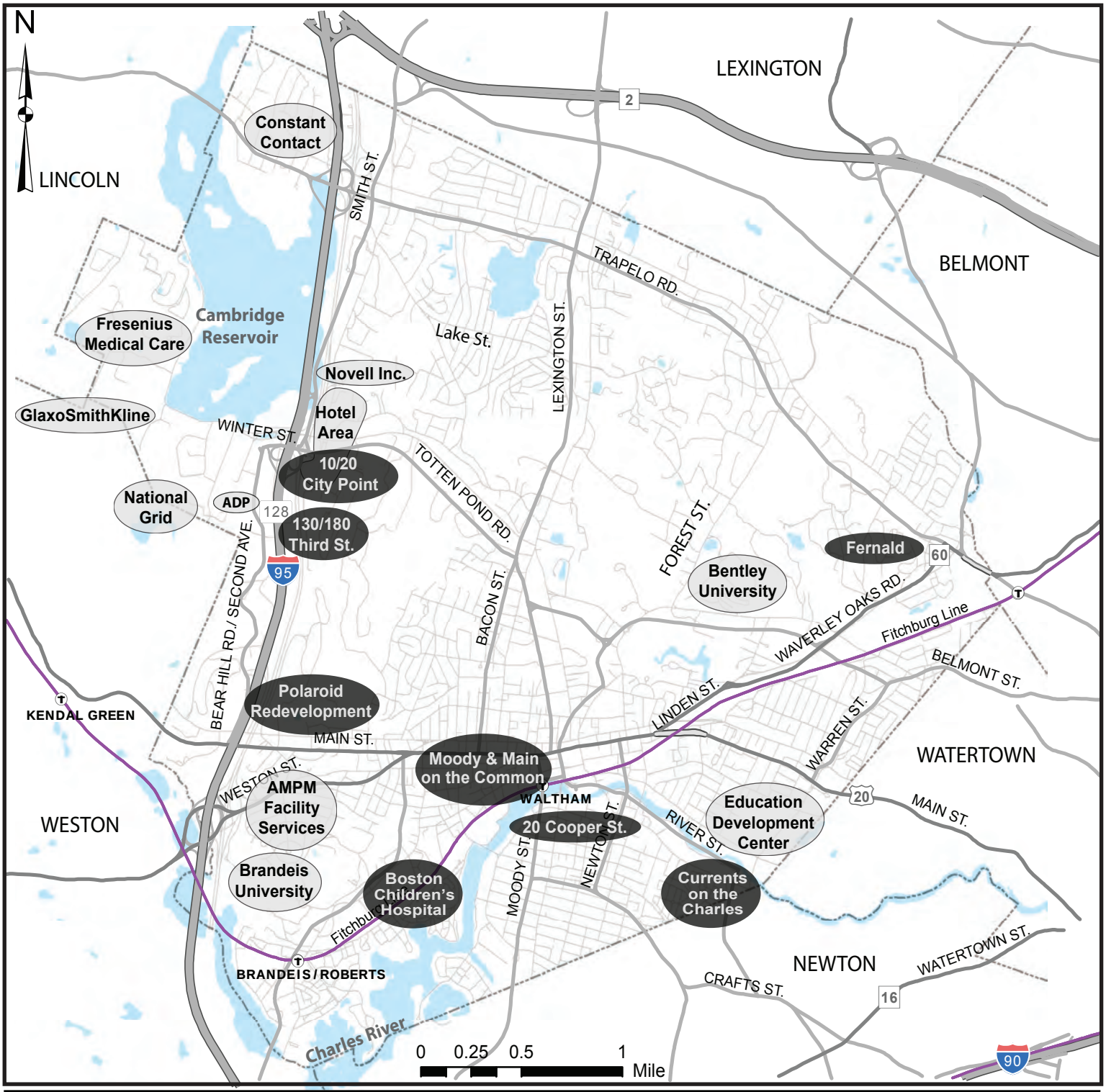
B. Background Growth

A one percent per year background growth rate was applied in order to forecast increases in traffic volumes on the study area roadways and intersections for our future analyses. This growth rate was determined based on data from the Central Transportation Planning Staff (CTPS) and was confirmed by the City of Waltham Planning and Traffic Engineering departments. This rate captures growth associated with genera changes in population and accounts for other small developments in the vicinity of the study area and is consistent with similar traffic studies completed in this area in recent years.

C. Future Land Use Development

Proposed Developments

Current proposed and recently completed developments are summarized in Table 3-1. Summaries are each project are provided below. A map of these developments is provided in Figure 3-1.



LEGEND

Existing Major Developments

New development

Figure 3-1
Proposed Developments
Transportation Master Plan
Waltham, Massachusetts

Table 3-1: Proposed Developments

Development	Location	Year of Completion	New SF/ Residential Units
Currents on the Charles	36 River Street	2015	200 dwelling units
10/20 City Point	470-504 Totten Pond Road	2016	230,000 SF office/21,282 SF restaurant, 26,563 SF retail, 400,000 SF office
Redevelopment of 130/180 Third Avenue	130/180 Third Avenue	2016	399,000 SF commercial
The Merc at Moody and Main	1 Moody Street	2018	29,000 SF retail, 277 dwelling units
Polaroid Site Phase 1	1265 Main Street	2015	120,000 SF office, 60,000 SF retail, 120,000 SF under construction for Clark's American's Inc.
Polaroid Site Phase 2	1265 Main Street		1,000,000 SF,
20 Cooper Street	20 Cooper Street	2017	264 dwelling units
Boston Children's Hospital	9 Hope Ave	2019	48 new beds

Currents on the Charles

This is a multifamily residential building, with 200 dwelling units and 400 parking spaces, located on 179,003 square feet of local land. The development is located on River Street in south eastern Waltham near the city's border with Newton.

10/20 City Point

The proposed project is a complete redevelopment of the site which currently consists of three existing 35 year old buildings that will be demolished. It is located along the Route 128 corridor in northwestern Waltham. The 450,000 square foot mixed-use development at 20 City Point will contain approximately 400,000 SF of office space, including 27,800 sf of retail space and restaurant place and 1,555 parking spaces. 10 City Point contains 230,000 SF of office space, including street level retail and restaurant space. The projects are currently under construction and expected to be completed in 2016.

Redevelopment of 130/180 Third Avenue

The project involves the redevelopment of the existing site including the demolition of the existing buildings and the construction of approximately 399,000 square feet of office space in two separate buildings on two separate lots. Lot A is located at 130 Third Avenue and will contain a four story building of 129,000 SF of office space, and a three story underground and one story above ground parking garage fitting 405 vehicles. Lot B is located at 180 Third Ave and will contain a six story building of 270,000 SF of office space with a six level parking garage.

The Merc at Moody and Main

This is a multi-phase construction project where all existing lots will be consolidated into one large new lot containing approximately 4.5 acres. A total of 269 units with 27,595 SF of retail space and 337 parking spaces will be provided. The three buildings will contain:

- Building A - 87 residential units (15,303 SF of retail)
- Building B - 118 residential units (12,292 SF of retail)
- Building C - 64 residential units and no retail space

Polaroid Site Phase 1

Phase I of the Polaroid Site redevelopment, located in south western Waltham, consisted of 160,000 SF of retail space, including a supermarket, restaurant, retail and service land uses. It also includes the Clarks Shoes headquarters, comprising 120,000 square feet of office space with potential to expand an additional 25,000 square feet to 145,000 total square feet. The development also included the construction of 1,376 surface parking spaces and associated utilities and stormwater management infrastructure. An additional 117 parking spaces were necessary to secure potential tenants for the Clarks Shoes office space as well.

Polaroid Site Phase 2

The full build out of the Polaroid site includes the development of an additional 1,825,000 square feet of mixed use development, including:

- 850,000 square feet of office development
- A hotel containing 300 rooms
- 200,000 square feet of retail
- 150,000 square feet of a health and fitness center
- A potential future 350-unit residential development

A Draft Environmental Impact Report (DEIR) was published in July 2016 by Vanasse Hangen Brustlin, Inc (VHB). To mitigate the expected increase in traffic volumes associated with the full build out of the Polaroid development, several improvements are proposed and shown in detail in the DEIR, including:

- Replacing and widening the Route 117 bridge
- Route 20 interchange improvements
- Route 117 interchange improvements
- Third Avenue interchange improvements
- Connection between Totten Pond Road and Route 117
- Stow Street Improvements

Route 117 Bridge

The existing bridge on Route 117 located between Stow Street/Tower Street and Bear Hill Road presently provides a four lane cross section and constrains traffic at the adjacent signalized intersections on either side of the bridge. The bridge is proposed to be replaced with a seven lane cross section, allowing for additional auxiliary lanes at the adjacent intersections as well as bicycle and pedestrian accommodations.

Interchange Improvements

Improvements are also proposed to provide improved access to/from I-95/Route 128 between Route 20 and Totten Pond Road/Winter Street. Improvements are proposed to add an interchange at Route 117, including an I-95/Route 128 southbound off-ramp to Bear Hill Road and a connection using Green Street which will serve as a frontage road to the Route 20 interchange. Improvements to Green Street include widening and providing a direct connection between Route 20 and Route 117 in both directions. An I-95/Route 128 northbound on-ramp is also proposed from Route 117 opposite Stow Street at the traffic signal.

The improvements adding connections to I-95/Route 128 at Route 117 will help reduce the volume of traffic traveling along Weston Street through the Tavern Square residential area. Additionally, the subsequent change in traffic patterns will alter the traffic patterns at the Banks Square intersection, as many motorists traveling on Main Street in route to I-95/Route 128 will be able to continue as through movements on Main Street. Under the current street network, these motorists access Weston Street at Banks Square in order to access I-95/Route 128, creating a high volume of left turns at the Banks Square intersection.

Additional improvements are proposed for the interchange at Winter Street at Totten Pond Road to realign the I-95 Northbound off-ramp opposite Prospect Hill Lane and signalize the intersection. The on ramp to I-95 northbound would also be realigned to be accessed from this location. Currently vehicles exiting I-95 northbound have to travel southbound on 3rd Avenue and make an unsignalized U-turn at the Prospect Hill Lane intersection to access Winter Street/Totten Pond Road to the north. Relocating the I-95 on-ramp requires vehicles from Winter Street to travel through the congested Totten Pond Avenue at 3rd Avenue intersection, but allows direct access to I-95 northbound from the commercial properties on Prospect Hill Lane, 4th Avenue, and 3rd Avenue, and removes these traffic volumes from the traffic signal at Totten Pond Road and 3rd Avenue.

Connection between Totten Pond Road and Route 117
Land is proposed to be redeveloped north of Route 117 on the Polaroid Site to approximately 5th Avenue. As part of the redevelopment, a connection was made between the 5th avenue commercial development and the Polaroid development that connects Totten Pond Road to Main Street (Route 117). The connection is currently approved as an "off-peak link" between the two commercial developments and can be open full time pending the City's approval. The link is expected to help reduce congestion on other local roadways and key intersections in Waltham as well as I-95/Route 128.

Stow Street Improvements
The DEIR also addresses improvements to Stow Street. Stow Street currently serves as a connection between Weston Street and Main Street. With the proposed interchange improvements, alternatives are being considered to minimize cut through on Stow Street, including:

- Restricting access to Main Street to a right turn only from Stow Street, limiting the connection to the interchange ramps and Polaroid Site and reducing cut-through traffic.
- Ending Stow Street before the connection with Main Street in a cul-de-sac and eliminating the connection, keeping all traffic on Stow Street and adjacent roadways local.

20 Cooper Street

A luxury apartment complex providing 264 apartments is proposed for 20 Cooper Street. The complex would be a four to five story building that would include four studio apartments, 174 one-bedroom apartments, 86 two-bedroom apartments, and 25 affordable housing units. Each apartment would be given two above ground parking spaces, with other transportation elements such as Zipcar, bike storage, and access to the Carter Street bus stop and MBTA commuter rail. The developers have proposed to make improvements to the area's walkways and to clean up the site.

Boston Children's Hospital

The Boston Children's Hospital's Satellite campus in Waltham is undergoing expansion alongside the main campus in the Longwood area of Boston. The expansion in Waltham includes 48 new beds to the outpatient facility, and doubling the number of operating rooms in Waltham to two.

The Fernald School Site

The Fernald School Site was previously a state owned psychiatric facility that has since closed. The 196 acre parcel was purchased by the City of Waltham in December 2014 and the development of the site has been widely speculated. Approximately 70% of the funds used to purchase the parcel are from the Community Preservation Act (CPA), meaning that the majority of the site can only be used for open space, recreation, or historic preservation. Currently, there are no planned or permitted plans for

redevelopment of the parcel, but the City of Waltham purchased the site in 2014. Any changes to the site by the City will involve traffic analysis.

Kendal Green Station

Improvements are proposed to relocate Kendal Green Station in Weston on the Fitchburg Line to a more central location to help create multi-modal opportunities for the region including improved access to transit and enhanced bicycle and pedestrian connectivity including connections to the Wayside Trail.

Autonomous Vehicles

The future of vehicular travel may change over the ten year study horizon of this master plan with the introduction of autonomous vehicles. The new technology is still in the early stages and the specific impact on traffic is not yet known. It is expected that the introduction of this technology will aid in the reduction of crashes that result from driver error and possibly improve traffic operations be removing driver subjectivity. While specifics on how vehicles will interact with roadway infrastructure or other modes of transportation including pedestrians and bicyclists are not fully known, the City of Waltham will want to stay informed on this topic, train appropriate staff, and be prepared to potentially change current practices to better serve autonomous vehicles. For example, since it is expected that the maintenance of roadway pavement markings and infrastructure will be important to provide a clear message to the vehicle, Waltham may need to adjust their rate for applying pavement markings and updating signs. In some cases additional signing and striping may be required, particularly in area identified within the City where lane markings are ambiguous or unclear to motorists.

D. Development of 2025 Traffic Volumes

Coordinating with the City of Waltham Planning and Traffic Engineering Departments, six of the future developments described above were considered as special traffic generators and included in the future year 2025 projections including:

- Currents on the Charles (36 River Street)
- 10/20 City Point
- 130/180 Third Avenue
- Moody & Main on the Common (“The Merc”)
- 20 Cooper Street
- The Polaroid Site (Phase 1 and Phase 2)

The additional developments identified and described above were considered to be part of the general background growth, either due to their size or because there was insufficient information about the proposed development at this time. The selection of these developments was based on information provided at the time of the future traffic volume development. The transportation master plan is a living document. As additional development proposals come forward, including “by right” and “special permits,” the proponents will need to present data to

demonstrate how the plans fit with the vision and recommendations of this transportation master plan.

Specific traffic volume information for these developments was obtained from the traffic impact studies prepared for each development, which were provided by the City. The 2014 existing traffic volumes were grown by the 1% growth rate, and the site specific traffic was added to the study area intersections adjacent to each development in accordance to the information provided in each traffic study, including volume redistribution of traffic that was projected to occur as a result of mitigation. 2025 No Build Traffic volumes are shown in detail in Appendix I.

E. Traffic Conditions

The study area intersections were analyzed for the 2025 future year condition using the 2025 traffic volumes described above and planned roadway improvements; including roadway improvements associated with the proposed developments and roadway improvements planned by the City. The intersection operations for future year 2025 for each intersection are shown in Figure 3-2 and Figure 3-3 below. Detailed capacity analysis for the 2025 No Build condition is shown in Appendix J for the weekday morning and weekday afternoon peak hours.

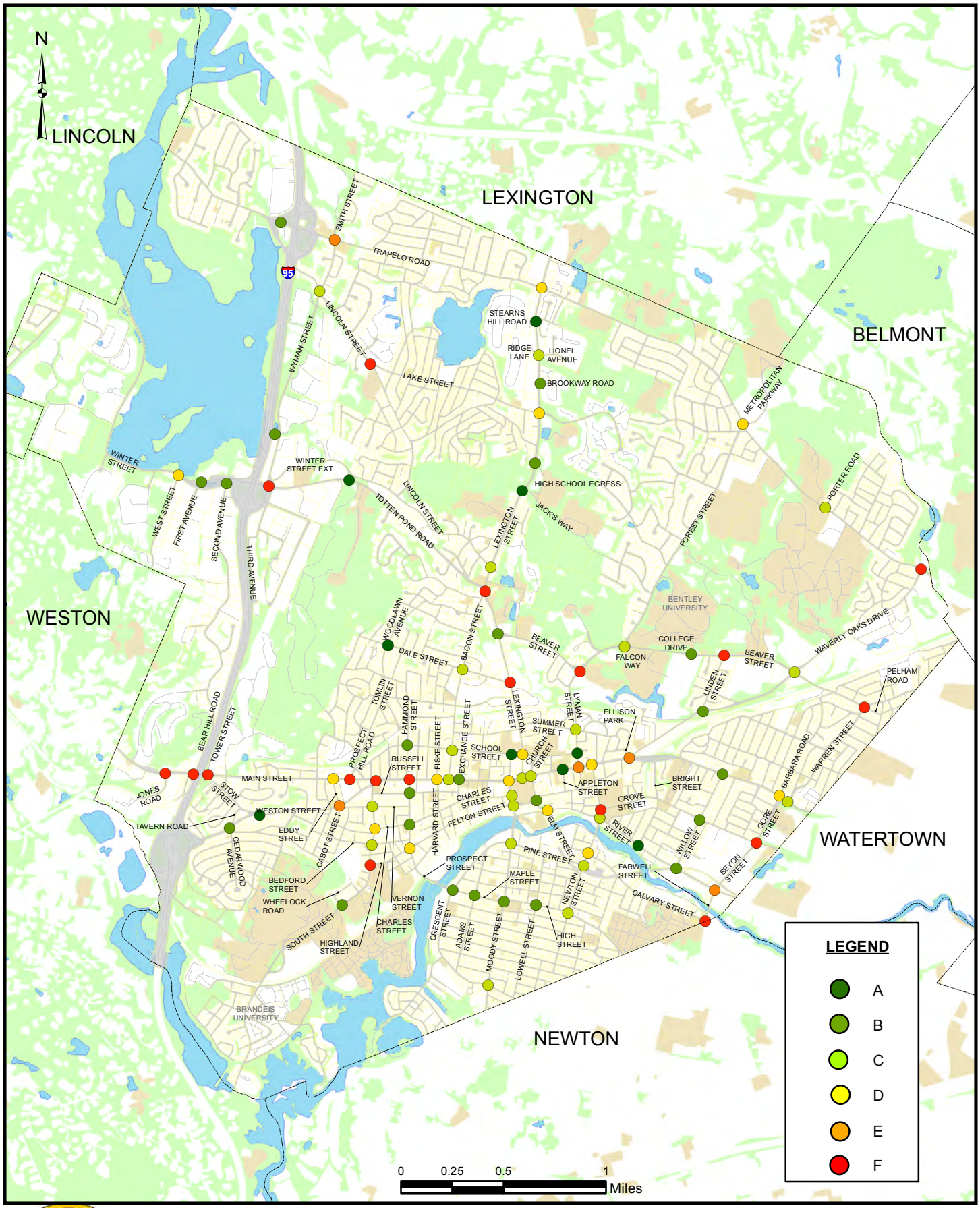


Figure 3-2
2025 No Build Weekday Morning
Peak Hour LOS Summary
Transportation Master Plan
Waltham, Massachusetts

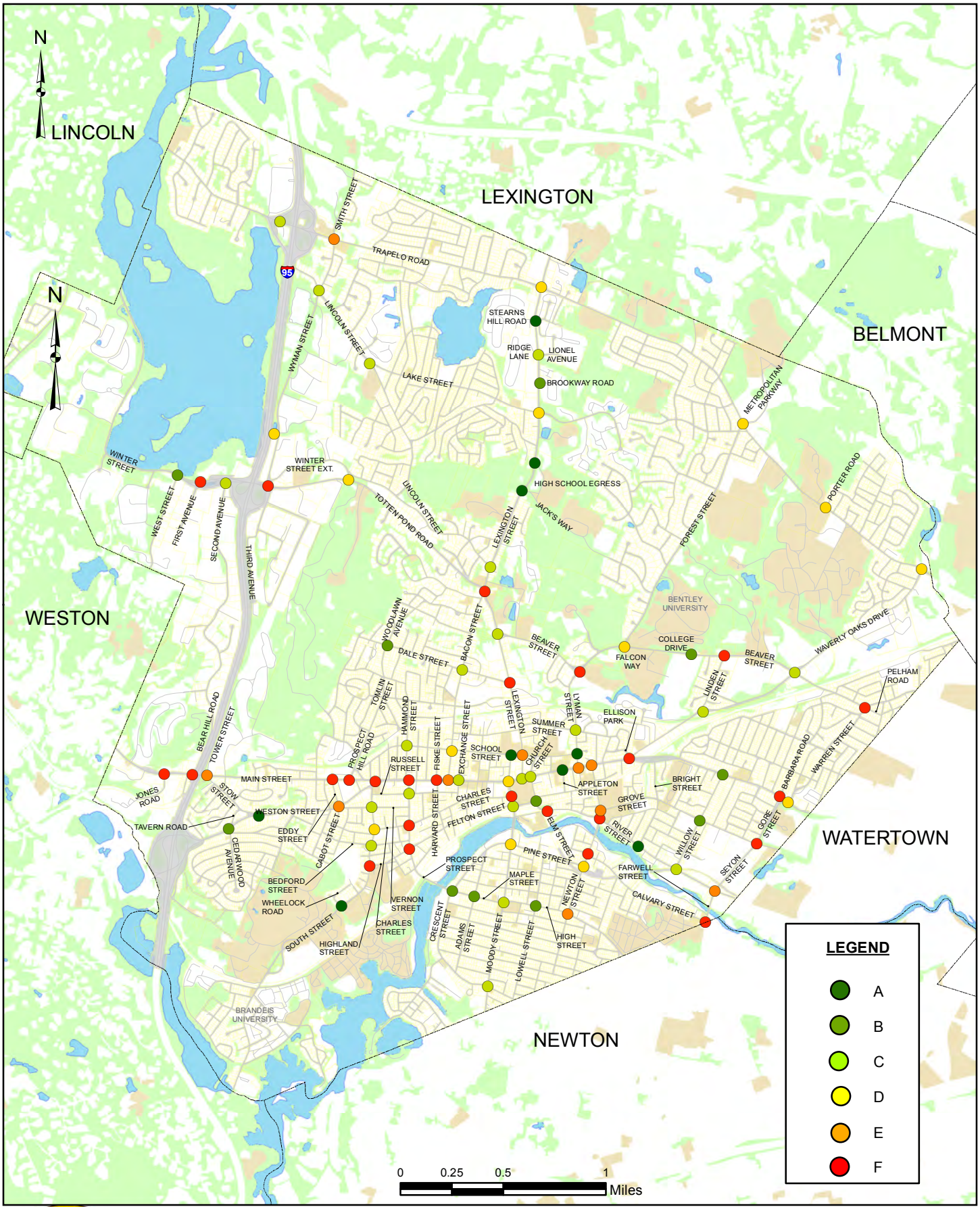


Figure 3-3
2025 No Build Weekday Afternoon
Peak Hour LOS Summary
Transportation Master Plan
Waltham, Massachusetts

4. Deficiencies (Geographic or Modal)

The City has a strong roadway network with generally good pedestrian connections and pedestrian facilities throughout. The City is also well serviced by various transit routes including bus and commuter rail, however, it lacks a transit hub with connections to other modes and lacks bicycle facilities overall through the city.

As part of this master plan, a specific focus was placed on five corridors and 20 study area intersections. Based on a review of the analysis presented and observations of the study area intersections and surrounding roadway network within the City, five corridors and 20 intersections were selected for specific review.

A. Corridor (5)

Bear Hill Road/2nd Avenue

The Bear Hill Road/2nd Avenue corridor was reviewed from Main Street to the south to Winter Street to the north. Bear Hill Road connects to Main Street from the south and continues north for approximately ¾ of a mile where meets 2nd Avenue, and 2nd Avenue continues on the same roadway corridor north to its terminus at Winter Street. The Bear Hill Road/2nd Avenue provides access to several commercial properties and has one lane in each direction and two-way left turn lane (TWLTL) beginning approximately 200 feet south of Fox Road and continuing north to the Costco driveway. . There is sidewalk on the eastern side of the road for the length of Bear Hill Avenue. The length of 2nd Avenue has sidewalk on the western side of the roadway. The two sidewalk segments are connected via one crosswalk adjacent to the intersection of 2nd Avenue and Bear Hill Avenue.

Bear Hill Road/2nd Avenue

The following deficiencies have been identified:

- There are no bicycle amenities on the roadway. The corridor provides a major connection for cyclists to the Winter Street corridor and surrounding commercial businesses.
- There are limited pedestrian amenities in the form of sidewalk on only one side of the roadway and only one pedestrian crosswalk at the 2nd Avenue/Bear Hill Avenue intersection.
- In some cases utility poles and other obstructions reduce the effective width of the sidewalk and the sidewalk width becomes insufficient to meet ADA requirements.
- Several businesses have wide curb cuts, multiple curb cuts, and curb cuts adjacent to one another that create additional conflict points along the roadway.

Bear Hill Road Cross Section

Lexington Street

The Lexington Street corridor was reviewed from Piety Corner to the south to Trapelo Road to the north. Lexington Street primarily provides two lanes of travel in each direction with sidewalk on both sides of the roadway. Additional lanes are provided at major intersection through the corridor and a center median exists in the vicinity of the High School and at Trapelo Road. Between Piety Corner and Lake Street, Lexington Street provides access to residential properties. Through this segment, sidewalks are separated from the roadway by a grass buffer. To the north of Lake Street, Lexington Street provides access to commercial properties through to Trapelo Road.

Lexington Street

The following deficiencies have been identified:

- Speeding on Lexington Street has been identified by the Waltham Police Department as a significant issue. The posted speed limit on Lexington Street is 40 mph. Speed limit signage is infrequently posted throughout the corridor.
- At the entrances to the Waltham High School and to the Kennedy Middle School, pedestrian facilities are substandard.
- There are no bicycle facilities on Lexington Street and this roadway serves as a major north/south route through the city.
- When there is an incident on I-95 south, vehicles often will bypass I-95 via Lexington Street southbound.

Lexington Street Cross-Section South of Waltham High School

Moody Street

The Moody Street corridor was reviewed from Pine Street/Crescent Street to the north and High Street/Maple Street to the south. Moody Street provides access to a downtown commercial area and consists of one travel lane in each direction as well as on-street parking and 10 foot--wide sidewalks on both sides of the roadway. Within the sidewalk area, street trees, decorative lighting, trash receptacles, and utilities are housed. All on-street parking in this segment of Moody Street is time restricted for 1-hour. There are several unsignalized crosswalks spanning Moody Street as well as signalized crossings at the intersections with Pine Street/Crescent Street and High Street/Maple Street.

Moody Street

The following deficiencies have been identified:

- The crossing locations service a high volume of pedestrians and are in need of improved visibility.
- Several of the crosswalks, particularly those spanning minor cross-streets are inconsistent from the City standard for marked crossings.
- There are no bicycle facilities on Moody Street.

Moody Street Corridor

Main Street (Section 1)

Two segments of the Main Street corridor were selected for evaluation and recommendations. The first section extends between Banks Square (where Main Street and Weston Street converge) to the west and Elm Street/Church Street to the east. This section of Main Street provides access to commercial properties. The segment of Main Street between Banks Square and Prospect Street provides two lanes in each direction and sidewalk on both sides of the roadway and on-street parking on the northern side of the roadway. The remainder of Main Street provides one lane in each direction with additional auxiliary lanes at intersections. On-street parking is generally provided on both sides of the roadway, but is restricted in certain areas where additional lanes are needed. There is 10 foot-wide sidewalk on both sides through the length of this segment of Main Street.

Wide Lanes on Main Street

Main Street (Section 1)

The following deficiencies have been identified:

Trap lane for eastbound left turn lane at Bacon Street.

- Main Street has several trap turn lanes, lanes that are through lanes ending in a turn lane. This causes drivers to make last minute lane changes, and increasing the occurrence of sideswipe collisions along Main Street. Drivers also are forced to constantly change lanes to continue through movement on the Main Street corridor.
- There are several crosswalks on Main Street, but often crosswalks are positioned adjacent to on-street parking. The MUTCD cites that a buffer of 20 feet is appropriate between on-street parking and crosswalks.
- Operations on Main Street during the weekday morning and weekday afternoon peak hours are congested. The lack of traffic signal coordination was noted as a contributing factor.
- Speeding on this segment of Main Street was observed to be an issue.
- There are wide lanes on Main Street which make it unclear if the roadway is intended to be one large lane or two lanes. Motorists have been observed passing in these single lane segments due to the width of the roadway.
- There are no bicycle facilities on Main Street.

Main Street (Section 2)

The second segment of Main Street extends from Elm Street/Church Street to the west to Linden Street to the east. This section of Main Street provides access to primarily residential land uses and provides one lane of travel in each direction with on-street parking and sidewalks provided on both sides of the roadway. Additional auxiliary lanes are present at several signalized intersections.

Main Street (Section 2)

The following deficiencies have been identified:

- The intersection of Main Street with Appleton Street is not included in the coordinated system on Main Street, which currently consists of Main Street at Lyman Street/Heard Street and Main Street at Newton Street. Based on its close proximity, the coordinated system should be extended to include the intersection of Main Street at Appleton Street.
- The section of Main Street between Pleasant Street and Linden Street has wide ambiguous lanes where it is unclear if the roadway provides one lane or two travel lanes.

Right turn trap lane at Amin Street at Newton Street

- The intersection of Main Street at Linden Street/Ellison Park Road is a 5-way intersection that operates poorly. Traffic from Ellison Park Road is primarily traffic cutting through the adjacent neighborhood to avoid Main Street.
- There is a turn lane trap for the eastbound right turn and westbound left turn lanes at the intersections of Main Street at Newton Street.
- There are no bicycle facilities on Main Street through this segment.

B. Intersection (20)

Winter Street at 1st Avenue/2nd Avenue

Winter Street at 1st Avenue and 2nd Avenue are both signalized intersections on either end of the Winter Street circulator. Winter Street at 1st Avenue is a clustered intersection that provides three lanes in the eastbound and westbound direction on Winter Street, two U-turning lanes to continue around the circulator and one lane to access 1st Avenue on the southbound approach, and a one lane approach northbound on 1st Avenue.

Winter Street at 2nd Avenue is a clustered intersection. In the westbound direction, Winter Street provides three through lanes. In the eastbound direction, Winter Street provides two lanes to reverse travel direction to access Winter Street westbound, three through lanes, and two right turn lanes onto 2nd Avenue.

Winter Street at 1st Avenue/2nd Avenue

2nd Avenue provide three lanes northbound. As previously described, 2nd Avenue is a dense commercial area that draws heavy traffic volumes. To access 2nd Avenue, vehicles must navigate the circulator through the 1st Avenue intersection.

The following deficiencies have been identified:

Right turn access to 2nd Avenue

- 2nd Avenue is a major traffic generator and no direct access to this roadway is provided. Vehicles from Winter Street to the east and I-95 must navigate the Winter Street circulator to access 2nd Avenue.
- Sections of Winter Street have an 8-lane cross section. There are several lanes that are underutilized and unnecessary, and add to the wide confusing geometry of Winter Street.
- During the weekday morning peak hour, there are several operation issues that have been observed within this corridor. There is a weave condition between the traffic exiting I-95 south and Winter Street westbound. This condition has adverse impacts on I-95 operations.
- The signalized intersections on the Winter Street corridor, including West Street and 3rd Avenue, are not coordinated.
- There is insufficient guidance on lane assignments for motorists driving through the circulator. The 2nd Avenue intersection had a total of 35 crashes over the three year period reviewed (2011-2013), the majority of which were sideswipe crashes, indicating there is driver confusion navigating this intersection.
- There are no bicycle facilities on Winter Street within this corridor. To the west, there are sharrows and the roadway is a popular off-peak cycling area.

Winter Street at 3rd Avenue/Totten Pond Road/Wyman Street

The signalized intersection of Winter Street at 3rd Avenue/Totten Pond Road/Wyman Street is a 4-way intersection. Winter Street approaches from the west and provides an exclusive left turn lane, two through lanes, and an exclusive right turn lane. Totten Pond Road approaches the intersection from the east and provides an exclusive left turn lane, a through lane, and a shared through and right turn lane. The northbound approach from 3rd Avenue

Winter Street at 3rd Avenue/Totten Pond Road/Wyman Street

provides an exclusive left turn lane, a shared through and left turn lane, and a shared through and right turn lane. The southbound approach from Wyman Street provides an exclusive left turn lane, a shared through and left turn lane, a through lane, and a channelized right turn lane that provides free flow from the I-95 ramps to the north to Winter Street. There is sidewalk on both sides of Totten Pond Road adjacent to the intersection, on the northern side of Winter Street, and on the eastern sides of Wyman Street and 3rd Avenue, and crosswalks are provided on the southbound and westbound approaches.

The following deficiencies have been identified:

- The intersection operates at LOS F during the weekday morning and weekday afternoon peak hour. The intersection acts as a major connection from I-95 north to the Winter Street corridor.
- The I-95 connections rely on utilizing this intersection to facilitate traffic to Winter Street. Increases in development at Winter Street will decrease operations at this intersection.
- No bicycle facilities are provided at this intersection.

Lexington Street at Bacon Street/Totten Pond Road (Piety Corner)

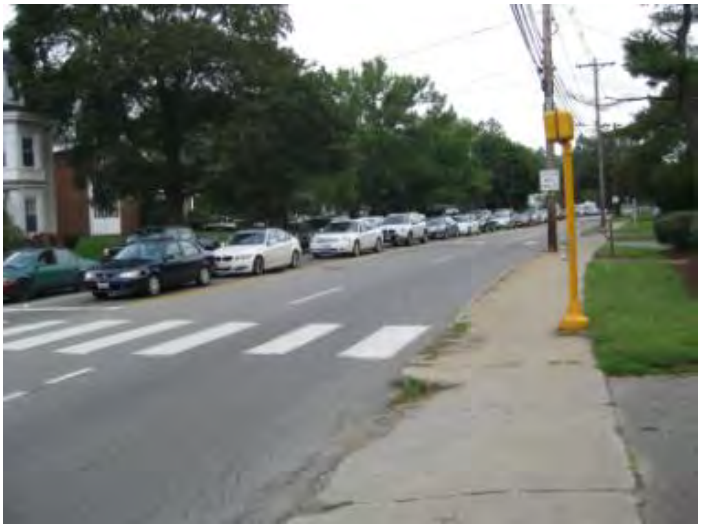
The signalized intersection of Lexington Street at Totten Pond Road/Lexington Street (Piety Corner) is a 4-way intersection with Lexington Street approaching from the southeast and continuing northerly, Bacon Street approaching from the south, and Totten Pond Road approaching from the west. There is a large offset between the Totten Pond Road from the west and Lexington Street from the southeast causing the intersection to be approximately 240 feet in length. The northwest approach on Lexington Street provides two left turn lanes to Totten Pond Road and one through lane to make a slight right to continue on Lexington Street. The Bacon Street approach from the south and the Lexington Street approach from the north both provide two multi-use lanes. The eastbound approach from Totten Pond Road Provides a left turn lane and two right turn lanes to Lexington Street with the inner right turn lane also providing access to Bacon Street. The traffic signal operates with four phases for vehicular traffic with each approach provided an exclusive phase with right turn overlaps as well as an exclusive phase for the adjacent church driveway though this phase is rarely called during the weekday morning

Lexington Street at Bacon Street/Totten Pond Road (Piety Corner)

and weekday afternoon peak hours. There is an exclusive pedestrian phase with crosswalks spanning each approach and sidewalk on both sides of Lexington Street, Totten Pond Road adjacent to the signal, and Bacon Street and no bicycle amenities.

The following deficiencies have been identified:

- The intersection operates at LOS F during the weekday morning and weekday afternoon peak hours.
- The intersection is a high crash location with 60 recorded crashes over the three year period reviewed (2011-2013), resulting in an above average crash rate.
- The geometry of the intersection is difficult to navigate and insufficient guidance for lane utilization is given as supported by the high number of sideswipe crashes recorded.



Congestion and queueing at Piety Corner

- The intersection is offset by over 200 feet. A significant amount of time is wasted on vehicular clearances, adversely impacting operations.
- The sidewalks adjacent to the signal and pavement are in need on maintenance.
- There are no bicycle amenities at this intersection and bicycles have been observed to utilize travel lanes to navigate this intersection.

Main Street at Barbara Road/Gore Street/Warren Street

The signalized intersection of Main Street at Barbara Road/Gore Street/Warren Street is a clustered intersection with two intersections on Main Street operating under one signal system. Main Street runs in the east-west direction through both intersections. The intersection to the west provides access to Barbara Street and Gore Street. The eastern intersection has Warren Street approaching from the north and the right turn and through movement to Warren Street from Gore Street approaching from the south in the form of a channelized right turn lane.

Main Street at Barbara Road/Gore Street/Warren Street

The intersections operate on one traffic controller and provide four phases for vehicular traffic that allow for combinations of traffic between the two intersections. There is an exclusive pedestrian phase and sidewalk on both sides of Main Street, Warren Street, and Gore Street, but no sidewalk is provided on Barbara Street. There are sharrows provided in the right lane of Main Street in both directions, but there are no bicycle facilities present on Warren Street, Barbara Street, or Gore Street.

The following deficiencies have been identified:

- The clustered intersection operates at LOS F during the weekday afternoon peak hour.
- The intersection has a confusing geometry and does not align vehicular desire lines.
- There is a missing pedestrian signal at the crosswalk spanning the westbound approach of the eastern intersection.
- There are several curb cuts that access the clustered intersection adding additional conflict points.
- Two separate approaches from Gore Street complicate the traffic signal phasing for the clustered intersection.

Intersection geometry on Main Street at Barbara Street/Gore Street)

- There are no bicycle facilities on Gore Street, Warren Street, or Barbara Street.

Beaver Street at Warren Street

The unsignalized intersection of Beaver Street at Warren Street is a 4-way intersection with Warren Street running in the north/south direction, Beaver Street connecting from the west, and Pelham Road, a minor residential road, connecting from the east. Pelham Road and Warren Street are under stop-control and Warren Street runs uncontrolled. There is sidewalk available on both sides of Beaver Street and on both sides of Warren Street for the majority of the roadway. There is a crosswalk spanning Pelham Road and a crosswalk spanning Warren Street approximately 200 feet to the south of Beaver Street. There are no bicycle facilities on Beaver Street or Warren Street.

Beaver Street at Warren Street

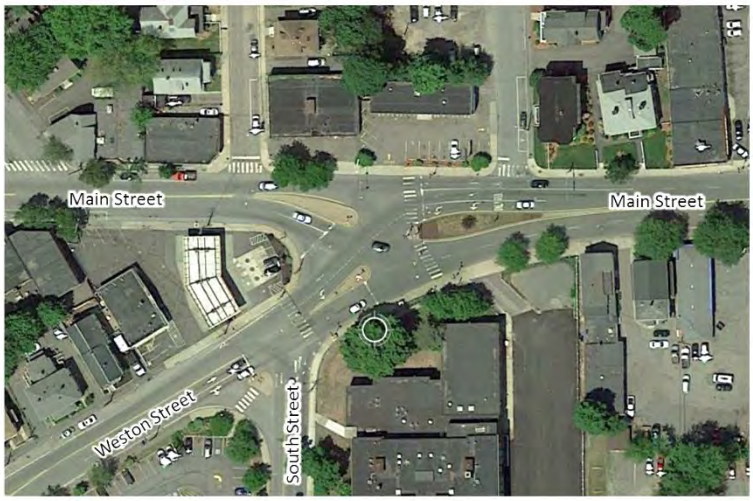
The following deficiencies have been identified:

- The Warren Street approach operates at LOS F during the weekday morning and weekday afternoon peak hours.
- There are no pedestrian crossings spanning Beaver Street or the northern section of Warren Street in the vicinity of the intersection.
- The southbound right turn radius from Warren Street is a free right turn with a high volume of vehicles and a large radius, which encourages high vehicle speeds through a residential area.
- There are no bicycle facilities at this intersection or adjacent roadways.

Wide radius for southbound right turn.

Main Street at Weston Street/South Street (Banks Square)

The signalized intersection of South Street at Weston Street/South Street (Banks Square) is a clustered intersection where Main Street runs in the east/west direction, South Street connects from the south, and Weston Street connects from the southwest. The dominant traffic flow is along Route 20 from Main Street to the east to Weston Street for vehicles accessing I-95. Weston Street and South Street both provide two lanes that continue through to Main Street to the east. From either approach left turns to Main Street to the west are restricted. Main Street from the east consists of an exclusive left turn lane to South Street only, an exclusive left turn lane to Weston Street only, and a through lane to continue on Main Street. Beyond the intersection approach, there are additional lane extension lines and pavement markings to guide motorists. Main Street from the west provides two lanes that access Main Street with the rightmost lane allowing access to Weston Street.



Main Street at Weston Street/South Street (Banks Square)

The traffic signal operates with three phases for vehicular traffic including a phase for Route 20 traffic, a phase for Main Street traffic, and a phase for South Street traffic. There is also an exclusive pedestrian phase with sidewalk provided on both sides of each intersection approach

and several crosswalk connections through the clustered intersection. There are no bicycle facilities on any of these roadways leading to the intersection.

The following deficiencies have been identified:

- The intersection operates at LOS F overall during the weekday morning and weekday afternoon peak hours.
- The intersection is a high crash location with 38 recorded crashes over the three year period reviewed (2011-2013), resulting in an above average crash rate. There were varying types of crashes.
- The geometry of the intersection is difficult to navigate and insufficient guidance for lane utilization is given supported by the high number of sideswipe crashes recorded.

Confusing intersection geometry on the westbound approach on Main Street.

- The intersection is very wide and requires high clearance intervals to clear traffic and pedestrians in the intersection.
- There are a number of curb cuts that add additional conflict points through the intersection.

South Street at Bedford Street

The signalized intersection of South Street at Bedford Street is a 4-way intersection with South Street running in the north/south direction and Bedford Street running in the east/west direction. Each approach to this intersection provides a single multi-use lane. The traffic signal provides two phases for vehicular traffic including a northbound/southbound phase for South Street traffic and an eastbound/westbound phase for Bedford Street traffic. There is also an exclusive pedestrian phase with crosswalks spanning all intersection approaches and sidewalk on both sides of South Street and Bedford Street. There is on-street parking on Bedford Street and no bicycle facilities on South Street or Bedford Street.

South Street at Bedford Street

The following deficiencies have been identified:

- The intersection is a high crash location with 20 recorded crashes over the three year period reviewed (2011-2013), resulting in an above average crash rate. The majority of crashes were angle collisions between Bedford Street and South Street which indicates that red light running may be an issue at this location.
- The traffic signal equipment is outdated and the signal heads are mounted on posts, which are less visible to motorists.
- The clearance intervals for vehicular traffic and pedestrians do not provide enough time to clear the intersection.
- There are no bicycle facilities at this intersection or adjacent roadways. South Street is well traveled by bicycle traffic due to the adjacent Brandeis University to the south on South Street.

South Street at Vernon Street

South Street at Vernon Street

The signalized intersection of South Street at Vernon Street is a 4-way intersection with South Street running in the north/south direction and Vernon Street running one-way in the eastbound direction. All approaches to the intersection provide a single multi-use lane. The traffic signal operates with two phases for vehicular traffic including a northbound and southbound South Street phase and an eastbound phase. There is also an exclusive pedestrian phase with crosswalks spanning each intersection approach and sidewalk provided on both sides of South Street and Vernon Street. On-Street parking is available on Vernon Street and there are no bicycle facilities on South Street or Vernon Street.

The following deficiencies have been identified:

- The intersection is a high crash location with 18 recorded crashes over the three year period reviewed (2011-2013), resulting in an above average crash rate. The majority of crashes were angle collisions between Vernon Street and South Street which indicates that red light running may be an issue at this location.

Signal heads mounted on pedestal poles.

- The traffic signal equipment is outdated and the majority of signal heads are mounted on posts, which are less visible to motorists.
- The traffic signal is currently uncoordinated with any other traffic signals despite the proximity to other traffic signals on South Street.
- The clearance intervals for vehicular traffic and pedestrians do not provide enough time to clear the intersection.
- There are no bicycle facilities at this intersection or adjacent roadways. South Street is well traveled by bicycle traffic due to the adjacent Brandeis University to the south on South Street.

Prospect Street at Highland Street/Felton Street

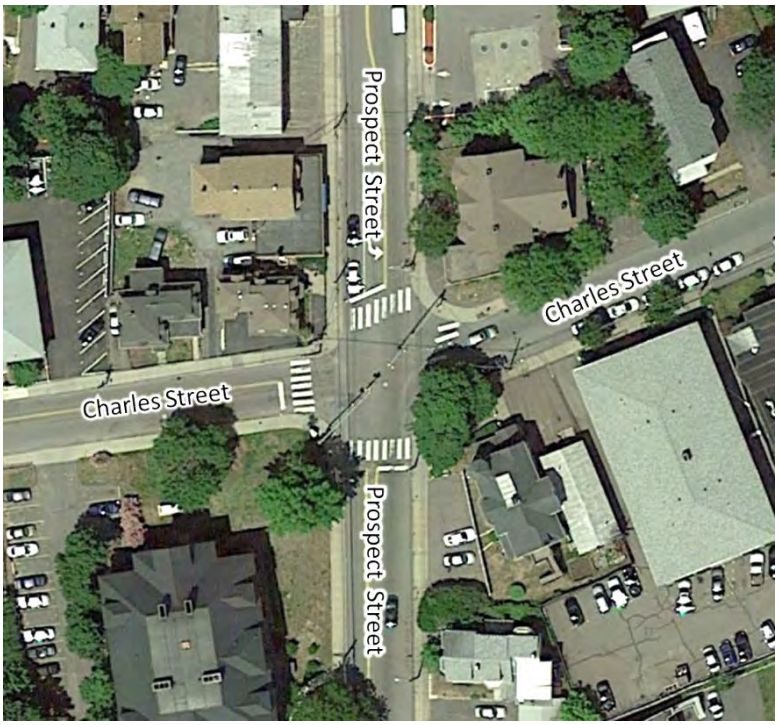
Prospect Street at Highland Street/Felton Street

The signalized intersection of Prospect Street at Highland Street/Felton Street is a 4-way intersection with Highland Street connecting from the west, Felton Street connecting as a one-way roadway from the east carrying traffic in the eastbound direction, and Prospect Street running in the north/south direction. The northbound and southbound approaches on Prospect Street as well as the eastbound approach from Highland Street all provide a single multi-use lane. The westbound approach from Felton Street provides an exclusive left turn lane and a shared through and right turn lane. The traffic signal operates with three phases for vehicular traffic including a phase for northbound and southbound traffic on Prospect Street and split phasing between the eastbound and westbound approaches. There is also an exclusive pedestrian phase and crosswalk spanning each intersection approach at this intersection and sidewalk on both sides of Prospect Street, Highland Street, and Felton Street. There are no bicycle facilities on Prospect Street or Charles Street in the vicinity of this intersection. On Street parking is provided on Prospect Street.

The following deficiencies have been identified:

- The intersection operates at LOS F during the weekday afternoon peak hour.
- The existing handicap ramps are apex style ramps that do not provide sufficient guidance to sight impaired users.
- The clearance intervals for vehicular traffic and pedestrians do not provide enough time to clear the intersection.

Prospect Street at Charles Street



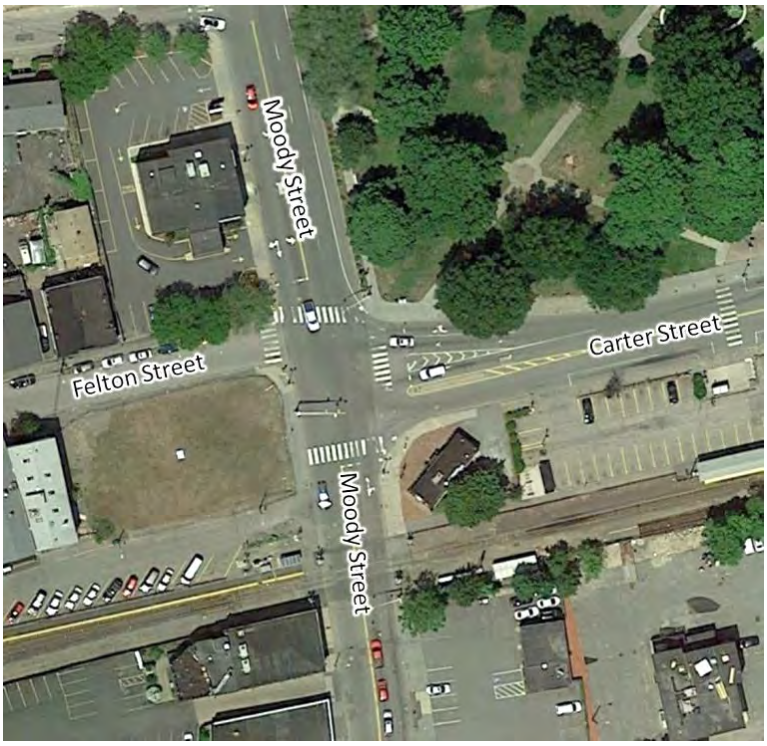
Prospect Street at Charles Street

The signalized intersection of Prospect Street at Chares Street is a 4-way intersection with Prospect Street running in the north/south direction and Charles Street running in the east/west direction. The northbound and eastbound approaches each provide a single multi-use lane, the southbound direction provides an exclusive left turn lane and a shared through and right turn lane. The eastern leg of Charles Street is one-way in the eastbound direction, away from the intersection. The traffic signal operates with three phases for vehicular traffic including a lead southbound approach phase, a phase for northbound and southbound traffic on Prospect Street, and a phase for the westbound approach on Charles Street. There is also an exclusive pedestrian phase and crosswalk spanning each intersection approach at this intersection and sidewalk on both sides of Prospect Street and Charles Street. There are no bicycle facilities on Prospect Street or Charles Street in the vicinity of this intersection.

The following deficiencies have been identified:

- The intersection operates at LOS F during the weekday afternoon peak hour. The northbound approach operates at LOS F with high delays and is over capacity.
- The clearance intervals for vehicular traffic and pedestrians do not provide enough time to clear the intersection.
- There is an outdated emergency phone in the sidewalk adjacent to the southeastern quadrant of the intersection.
- The traffic signal equipment is outdated and does not meet current standards.
- The existing handicap ramps are apex style ramps that do not provide sufficient guidance to sight impaired users.
- There are no bicycle facilities at this intersection or adjacent roadways.

Felton Street at Moody Street/Carter Street



Felton Street at Moody Street/Carter Street

The signalized intersection of Felton Street at Moody Street/Carter Street is a 4-way intersection with Moody Street running in the north/south direction, Carter Street entering from the east, and Felton Street running one-way in the westbound direction away from the intersection, and is slightly offset to the north from Carter Street. The northbound approach on Moody Street provides a through lane and a shared through and right lane where left turns to Felton Street are restricted. The southbound approach on Moody Street provides an exclusive left turn lane and a shared through and right turn lane. The westbound approach on Carter Street provides a left turn lane, and through lane, and a shared through and right turn lane. The traffic signal provides three phases for vehicular traffic including a lead northbound phase on Moody Street, a lagging southbound left turn phase, and a phase for the westbound traffic on Carter Street. There is also an exclusive pedestrian phase.

Sidewalk is provided on both sides of Carter Street, Moody Street, and Felton Street, and crosswalks are provided on all intersection approaches. There are no bicycle facilities adjacent to this intersection. Just south of the intersection, the MBTA commuter rail crosses Moody Street, and there is a commuter rail station in the southeastern quadrant of the intersection.

The following deficiencies have been identified:

- This intersection is a high crash intersection with 33 crashes over the three year period reviewed (2011-2013). Approximately one third of these crashes are rear-end crashes in the southbound direction. Three of that crashes that occurred at this locations were pedestrian crashes.
- The traffic signal equipment for the southbound approach is located very far from the stop line and is difficult for motorists to see.
- The geometry of the intersection is offset making the intersection very wide, lengthening the distance that motorists and pedestrians must travel through the intersection.
- There are no bicycle facilities on Moody Street or Carter Street. The Charles River Greenway is located approximately 450 feet to the south of the intersection.

Elm Street at River Street

Elm Street at River Street

The unsignalized intersection of River Street at Elm Street is a 3-way intersection. River Street begins at this intersection and continues to the east while Elm Street connects to this intersection from the west and south. The northbound approach on Elm Street is stop-controlled while the other approaches are uncontrolled. The northbound and westbound approaches provide a single multi-use land while the eastbound approach provides a through lane and a channelized right turn lane. On-Street parking is available for a short segment of River Street adjacent to the intersection. There is sidewalk on both sides of Elm Street and River Street and crosswalks spanning River Street on the westbound approach and Elm Street on the northbound approach. There are no bicycle facilities on either River Street or Elm Street.

The following deficiencies have been identified:

Channelized right turn from Elm Street.

- The northbound approach on Elm Street operates at LOS F during the weekday afternoon peak hour.
- It is difficult for motorists traveling northbound to determine when there is an appropriate gap in traffic due to the geometry of the eastbound channelized right turn.
- Sight lines are obstructed by the adjacent commercial property in the southeast quadrant to the intersection.
- There are no bicycle facilities on River Street or Elm Street. The Charles River Shared-use Path is located approximately 450 feet to the south of the intersection.

River Street at Newton Street

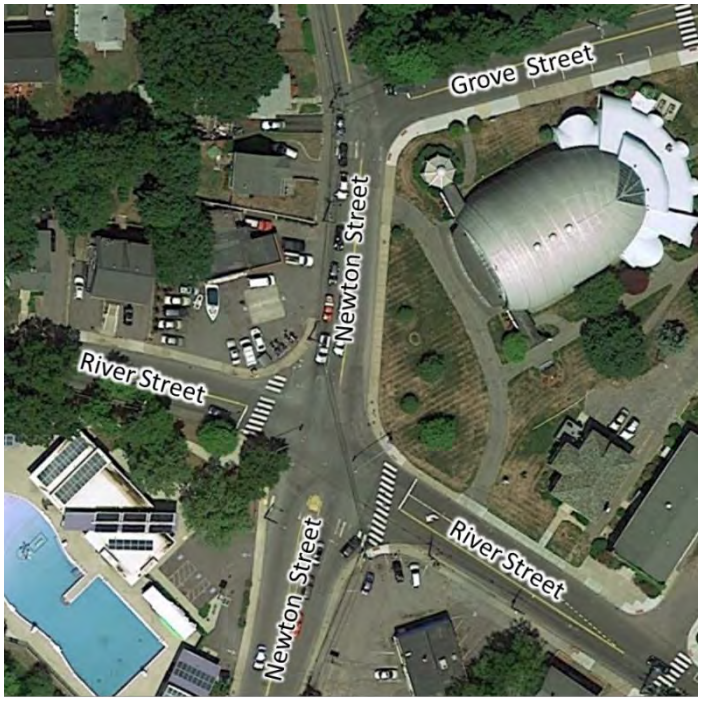
The signalized intersection of River Street at Newton Street is a 4-way intersection with River Street running in the east/west direction and Newton Street running in the north/south direction. The northbound and southbound approaches on Newton Street both consist of an exclusive left turn lane and a shared through and right turn lane. The eastbound approach on River Street consists of a single multi-use lane and the westbound approach consists of an exclusive left turn lane and shared through and right turn lane. There is sidewalk on both sides of River Street and Newton Street and crosswalks spanning each intersection approach. There are no bicycle amenities on River Street or Newton Street. The existing traffic signal operates with 3 phases for vehicular traffic including a lead westbound approach phase, followed by a phase for through traffic on River Street, and a phase for northbound and southbound traffic on Newton Street. There is also an exclusive pedestrian phase.

The following deficiencies have been identified:

- The intersection operates at LOS F during the weekday afternoon peak period. The eastbound and northbound approaches operate over capacity.
- The traffic signal equipment is old and needs to be upgraded to the most recent standards.
- The northbound leg has a raised concrete center median that acts as an obstruction to motorists.
- The pedestrian clearance timings are substandard.
- There is no eastbound left turn indication on the traffic signal head. Only a three section signal head is provided.
- There are no bicycle facilities on River Street or Newton Street. The Charles River Greenway is located approximately 450 feet to the south of the intersection.

Newton Street at Grove Street

The unsignalized intersection of Newton Street at Grove Street is a 3-way intersection with Newton Street running uncontrolled in the north/south direction and Grove Street connecting from the east under stop control. The intersection is located approximately 200 feet north of River Street. All approaches provide a single multi-use lane. There is sidewalk on both sides of Grove Street and Newton Street and a crosswalk spanning Newton Street on the northbound approach. There are no bicycle facilities on Newton Street or Grove Street.



Newton Street at Grove Street

The following deficiencies have been identified:

- The Grove Street approach operates at LOS F during the weekday morning peak hour and LOS E during the weekday afternoon peak hour.
- The intersection has a crash rate of 1.18 crashes per million entering vehicles, which is higher than average.
- There is a stone wall along the back of sidewalk of the northeastern quadrant of the intersection that blocks sight lines for motorists tuning left from Grove Street to Newton Street.
- While there is a crosswalk spanning Grove Street adjacent to the church parking lot approximately 200 feet east of the intersections, there is a missing crosswalk spanning Grove Street at the intersection with Newton Street.
- The crosswalk spanning Newton Street is faded and difficult for motorist to see.
- There is a missing handicap ramp on the western side of Newton Street at the marked crosswalk.
- There are no bicycle facilities on Newton Street or Grove Street.

Stone wall obstructing sight lines from Grove Street

Grove Street at Gore Street/Seyon Street

The unsignalized intersection of Grove Street at Gore Street/Seyon Street is a 4-way all-way stop controlled intersection. Grove Street run in the east/west direction, Gore Street approaches the intersection from the north, and Seyon Street approaches the intersection from the south. All approaches provide one lane of travel in each direction. Sidewalk is provided on both sides of Gore Street and Seyon Street, and on the northern side of Grove Street, and crosswalks are available on all intersection approaches. There are no striped shoulders or bicycle lanes.

Grove Street at Gore Street/Seyon Street

The following deficiencies have been identified:

- The intersection operates at LOS F overall during the weekday morning and weekday afternoon peak hours. The intersection was noted by the Waltham Police Department as a problem in terms of intersection congestion.
- There are no bicycle facilities at this intersection or roadways leading to this intersection.
- The crosswalk spanning the eastbound approach is much longer than necessary.
- The existing handicap ramps are apex style ramps that do not provide sufficient guidance to sight impaired users.
- There is missing sidewalk on the southern side of Grove Street.

Trapelo Road at Waverley Oaks Road

Trapelo Road at Waverley Oaks Road

The signalized intersection of Trapelo Road at Waverley Oaks Road is a 3-way intersection with Trapelo Road running in the east/west direction and Waverly Oaks Road connecting from the south. The eastbound approach on Trapelo Road provides a single multi-use lane, the westbound approach provides an exclusive left turn lane and a through lane, and the Waverley Oaks Road approach provides an exclusive left turn lane and a channelized right turn lane. Sidewalk is provided on both sides of Waverley Oaks Road and on the southern side of Trapelo Road adjacent to this intersection. There are no bicycle facilities provided. The traffic signal operates with three phases for vehicular traffic. The first is an exclusive westbound phase to allow an exclusive phase for the high volumes of westbound left turns, followed by a phase for through traffic on Trapelo Road with permissive westbound left turns, and a phase for the Waverley Oaks approach. There is also an exclusive pedestrian phase and a crosswalk spanning Waverley Oaks Road and the channelized right turn.

The following deficiencies have been identified:

- The traffic signal is expected to operate at LOS F during the weekday morning peak hour and LOS D during the weekday afternoon peak hour overall. The eastbound approach during both the weekday morning and weekday afternoon peak hours operates at LOS F and over capacity.
- The majority of crashes at this intersection are eastbound rear-end collisions, likely due to the long eastbound queue around a curve.

- The channelized northbound right turn lane from Waverley Oaks Road has a large radius that encourages high speed right turns onto Trapelo Road.
- There is a missing link of sidewalk on the northern side of Trapelo Road between Upton Road to the west to the Watertown City line to the east.
- There are no pedestrian crossings for Trapelo Road at this intersection.
- There are no bicycle facilities on Trapelo Road or Waverley Oaks Road.
- In the westbound direction, there are two through lanes continue from Watertown to Waltham, but the left most lane ends in a left turn trap at the intersection with Waverley Oaks Road.

Northbound channelized right turn.

- The signal is uncoordinated despite an adjacent traffic signal located approximately 500 feet to the east.

Lexington Street at Dale Street

The unsignalized intersection of Dale Street at Lexington Street is 3-way intersection with Lexington Street running uncontrolled in the north/south direction and Dale Street connecting from the west at a stop controlled approach. Opposite Dale Street, there is a private driveway for the Domino's as well as an adjacent private driveway for a tile store. In the southwestern corner of the intersection, there is a parcel with a driveway on Dale Street adjacent to the stop line and a driveway on Lexington Street just south of the intersection. Lexington Street has a three lane cross section providing one lane of travel in each direction and a TWLTL. Dale Street provides one lane of travel in each direction. There are sidewalks provided on both sides of Lexington Street and Dale Street.

Lexington Street at Dale Street

The following deficiencies have been identified:

- The eastbound approach from Dale Street operates at LOS F and well over capacity during both the weekday morning and weekday afternoon peak hours.
- The TWLTL on Lexington Street at the intersection with Dale Street does not have the appropriate turn lane treatment.
- The intersection is missing crosswalk links spanning Lexington Street at this location.
- There are no bicycle facilities at this intersection on either Dale Street or Lexington Street.

High Street at Joyce Road/Hamblin Road

The unsignalized intersection of High Street at Joyce Road/Hamblin Road is a 4-way intersection with High Street running uncontrolled in the northwest/southeast direction, Joyce Road connecting from the south at a stop controlled approach, and Hamblin Road connecting from the west at a stop-controlled approach. Each approach provides a single lane of travel in each direction with the exception of Hamblin Road, which is one way into the intersection. There is sidewalk present on both sides of each intersection roadway. On-Street parking is available on the northern side of High Street, and the southern side of High Street to the east of the intersection.

High Street at Joyce Road/Hamblin Road

The following deficiencies have been identified:

- During the weekday morning and weekday afternoon peak hours, the Joyce Road approach operates at LOS F. The Hamblin Road approach was not able to be analyzed due to the unique geometry of the stop controlled intersection.
- Both stop controlled approaches have restricted sight distance. The Joyce Road approach is set back from High Street due to the Hamblin Road approach. The Hamblin Road approach sight distance is completely restricted to the left (west). Vehicles are not able to see Hamblin Road until they are in the intersection.
- There are missing pedestrian connections across High Street at this intersection. There is a mid-block crossing approximately 150 feet to the east of Joyce Road.

Sight distance from Hamblin Road to the west.

- Hamblin Street and Joyce Street come together to the south of High Street making operations confusing for motorists.
- Three of the five crashes recorded at this intersection for the period reviewed were single vehicle crashes in the eastbound direction in inclement weather conditions. There are utility poles located on the sidewalk adjacent to the road that may be an obstruction to motorists.

C. Parking

Parking supply is not a deficiency in downtown Waltham in both the Main Street and Moody Street study areas. There does not currently appear to be a lack of parking supply in the study area, but inadequate distribution of demand throughout the day and evening due to the shifting destinations of drivers influencing pockets of underutilization in parking. The utilization study detailed in Chapter II, Existing Conditions, documented:

- There was always available parking downtown in either on-street or off-street spaces.
- During peak utilization of the Moody Street study area, at 8:00 PM, off-street parking was only 71% utilized, while on-street parking was 96% utilized, totaling 76% overall utilization. This is below the optimal 85% utilization for a healthy downtown parking supply.
- Parking along Main Street never exceeded 85% utilization during the study period.
- By dividing the Moody Street study area into sub areas, it is evident that there is always parking available somewhere. For example, Area A was most utilized during the day and underutilized in the evening, while Areas B and C were less utilized during the day and more utilized in the evening.

The deficiency in Waltham's downtown parking condition is one of parking management rather than supply. Parking management is needed to spread parking demand between both on- and off-street spaces. Currently, parking policies appear to incentivize parkers to use on street spaces and avoid off street parking until there is no available alternative. This is indicated through the comparison of on- and off-street parking on Moody Street, where on-street parking peaks at 96% utilization and off-street parking at only 71% utilization. Several factors contribute to an imbalance of utilization for on- and off-street parking:

- Free on-street parking
- Priced off-street parking
- Lack of wayfinding for drivers and pedestrians to/from off-street lots
- Lack of special parking programs for long term users, such as commuters and employees
- The Charles River serving as a barrier, dividing the areas on Moody Street north and south of the river.
- Lack of a park and walk atmosphere/culture. People expect to park at the door of their destination.

Changes in parking management can improve the appearance of a lack of parking supply and balance the demand for parking within the existing spaces. In particular, parking management can support the turnover of spaces near commercial businesses and provide a system that incentivizes customers to extend their stays downtown. It can also help facilitate the use of on-

street parking to provide traffic calming, incentivize transit use by providing designated parking, and contribute to streetscape improvements.

The availability of parking ¼-½ mile from a destination in downtown Waltham illustrates the importance of the pedestrian environment and wayfinding to parking management. If a safe and comfortable pedestrian environment is provided people will be more likely to park further from their destination or "park and walk" to multiple destinations. This shift in parking behavior can immediately reveal the lack of a parking supply shortage once people no longer have the expectation of parking in front of their destination. A park and walk culture is promoted through providing adequate sidewalks, street trees, lighting, and street furniture. Similarly, extending the existing wayfinding strategies will benefit parking management. For example, providing signs for drivers leading them to off-site parking and signage for pedestrians towards destination areas, can help facilitate the use of available parking supply.

Wayfinding Example

Missing Wayfinding on Moody Street

Managing parking in downtown Waltham as a system is recommended for the downtown area to help reduce pockets of heavy utilization. Parking management can include encouraging turnover to attract customers, using pricing strategies, and providing alternatives for long-term commuter and employee parking. These strategies can help more efficiently distribute cars to underutilized areas. This will allow for a healthier utilization of the existing parking within the study area, reducing the need for additional parking facilities, while increasing availability for parkers to access their destinations.

D. Public Transportation

Although Waltham has MBTA public transit service both in terms of local and express bus routes and two commuter rail stops, these are transit-related deficiencies that negatively impact access, reliability, convenience impacting current transit customers and discouraging potential new customers.

Key to improving access and increasing ridership is an improved customer experience and these are the key deficiencies noted across both the private and public transit system

- One track for Fitchburg Commuter Rail Service to operate inbound/outbound service
- Low ridership for two commuter rail stops (2013 MBTA data)
- Some MBTA bus routes appear to be routed inefficiently
- Overlap between MBTA/128 shuttles
- Bus ridership drops outside of the downtown area
- Traffic congestion and bus operational issues caused by location of bus stop and dedicated turn lanes
- Stop line placement does not always provide room for bus turning radius
- Bus stops placed too closely together delays service
- Bus stops blocking driveway access
- Lack of wayfinding signage for drivers, pedestrians and bicyclists
- Lack of crosswalks near some bus stops
- Poor visibility of bus stop sign for driver/customer
- Worn or old bus stop signage and painted markings
- Lack of amenities such as shelter/benches or real time transit information

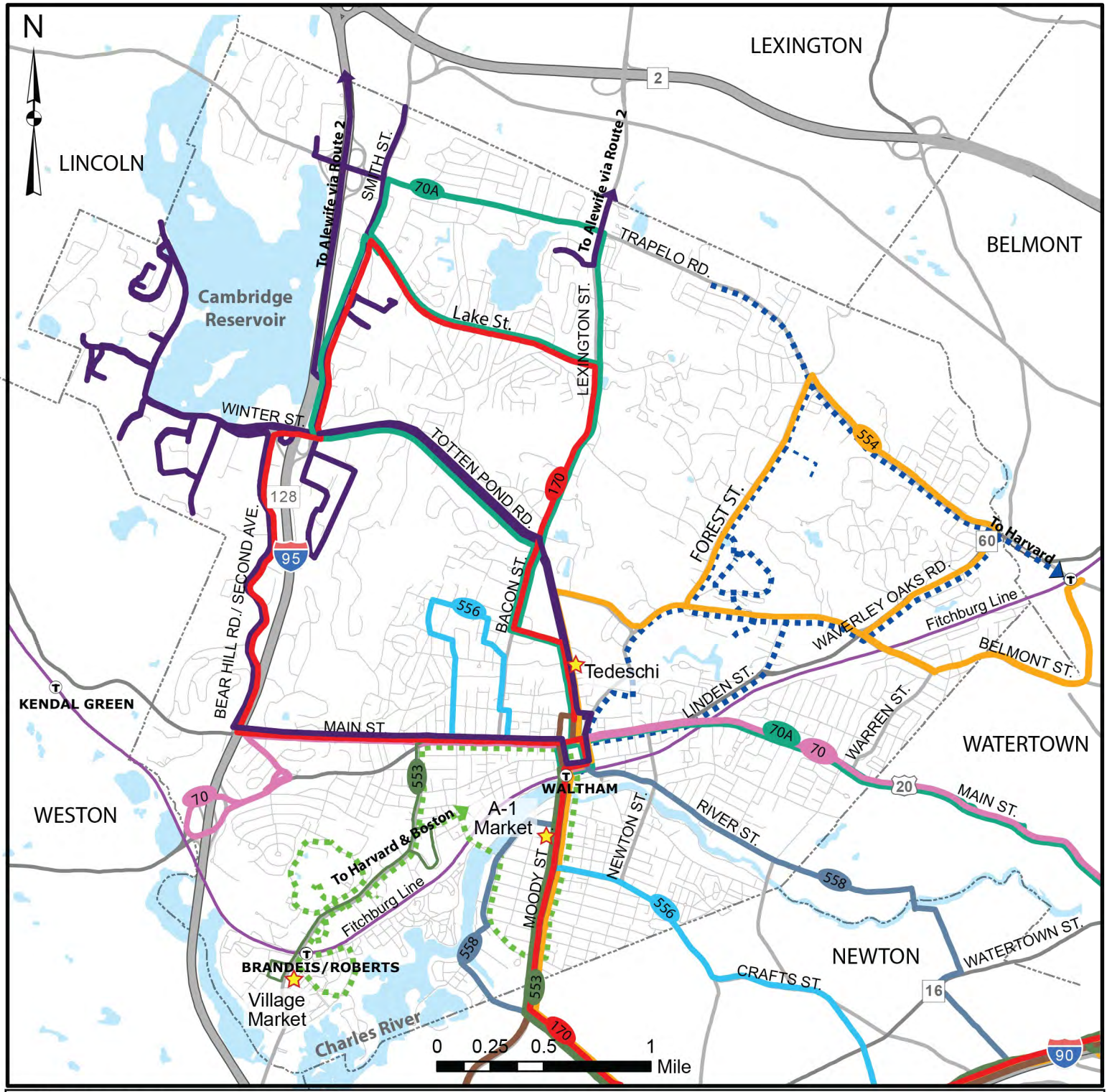
MBTA Commuter Rail

Line and Service

The frequency of commuter rail service is generally consistent with other lines and the ridership is comparable to other stations. (Waltham Station ranks 52 and Brandeis Station ranks 71 out of 133 station in terms of highest ridership stations systemwide).The low ridership is not attributable to the availability of parking, since additional parking capacity exists at both stations (MBTA website indicates 86% availability at Brandeis/Roberts Station, and parking data from the city indicates the Waltham Station lots have 15% and 50% availability at Railroad and Carter Street lots respectively). Therefore, the opportunity to attract more riders has not yet been maximized.

Access to retail outlets to purchase MBTA commuter rail passes fare products is limited to three locations in Waltham (Source mbta.com July 15, 2016), as shown in Figure 4-1.

1. Village Market at 588 South Street
2. 7-Eleven at 131 Lexington Street, and
3. A-1 Market at 359 Moody Street



MBTA Bus Routes

- 70
- 70A
- 170
- 505
- 553
- 554
- 556
- 558

LEGEND

- MBTA Commuter Rail Station
- MBTA Commter Rail Line
- 128 Business Council Route
- Bentley University Shuttle Route
- Brandeis University Shuttle Route
- Retail Sales Locations for MBTA Tickets and Passes

Note: Routes for Brandeis shuttles are approximate

(Employers noted are the top ten employers in Waltham Bureau of Labor Statistics)

Source: MassGIS MBTA Bus Routes, 128 Business Council Shuttle Schedules, Bentley University Shuttle Schedule, Brandeis University Van and Shuttle Service

WALTHAM — INCORPORATED A TOWN 1736 — INCORPORATED A CITY 1884

McMAHON TRANSPORTATION ENGINEERS & PLANNERS

Figure 4-1
Figure MBTA Retail Sales Outlets
Transportation Master Plan
Waltham, Massachusetts

These retail outlets are clustered in the downtown area and located next to Brandeis. The number of locations is limited and many riders may not be aware that they exist. For riders that are not aware of these outlets or do not frequent these stores, fares and passes can be purchased online and through the M-ticket mobile app, at other locations outside of the city, or through the MBTA Corporate Pass Program through some employers, while others may be purchasing fares on board the commuter rail. Payment is limited to cash-only, therefore commuter rail conductors must carry cash, and the processing of cash fares adds time to the fare payment validations that are required. This is challenging during busy periods, especially when there is standing room only and conductors have to navigate the congested aisles of standing passengers. For transit customers using the buses, fare payment without prepaid card requires extra time to pay with cash, delaying the trip.

Stations

The existing Waltham Station is located in a good centralized location in downtown Waltham, however the single track on this section of the line, services both the inbound and outbound platforms, causing additional delay. The location of the inbound and outbound raised platforms, approximately 800 feet apart on opposite sides of Moody Street, could be very confusing for passengers. Passengers typically expect to see the station/platform for their return trip directly opposite from where they first board or alight the train. The station is also outdated and the raised platforms are in need of improvement. Improvements could include updated tactile strips, repaving to repair cracks in the pavement, and modernized railings.

As noted in Table 4.1, there is a lack of sidewalks in Waltham, particularly outside of the downtown area. This affects pedestrian access to Brandeis/Roberts Station, as side streets such as Old South Street, Turner Street, Hartwell Street, and Angleside Road, have incomplete sidewalk networks. Sidewalks are either absent on one or both sides of the street, or partially crumbling with low curb reveal. These streets are off South Street, which provides direct access to the station. Due to Waltham Station's downtown location, it benefits from a strong surrounding sidewalk network, which facilitates pedestrian access; however, the approach to the outbound platform is in disrepair and pedestrian access is poorly defined.

There is a lack of pedestrian scale lighting, station branding and wayfinding at both commuter rail stations. Both stations lack proper MBTA signage directing pedestrians and vehicles towards the boarding platforms. There is a sign directing vehicles in the northbound direction on South Street to the Brandeis/Roberts stop, but not one in the southbound direction. Additionally, the inbound platform sign is located near South Street, while it should be located next to the platform.

Waltham Station Entrance

At Waltham Station, there is inconsistent signage for the inbound and outbound platforms. For the

outbound platform there is a standard MBTA commuter rail trailblazer sign for vehicles while at the inbound platform there is a sign pointing towards the Carter Street parking lot, but not an MBTA commuter rail sign. There is also a lack of wayfinding between the inbound and outbound platforms, which are barely visible from each other, being across Moody Street and about 800 feet apart. There is only a small wayfinding sign on the inbound side to guide riders to the platform for their return trip.

Commuter Rail Wayfinding Signage

Wayfinding signage for pedestrian access to the inbound and outbound platforms at Waltham Station also needs improvement. Both platforms can be reached by pedestrian paths, yet neither of these entryways are appropriately signed. They lack wayfinding signage and pedestrian scale lighting, which would help delineate a clear path to the commuter rail.

MBTA Bus

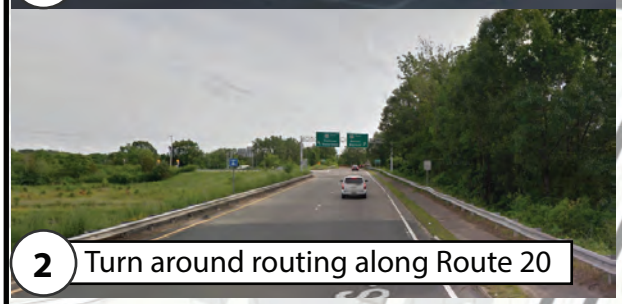
Routes and Service

The most obvious routing deficiency is the circuitous routing of Route 70A through North Waltham, as described in the existing conditions chapter. The routing through here is long, and the bus travels along Lincoln Street and Lake Street twice in the same direction, on any given trip throughout the day. It is very confusing to know which direction the bus is traveling, and for people on Lake Street and Lincoln Street they may end up traveling by their stop a second time, on the same trip, if their trip is not carefully planned and timed for the second pick-up time. The duplication of the route adds time to the transit customers' trip. There is also some duplication of services between Route 70A and the 128 Business Council shuttles; although they do provide connections to/from different areas within and outside of the city.

Also on Route 70A the route does not operate very reliably. Its on-time performance was only 45% in June 2015. The long length of the route, and the congested corridors it travels along contributes to the reliability issue.

The layover (and last outbound stop/first inbound stop) for Route 70 is currently located on Weston Street – eastbound side, west of Cedarwood Avenue, however in order to access the layover, all buses must turn right from Tavern Road onto Weston Street westbound, u-turn via the I-95/Route 20 interchange and return to Weston Street eastbound. This route is displayed in Figure 4-2 and adds one mile of non-revenue mileage to each trip. Although the trip only takes about two minutes without traffic, this section of Weston Street is regularly congested, and trips can sometimes take between 10 and 15 minutes. These long trip times can then affect the reliability of the trip start time at Cedarwood and could ultimately affect the reliability of trips along the remainder of the route.

1 Existing layover at Cedarwood Ave.



2 Turn around routing along Route 20

N

Main Street

Stowe Street

Stowe Street

Tavern Road

Weston Street

1

Existing Layover

2

Interstate 95

Cedarwood

Legend

Existing Route 70

Existing bus stop

0 0.02 0.045 0.09 0.135 0.18 Miles

Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Figure 4-2
Route 70 Layover
Transportation Master Plan
Waltham, Massachusetts

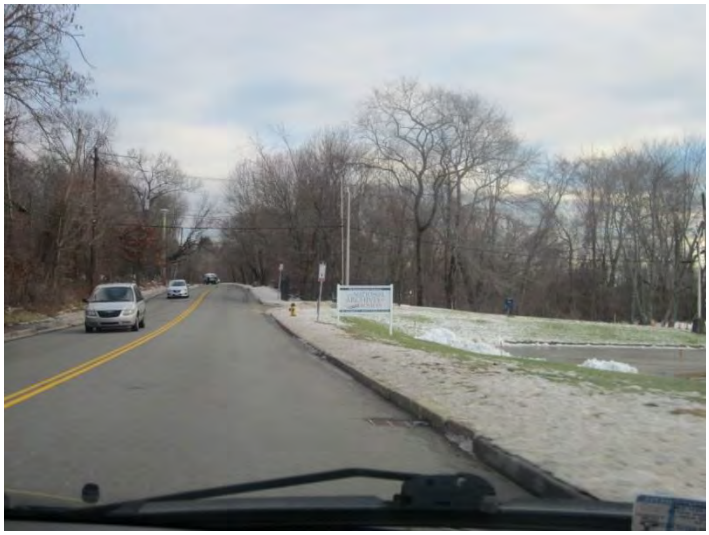
On Route 554 three trips in the morning, and three trips in the afternoon serve the area surrounding Bentley University – Forest Street, Trapelo Road and Waverly Oaks Road. A loop that is over three miles long (which takes at least seven minutes with no traffic), and adds two more miles (or five or more minutes) over traveling directly along Beaver Street. Similar to Route 70A this adds to operator labor, mileage and maintenance costs, and potentially creates operational delays as well.

Several bus routes travel along narrow roadways in the city. Tight turn radii and geometry at some of these intersections create difficult turns (especially right turns) for operators if STOP lines are not sufficiently set back e.g. on Bacon Street at Dale Street. Along Moody Street with parking on both sides of the street it is tight for two buses to pass by each other at the same time. This problem is exacerbated at loading zones or when commercial vehicles illegally park in turn lanes, as these larger vehicles encroach more on the travel lane. Traffic congestion on roadways, including Main Street, Moody Street, Weston Street, and Lexington Street adds to the overall travel time for buses and impacts service reliability.

Similar to commuter rail, the bus ridership outside of the downtown core is relatively low for servicing a 'city'. This may be as a result of infrequent and limited service, making for a poor customer experience or there may be a lack of awareness that the service exists, how to pay or how much it costs, the connections offered, or that it provides a good alternative to traveling by car, especially to downtown Boston via the express bus routes.

Access to retail outlets and fare vending machines to purchase MBTA passes and add value to fare products is limited to three locations in Waltham, as previously noted. For riders that are not aware of these outlets or do not frequent these stores, fares and passes can be purchased online, at other locations outside of the city, or through the MBTA Corporate Pass Program through some employers, but others may be purchasing fares on board the bus. Payment is limited to cash-only and payment must be exact, or change is given in the form of a Charlie Ticket. Cash payment for individual fares, or to add stored value/purchase passes adds to the dwell time at bus stops and thereby increases overall travel time.

Bus Stops



Lack of sidewalks on Trapelo Road for Route 554.

Many bus stops in the city do not meet ADA or MBTA accessibility requirements or conform to the MBTA's Bus Stop Design Guidelines (first issued in draft format in September 2014). Sidewalks or sidewalk connections are missing in some locations. Sidewalks that are narrow, obstructed, uneven or generally in poor condition have resulted in a lack of or deficient ADA landing areas and clear zones at bus stops. The presence of wide/busy roadway cross sections without marked crosswalks, and deficient/missing curb ramps, prohibits safe access to and from bus stops. In addition many of the stops are not long enough to allow

operators to pull the bus flush to the curb and for both doors to open to a level sidewalk. Besides being an accessibility issue and potential hazard for riders boarding/alighting away from the curb; in some cases, this results in a bus nose-diving into the stop, then partially blocking the adjacent travel lane, which impacts traffic flow, or the bus straddles and blocks crosswalk access behind the stop. Illegal parking in bus stops (as observed on Moody Street) also impacts accessibility, as well as delaying service.

Illegal Parking at Bus Stop on Moody Street

Several areas of the city, but particularly noticeable along Main Street, west of the Common, adverse traffic impacts are experienced due to buses stopping in a through-right lane, next to a left turn-only lane, or in a right-turn only lane. Bus operators are also forced to make difficult maneuvers when a stop is located nearside of the intersection and the bus needs to make a left turn at that intersection.

There are several instances of bus stops located too close to one another along each of the bus routes, including the city's busiest transit corridors on Main Street and Moody Street, and many are located immediately in front of driveways, and therefore do not meet the MBTA's Bus Stop Design Guidelines. While using driveways to access and egress from a bus stop helps to minimize the curbside space required for bus stops and minimizes parking impacts, stopped buses should not overhang and block access to driveways. Also, not all bus stops have a companion or bus stop pair i.e. bus stops at the same location, one in each direction. It is easier for riders when bus stops are located opposite each other in pairs, and pedestrian crossings connect the two stops.

Bus stops in driveways are common throughout the city.

At the stops themselves, issues include faded/outdated bus stop signs, bus stop signs obscured by hanging tree limbs or overgrown foliage making it difficult for bus operators and riders to locate the stop, and missing rear bus stop signs to delineate the no parking area. Some signs are positioned incorrectly – so high that riders might not be able to read the information, or so low that pedestrians risk walking into them, or oriented more towards the roadway than angled for visibility from both the roadway and sidewalk. Absent or poor/faded bus stop pavement markings, for example on Moody Street, could also be added or improved.

High Positioned Bus Stop

Faded Bus Stop

There is also a lack of (quality) bus stop amenities, especially bus shelters. According to the MBTA shelter database there are only six shelters (in addition to the three JCDecaux (formerly CEMUSA) shelters at Waltham Station) within the city; although two new shelters have recently been installed by others on Wyman Road and Winter Street. MBTA shelters identified include those located on:

- Carter Street (2)
- Weston Street at Cedarwood Avenue (terminus of Route 70)
- Main Street at Stow Street
- Wyman Street at Winter Street
- Beaver Street at Field Road

Four of the shelters are the standard bronze style and two are silver, and all appear to be at least 25 years old. The older silver bus shelter on Beaver Street, east of the Bentley University pedestrian bridge, has two narrow entry points and does not appear to meet ADA requirements.

Shuttle Routes

With the exception of the 128 Business Council shuttles, all other shuttles are private and not available to the general public. The private shuttles have limited public data and therefore, are not described in detail.

The ridership on the 128 Business Council shuttles were relatively low. With the service only running during morning and evening commute times, it provides adequate transit for work-based trips between the Alewife – Route 128 area and Waltham Center – Route 128 area, but lacks a comprehensive service for midday business trips or for workers with non-traditional hours.

5. 10-year Action Plan

A. Alternative Development Approach and Process

A 10-Year action plan was developed to outline a strategy for the implementation of the City of Waltham's transportation vision. Alternatives were developed for each mode of transportation by the project team and a wide range of alternatives were considered for each of the key roadway corridors and intersections prior to selecting preferred alternatives.

Both short-term mitigation and long-term concepts were developed. The concepts were molded by public input obtained from the public survey, which helped to identify the major deficiencies, the desired types of improvements, and the highest priority locations. The concepts were developed in coordination with the City Traffic Engineering and Planning departments.

After developing draft improvement concepts, a Public Meeting was held on May 17, 2016 to present these concepts to the City and to collect feedback on the concepts. The meeting consisted of an afternoon workshop, followed by a presentation of the concepts, and ended with an additional workshop. The concepts were displayed for the public to review during the workshop portion of the public meeting and the project team was available to discuss specific issues, explain the details of the improvements and to gather public feedback on the concepts presented. The public meeting was followed with a one-month comment period and the project concepts were available to view on the City's website. Some of the original improvement concepts were revised in response to public input.

This final report will serve as guide for future transportation improvements within the City and will serve as a living document to guide development and infrastructure improvements in the City.

B. Citywide Recommendations

Several recommendations, policies and goals were developed to be implemented for the City as a whole for all modes of transportation. These recommendations are categorized as short-term or long-term. Short-term recommendations capture minor changes in policy or infrastructure that can be implemented in the near future (less than five years) and requiring major construction. The long-term recommendations are generally larger, more detailed improvements that would take additional time and planning to implement and require significant funding.

Pedestrian Improvements

Short-Term:

- Development of criteria for the City for the installation of crosswalk (including painted crosswalks, raised crosswalks, and high visibility crosswalk treatments) based on state and federal standards.
- Improvements to existing pedestrian infrastructure including sidewalk maintenance and the restriping of crosswalks to ladder-style crosswalks with high visibility markings in a consistent manner that confirms with the City's crosswalk standards.
- Modifications to existing traffic signals to include lead pedestrian intervals at intersections with concurrent pedestrian phases and in particular, at locations where

pedestrians are crossing with a high volume of left turn traffic traversing the crosswalk. The lead pedestrian interval gives the pedestrians a few seconds of walk time prior to the onset of the concurrent vehicle phase, allowing pedestrians to get into the crosswalk where they are more visible to oncoming left turn traffic.

- Install new crosswalks and lighting treatments to improve pedestrian safety.
- Install new curb ramps and crosswalks at intersections that currently lack pedestrian accessibility.
- Replace substandard curb ramps including apex style ramps with ramps that meet the current standards for ADA accessibility.
- Encourage commuters to walk to the commuter rail station.
- Upgrade pedestrian signal equipment at signalized intersections to include push buttons and countdown timers.

Long-Term:

- Complete installing up to date crosswalks and curb ramps at intersection approaches.
- Install new sidewalks to improve the city's pedestrian network and to fill in missing links.
- Install traffic signals with pedestrian signal heads, push buttons, and countdown timers at identified intersections. Construct raised crosswalks at appropriate locations to raise awareness of pedestrian crossings. Raised crosswalks are inappropriate on curves and steep roadway grades and may be inappropriate for emergency routes, bus routes, or high speed streets. Raised mid-block crosswalks should not be used in isolation but rather placed in series or with other traffic calming measures.

Countdown Pedestrian Signal Head

- Install curb extensions where appropriate to reduce pedestrian crossing lengths.
- Plan a network of off-road walking trails to promote walking as a health benefit.
- Encourage the addition of buffer space between vehicular and pedestrian traffic.
- Conduct a city-wide ADA compliance program aimed at identifying and rectifying pedestrian locations within the transportation network that currently lack compliance.
- Implement complete street practices when upgrading existing facilities and considering new development
- Prepare a city wide walking map to inform users of the pedestrian facilities available, and to better assess pedestrian connectivity issues including connectivity between alternative modes of transportation.
- Evaluate and improve the pedestrian network in the vicinity of schools. Implement an educational program to teach pedestrian safety and to encourage walking as a positive health incentive.

Pedestrian recommendations for the city focus on identifying the missing links in Waltham's sidewalk network. This is a particular concern in the northern portion of the city, where pedestrian connectivity is lacking due to the land use that evolved without a clear sidewalk network created. Comments from the public meeting held on May 17, 2016 note the need for an improved sidewalk network. Particular roads that were referenced in need of additional sidewalks were Warren Street, Totten Pond Road, and Winter Street. The public survey identified the Banks Cedarwood and Bentley/Fernald neighborhoods as areas in need of pedestrian improvements, which is consistent with the lower, vehicle dependent walk score for these locations.

Pedestrian recommendations are included in the specific recommendations for four roadway corridors and twenty intersections. The recommendations prioritize pedestrian connectivity, accessibility and safety through updated signal heads, crosswalks and curb ramps to meet modern standards. Ladder style crosswalks are recommended to connect missing links in the sidewalk network. Features like pedestrian push buttons and countdown timers are also used at several intersections to aid pedestrian safety identified in the intersection improvements in the section below.

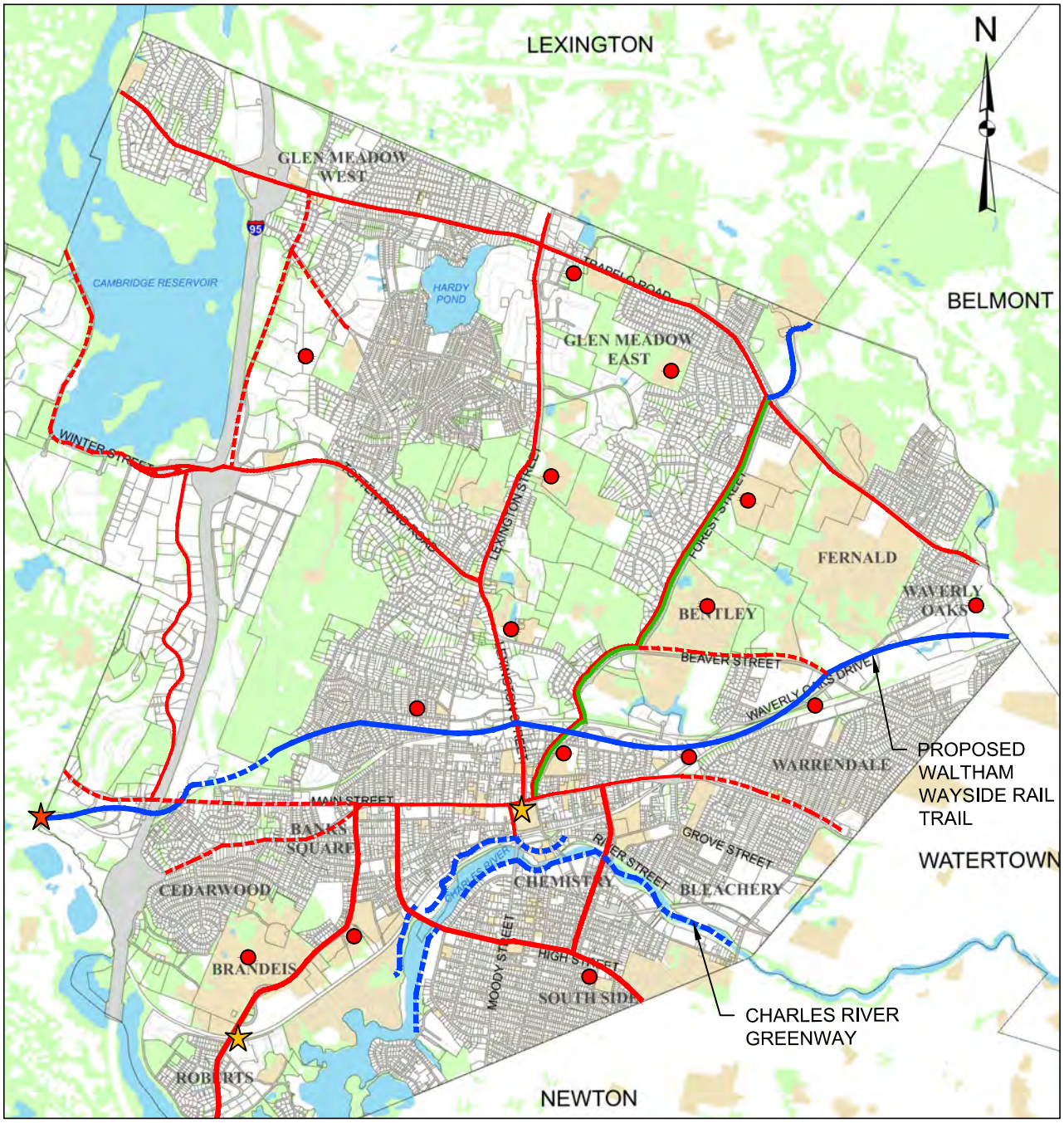
ADA Compliant Curb Ramp

Bicycle Improvements

The City has made considerable improvements to facilitating bicycle travel. The following improvements were recently implemented or in progress within the City:

- Installation bike sharrow markings and bike lane striping on appropriate roadways to initiate a bike network in Waltham.
- A city-wide bicycle network was drafted that details the existing and future routes for bicyclists of all ages. On-street facilities are able to feed into existing and future off-street paths, such as the Charles River Greenway and potential future Mass Central Rail Trail. The proposed network of bicycle facilities and connections is illustrated in Figure 5-1.

J:\Analysis\City of Waltham\Transportation Master Plan\Notes\Bike Plan Notes\Bike Routes Map.dwg 10/27/16



LEGEND

- Existing Multi-Use Path
- Proposed Multi-Use Path
- Existing On-Road Bike Facilities
- Proposed On-Road Bike Facilities
- Connectors to Multi-Use Path
- Schools
- Existing Multi-modal Hub
- Proposed Multi-modal Hub

Figure 5–1
Proposed Bicycle Facility Network
Transportation Master Plan
Waltham, Massachusetts

Additional improvements to consider include:

Short-Term:

- Provide short-term bicycle parking or bicycle corrals in place of a vehicle parking to encourage biking in downtown.
- Improve bicycle safety on the existing network by addressing roadway maintenance issues including street sweeping, obstacle removal, resurfacing, elimination of potholes, and parking enforcement.
- Implement educational and encouragement programs to instruct both bicyclists and motorists as to the rules of the roads. Encourage bicycle educational programs for children and adults to promote safe bicycling practices. Partner with advocacy groups like MassBike to develop the programs.
- Implement “pop-up” or “pilot” bike lanes or separated bike lanes to expose the community stakeholders to new bicycle infrastructure. Encourage feedback and develop future plans based on the community consensus.
- Continue plan responsive improvements at high bike crash locations.
- Develop criteria for bicycle facilities in conjunction with bicycle facility implementation strategy.

Long-Term:

- Leverage the existing trail networks in Waltham to create low stress routes with off-road bicycle connections.
- Complete bike lane striping and construction on designated roadways.
- Evaluate use of bike boxes at Winter Street and Totten Pond Road and other intersections where bike lanes are implemented.
- Complete the Mass Central Trail within Waltham and continue work with neighboring communities.
- Develop off-road trail networks for bicycles to foster both commuting and recreational bike ridership. Include connections to the on-road bicycle network.
- Consider the implementation of bicycle crosswalks and bicycle signals at major signalized intersections with bike lanes.
- Encourage new developments to promote bicycle use by including bicycle facilities, including parking, on site, proving employees with showers, and offering incentives to commuters using non-motorized means of travel.
- Implement a bike share program for the City of Waltham.

The Association of Pedestrian and Bicycle Professionals (APBP) Bike Parking Guidelines provides resources on planning and designing bike parking to help create short term and long term bicycle parking mobility hubs. There is a need for upgraded and expanded bicycle infrastructure in Waltham. Based on the May 17, 2016 public meeting, residents wish to see the addition of bike lanes on roadways throughout the city. The roadways designated for improvement should be planned and designed with the most current design guidance available, like the *MassDOT Separated Bike Lane Planning and Design Guide*. Use the available guidance to create safe and low stress route for cyclists. On high speed roadways, with speeds above 35 miles per hour, physically separating the bicycles lanes from the roadway may be desirable. Alternatively, bicycle boulevards, bike routes on low speed and low volume roads,

could be considered on parallel roads to the desired bicycle connections without having to construct separated lanes. The bicycle boulevards would be constructed with a network of traffic calming and wayfinding could direct cyclists on low stress routes to their destinations.

After gaining a comprehensive understanding of bicycling patterns and problem areas in Waltham, the city can identify the potential issues and corresponding solutions such as:

- The need for a bike lane on a one-way street, and also the subsequent consideration of a contraflow bike lane to allow bike travel in the opposing direction from vehicular traffic.
- Another solution may be the implementation of bike boxes and bike signals at high crash intersections to facilitate safer bike movements and left-turns through an intersection.
- If there are conflicts between on-street parkers that "door" cyclists as they ride by (open their car doors into cyclists), the city may consider the use of buffered bike lanes or placing bike lanes in between the sidewalk curb and parking.

Two-Stage Bike Box

Contraflow Bike Lane

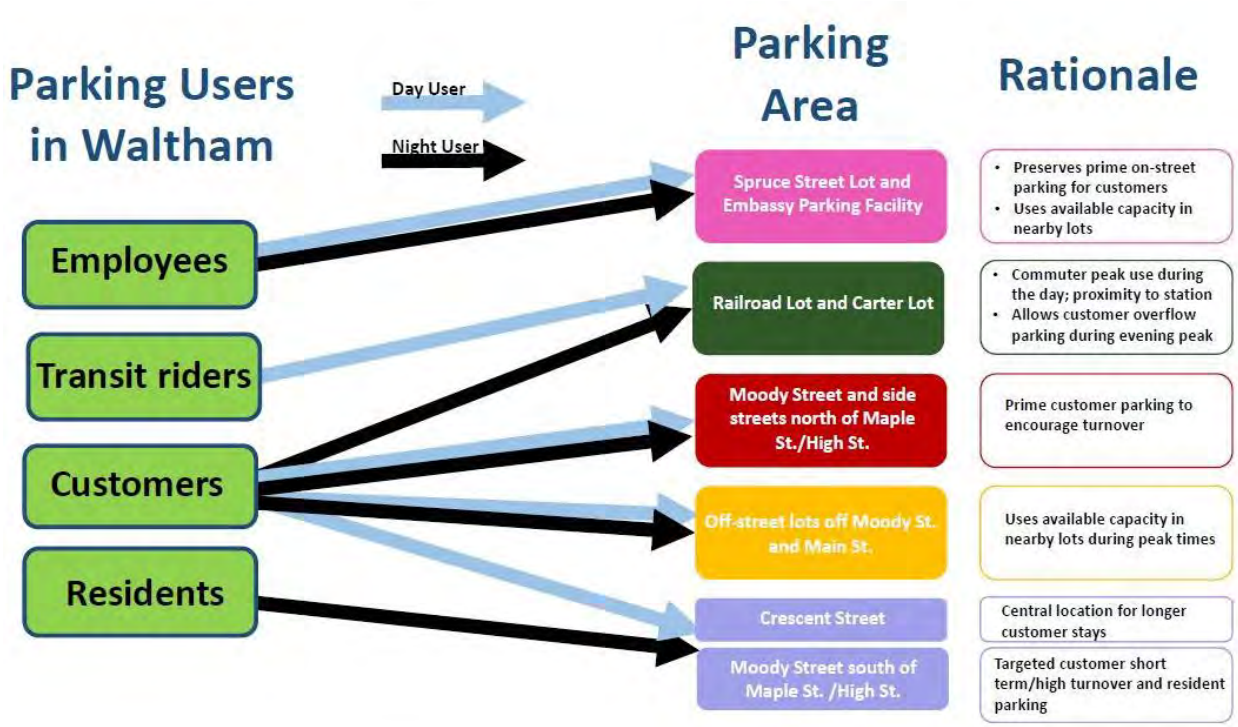
Once potential solutions are identified, standards for bicycle facilities can be developed. This includes providing guidance on standard widths for facilities such as a separated bike lane, bike lane, buffered bike lane, and sharrow lane. The guide may also include example cross-sections for different street types within the city. For example, the cross section may differ based on the roadway types such as local, arterial, collector, and which type of bicycle facility is warrant by each.

In order to implement recommended bicycle improvements the city should also identify funding sources, develop costs estimates, and seek additional funds through grants. This will make it easier to implement bicycle improvements as part of other projects or as funding becomes available.

Parking Improvements

Based on the parking analysis previously described, downtown Waltham as a whole provides an adequate parking supply relative to existing demand. Waltham's parking issue is not one of supply, but rather convenience, reflected in high demand in distinct areas at specific times. The goal is to manage parking as a system downtown to spread the parking demand throughout the existing on-street and off-street parking supply. Current supply is adequate if demand is managed through a combination of parking pricing and time enforcement policies, designated employee parking, wayfinding improvements, and Transportation Demand Management (TDM) strategies. A summary of parking users and the recommended areas the parking management strategy will direct them to use by time of day are depicted in Figure 5-2.

Figure 5-2: Parking Users in Waltham



Currently, on-street parking is regulated by time limits and off-street parking is regulated by parking meter fees of $.50 per hour until 6:00 P.M, with a $2.00 per day maximum fee. This incentivizes customers to search first for free on-street parking to avoid paying parking fees charged in the lots. If parking time limits are not strictly enforced, customers as well as employees, may be occupying prime on-street spots next to popular businesses for long periods of time, reducing customer turnover, and therefore reducing sales at local businesses. Based on parking data from neighboring communities, parking spaces in premium locations are generally priced at $1.00 per hour. Implementing a pricing scheme for downtown parking will likely require monitoring and adjusting prices to maintain the optimal 85% utilization of parking supply. A sample pricing and time limit structure for Waltham is depicted in Figure 5-3.

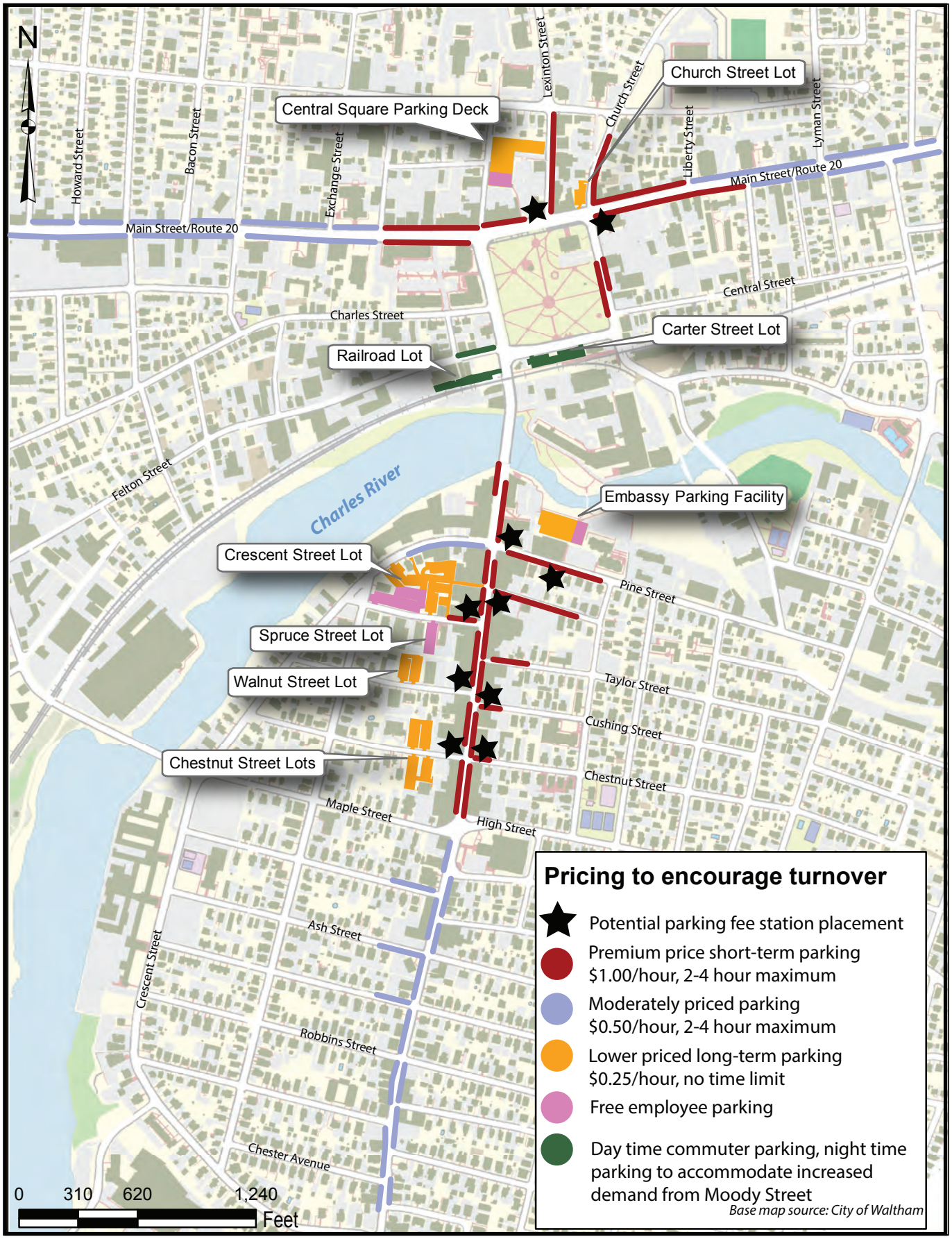


Figure 5-3
Parking Recommendations and Regulations
Transportation Master Plan
Waltham, Massachusetts

The following goals and recommendations have been identified as part of the parking management strategy:

Short term:

- Develop an employee parking program to provide employees of Main Street and Moody Street businesses with a free designated parking area.
    - Potential locations for Moody Street employees are the Embassy Lot, the south western portion of the Crescent Street Lot, and Spruce Street Lot.
    - A potential dedicated parking area for Main Street employees is the Central Square Parking Deck.
    - Incentivizing employees to park in these areas with free passes will increase the availability of on-street parking for customers and increase turnover rates.
- Transition to fee parking for on-street spaces. This includes selecting meters and/or pay stations to place on-street and developing a system of tired priced parking. Changes will also have to be made to the pay stations/meters in off-street lots. Altering time limits will also be necessary.

Long term:

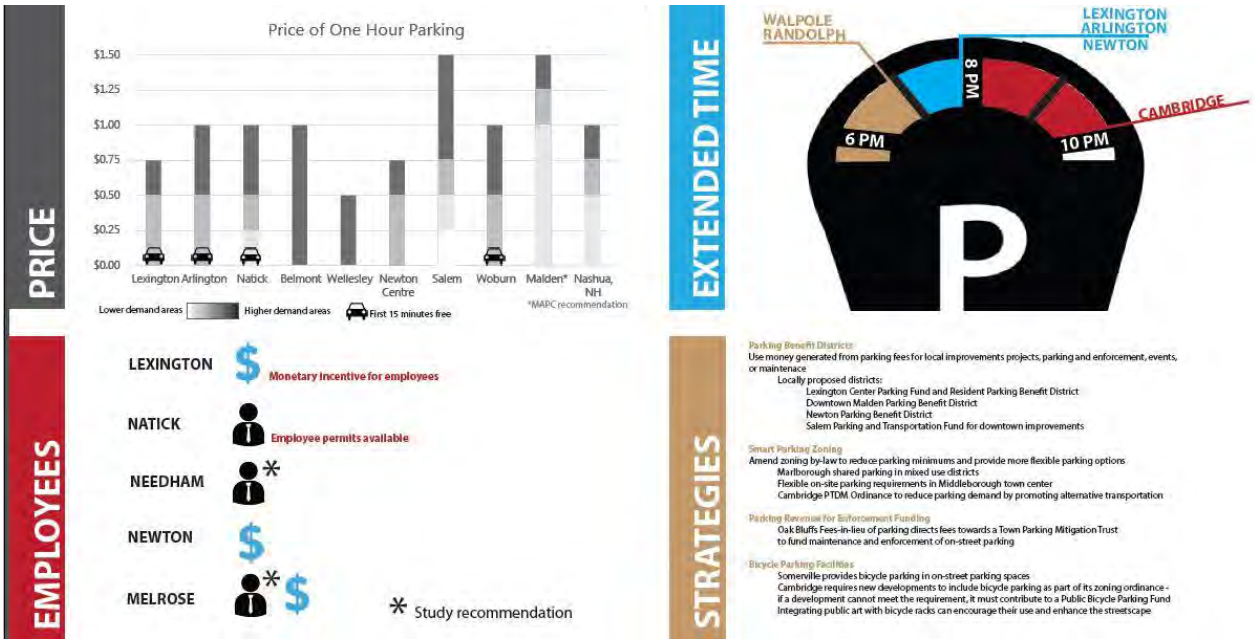
- Implement a full system of parking and permits. The full system will include tiered priced parking that includes on-street and off-street prices and time limits working as a system to spread parking demand. It will also include designated areas for commuter and employee parking.
    - A tiered pricing program places the highest price on “premium” locations that provide front door service.
    - Modestly priced parking is proposed for less desirable spots, such as the Main Street corridor where utilization did not rise above 71% on the date of data collection
    - Longer term parking with the lowest price, or potentially free, is proposed for off-street lots.
    - Provide parking for free or at a reduced price at a convenient off-street location
    - Make available prime front-door parking spaces in front of businesses for customer parking.
- Extend time limits beyond one hour in on-street parking spaces
    - Short time limits may give customers the notion that they must rush out of downtown once their time is done.
    - Extended time limits with a pricing structure, such as the one noted above, can remedy this by allowing customers to stay so long as they are willing to pay the fee.
    - Overall parking management strategy supports use of one parking space to serve multiple purposes and trips, reducing traffic congestion and supporting economic development.

- Set up parking fund to help pay for parking enforcement, streetscape, or wayfinding improvements. Parking funds help justify the cost of parking and direct the revenue collected towards improving the parking system and downtown.
- Encourage drivers to utilize off-street parking areas and park further from their destinations to spread parking demand and reduce congestion created from vehicles searching for parking downtown
    - Provide better connections to longer-term, lower-cost off-street parking through improved wayfinding and streetscape features.
    - Expand wayfinding signage at key intersections.
    - Improve pedestrian connections and safety so that people feel more comfortable parking further away from their destinations.
    - Invest in streetscape and lighting improvements to link areas such as Moody Street south of the Common and Main Street north of the Common.

There are a wide range of technology options for parking and enforcement. Parking kiosks can be used on a block-by-block basis rather than using individual meters that clutter the sidewalk. The parking pay stations also aid in enforcement as parking control can print reports and seek only those vehicles that are in violation, rather than patrolling each space. Parking payment can be by parking spaces or license plate and allow greater flexibility for paid parking, as well as provide options for tiered payment to assist with differing time-of-day regulations, full-time residents or the elderly. Certain types of smart meters can also provide pay by cell, real time availability information, and integration with enforcement equipment.

Implementing a Parking Benefit District program can help build support for a priced parking structure. This would direct funds collecting from parking fees into local improvements such as street cleaning, snow removal, sidewalk maintenance, traffic calming, lighting, signage, and public space enhancements. Unlike other areas of the United States, the use of parking benefit is not yet widely adopted in Massachusetts. Multiple communities in Massachusetts are considering Parking Benefit Districts to build support for paid parking and help improve their communities. These communities include Lexington, Malden, Newton, and Salem. The town of Oak Bluffs fees-in-lieu of parking system directs funds towards a Town Parking Mitigation Trust to fund maintenance and enforcement of on-street parking. Nashua, New Hampshire is the closet city providing a best practice example of implementing a Parking Benefit District. A summary of comparable city's parking price structures, time limits, employee programs, and parking benefit districts is provided in Figure 5-4.

Figure 5-4: Parking Comparison



Wayfinding improvements for both pedestrians and drivers can make off-street parking easier and more desirable. Pedestrian improvements can increase the likelihood of a customer of a restaurant extending their stay by getting dessert or a gift at a second establishment. This can create more spending downtown without creating demand for additional trips. Wayfinding can also help assist in reducing traffic congestion because vehicles will not need to circle downtown in search of parking. Wayfinding improvements are summarized in Figure 5-5.

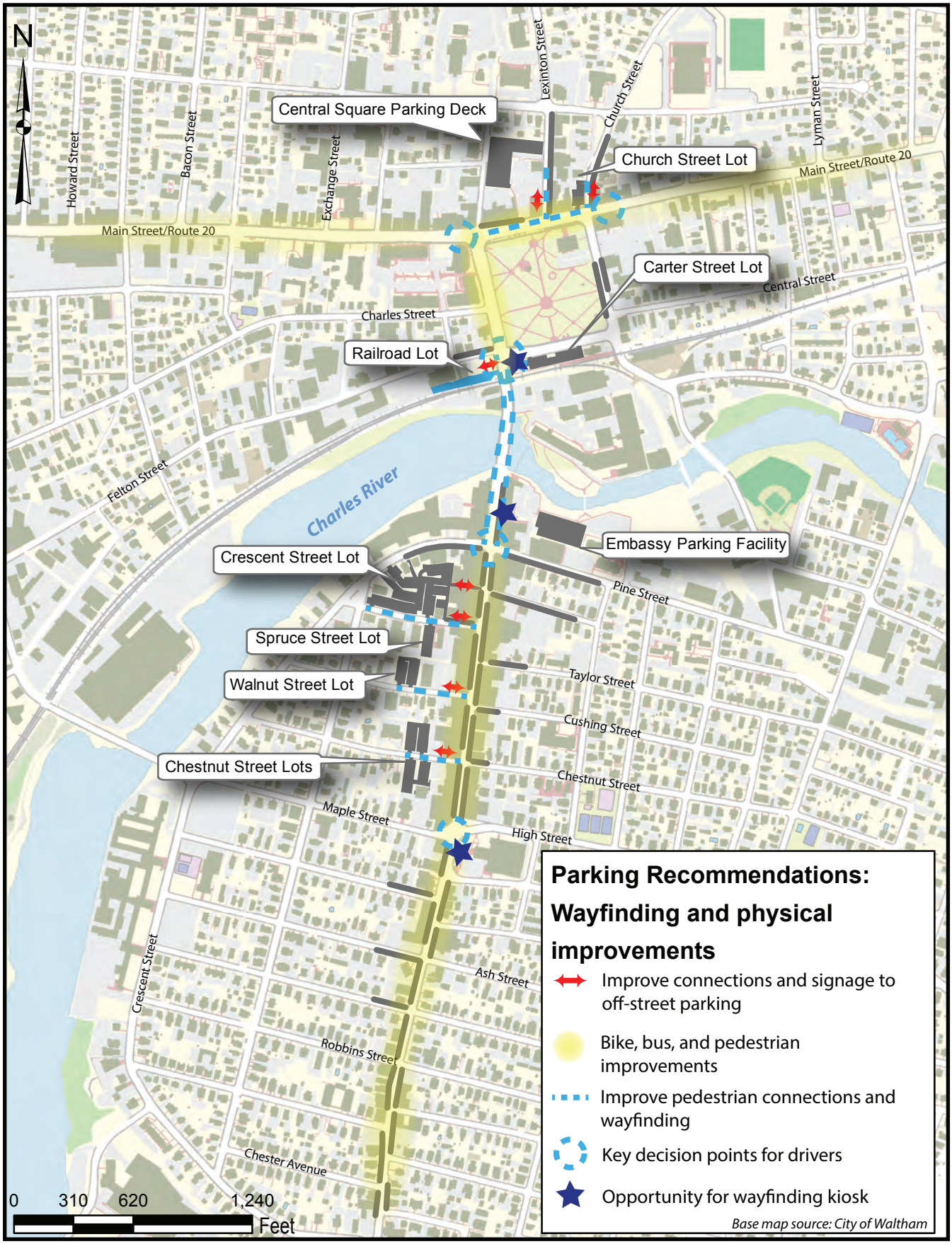


Figure 5-5
Wayfinding and Physical Improvements
Transportation Master Plan
Waltham, Massachusetts

Transit Improvements

The following transit recommendations have been developed through a combination of identified deficiencies, and comments received at community meetings and from the public survey. The overall sentiment of the public comments was for increased service and frequency. Waltham is a transit-orientated city. However, its user base feels that over time they have continued to receive less in transit service. While transit convenience and affordability are greatly desired, the community has been faced with cutbacks in service, increased fares, and deteriorating efficiency, all of which has consequentially contributed to low satisfaction of current users and limited motivation for potential users.

Recommendations have been vetted through a collaborative effort between the city and the MBTA. Additional community meetings are anticipated as the detailed recommendations outlined in this section are progressed. The majority of these recommendations are likely to be implemented in the long-term, unless otherwise noted.

Commuter Rail Improvements:

Short-Term:

- Monitor progress and attend meetings on the MBTA's new fare collection project AFC 2.0.
- Identify specific locations for improved commuter rail wayfinding signage.

Long-Term:

- Investigate commuter rail capacity on the Fitchburg Line for opportunities to attract more riders from Waltham.
- Explore the feasibility for commuter rail station upgrades.
- Develop a strategy to advance commuter rail station improvements, including improvements to entrance, wayfinding and trailblazer signs.

Waltham's two commuter rail stations have not reached their ridership potential. Unused parking capacity exists in close proximity to the stations. To determine the feasibility of attracting new ridership, a passenger capacity access analysis should be undertaken, both of the existing service and future projected ridership and service along the line. Notwithstanding any capacity issues, the recommendations below are focused around projects or improvements that the city could potentially initiate to improve transit conditions and encourage ridership:

- Station Platform and Area: A major investment to study, design, construct and potentially acquire land for a new station configuration with double-tracking, in conjunction with platform consolidation to one location, on each side or between the tracks, is desirable to improve the conditions at the Waltham Station for the transit users. The city could potentially initiate the study, and in partnership with the MBTA determine the feasibility for the design and construction of station improvements.

- Wayfinding Signage: Due to the separate locations of the inbound and outbound platforms at Waltham Station, wayfinding improvements are needed to assist riders in finding the platform for their return trip. New signage to improve the visibility of both stations should be explored. The entrance to the Melrose/Cedar Park Station in Melrose provides a good example of how the entrances to both commuter rail stations in Waltham could be improved, making them more visible and attractive.

Melrose/Cedar Park Station Entrance

- Pedestrian Access: Improvements to sidewalks, crosswalks, curb ramps, and lighting would improve the users' experience and safety.
- Bike Connections: The addition of bike lanes throughout the city and particularly around the rail stations would encourage bike access to the stations.
- Bike Parking: Improved bike parking would encourage bicycle access to the station.

Bus Route/Stop improvements:

Short-Term:

- Separate and restructure Routes 70 and 70A as part of the next MBTA Service Plan to improve the efficiency/reliability of the route and to shorten the route length.
- Further study/service analysis and public process is recommended for Route 505 relative to the trips serving the Central Square parking deck, for the extension of Route 553, and to potentially short-turn trips for Route 554, all in an effort to better serve the transit users in Waltham.
- Implement minor routing changes to Route 558 to service more of Crescent Street, avoiding a short segment of Moody Street.
- Commence auditing bus stops for accessibility and incorporate pedestrian upgrades at bus stops in current projects.
- Identify and report to MBTA stops with bus stop signage issues and address obscured signs.
- Coordinate with MBTA to replace new bus stops signs, and restripe/add bus stop pavement markings, as part of current programmed roadway/sidewalk projects.
- Increase parking enforcement to discourage illegal parking in bus stops, especially on Main Street and Moody Street.
- Enhance existing bus stops to improve the conditions for the transit users by adding low cost facilities, such as benches, bike racks and trash receptacles.
- Relocate the Cedarwood layover to the existing bus stop on Tavern Road.
- Restripe STOP line on Bacon Street southbound approach at Dale Street.
- Consider implementing some of the modifications suggested in the Main Street and Moody Street bus stop modification plan in order to improve this transit route for its users

by decreasing the travel time and increasing the efficiency and reliability. Further public process is recommended to be held with the community.

- Introduce transit priority measures on Moody Street, including a shared right-turn/bus only lane i.e. queue jump lane on Moody Street, approaching Crescent Street and Pine Street. These measures serve to prioritize transit travel over general motor vehicles and reducing bus route travel times. Additional public process is recommended to refine concept.

Long-Term:

- Maintain ongoing communications with MBTA regarding future expansion of service to meet growing development needs.
- Explore opportunities for transit priority measures city-wide, including transit signal priorities.
- Advance the design of an enhanced Carter Street transit hub.
- Improve bus stops, including sidewalk area, crossings, curb ramps and lighting, to enhance the user experience, to meet ADA requirements, and to enable addition of shelters and benches that require an ADA accessible bus stop.
- Upgrade bus stop signs and restripe/add bus stop pavement markings as part of future roadway, sidewalk and streetscape projects.
- Consider adding concrete bus pads at heavily served bus stops.
- Invest in bus facilities, such as shelters, to increase the safety and comfort levels of the users.
- Implement the remaining proposals (that were not rolled out in the short-term) in the stop modification plans for Main Street and Moody Street.
- Construct bus stop curb extensions on Moody Street at the proposed inbound Chestnut Street stop and on Main Street at the proposed stop. This will improve user safety and comfort, minimize parking impacts, facilitate pedestrian safety, and provide additional space for facilities.
- Explore opportunities for specific transit priority measures along Main Street in an effect to prioritize transit travel on the street network.

Responses from the public survey indicate a specific need for improved service frequency, hours of service, and more route and origin-destination connectivity. These types of improvements generally require implementation by the MBTA and the City should continue to advocate for these improvements. Specific routing recommendations to be considered are described below:

Routes 70 and 70A: MBTA's Service Planning Unit is considering removing the Route 70 trunk portion of Route 70A east of Central Square. This separation of the route would allow Route 70A to be converted into a separate route and serve more as a local circulator between Central Square and North Waltham. This would benefit the user in terms of improved headways and reliability on Route 70, and more flexibility in terms of span of service, improved or increased frequency of service, and better reliability on Route 70A.

Route 505: it is recommended that this route be further analyzed to determine the appropriate number of trips servicing the Central Square parking deck garage, in relation to the adjacent stops. The existing routing north of the Common to service the Central Square Parking Deck is illustrated in Figure 5-6 (Route 505).

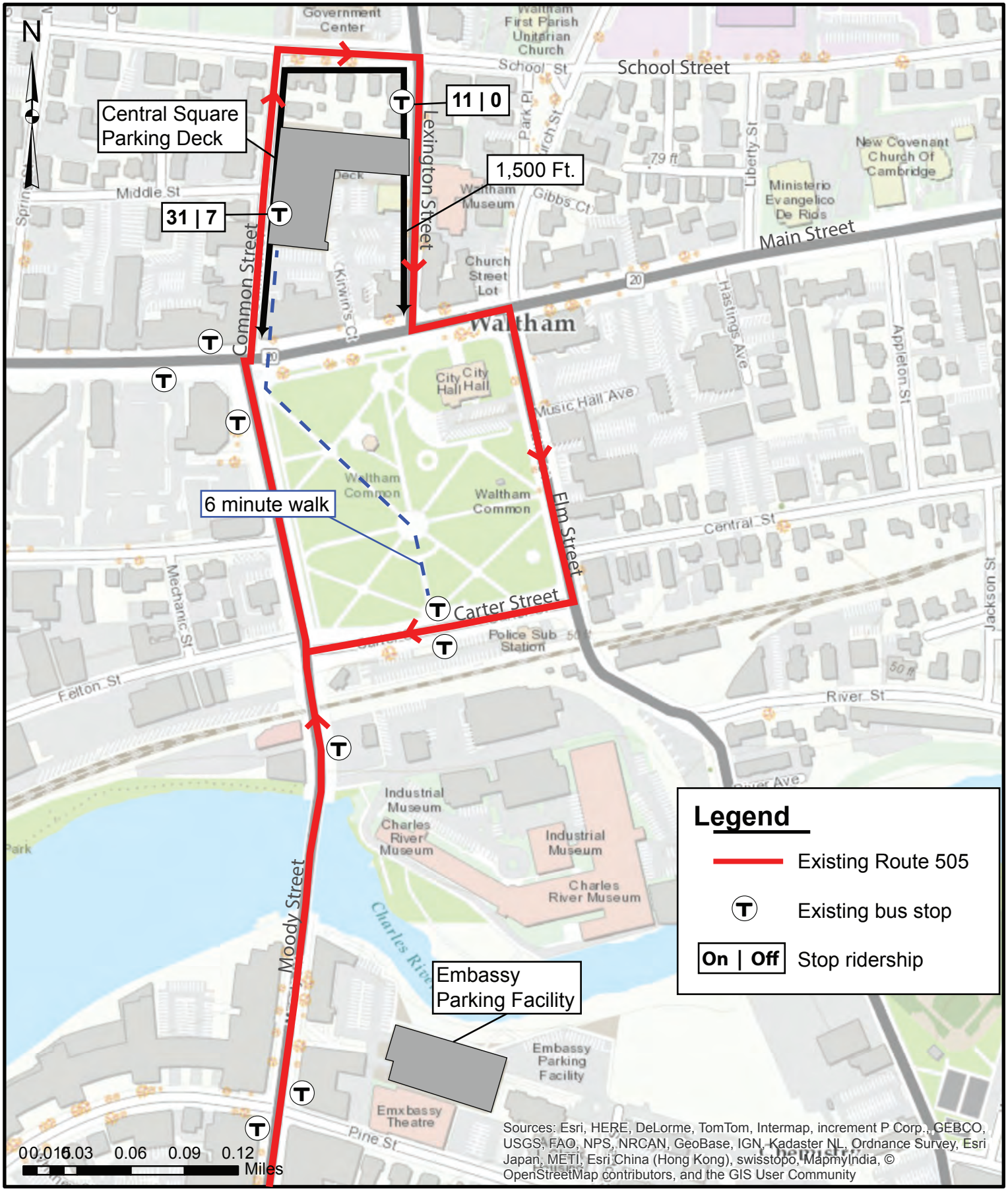


Figure 5-6
Route 505 Alternative
Transportation Master Plan
Waltham, Massachusetts

Route 553: The possibility of extending Bus Route 553 to include service to Watermill Center should be explored. Watermill Center is a large office building that could potentially generate transit trips located south of the Route 553 terminus, opposite the Stony Brook Basin. A potential route via South Street, Charles River Road and Angelside Road has been provisionally identified. Charles River Road is a potential route although it is a narrow road with no sidewalk on one side, and does not appear to be well traveled. Angelside Road on the contrary has sidewalks on both sides of the road, and relatively dense residential buildings, including an apartment-style complex owned by Brandeis University, which could generate additional transit ridership if more directly served. Since all these developments are within a half mile of the existing service, an immediate review of potential route changes is not required, however a future study of the service potential is warranted and would be beneficial in the short-term.

Route 554: Route 554 loops around the Bentley campus and services Waverly Oaks Road, Trapelo Road and Forest Street. Recommendations are to enhance ridership by outreach efforts at Bentley University and route evaluation/modification to increase efficiency and reliability.

Route 558: Discussions between the city and the MBTA regarding improvements to Route 558 had already initiated prior to the start of the WTMP. To help reduce travel times, improve reliability on the route, and avoid a congested section of Moody Street, it is recommended to re-route Route 558 along Crescent Street, rather than Spruce Street. Sidewalk and accessibility improvements, as well as slight modifications to the STOP line on the Crescent Street eastbound approach, and lengthening the existing outbound stop on Moody Street at Pine Street to enable the bus to pull into the stop, will need to be made prior to the implementation of the rerouting plan. The proposed new route and bus stops, and bus stops affected by the change are depicted in Figure 5-7.

Additional detail on these service and routing improvements is provided in Appendix K.

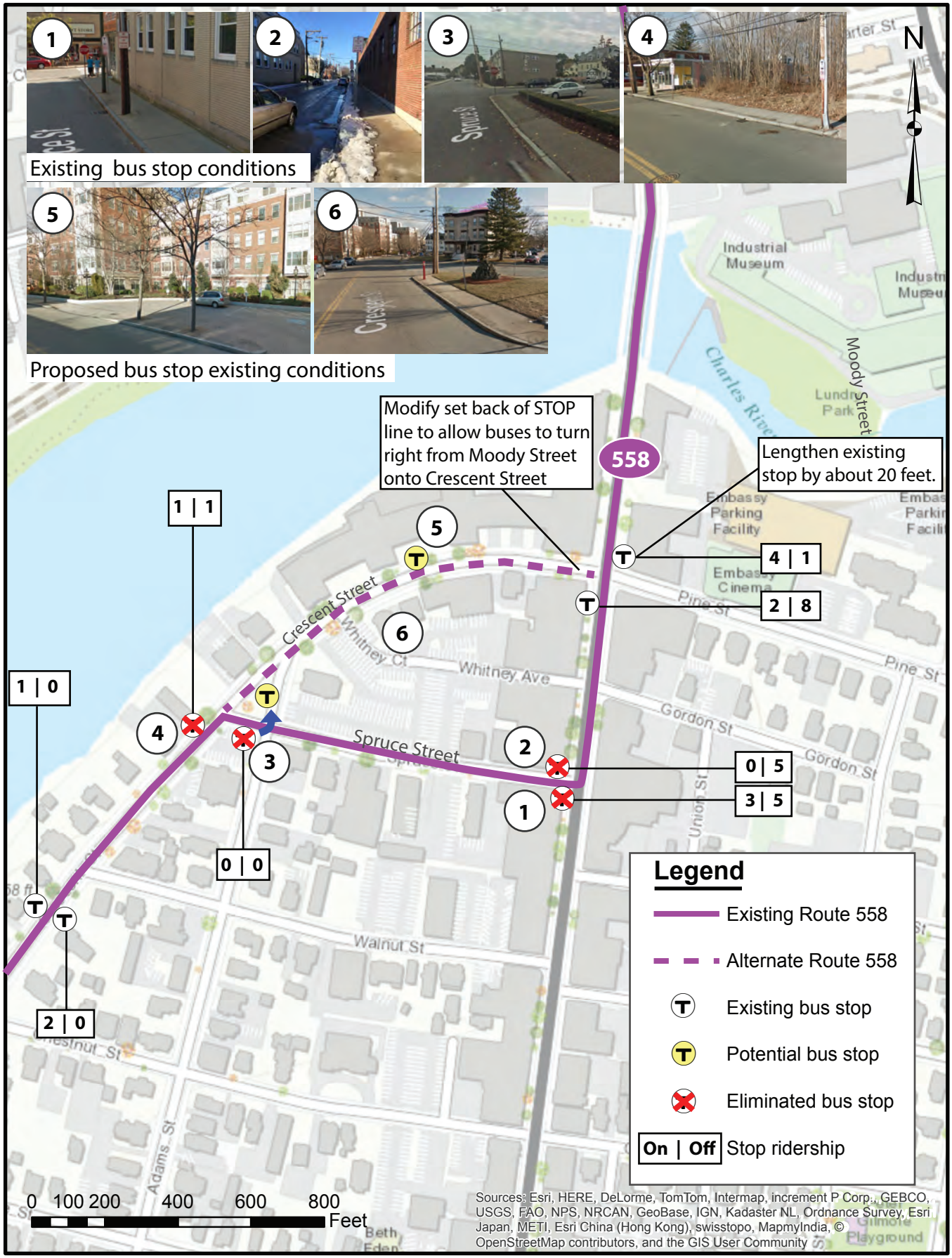


Figure 5-7
Route 558 Alternative
Transportation Master Plan
Waltham, Massachusetts

The focus of the recommendations in the following sections are on those that can be initiated, led, and or implemented by the city, and include:

- Bus stop optimization
- Accessibility improvements
- Improved bus stop visibility and safety
- Bus stop facilities (the incorporation of shelters, benches, bike racks, trash containers)
- Transit priority measures
- Bus Stop relocation

These recommendations should also be considered in combination in order to improve the overall transit satisfaction, to maximize access to and marketability of the service, and to attract more riders. For further detail on each of these elements and how they can be applied in the city, see Appendix L.

Locations with specific recommendations are outlined below.

1. Main Street

Bus Stop Optimization Plan

The existing bus stops on Main Street are shown in Figure 5-8. The proposed plan, with existing average daily bus stop ridership, is shown in Appendix M. The current bus route and its stops were analyzed in terms of location, connectivity, spacing, convenience, and surrounding pedestrian features. Efforts were made to select a reorganization of the bus stops along Main Street that would achieve the following:

- Continue to service the current users in an efficient manner
- Position bus stops to provide reasonable spacing, ensuring users can reach a stop in practical distance
- Provide missing pair at bus stops that currently service in only one direction
- Improve the travel time of the bus route
- Position stops to better align with pedestrian desire lines and pedestrian features

Details of the recommended bus stop optimization plan are included in Appendix M. In summary, the plan recommends the relocation of eight stops, the removal of seven stops, the installation of four new stops, and a bus stop curb extension on Main Street at Hammond Street. Further public process is recommended to refine and communicate the concept.

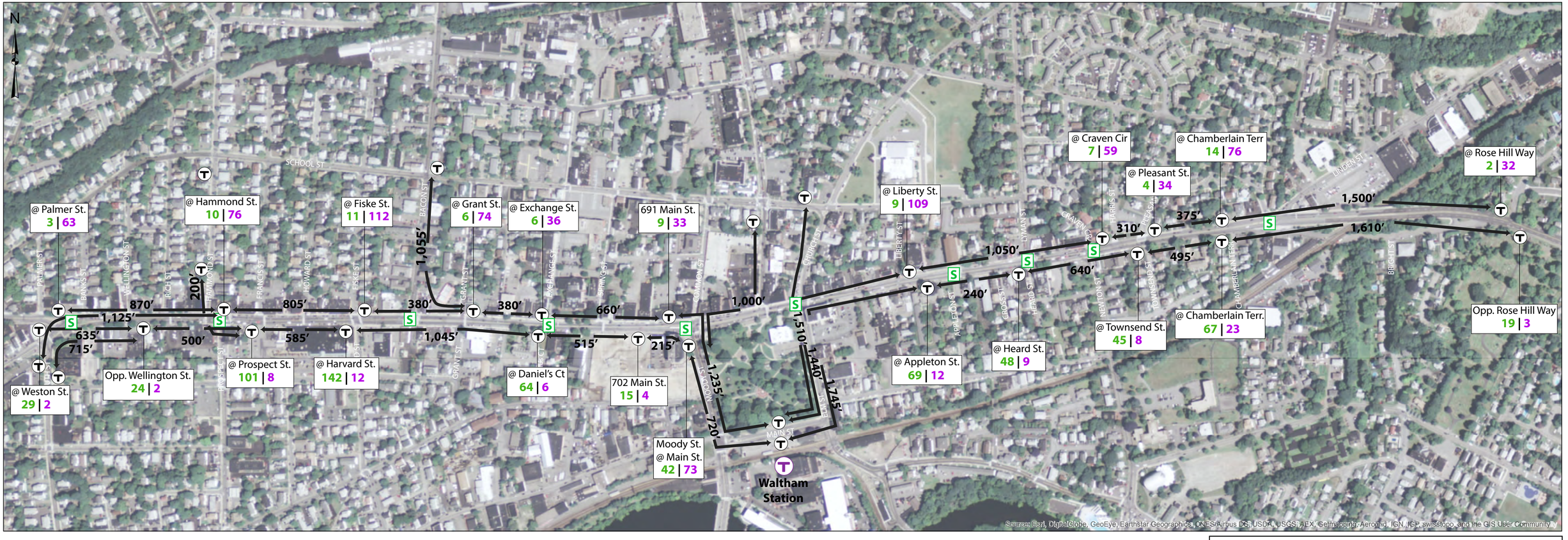


Figure 5-8
Main Street Existing Bus Stops
Transportation Master Plan
Waltham, Massachusetts

Transit Priority Measures

The travel time and number of bus passengers along Main Street were evaluated to inform recommendations for transit priority measures. Details of the evaluation are provided in Appendix N. It is recommended that transit priority measures be considered along the entire corridor, but notably between the following bus stops and at the following intersections to speed up service:

Eastbound:

- Between Weston Street and Moody Street in the AM
  Between Daniel's Court and Moody Street in the PM
  Between Appleton Street and Townsend Street
- Moody Street and Main Street intersection

Westbound

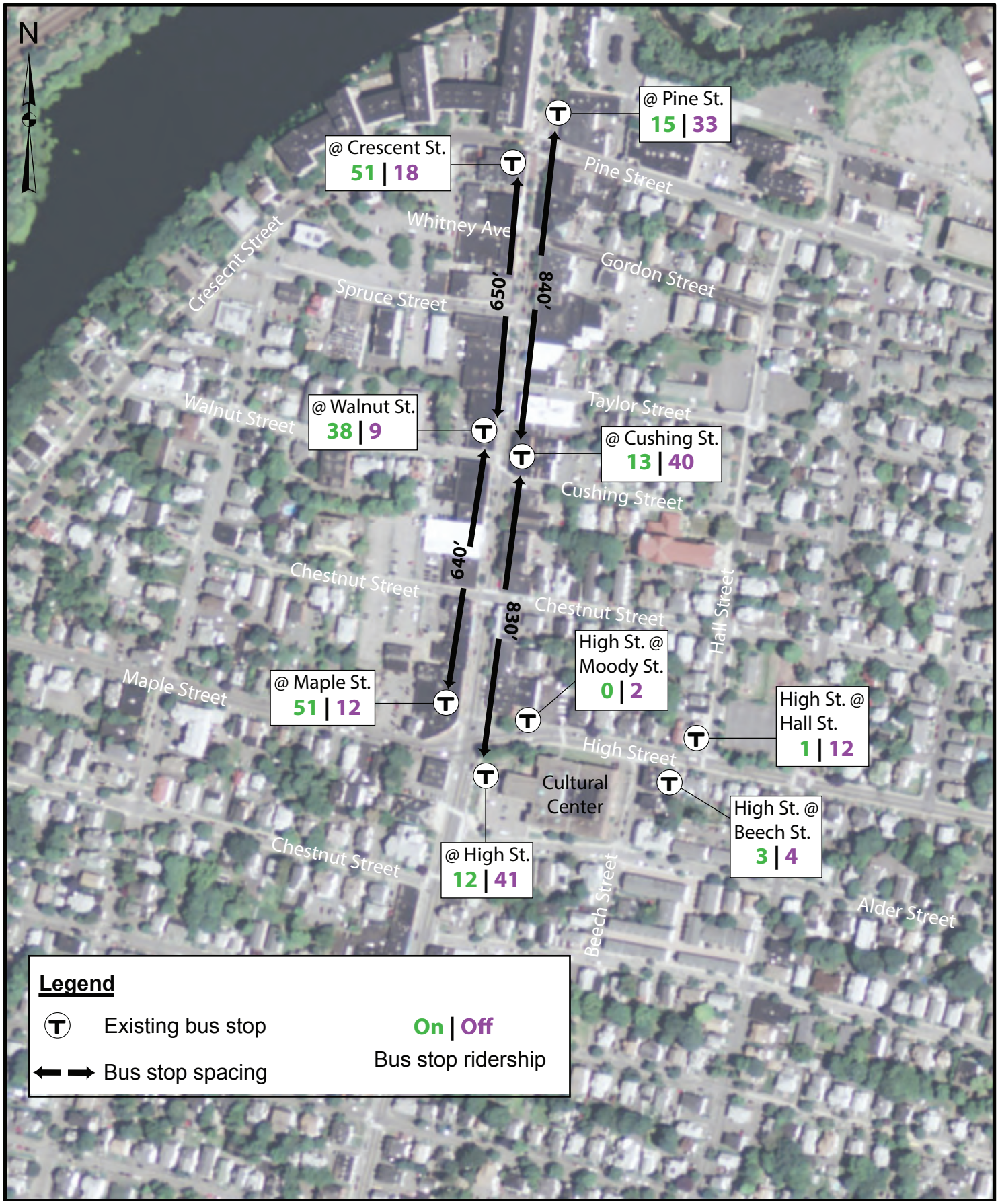
- Chamberlain Terrace and Church Street in the AM
- Chamberlain Terrace and Craven Circle (the next signalized intersection after Pleasant Street stop) in the PM

Further study, additional traffic analysis and public process are recommended to evaluate the types of transit priority measures, such as signal optimization, transit signal priority, and queue jump lanes, that should be implemented in each of the above segments or at the intersections.

2. Moody Street

Bus stops on Moody Street were evaluated in detail within the dense commercial and multimodal center of activity in downtown Waltham, between the Charles River and Chestnut Street/Maple Street, for opportunities to improve bus operations, bus stop accessibility and to enhance multimodal access and mobility. The road improvements along Moody Street planned for 2017 offer an opportunity in the very near future to simultaneously implement transit improvements.

A bus stop optimization plan was developed for Moody Street. Existing bus stop locations, ridership, and spacing along Moody Street is shown in Figure 5-9. In summary, the optimization plan involves the removal of 4 bus stop pairs, the installation of a bus stop curb extension at the new proposed inbound stop at Chestnut Street, a shared right turn/bus only lane on Moody Street southbound approaching Crescent Street, and northbound approaching Pine Street to improve bus operations and reduce service delays. Details of the plan are provided on Appendix O.



MBTA Load Profiles, Fall 2014

Figure 5-9
Moody Street Existing Bus Stops
Transportation Master Plan
Waltham, Massachusetts

3. Carter Street

The recommended improvements to Carter Street will enhance the area as a transit hub in line with the city's vision for the area around the commuter rail station and the Carter Street bus stops. Creation of a bus only area, combined with improved pedestrian and bicycle facilities and limited vehicular access were the primary goals achieved in the development of a concept plan for the area. While it would be ideal to remove general traffic from the street entirely, the demand for east to west vehicular travel was too high.

Figure 5-10 illustrates a potential layout for an enhanced transit hub on Carter Street and the vehicular diversion that results from the new configuration. As the concept is advanced, public process is recommended to gain input as the concept is refined. The major features of the proposed transit hub are as follows:

- Create a bus only area for eastbound and westbound bus movements. Buses would stop curbside at the existing southern sidewalk, while the north side stop would shift further south and be serviced from a new bus island.
- Designate an area for private and 128 Business Council shuttles, adjacent to MBTA buses, to help operations run efficiently and take advantage of designated bus stops and layover spaces.
- Explore options to retain and permit bicycle access through the hub to maintain good multimodal connections.
- Close Carter Street to eastbound general through traffic, but maintain one westbound travel lane for vehicular traffic.
- Maintain access to and egress from Waltham Police Department Neighborhood Center, and loading access to Biagio Express for vehicular traffic.
- Add a bus only signal phase at the western end of Carter Street approaching Moody Street.
- Enhance pedestrian facilities through wider, "super" crosswalks and improved sidewalks and curb ramps. The bus island effectively creates a pedestrian refuge, thereby reducing the crossing distance and time for pedestrians, and minimizing delays to bus and traffic flow. Consider other enhanced pedestrian crossing features, as may be appropriate, including hybrid or flashing beacons coupled with inlaid LED roadway warning lights.
- Install bus shelters, benches, trash containers throughout the hub to enhance the comfort of the transit riders.
- Consider the integration of re-enforced concrete pads at bus berths.
- Add pavement markings to add emphasis to the bus-only areas and bus berths
- Provide real-time information displays with an audible function, at one or two centralized areas within the bus hub to better inform the transit users.
- Consider the addition of landscaping and trees for shade and aesthetic improvements.
- Convert the Carter Street parking lot into a "Kiss n' Ride" (i.e. pick-up/drop-off area) for the station and bus stops, combined with a relocated taxi stand.
- Identify alternate parking areas for existing riders who park in this lot.
- Consider signage, design and other techniques to deter eastbound traffic from cutting through the proposed Kiss n'Ride and Taxi stand area.

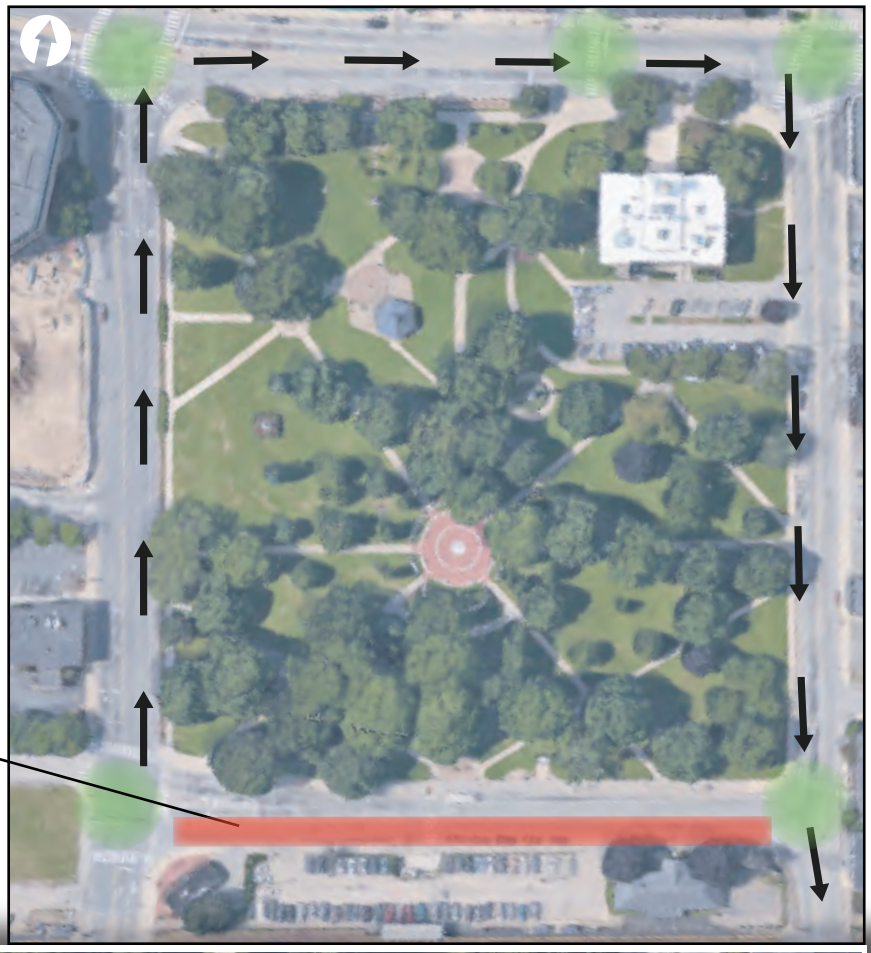
- Designate space for shared car services like those provided by ZipCar, Enterprise CarShare, and Hertz 24/7.
- Create additional platform access points to the inbound commuter rail platform.
- Improve bicycle facilities such as secure covered bike storage and adding a bike share station (as part of a city-wide bike share network).
- Additional areas can be investigated to add parking adjacent to the transit hub to balance lost parking directly at Waltham Station.
- Finally, ensure good pedestrian and bicycle facilities connect to the hub, in particular at intersections abutting each end.

The Carter Street enhanced transit hub plan was presented at the public meeting. The concept was well supported by attendees and subsequently in comments received following the public meeting. Participants did voice a concern regarding the elimination of general parking at the station and asked that alternative parking be supplied nearby.

This conceptual plan was also presented to the MBTA for their input and while they are supportive of an enhanced transit hub on Carter Street, including real-time information displays, they requested that alternative designs be explored. The proposed plan is conceptual in nature, and additional study is recommended to further advance the enhanced transit hub.

Legend

- Signalized intersection
- Eastbound traffic rerouting
- Exclusive bus lane
- Taxi standing
- Kiss'n Ride
- Pedestrian area
- Fence
- Tree
- Bench
- Shelter
- Bike parking



Enhanced transit hub maintaining westbound travel only, and access to commuter rail parking lot, WPD Neighborhood Center, and Biagio Express loading area
(see details in inset below)

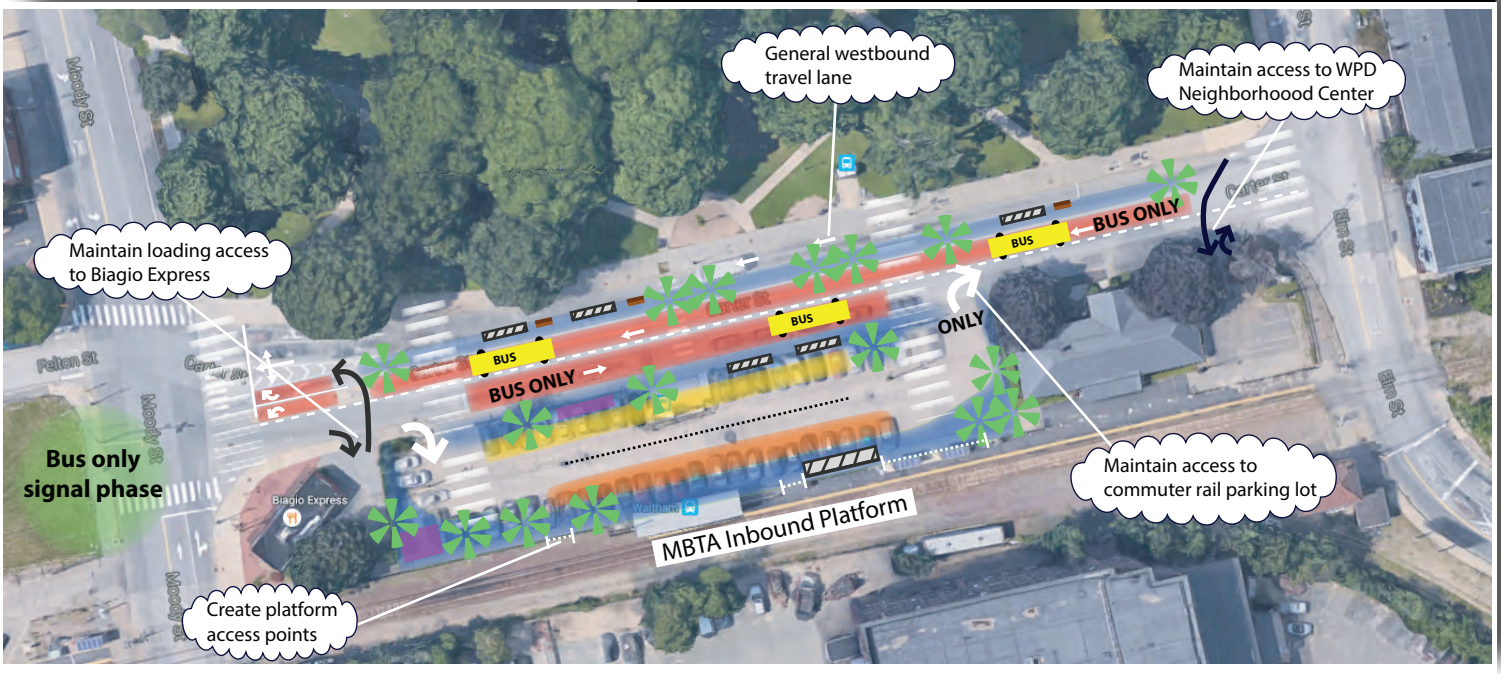
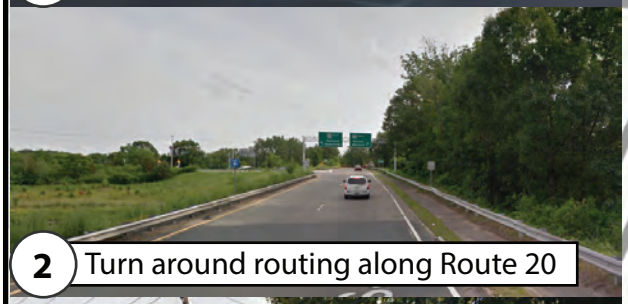


Figure 5-10
Carter Street Bus Hub
Transportation Master Plan
Waltham, Massachusetts

4. Cedarwood Layover

The existing bus layover on Weston Street at Cedarwood Avenue is recommended to be relocated to Tavern Road, depicted in Figure 5-11. This improvement could be made in the short-term as part of a quarterly schedule review, in coordination with MBTA. As noted in the deficiencies chapter – the only way to access the current layover is to drive one mile westbound on Weston Street, loop through the I-95/Route 20 interchange and head back eastbound on Weston Street, which is not efficient. The ridership that currently boards at Cedarwood (85 riders) would be impacted by this change, however the Tavern Road stop is less than 500 feet away. The current bus stop is sufficiently set back from Weston Street to enable buses to access the left-turn only lane to turn onto Weston Street eastbound. Unfortunately, the sidewalk width at the Tavern Road stop does not allow for the addition of a bus shelter. The existing stop has a grass strip in the landing area and should be programmed for improvement in the near future. An alternative layover location was considered on Weston Street, east of Cedarwood Avenue, but not recommended because of vehicle queuing and traffic congestion, limited right-of-way and insufficient space between residential driveways.

1 Existing layover at Cedarwood Ave.



2 Turn around routing along Route 20

3 Proposed layover on Tavern Rd. to create more effiecint routing and avoid Route 20 loop

N

Main Street

Stowe Street

Stowe Street

Tavern Road

Proposed Layover

3

1

Existing Layover

2

Weston Street

Interstate 95

Interstate 95

Spencer St

Keach St

Cutting Ln

Colburn St

Dorchester St

Milton St

Livingstone Ln

Villa St

Florence Rd

Virginia Rd

Thornton Rd

Sibley Rd

Flagg Cir

Hill Rd

Sheridan Rd

Border Rd

Legend

- Existing Route 70
- Proposed Route 70
- Existing bus stop
- Proposed removed bus stop

0 0.02 0.045 0.09 0.135 0.18 Miles

Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Figure 5-11
Proposed Route 70 Layover
Transportation Master Plan
Waltham, Massachusetts

5. Bacon Street at Dale Street

It is recommended to evaluate the STOP line on the Bacon Street southbound approach at Dale Street and consider setting it back further north, away from Dale Street, to enable buses to make right turns from Dale Street westbound onto Bacon Street northbound. Currently vehicles stopped on the Bacon Street southbound approach must reverse to enable this bus turning movement. Since Bacon Street is programmed for repaving in the short-term it is recommended that this adjustment be made as part of the repaving project.

Transportation Demand Management (TDM) and Policy Recommendations:

Short-Term:

- Require membership of the 128 Business Council for new developments in the Route 128 catchment area, as part of their TDM mitigation, and continue to coordinate with the 128 Business Council.
- Continue to engage in ongoing regional, state and MBTA planning efforts and projects.
- Access to Fare Products: Although the city would like to see additional MBTA retail sales outlets/terminals, for riders to purchase passes and other fares, the MBTA has indicated that the necessary infrastructure is not readily available, and the purchase of new infrastructure is not likely at this time due to the recent launch of a new fare project – AFC 2.0. This new project is likely to result in cashless and mobile payment technology, which will vastly reduce the need for brick and mortar facilities to sell fare products. The city should monitor this project and attend public meetings on the project to learn of new opportunities to boost access to fare products and inform residents, employees and visitors in Waltham of upcoming changes and improvements that affect access to the transit system within the city.

Long-term:

The City should concentrate efforts on ways to connect the economic benefits of the transit orientated development (TOD) to its multi-modal transportation system, including transit, bicycle and walking networks.

Shuttle Routes Coordination

Consolidation, coordination or partnerships between the Brandeis and Bentley shuttles could be advantageous for both universities, especially where they overlap in service areas, such as service to Harvard Square. A combined service could provide more frequency or hours of service and ultimately generate more ridership. Both universities expressed a willingness to explore collaboration.

Partnerships with other shuttle providers in the area, as well as an increase in membership of the 128 Business Council TMA could help boost ridership. Large firms and facilities within the catchment area of the 128 Business Council should be encouraged, or even required by the city to become a member of the TMA. As a member, employees would have better access to transit information which could help boost transit ridership, and reduce traffic congestion within the area. The city's continued engagement in the operations of the 128 Business Council could provide opportunities to seek collaborative means to improving shuttle service across the city. These are recommendations that could be pursued in the short-term.

Transit Oriented Development

In terms of transit policy, the City of Waltham has encountered transit orientated development (TOD) in its downtown area and specifically around the Waltham Station. Transit oriented development (TOD) is high density, mixed-use development that is pedestrian friendly and located within one quarter to one half mile, or a five to seven-minute walk, of a transit station. A recommendation of the WTMP is that moving forward, the City should concentrate efforts on ways to connect the economic benefits of the TOD development to its transportation system.

Traffic Improvements

Based on the deficiencies identified, several improvements have been considered to improve traffic operations within the City of Waltham as a whole and at the specific intersection indented.

Short Term:

- Review access management to minimize the number of curb cuts on roadways including shared access and internal connections between retail sites. Minimizing the number of curb cuts and access points reduces the number of conflict areas within a corridor and allows for improves traffic flow and safety.
- Review traffic signal timings and phasing and optimize for improved vehicular operations. Several traffic signals timing plans are outdated and do not provide optimal timings for current traffic conditions.
- Implement coordinated traffic signal systems to facilitate the flow of traffic along signalized corridors. This improvement will also reduce the amount of delay for vehicles traveling through a corridor.

Long Term:

- Replace outdated traffic signal equipment with equipment that is compliant to current Manual on Uniform Traffic Control Devices (MUTCD). The existing equipment is inconsistent through the City and some of the equipment is substandard.
- Provide traffic calming measures through appropriate areas of the City that experience issues with speeding or safety.
- Modify travel lanes to define lane use, install turn lanes, eliminate trap turn lanes, and balance lanes.

Additional location specific recommendations are shown in detail in the section below.

C. Location Specific Recommendations

Traffic Signal Warrant Analysis

Signal warrant analyses were performed for the unsignalized study area intersections based on procedures outlined in the latest edition of the MUTCD. The warrants were performed to help determine the top 20 intersections to be selected for additional improvements. The MUTCD establishes eight criteria, referred to as warrants, for the installation of traffic signals. The manual states that satisfaction of these warrants does not in itself require the installation of a traffic signal. However, a traffic signal should not be installed unless one or more of the warrants is met. The analyses performed for this report are based on the criteria for the eight-hour, four-hour, and peak hour volume warrants.

Eight-hour, four-hour, and peak hour signal warrant analyses were performed using existing traffic volumes at each study area intersection reviewed. The results of the signal warrant analyses are summarized in Table 5-1 below.

Table 5-1: Traffic Signal Warrant Summary

Intersection	Warrant 1 Eight-Hour	Warrant 2 Four-Hour	Warrant 3 Peak Hour
Lincoln Street at Lake Street	Not Available	Yes	No
Lexington Street at Dale Street	Yes	Yes	Yes
Beaver Street at Linden Street	No	No	No
Beaver Street at Warren Street	Yes	Yes	Yes
Main Street at Harvard / Fiske Street	Yes	Yes	Yes
Charles Street at Moody Street	No	No	No
Elm Street at River Street	Yes	Yes	Yes
Newton Street at Calvary / Benefit Street	Not Available	No	Yes
Newton Street at Grove Street	Yes	Yes	Yes
Grove Street at Gore / Seyon Street	Yes	Yes	Yes
Farwell Street at Calvary Street	Yes	Yes	Yes

As shown in Table 5-1, five of the twelve unsignalized study area intersections reviewed meet the criteria to justify the installation of a new traffic control signal under Warrants 1, 2, and 3 based on the traffic volumes collected. The intersection of Lincoln Street at Lake Street does not meet the criteria for the peak hour signal warrant, but does meet the four hour warrant. The intersection of Newton Street at Calvary Street and Benefit Street does not meet the criteria for the four-hour signal warrant, while meeting the peak hour warrant. Also, the intersections of Beaver Street at Linden Street, and Charles Street at Moody Street (excluding right turn on Charles Street), do not meet the criteria for any of the three signal warrants. Of the intersections shown in Table 1, several intersections were selected for specific intersection review and are described in greater detail below.

Corridor Improvements

Bear Hill Road/2nd Avenue

The Bear Hill Road/2nd Avenue corridor extends from Main Street from the south to Winter Street to the north. The lack of pedestrian and bicycle facilities on Bear Hill Road/2nd Avenue were noted as a deficiency. Several alternatives were considered to help improve all modes of transportation through this corridor. Ideally, each of these modes would be allowed dedicated space to travel through the corridor.

To better accommodate pedestrians and bicyclists utilizing the Bear Hill Road/2nd Avenue corridor, a two-way left turn lane (TWLTL) analysis was conducted to determine if the existing TWLTL can be removed and the space reallocated to other modes of transportation. Due to the high volume of commercial driveways, however, the TWLTL is an appropriate and necessary treatment for Bear Hill Road/2nd Avenue and the removal of the TWLTL is not recommended. As previously mentioned, the Bear Hill Road cross-section is approximately 46 feet in width including the eight foot-wide sidewalk, and does not occupy the etnire50 feet of available right of

way. Additionally, the existing travel lanes and sidewalk can be reduced in width and the space can be reallocated to provide additional facilities on Bear Hill Road/2nd Avenue.

Three long-term concepts were developed:

- The first concept adds sidewalk to both sides of the roadway to allow pedestrian access to the commercial properties on both sides of the roadway. The existing sidewalk is proposed to be reduced from eight feet to six feet in width and the space can be reallocated to provide new sidewalk on the opposite side of the roadway in combination with the unused right-of-way space.

Bear Hill Road - Alternative 1

- The second concept provides a shared use path on one side of the roadway to accommodate both pedestrians and bicycles. This concept proposes to remove the existing sidewalk. Reduce travel lane widths, and reallocate this space to a 10 foot-wide shared path for bicycles and pedestrians, separated from the vehicular travel lanes by a five foot-wide grass buffer.

Bear Hill Road - Alternative 2

- The third concept provides sidewalk on both sides of the roadway, a sharrow in the southbound travel lane, and a bike lane in the northbound direction. This concept proposes to reduce the widths of the sidewalks and the TWLTL to the minimum standard

for width and reallocate the space to a northbound bicycle lane. Since Bear Hill Avenue is uphill in the northbound direction, dedicated bicycle space in the northbound direction is more desirable.

Bear Hill Road - Alternative 3

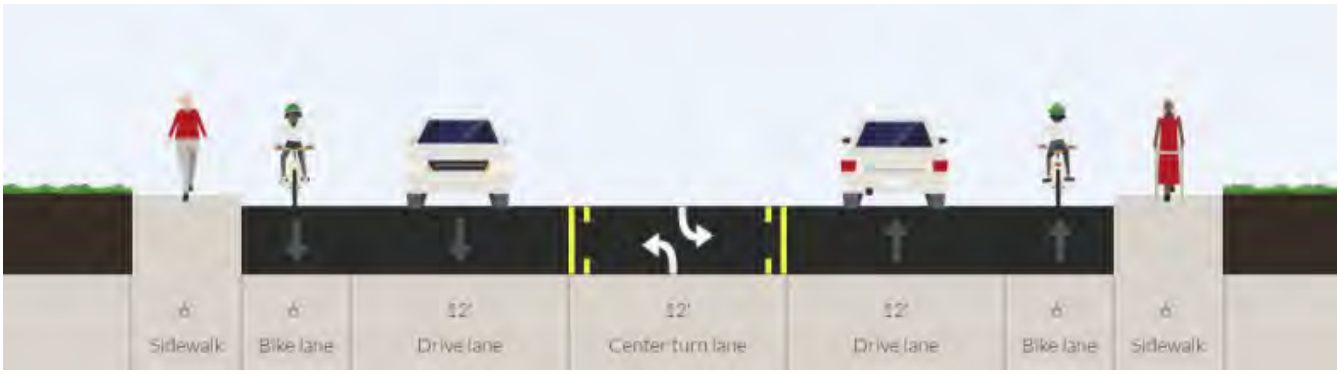
Based on public input and input from the Waltham Bicycle coalition, Alternative 3 is the preferred alternative to best accommodate all modes of traffic through this corridor.

Lexington Street

The Lexington Street corridor extends from Piety Corner to the South to Trapelo Road to the north. In an effort to reduce speeding issues on Lexington Street, analysis was conducted to determine the feasibility of lane reductions. Lexington Street currently carries two lanes in each direction. The reduction in the number of travel lanes can provide space to be reallocated for provide bicycle facilities. The results of this analysis show that the majority of the intersections along Lexington Street can be accommodated with a single through lane. The intersection with Lake Street, Trapelo Road, and Piety Corner require two through lanes to maintain adequate traffic operations.

The commercial segment of Lexington Street between Lake Street and Trapelo Road was reviewed for a lane reduction and it was determined that a TWLTL as well as a single lane in each direction will provide adequate operations at each intersection of Lexington Street within this segment with the exception of Trapelo Road. The additional space from the lane reduction can be reallocated to provide multi-modal improvements. Two alternatives were considered for this segment:

- The first alternative splits the 12 feet of additional roadway space to include a bicycle lane in each direction. This improvement allows the existing curb to be retained and would only require short-term restriping.



Lexington Street (Northern Segment) - Alternative 1

- The second alternative uses the additional space to include a multi-use path on one side of the roadway, providing more protected area for bicyclists and pedestrians. The proposed path would be 10 feet in width and would be separated from vehicular traffic by a five foot-wide buffer. Sidewalk would still be provided on the opposite side of the roadway and would be protected by a three foot-wide buffer. There would be no on-street facilities for bicyclists.

Lexington Street (Northern Segment) - Alternative 2

Similar to the feedback received for the Bear Hill Road corridor, a multi-use path is not a preferred treatment for bicyclists. Additionally, alternative 2 would require moving the existing curb lines, and would be a long-term, higher cost improvement. Alternative 1 is the preferred treatment for this segment of Lexington Street to the north of Lake Street, since it achieves the multi-modal objective, can be implemented within the existing curb lines, and is less costly than Alternative 2.

Lane reduction alternatives were also applied to the residential section of Lexington Street between Piety Corner and Lake Street and the following alternatives were considered:

- Extend the preferred Alternative 1 from the northern segment of Lexington Street to the residential section. A TWLTL, however, is not warranted due to the low volume of vehicles utilizing residential driveways, and this alternative is therefore not a preferable treatment.

- Eliminate a travel lane in both the northbound and southbound direction to modify the roadway to a two-lane roadway. The elimination of two travel lanes allows for a significant amount of space to be reallocated to multi-modal improvements. Exclusive bicycle lanes protected by a buffer can be provided as well as widened sidewalks or buffered sidewalks. This improvement would move the existing curb line and would be implemented as a long-term alternative.

Lexington Street (Southern Segment) - Alternative 1

- Eliminate a northbound travel lane and retain the existing two lanes in the southbound direction. Similar to the preferred alternative for the northern segment, the single lane reduction would allow for bike lanes on both sides of the roadway while retaining the existing curb line and sidewalks. The improvement would allow for capacity for fluctuations in southbound traffic volumes caused by incidents on I-95. The lane reduction will help mitigate issues with speeding within the corridor while still maintaining appropriate capacity for the corridor.

Lexington Street (Southern Segment) - Alternative 2

Based on public feedback on the alternatives, Alternative 2 provides the most flexibility for traffic volume fluctuations as identified by the City and can be implemented as a short-term striping improvement, and is therefore preferred. The concept for the corridor as a whole is shown in Figure 5-12: Lexington Street Corridor Improvements below.

It is important to note that Waltham High School is proposed to be relocated. The high school is currently located on the east side of Lexington Street with access via Jack's Way, which also provides access to the Middle School. The high school will be relocated to the Stigmatine Father & Brothers property, located on the western side of Lexington Street approximately 800 feet south of Jack's Way. While the relocation is not expected to significantly alter the number of trips to and from the high school, the relocation will alter traffic patterns along this stretch of Lexington Street. Specific traffic details relative to the school relocation are unknown at the time of this transportation master plan, however, future development of the property should reference the potential for geometric changes on Lexington Street, such as the preferred Alternative 2.

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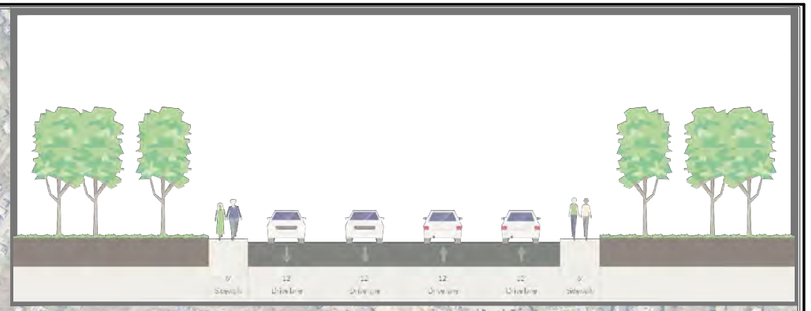
Lexington Street Corridor

Long-Term Improvements



N

Bacon St

Lincoln St

Curve St

Lexington St

Beaver St

Stanley Rd

Ward 2

Eliminate median

Waltham High School

Replace signal

Lexington St

Lake St

Wal-lex Shopping Center

Install curb ramps to meet current standards

Windsor Village

Trapelo Rd

Lexington St

Brookway Rd

Install crosswalks

Propose access management

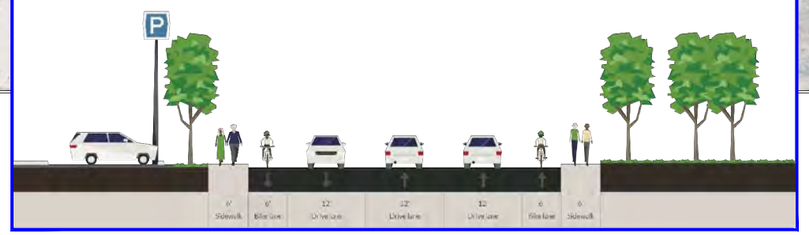
Ward 1

Ward 1

300 0 300 600

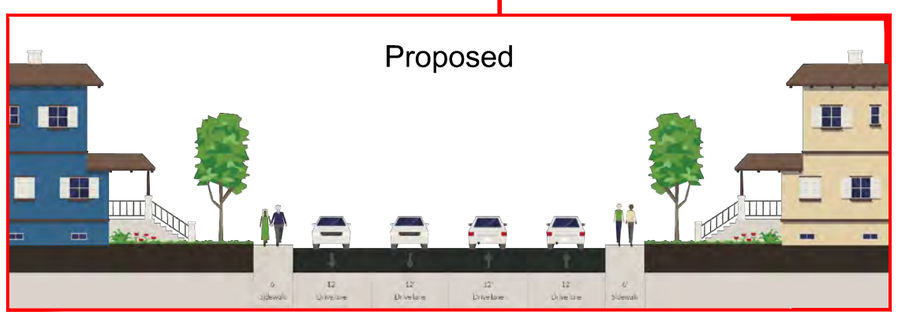
SCALE IN FEET

Proposed



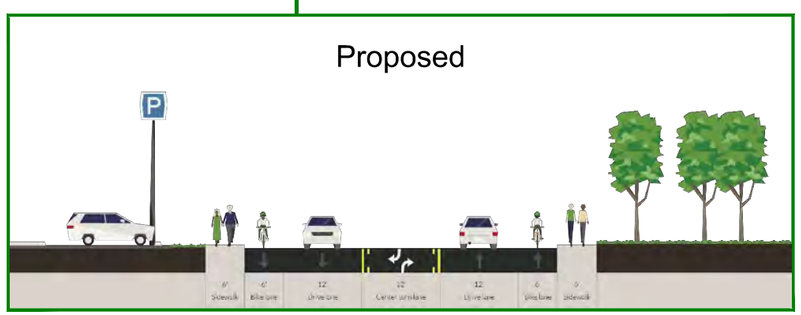
- 2 lanes in both directions
- Sidewalks on both sides of roadway

Proposed



- 1 lane northbound
- 2 lanes southbound
- Bike lanes in both directions
- Sidewalks on both sides of roadway

Proposed



- 2 lanes in both direction
- Two-way left turn lane
- Sidewalks on both sides of roadway

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Figure 5-12
Lexington Street Corridor Improvements
Waltham Transportation Master Plan
Waltham, Massachusetts

Moody Street

The preferred design concept for the Moody Street corridor focuses on pedestrian and parking facilities, as shown in Figure 5-13. The existing cross-section of the roadway will remain with a single lane of travel in each direction, on-street parking and sidewalk on both sides of the road.

To improve pedestrian safety, a series of curb extensions are proposed at the following locations:

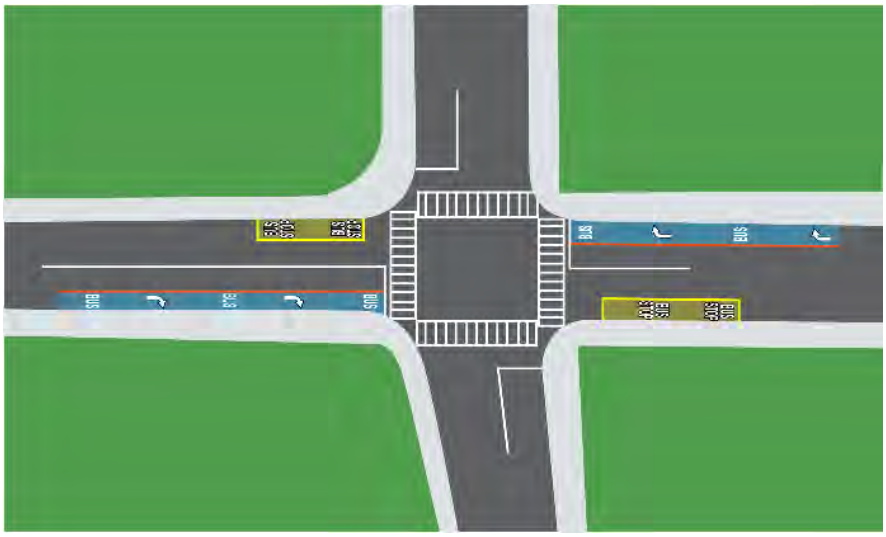
- Maple Street/High Street
- Chestnut Street
- Spruce Street

The Spruce Street crossing is also proposed to have additional treatments to increase visibility such as a Rectangular Rapid Flashing Beacon (RRFB) and inlaid lighting in the crosswalk. The southernmost crosswalk at Chestnut Street is proposed to be removed. Curb ramps throughout the corridor are proposed to be updated to meet current ADA standards.

Optimization of the existing traffic signal at the intersection of Pine Street and Crescent Street with Moody Street is proposed. Bicycles are proposed to be accommodated via an alternate parallel travel route identified as Crescent Street. There are a number of side streets between Crescent Street and Moody Street to connect bicycle traffic to Moody Street attractions.

A parking strategy is proposed to be implemented for the on-street parking on the Moody Street. And consists of metered parking to promote higher turnover for businesses. Additionally, the parking restriction times are proposed to be extended, so the new strategy is in effect during evening hours when several businesses are busiest. This turnover is expected to encourage long-term parking to the nearby surface lots where the parking fee is lessened for a longer stay.

Specific transit improvements are also proposed for the Moody Street corridor. Bus queue jump lanes are proposed in the northbound and southbound direction at the intersection with Pine Street/Crescent Street. Since there is an exclusive right turn lane in both directions and a stop on the far side of the intersection, buses are able to bypass the through queues on Moody Street by traveling through the intersection via the right turn lane.

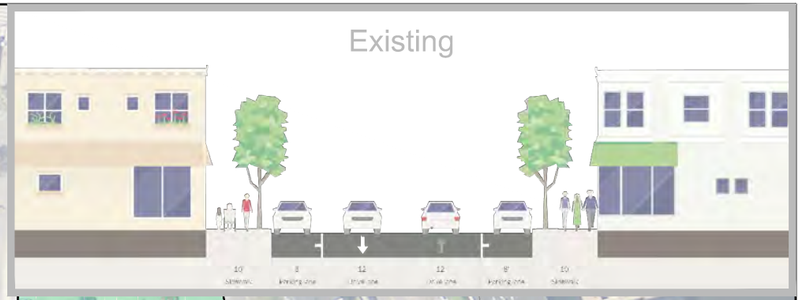


Example of a Bus Queue Jump Lane

Moody Street Corridor
Long-Term Improvements

- Pay $0.25/hour, unlimited parking proposed for off street lots
- Pay $1/hour, 2-4 hour parking proposed for on-street spaces
- Alternate bicycle route identified as Crescent Street to access points on Moody Street
- Replace curb ramps to current standards.

Existing



Ward 8

CHESTNUT STREET LOT (60 SPACES)

CHESTNUT STREET LOT (55 SPACES)

WALNUT STREET LOT (54 SPACES)

SPRUCE STREET LOT (34 SPACES)

CRESCENT STREET LOT 210 SPACES)

Add bike parking to Crescent Street lot

Maple St

Walnut St (One-way →)

Spruce St

Whitney Ave

Crescent St

Optimize traffic signal timings

Begin proposed parking to bridge

Propose bumpouts and in laid lighting in crosswalk

Remove existing crosswalk

Propose bumpouts and in laid lighting in crosswalk

Propose bumpouts and in laid lighting in crosswalk

Moody St

Chestnut St (One-way →)

High St

Cushing St (← One-way)

Change minor approach crosswalk to meet current standards for consistency

Taylor St (One-way →)

Gordon St (← One-way)

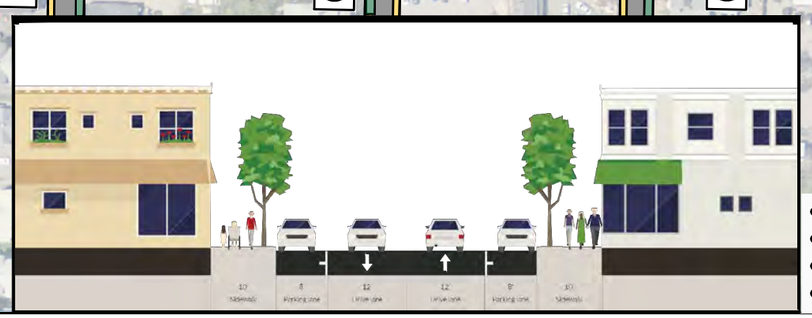
Pine St

Install bus queue jump lane

Ward 9

EMBASSY PARKING FACILITY (264 SPACES))

Legend:
- Handicap Parking
- Sidewalk
- Crosswalk
- Right-of-Way
- Parking



- 1 lane northbound
- 1 lane southbound
- Parking lanes in both directions
- Sidewalks on both sides of roadway

40 0 40 80
SCALE IN FEET

Figure 5-13
Moody Street Corridor Improvements
City of Waltham Transportation Master Plan
Waltham, Massachusetts

Main Street Corridor (Section 1)

Improvements developed for the first section of Main Street between Banks Square and City Hall were responsive to the deficiencies observed and guided by public survey input. Three major themes surfaced: traffic signal timings and coordination, pedestrian connections, and lane usage and balance.

In an effort to improve pedestrian facilities along Main Street, a series of curb extensions are proposed to provide improved pedestrian visibility at crossings and to calm traffic on Main Street. The curb extensions are proposed at the following locations:

- Rich Street (Northern Side only)
- Howard Street
- Spring Street

Restriping of the travel lanes on Main Street is proposed to provide lane usage guidance to drivers. Some of the through lanes on Main Street become turn lanes at the intersections, and motorists traveling in through lanes can become "trapped" in turn lanes, when they did not intend to turn. The trap lanes along the corridor were eliminated and replaced with tapered left turns that require motorists to make a lane change to enter the turn lane. Additionally, the lane width was reduced to a typical 12 foot-wide lane to reduce driver confusion as to the number of lanes and to better identify the expected area of travel.

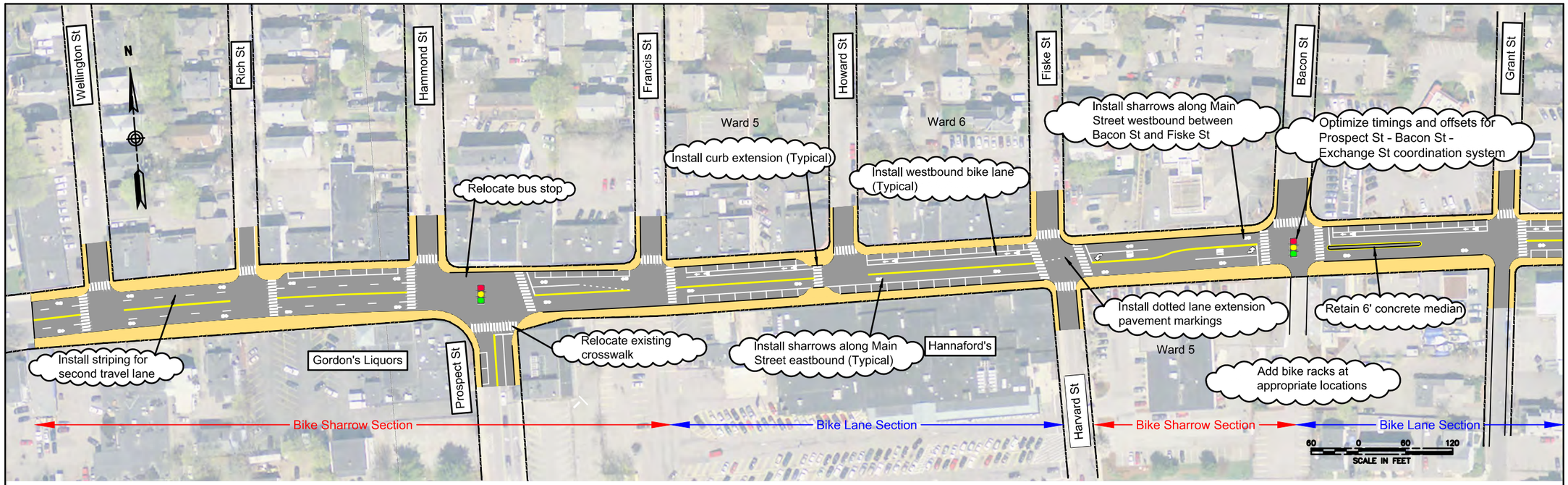
By reducing the width of these travel lanes, additional space can be reallocated to provide bicycle facilities through the corridor. A bicycle lane is proposed on the northern side of Main Street to facilitate westbound bicycle traffic. In locations where the bicycle lane is not feasible and in the eastbound direction, bicycles are accommodated by sharrows. Bike lanes are provided on the following segments in the westbound direction:

- between Fiske Street and Francis Street, and
- halfway between Common Street and Spring Street to Bacon Street

Along the entirety of Main Street, sharrows are proposed to be installed on the eastbound lane.

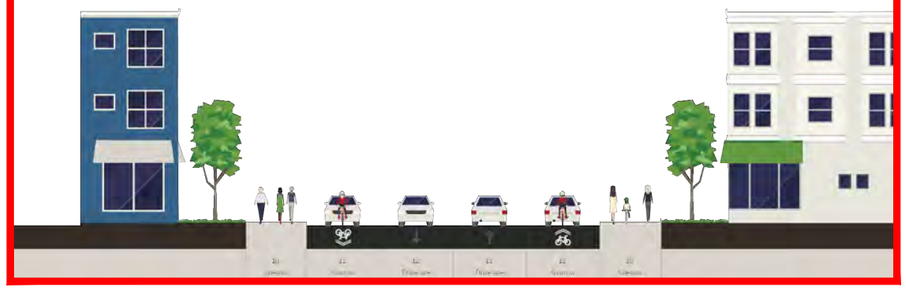
There are currently two traffic signal systems on the Main Street corridor, one including the three traffic signals adjacent to City Hall (Elm Street, Lexington Street, and Moody Street) and the other including the three traffic signals further west on Main Street (Prospect Street, Bacon Street, and Exchange Street. Traffic signal timings improvements are recommended to improve traffic operations and optimize coordination between signals within the corridor.

The Main Street concept is shown in Figure 5-14 and Figure 5-15 below.



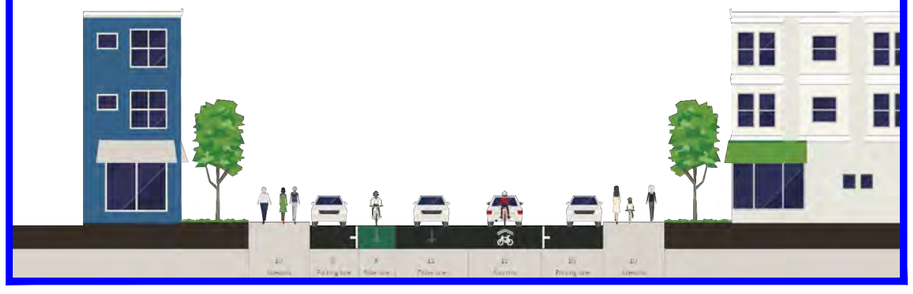
- 2 lanes in both directions
- Sharrows on outside lanes
- Sidewalks on both sides of roadway

Proposed - Bike Sharrow Section



- 1 lane in both directions
- Bike lane in westbound direction
- Sharrows in eastbound direction
- Parallel parking lane in both directions
- Sidewalks on both sides of roadway

Proposed - Bike Lane Section



Legend:
- Sidewalk
- Crosswalk
- Right-of-Way
- Bike Sharrow
- Bike Lane

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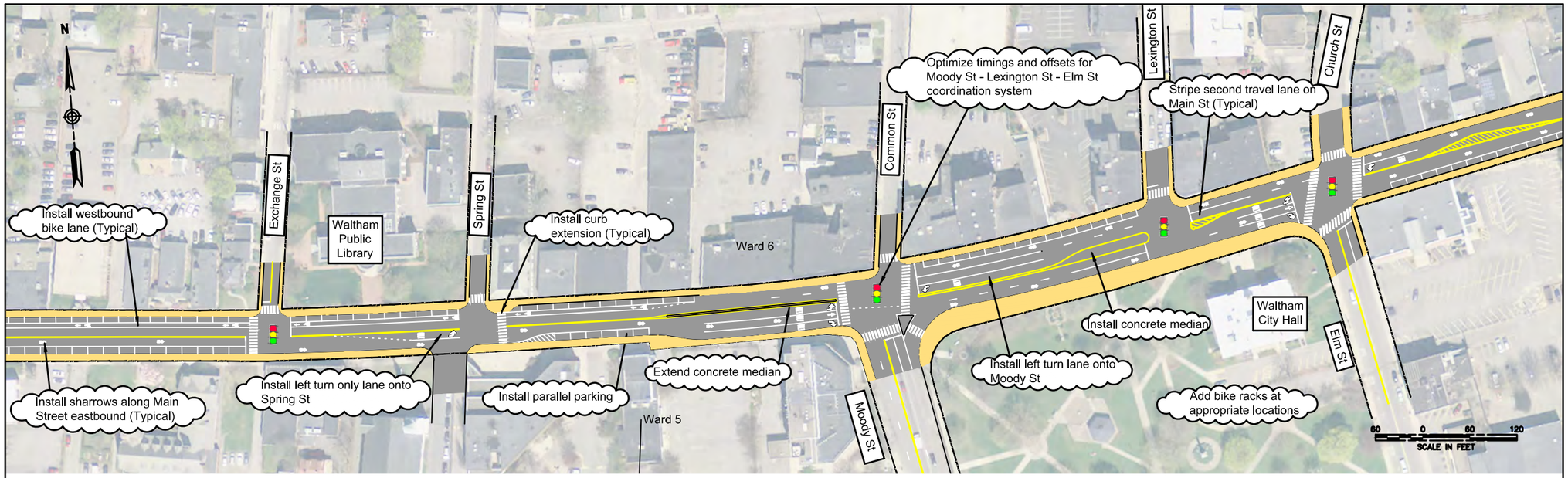
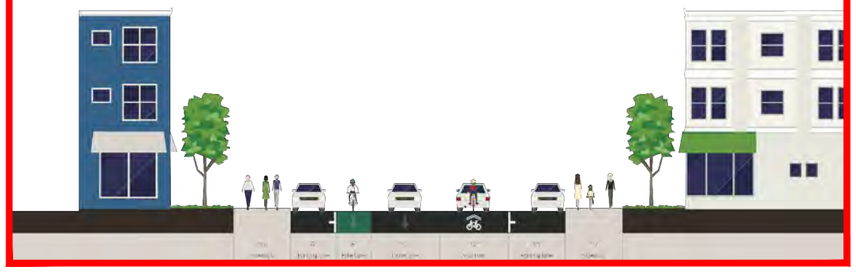
Figure 5-14
Main Street Section 1 Corridor Improvements – Western Segment
Waltham Transportation Master Plan
Waltham, Massachusetts



- 1 lane in both directions
- Bike lane in westbound direction
- Sharrows in eastbound direction
- Parallel parking lane in both directions
- Sidewalks on both sides of roadway

Proposed - Bike Lane Section



Legend:
- Sidewalk
- Crosswalk
- Right-of-Way
- Bike Sharrow
- Bike Lane

Figure 5-15
Main Street Section 1 Corridor Improvements – Eastern Segment
Waltham Transportation Master Plan
Waltham, Massachusetts

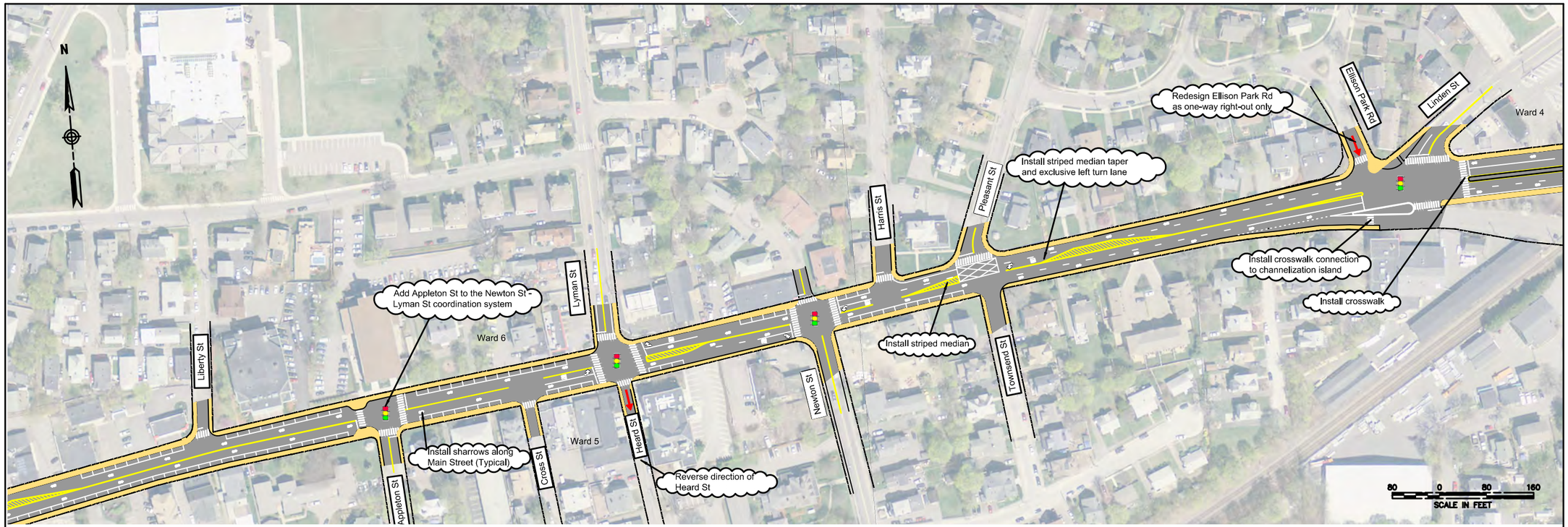
Main Street (Section 2)

The second section of Main Street extends between Elm Street to the west and Linden Street/Ellison Park Road to the east and is in need of similar improvement areas as the first commercial section. This section of Main Street is recommended to provide one marked lane of travel in each direction with additional auxiliary lanes as needed at intersections, as shown in Figure 5-16. Restriping of Main Street is recommended with balanced lanes and eliminated trap lanes.

Currently there is a coordinated traffic signal system including the intersections with Newton Street and Lyman Street/Heard Street. Appleton Street is in the vicinity of this coordinated system and experiences similar traffic patterns. Therefore, the expansion of the coordinated signal system to include Appleton Street is recommended.

Additional specific improvements are proposed for intersections in this corridor including:

- Reversing the one-way direction of travel on Heard Street from northbound travel to southbound is recommended to improve the traffic operations at this signalized intersection with conjunction with improvements to access/egress to the Senior Center.
- Restricting the left turn movement out of Ellison Park Road to reduce the amount of cut-through traffic in the Ellison Park neighborhood is recommended. This improvement would require further coordination with the Ellison Park neighborhood if advanced.
- Crosswalks are proposed on the westbound approach to the Main Street at Linden Street/Ellison Park Road intersection.



- 1 lane in both directions
- Sharrows in both directions
- Parallel parking lane in both directions
- Sidewalks on both sides of roadway

Legend:
- Sidewalk
- Crosswalk
- Right-of-Way
- Bike Sharrow
- Bike Lane

Proposed - Bike Sharrow Section

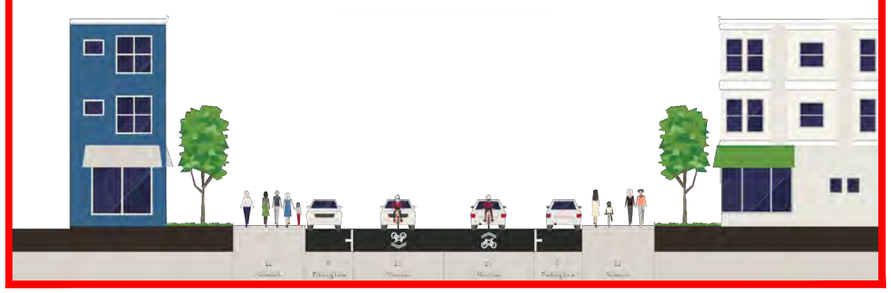


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Figure 5-16
Main Street Section 2 Corridor Improvements
Waltham Transportation Master Plan
Waltham, Massachusetts

Intersection Improvements

Specific improvements for the study area intersections were developed. The improvements for each intersection are broken down into short-term and long-term improvements. The estimated cost and feasibility of the improvements were considered as these concepts were developed, and some alternatives were eliminated from further consideration based upon feasibility, as shown in Table 5-2. Capacity analysis for each intersection is shown in Appendix O.

Table 5-2: Estimated Time Frame and Cost

Time Frame		Costs	
Short-Term	<1 Year	Low	<$10,000
Mid-Term	1-3 Years	Medium	$10,001-$50,000
Long-Term	>3 Years	High	>$50,000

Winter Street at 1st Avenue/2nd Avenue

There were several deficiencies identified through the Winter Street corridor between West Street and 3rd Avenue. The following concepts shown in Table 5-3 were considered to improve the capacity, safety, and efficiency along this corridor.

Table 5-3: Winter Street Corridor Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short-Term	Optimize traffic signal timings	Feasible	Low
Short-Term	Traffic signal coordination along Winter Street - West Street to Totten Pond Road	Feasible	Low
Short-Term	Lane Utilization pavement markings and signage	Feasible	Low
Short-Term	Lane reductions at the intersection with 2nd Avenue to simplify the traffic signal	Feasible	Medium
Long-Term	Develop corridor into a system of traditional intersections	Feasible	High
Long-Term	E-W connection from West St to 2nd Street	Feasible - ROW impacts	High
Long-Term	Half Diamond Interchange on Western side	Not Feasible - Poor Operations and construction concerns	High
Long Term	Double Roundabout at 1st Avenue and 2nd Avenue	Not Feasible - Poor Operations	High

To improve operations and efficiency on the Winter Street corridor, alternatives were considered to eliminate the existing circulator and redevelop the corridor with a traditional system of intersections. Several traffic signal phasing and geometric options were considered to identify an alternative with improved operations.

The Route 128 Business Council has initiated concept designs for Winter Street at 1st Avenue and 2nd Avenue. The Council presented their alternative to the City in a coordination meeting. The alternative, developed by Vanesse Hangen Brustlin, Inc. (VHB), aims to simplify the existing circulator and reduce conflict points to allow for improved circulation and safety. The concept was displayed at the public meeting, along with the preferred alternative developed as part of the Waltham Transportation Master Plan.

The preferred concept developed as part of the Transportation Master Plan for both intersections is shown in Figure 5-17 and reconfigures the intersections of Winter Street at 1st Street and 2nd Street to traditional intersections and Winter Street into a two-way roadway with no median divide. The intersection with 1st Street is proposed to provide full access to the adjacent retail parcel to the north as well as full access and egress to 1st Street. The intersection with 2nd Avenue is proposed to provide a jughandle to accommodate traffic destined to 2nd Avenue and the I-95 southbound on-ramp. The remainder of the intersection is proposed to provide full access. The intersection of Winter Street at 1st Avenue and 2nd Avenue are both expected to operate at acceptable levels of service during both the weekday morning and weekday afternoon peak hour. The intersection with 1st Avenue is expected to operate at LOS D overall during the weekday morning peak hour and LOS A during the weekday afternoon peak hour. The intersection with 2nd Avenue is expected to operate at overall LOS E during the weekday morning and LOS C during the weekday afternoon peak hour.

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Winter Street
at 1st Avenue and 2nd Avenue
Long-Term Improvements

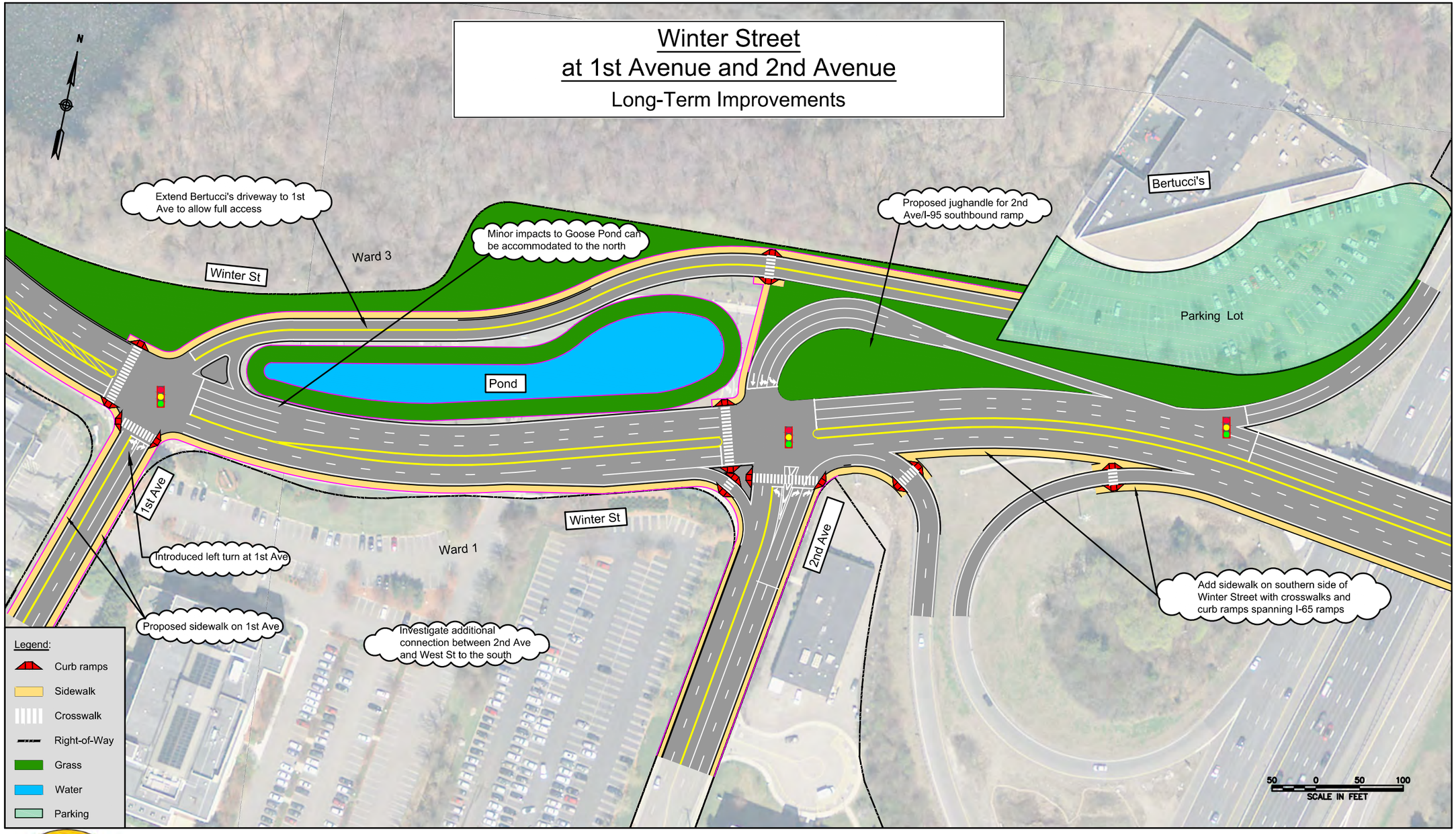

Figure 5-17
Winter Street Long-Term Improvements
City of Waltham Transportation Master Plan
Waltham, Massachusetts

Winter Street at 3rd Avenue/Totten Pond Road/Wyman Street

Several improvements have been identified to mitigate deficiencies at the intersection of Winter Street at 3rd Avenue/Totten Pond Road/Wyman Street, as shown in Table 5-4 below.

Table 5-4: Winter Street at 3rd Avenue/Totten Pond Road Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short-Term	Optimize traffic signal timings	Feasible	Low
Short-Term	Replace exclusive pedestrian phase with lead pedestrian interval phase and concurrent pedestrian phasing	Feasible	Low
Short-Term	Coordination along Winter Street - West to Totten Pond	Feasible	Low
Long-Term	Extend sidewalk along the length of Totten Pond Road to Piety Corner	Feasible	Medium
Long-Term	Restrict southbound u-turn movement and require vehicles to access Winter Street to the east	Feasible	Medium
Long-Term	Investigate I-95 access improvements to reduce traffic volumes utilizing this intersection.	Feasible	High
Long-Term	Roundabout	Not Feasible - Poor Operations	High

The existing intersection is located in an area with a high amount of commercial and retail development. Under future conditions, 3rd Avenue will connect to Main Street from the south and additional retail development is planned for the area. The connections to I-95 through this area should be reviewed to determine if improvements to the I-95 ramps can reduce traffic volumes at this intersection. While the City should be proactive in investigating potential changes in connections to reduce traffic at this intersection, some improvements are likely to be implemented as developer mitigation.

The proposed improvements include traffic signal retiming and phasing improvements, as shown in Figure 5-18. A lead pedestrian interval (LPI) is proposed to provide protected time to pedestrians while maintaining acceptable levels of service for vehicular traffic. With the proposed improvements implemented, the intersection is expected to improve to LOS D and under capacity during the weekday morning peak hour and LOS E during the weekday afternoon peak hour.

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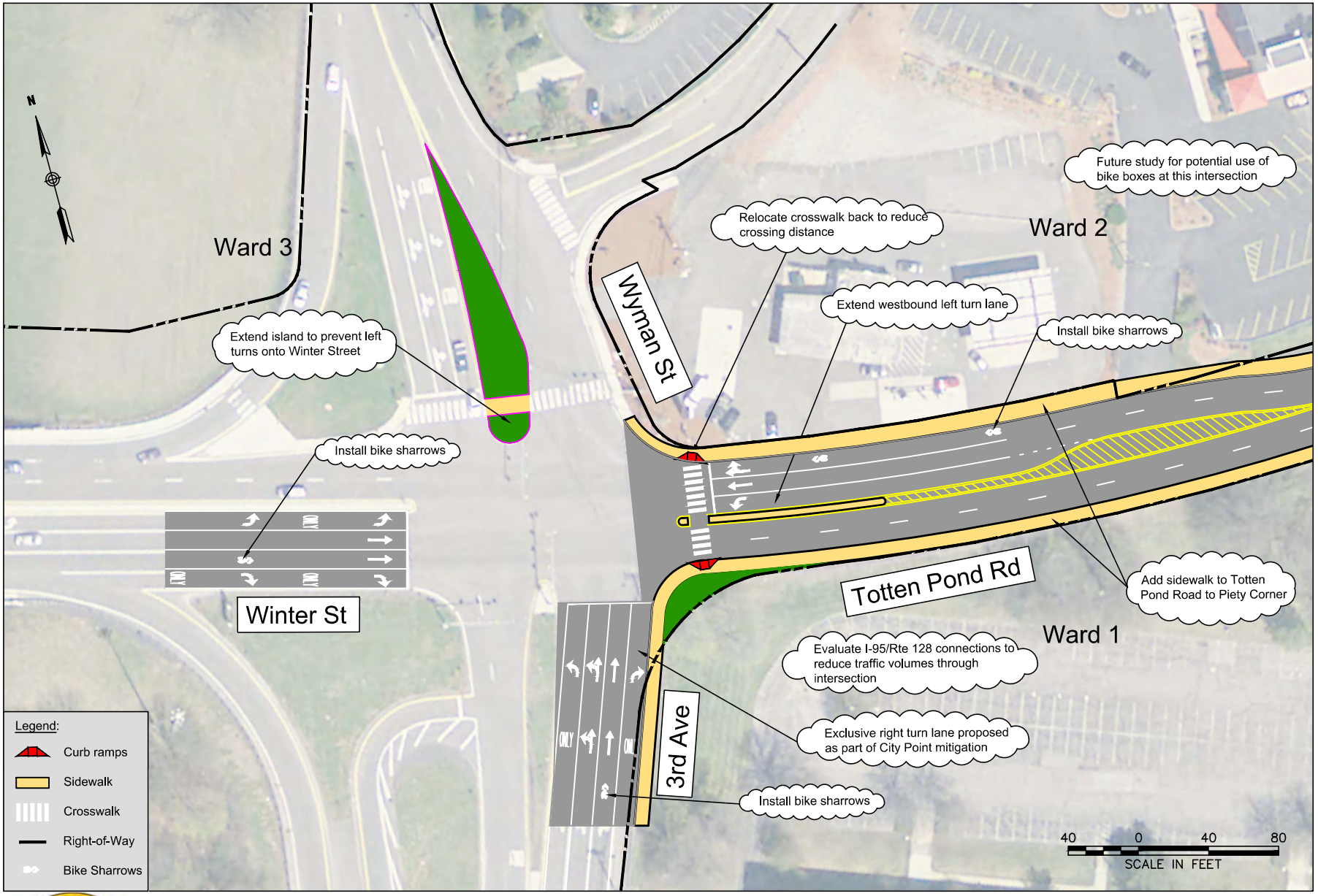

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Figure 5-18
Winter St at 3rd Ave/Totten Pond Rd/Wyman St
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City of Waltham Transportation Master Plan
Waltham, Massachusetts

Lexington Street at Bacon Street/Totten Pond Road (Piety Corner)

Piety Corner suffers in operations due to the high volume of traffic that utilizes the intersection and limitations to traffic phasing due to the wide, offset geometry. Several concepts were reviewed to mitigate the deficiencies identified, as shown in Table 5-5.

Table 5-5: Main Street at Barbara Road/Gore Street/Warren Street Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short-Term	Traffic Signal retiming and optimization	Feasible	Low
Short-Term	Sidewalk and pavement maintenance	Feasible	Medium
Short-Term	Improved Street Lighting	Feasible	Low
Short-Term	Restripe Pavement Markings	Feasible	Low
Short-Term	Lane Assignment signage/pavement markings	Feasible	Low
Mid-Term	Traffic Signal Coordination with Beaver Street/Lexington Street	Feasible	Low
Long-Term	Roundabout	Not Feasible - Poor Operations	High
Long-Term	Adaptive Signal Control	Feasible	High
Long Term	Traditional intersection with Parcel Acquisition	Feasible	High

Intersection operations can be improved by optimizing traffic signal timings and phasing, but without geometric changes to the intersection, there are limited improvements that can be made to address the intersection capacity and safety issues.

There is an opportunity to acquire the parcel in the southwestern quadrant of the roadway to help realign the offset intersection. This would improve safety, allow for additional auxiliary lanes to facilitate traffic, and improve the overall capacity and efficiency at the intersection, as shown in Figure 5-19. With the proposed improvements in place, the intersection is expected to improve to overall LOS E from LOS F during the both the weekday morning and weekday afternoon peak hours.

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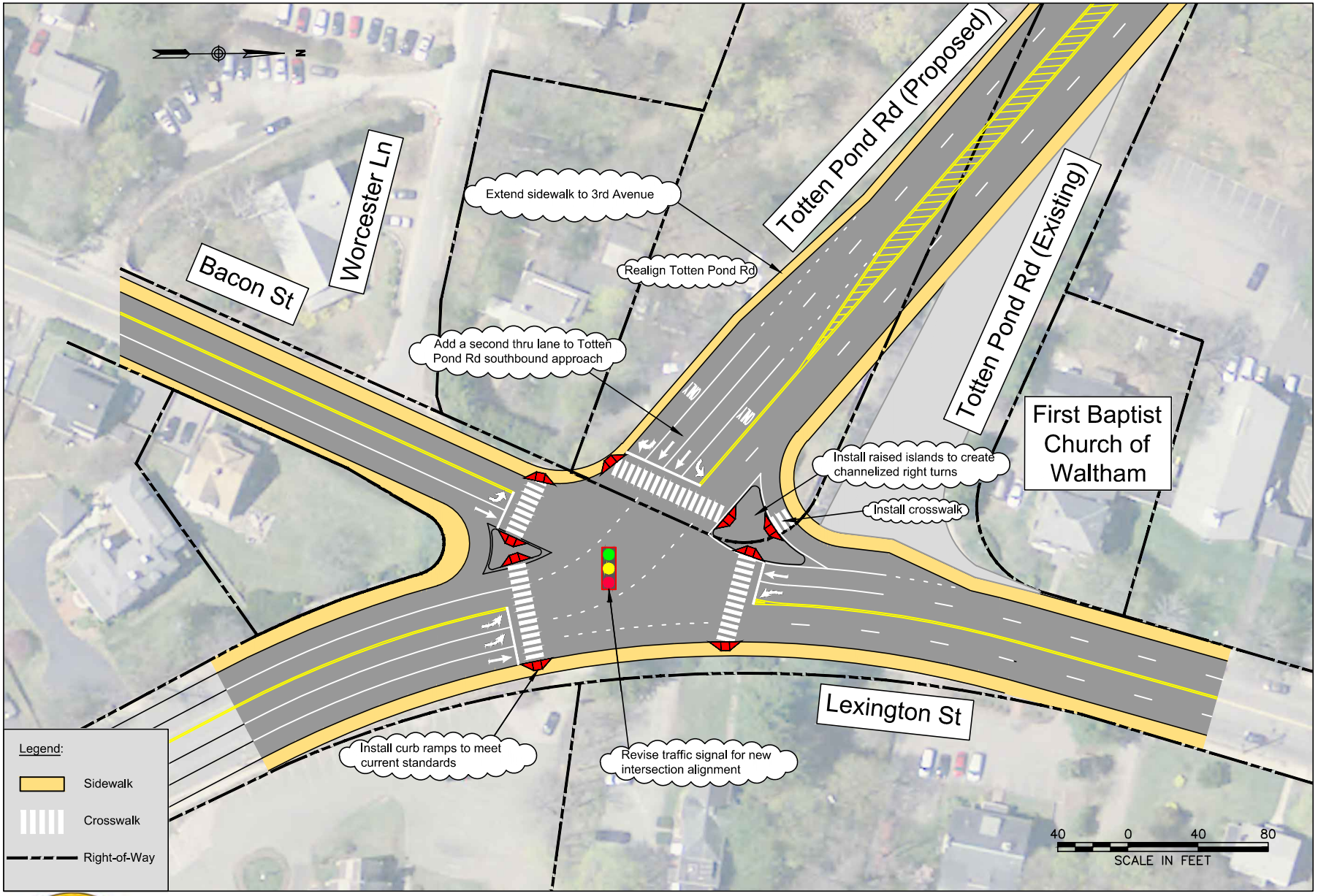

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Figure 5-19
Piety Corner Preferred Concept
City of Waltham Transportation Master Plan
Waltham, Massachusetts

Main Street at Barbara Road/Gore Street/Warren Street

The major issue identified for the intersection of Main Street at Barbara Street/Gore Street/Warren Street is the current offset geometry of the clustered intersections. The desire for vehicles to travel north/south via Gore Street and Warren Street is significant. Currently this movement is accommodated for vehicles in the northbound direction via a channelized right turn from Gore Street. This two stage turn approach to continue north-south travel between Gore Street and Warren Street has an adverse impact on the clustered system of intersections since it adds an additional signal phase. Several alternatives were reviewed to help improve intersection operations, as shown in Table 5-6.

Table 5-6: Main Street at Barbara Road/Gore Street/Warren Street Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short-Term	Remove northbound channelized right turn lane to Warren Street only	Not Feasible - Needs additional improvements	Low
Short-Term	Add signalized pedestrian crossing at Warren Street westbound approach	Feasible	Medium
Short-Term	Add bike lanes on Gore Street	Feasible	Low
Short-Term	Review access management opportunities on Main Street between intersections	Feasible	Low
Long-Term	Remove northbound channelized right turn lane to Warren Street and add a northbound right turn on Gore Street and eastbound left turn on Main Street to Warren Street	Feasible	Medium
Long-Term	Realign Gore Street to connect opposite Warren Street	Not Feasible - Land limited by Gore Place	High
Long-Term	Roundabout	Not Feasible - Land limited by Gore Place	High
Long-Term	Circulator with signalized intersections.	Not Feasible - Poor Operations	High

Ideally, the intersection would operate optimally if the Gore Street and Warren Street approaches were aligned, resulting in a single signalized intersection. The available right-of-way, however, is limited by the historic Gore Place to the south. Since the intersection is restricted by adjacent land uses, other alternatives were considered to reduce the number of conflict points, to make the intersection safer, and to reduce the number of vehicular phases to facilitate traffic through the two clustered intersections.

Short term, simply closing the channelized northbound right turn lane does result in adequate traffic operations. Additional long term improvements such as the addition of a northbound right turn lane on the Gore Street approach and an exclusive left turn lane on Main Street eastbound to Warren Street would be required, as Shown in Figure 5-20. This alternative would simplify the traffic signal phasing and allow for improved operations.

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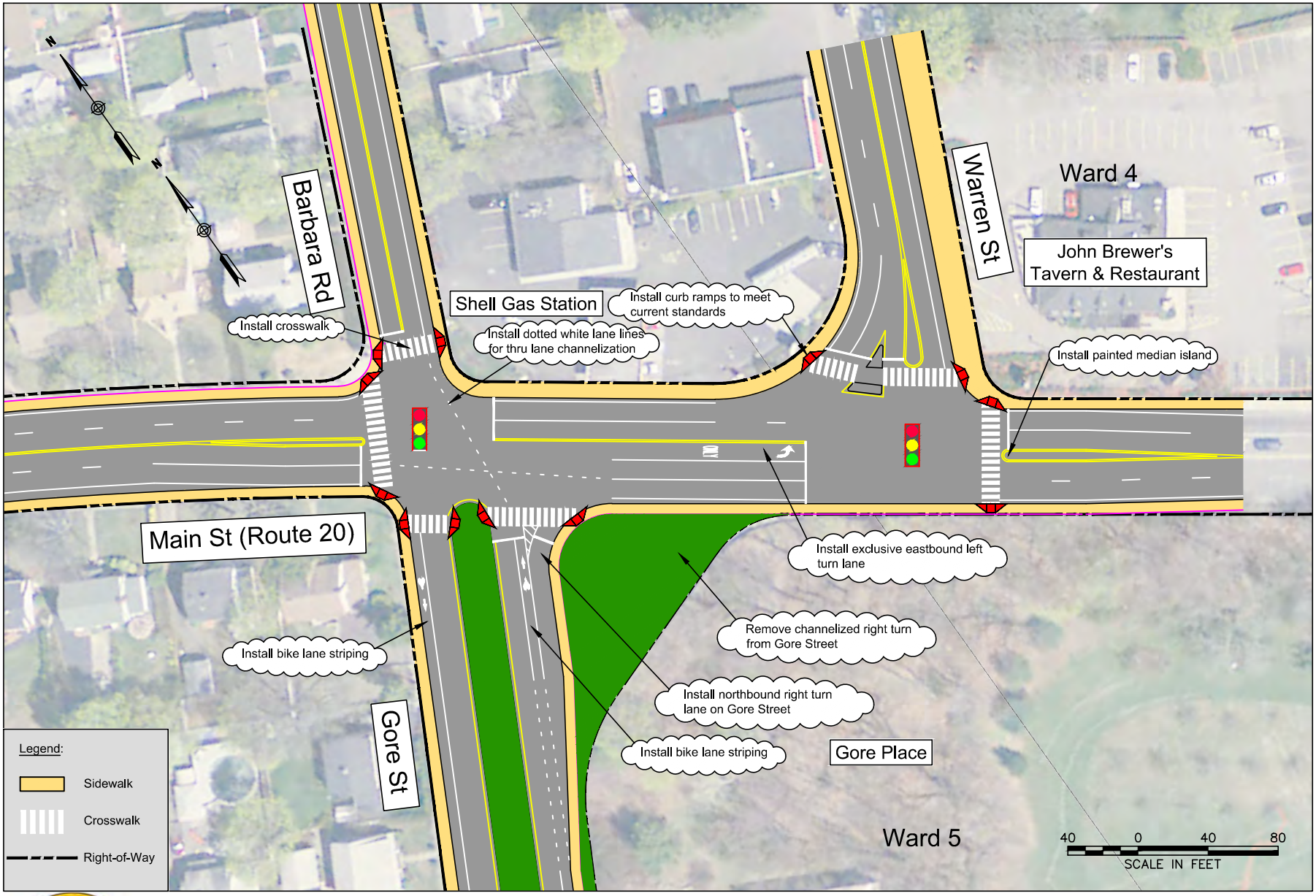

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Figure 5-20
Main Street at Barbara Road/Gore Street/Warren Street
Preferred Concept
City of Waltham Transportation Master Plan
Waltham, Massachusetts

Beaver Street at Warren Street

A series of improvements were considered to mitigate deficiencies at the unsignalized intersection of Beaver Street at Warren Street/Pelham Road, as shown in Table 5-7. As previously noted, the stop-controlled Beaver Street approach operates at LOS F during both the weekday morning and weekday afternoon peak hours.

Table 5-7: Warren Street at Beaver Street/Pelham Street Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short-Term	Relocate eastbound bus stop to far side of proposed crosswalk	Feasible	Low
Short-Term	Relocate westbound bus stop on Beaver Street to nearside of Hollace Street next to wider sidewalk	Feasible	Low
Short-Term	Add crosswalks spanning Beaver Street/Warren Street	Feasible	Low
Short-Term	Add appropriate ramps/signage with crossings	Feasible	Medium
Short-Term	Reduce SBR turn radius with striping (short term) or by moving the curb line (long term)	Feasible	Low
Short-Term	Intersection ahead warning signage (W2-1)	Feasible	Low
Short-Term	All way Stop	Not Feasible - Poor Operations	Low
Long-Term	Reduce southbound right turn radius with curb modifications	Feasible	Medium
Long-Term	4 legged roundabout	Not Feasible - Poor Operations	High
Long-Term	3-legged roundabout removing Pelham Street	Not Feasible - Poor Operations	High
Long-Term	Signalized intersection - Concurrent east-west phase	Feasible	High
Long-Term	Signalized intersection - Split east-west phasing, concurrent pedestrians	Feasible	High
Long-Term	Signalized intersection - Split east/west phasing, exclusive pedestrian phase	Feasible	High
Long-Term	Signalized intersection - Pelham Street one-way	Feasible	High

As shown, the roundabout alternatives experienced poor operations and were eliminated as a potential solution. Several combinations of signal phasing alternatives were reviewed for this location to provide improve safety and efficiency. As shown in Figure 5-21, signalization is recommended at the intersection of Warren Street at Beaver Street/Pelham Road and includes a lead phase for northbound left turns from Warren Street, a phase for northbound and southbound traffic on Warren Street, a Phase for eastbound traffic on Beaver Street, and a Phase for westbound traffic from Pelham Road. The traffic signal phasing would also provide an exclusive pedestrian phase. Improvements are also proposed for the southbound and eastbound right turns to reduce the turning radius to encourage slower speeds in the residential area. With the inclusion of a traffic signal, the intersection would be greatly improved overall and expected to operate at LOS C during the weekday morning peak hour and LOS B during the weekday afternoon peak hour.

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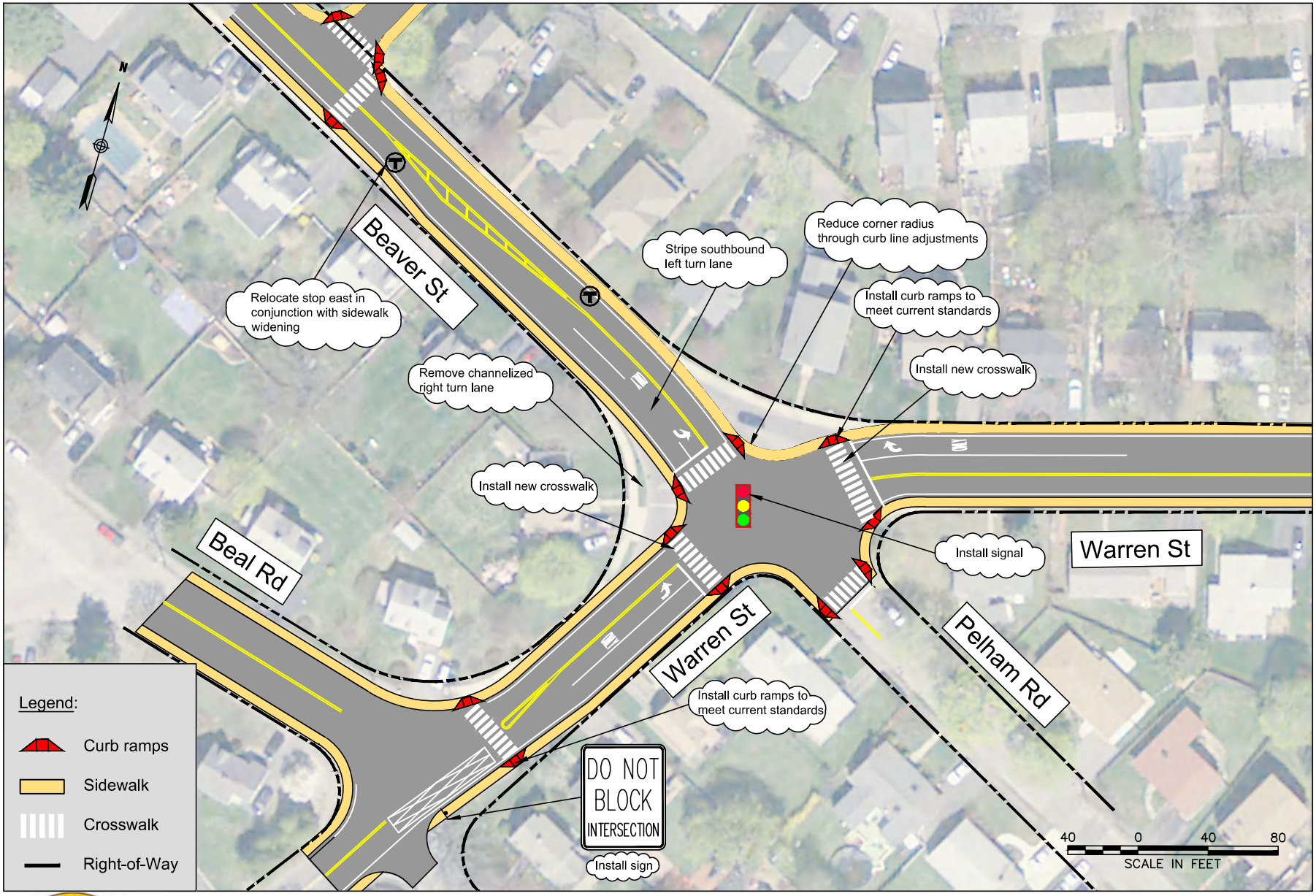

Figure 5-21
Warren Street at Beaver Street/Pelham Street
Preferred Concept
City of Waltham Transportation Master Plan
Waltham, Massachusetts

Main Street at Weston Street/South Street (Banks Square)

To mitigate several deficiencies at the intersection of Main Street at Weston Street/South Street, a series of improvements were considered as summarized in Table 5-8.

Table 5-8: Banks Square Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short-Term	Relocate inbound bus stop on Main St to nearside Palmer Street to enable both doors to open to a level sidewalk, and place the stop closer to a signalized crossing	Feasible	Low
Short-Term	Relocate outbound bus stop on Main Street to nearside of driveway	Feasible	Low
Short-Term	Restripe lanes to allow two through lanes from Main Street to Weston Street	Feasible - Impacts to South Street	Low
Short-Term	Add lane utilization signage and pavement markings on Main Street to Weston Street/South Street	Feasible	Low
Short-Term	Investigate access management opportunities	Feasible	Low
Long-Term	Realign Weston Street and South Street	Feasible	High
Long-Term	Realign Main Street approaches	Feasible	High

The intersection of Main Street at Weston Street/South Street is expected to experience a change in traffic patterns that presents an opportunity to realign the intersection to a more traditional three legged intersection. With expected improvements to the west on Main Street which are proposed under Phase 2 of the Polaroid project and include a new ramp to I-95/Route 128 from Main Street, traffic patterns are anticipated to change allowing Main Street to be the dominant “major” roadway at the Banks Square intersection rather than the current situation in which the dominant flow is from Weston Street to Main Street to the east.

The change in traffic patterns allows for the intersection of Main Street and Weston Street to be realigned to a three legged intersection with Main Street as the major approach and Weston Street as the minor approach, as shown in Figure 5-22. Additionally, South Street can be realigned to connect to Weston Street at an unsignalized three legged intersection to the south of Main Street. The improvements would result in improved levels-of-service from LOS F during the weekday afternoon peak hour to LOS B overall at the signalized intersection of Main Street and Weston Street. The unsignalized intersection of South Street at Weston Street is expected to operate at LOS F, but under capacity for the stop controlled left turn lane.

It is important to note that this improvement could only be implemented in conjunction with the Route 117 interchange improvements. Current traffic patterns would not support the improved geometry concept, but the expected changes in traffic patterns as a result of the Route 117 interchange improvements would make this concept possible.

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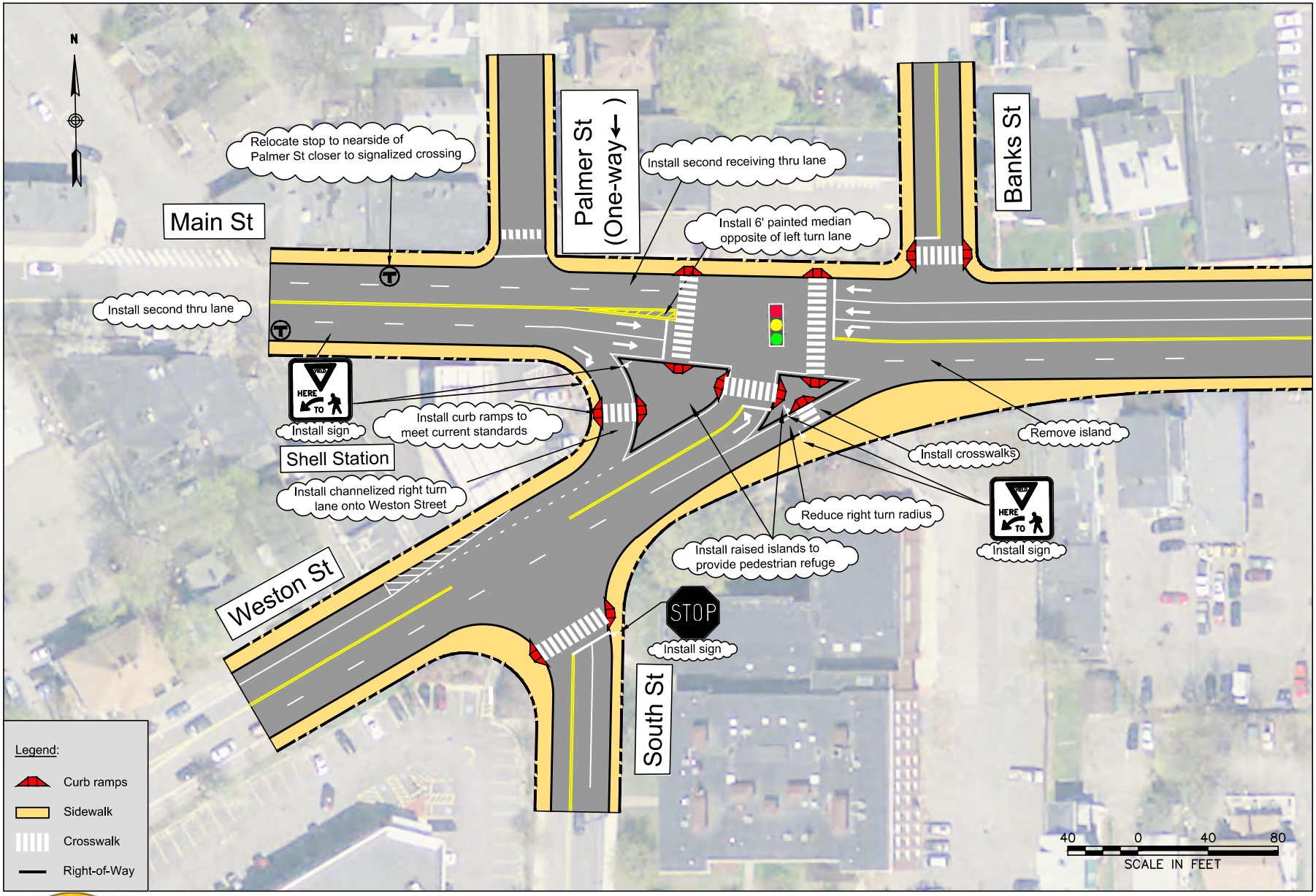

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Figure 5-22
Banks Square Preferred Concept
City of Waltham Transportation Master Plan
Waltham, Massachusetts

South Street at Bedford Street

A focus was placed on improving safety and efficiency at the intersection of South Street at Bedford Street. Several concepts were reviewed to mitigate the deficiencies identified, and the concepts are summarized in Table 5-9.

Table 5-9: South Street at Bedford Street Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short Term	Restripe crosswalks to meet City standards	Feasible	Low
Short Term	Add ADA compliant curb ramps, tactile pads, and pedestrian signal equipment	Feasible	Medium
Short Term	Optimize traffic signal timings with updated clearance intervals for vehicles and pedestrians	Feasible	Low
Short Term	Add northbound left turn phase with no lane improvements	Feasible	Low
Short Term	Incorporate split phasing between the eastbound and westbound approaches	Not Feasible - Poor Operations	Low
Short Term	Incorporate westbound left turn phase	Not Feasible - Poor Operations	Low
Long-Term	Coordinate in a system with Vernon Street and Highland Street	Feasible	Low
Long-Term	Stripe South Street corridor to have four foot-wide shoulders and 11 foot-wide lanes	Feasible	Medium
Long-Term	Replace traffic signal equipment and upgrade to current standards	Feasible	High
Long Term	Add a northbound left turn lane and phase	Not Feasible - Insufficient ROW	High

Several improvements to the existing traffic signal were considered to improve safety. To mitigate angle collisions, incorporating split phasing between eastbound and westbound traffic was reviewed, but determined to have an adverse impact on operations.

Improvements to timings and the addition of a northbound left turn phase is expected to help improve safety and was identified as a preferred alternative in conjunction with several short term improvements such as restriping South Street to allow for a marked shoulder for bicycle refuge and pedestrian improvements at the traffic signal as shown in Figure 5-23.

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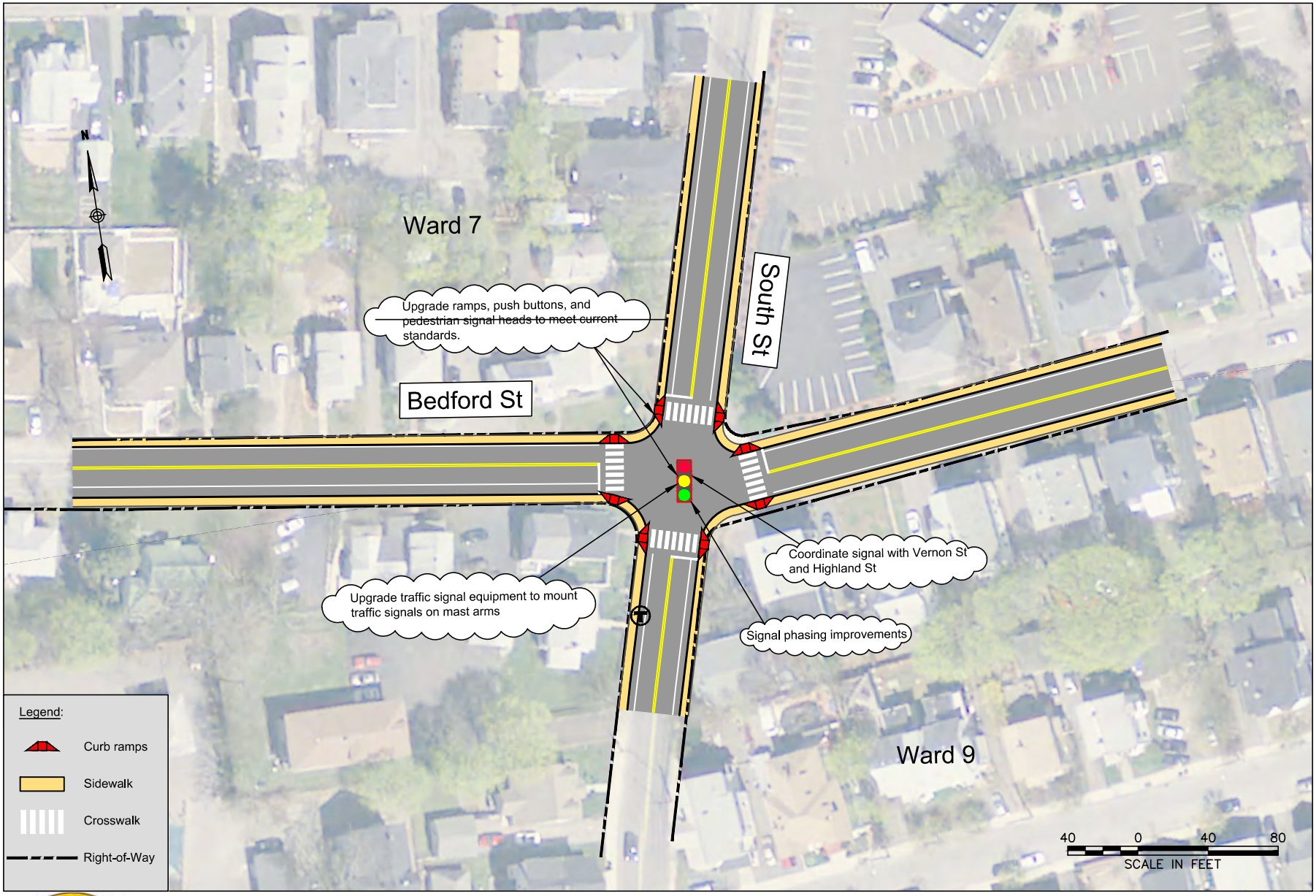

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Figure 5-23
South Street at Bedford Street Preferred Concept
City of Waltham Transportation Master Plan
Waltham, Massachusetts

South Street at Vernon Street

The intersection of South Street at Vernon Street operates well in terms of operations. The major focus at this location is safety. Several concepts were reviewed and are shown in Table 5-10.

Table 5-10: South Street at Vernon Street Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short-Term	Formalize parking on Vernon Street to restrict vehicles from parking at stop lines	Feasible	Low
Short-Term	Optimize traffic signal timings and update clearances	Feasible	Low
Short-Term	Add backplates to EB/WB facing signals to mitigate solar glare	Feasible	Low
Mid-Term	Add curb extensions at crosswalks on Vernon Street	Feasible	Medium
Mid-Term	Add an exclusive eastbound right turn lane	Feasible	Medium
Mid-Term	Upgrade push buttons, ramps, pedestrian signal heads to current ADA standards	Feasible	Medium
Long-Term	Coordinate traffic signal system with Bedford and Highland	Feasible	Low
Long-Term	Stripe South Street corridor to have four foot-wide shoulders and 11 foot-wide lanes	Feasible	Medium
Long-Term	Replace traffic signal equipment and upgrade to current standards	Feasible	High

The majority of the improvements aim at increasing the visibility of modes utilizing the intersection. Bike lanes are proposed on Vernon Street in the eastbound direction to provide a designed area for cyclists and an alternate eastern route through the City. Improvements to traffic signal equipment and pedestrian infrastructure are proposed, including a curb extension on Vernon Street to provide a pedestrian connection with improved visibility, as shown in Figure 5-24.

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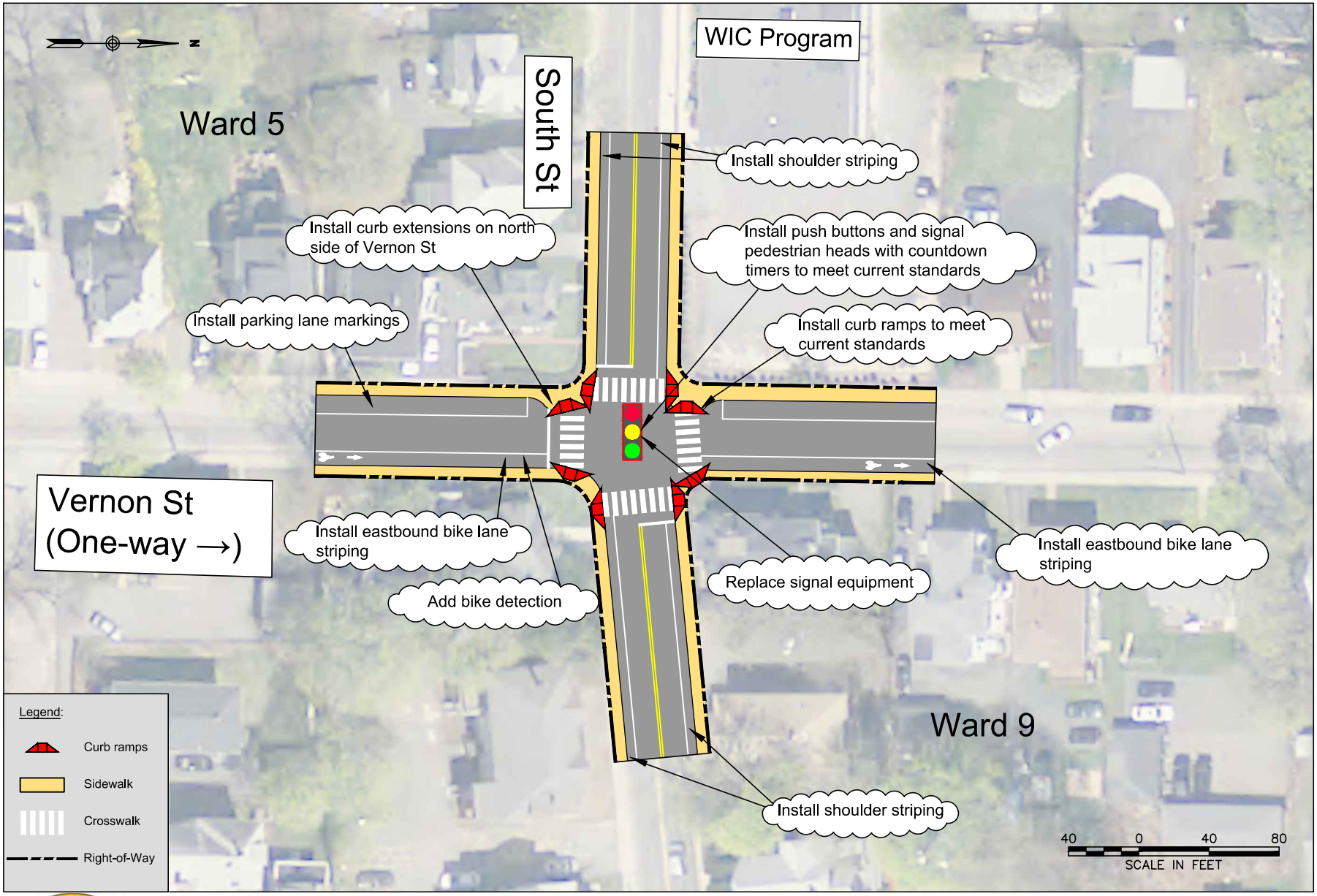

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Figure 5-24
South Street at Vernon Street Preferred Concept
City of Waltham Transportation Master Plan
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Prospect Street at Highland Street/Felton Street

A range of improvements were evaluated to address the deficiencies at the intersection of Prospect Street at Highland Street/Felton Street. As previously noted, the intersection is expected to operate at LOS F during 2025 No Build conditions during the weekday afternoon peak hour. The alternatives considered were aimed at improving intersection operations, and are shown in Table 5-11.

Table 5-11: Prospect Street at Highland Street/Felton Street Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short-Term	Optimize traffic signal timings and update clearances	Feasible	Low
Short-Term	Add a northbound left turn phase with no lane improvements	Feasible	Low
Short Term	Restrict northbound left turn movement	Feasible	Low
Long-Term	Add a northbound left turn lane and phase	Feasible	Medium
Long-Term	Upgrade push buttons, ramps, pedestrian signal heads to current ADA standards	Feasible	Medium

The northbound approach has one lane and permissive phasing for the northbound left turn and operates at LOS F during the weekday afternoon peak hour. Improvements were considered to improve this deficiency including restriping the northbound approach to include an exclusive left turn lane and through lane. However, the improvement necessitates the elimination of parking in front of local businesses and was determined to be an undesirable improvement for this reason. Adding a left turn phase with the current multi-use lane improves the intersection, but overall the intersection is still expected to operate over capacity.

Restricting the northbound left turn movement at the intersection is the preferred alternative, as shown in Figure 5-25. There is a low volume of northbound left turns that can be accommodated in adjacent intersections to access Highland Street. The restriction improves the intersection to an overall LOS D and under capacity during the weekday afternoon peak hour.

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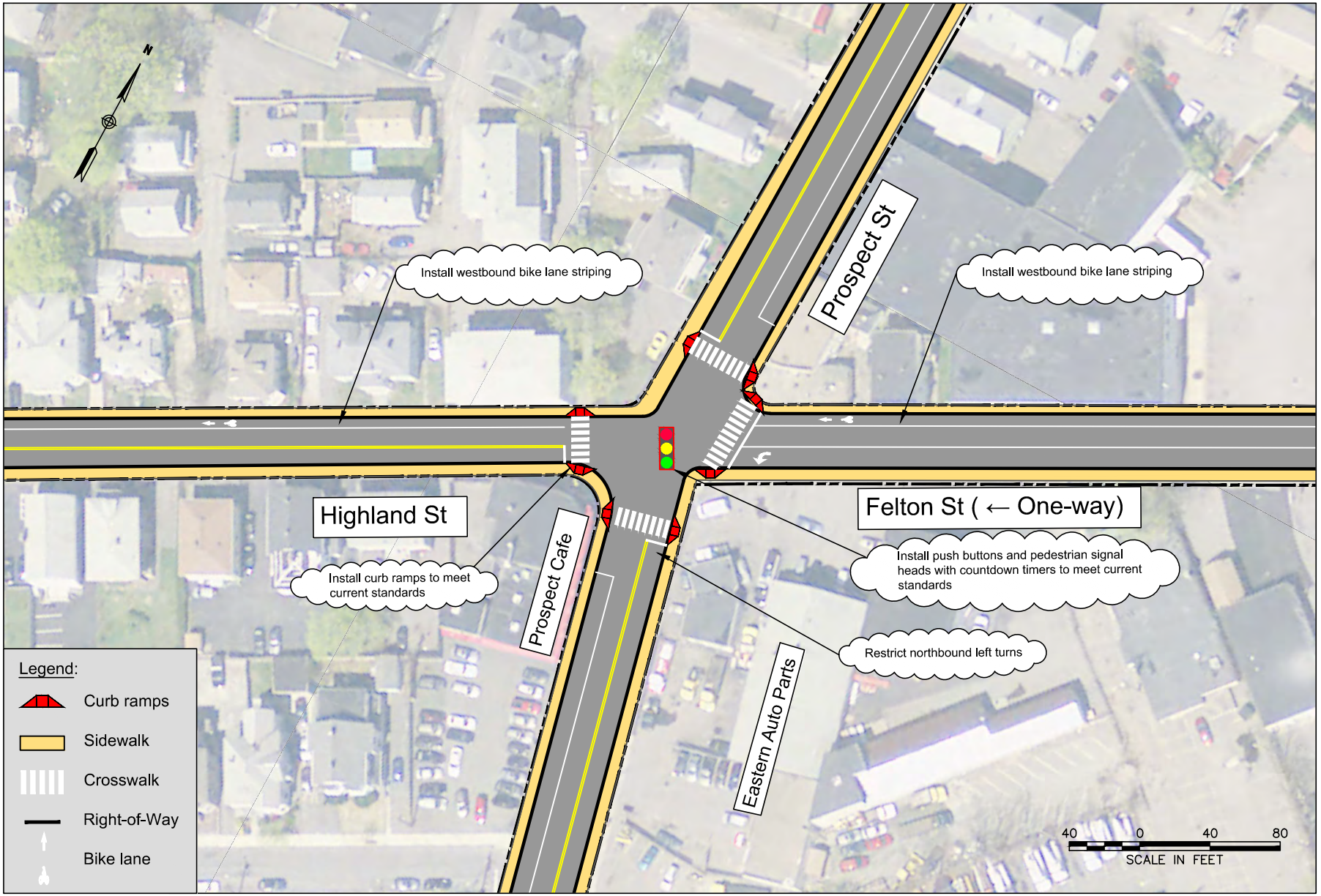

Figure 5–25
Prospect Street at Highland Street/Felton Street
Preferred Concept
City of Waltham Transportation Master Plan
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Prospect Street at Charles Street

Improvements at the intersection of Prospect Street and Charles Street focused on improving the traffic operations, as the intersection is projected to operate at LOS F during 2025 No Build conditions during the weekday afternoon peak hour. A summary of the alternatives considered is presented in Table 5-12.

Table 5-12: Prospect Street at Charles Street Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short-Term	Optimize traffic signal timings and update clearances	Feasible	Low
Short-Term	Remove emergency phone in southeast corner to provide clear walking path	Feasible	Low
Short-Term	Replace southbound left turn with flashing yellow arrow	Feasible	Low
Short-Term	Add a northbound left turn phase with current lane arrangement	Feasible	Low
Long-Term	Upgrade push buttons, ramps, pedestrian signal heads to current ADA standards	Feasible	Medium
Long-Term	Add a northbound left turn lane and phase	Feasible	Medium
Long-Term	Replace northbound mast arm to add signal head for northbound left turn	Feasible	High

The northbound approach operates at LOS F during the weekday afternoon peak hour making the focus of the improvements directed on this approach. There is sufficient width to strip an exclusive left turn lane. However, this would require the elimination of on-street parking adjacent to local businesses, and therefore was not advanced. Short-term changes to traffic signal timings and phasing improve the intersection to an overall LOS E from LOS F. See Figure 5-26 below.

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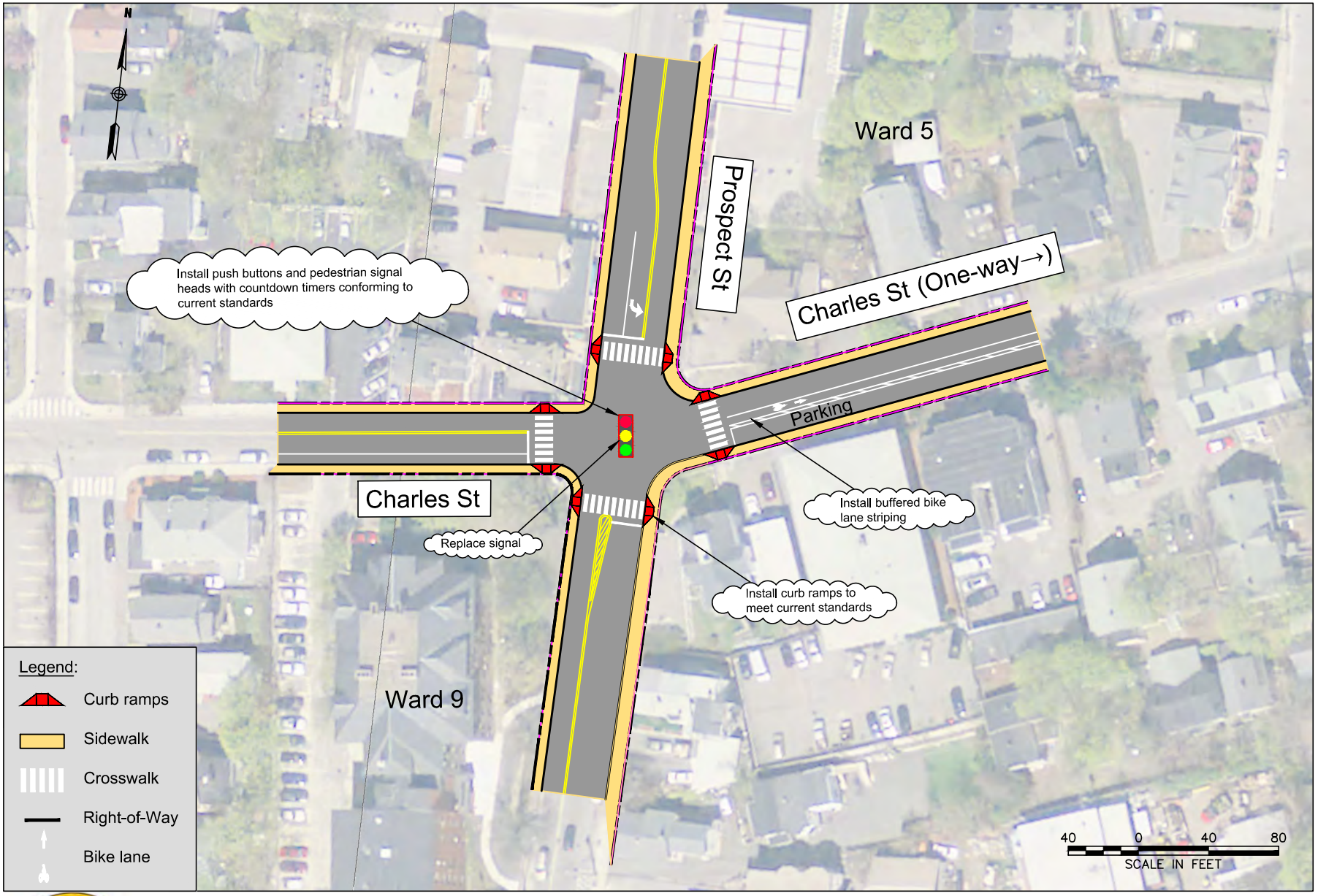

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Figure 5-26
Prospect Street at Charles Street Preferred Concept
City of Waltham Transportation Master Plan
Waltham, Massachusetts

Felton Street at Moody Street/Carter Street

The focus for the intersection of Felton Street at Moody Street/Carter Street was to improve the safety of the intersection for all modes of transportation as well as to provide improved connections to the commuter rail station. Several alternatives were reviewed to improve intersection operations, as shown in Table 5-13.

Table 5-13: Felton Street at Moody Street/Carter Street Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short-Term	Add high visibility crossing treatments at crosswalks	Feasible	Low
Short-Term	Add retro-reflective backplates to traffic signal heads	Feasible	Low
Short-Term	Flashing yellow arrow for southbound left turn	Feasible	Low
Short-Term	Optimize traffic signal timings and update clearances	Feasible	Low
Short-Term	Add audible pedestrian crossing treatment	Feasible	Low
Short-Term	Change concurrent pedestrian phasing to a lead pedestrian interval or exclusive pedestrian phasing	Feasible	Low
Short-Term	Add “Signal Ahead” warning signage	Feasible	Low
Short-Term	Add additional traffic signal heads post mounted closer to the southbound stop sign to improve visibility	Feasible	Low
Long-Term	Investigate property acquisition to realign intersection	Feasible	High
Long-Term	Replace traffic signal equipment and upgrade to current standards	Feasible	High
Long-Term	Redevelop Carter Street to make a transit hub adjacent to the commuter rail station	Feasible	High

As shown, the majority of the improvements listed aim to improve visibility at the intersection and provide additional measures to improve pedestrian safety, as shown in Figure 5-27.

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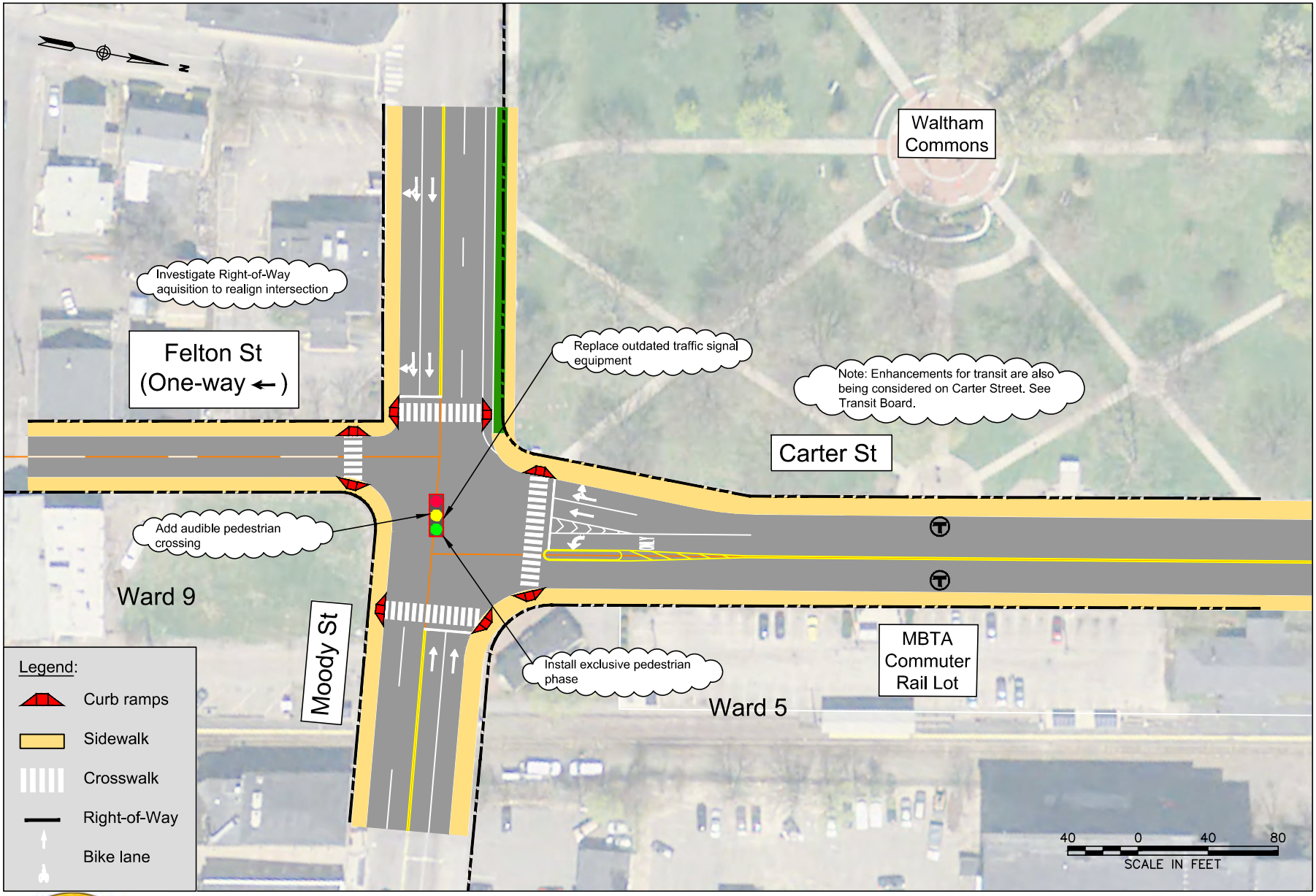

Figure 5-27
Felton Street at Moody Street/Carter Street
Preferred Concept
City of Waltham Transportation Master Plan
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Elm Street at River Street

As previously noted, the stop-controlled northbound Elm Street approach operates at LOS F during the weekday afternoon peak hour. Several alternatives were reviewed to help improve intersection operations and other deficiencies previously noted, as shown in Table 5-14.

Table 5-14: Elm Street at River Street Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short-Term	Remove channelization of the eastbound right turn and convert to a traditional right turn lane	Feasible	Low
Short-Term	Add bike lanes on Elm Street to the Charles River Greenway	Not Feasible - Insufficient bridge width	Low
Short-Term	Add an all way stop condition to the intersection to alleviate Elm Street delays	Feasible	Low
Long-Term	Add a traffic signal at the intersection to alleviate Elm Street delays	Feasible	High

As shown, there are two major improvement concepts to mitigate the high delays experienced at the stop controlled northbound Elm Street approach: an all-way stop and a traffic signal.

The all-way stop concept can be implemented in the short-term for low cost and improves the northbound movement from LOS F to LOS C, but also adds delay to the eastbound and westbound approaches. During the weekday afternoon peak hour, the westbound approach is decreased to LOS E.

The preferred alternative is a traffic signal, as shown in Figure 5-28, and is a long-term high cost improvement. The alternative improves the intersection to overall LOS B during the weekday afternoon peak hour with all movements operating at LOS B or better. The signal also can be coordinated with the adjacent traffic signal the intersection of Carter Street and Elm Street.

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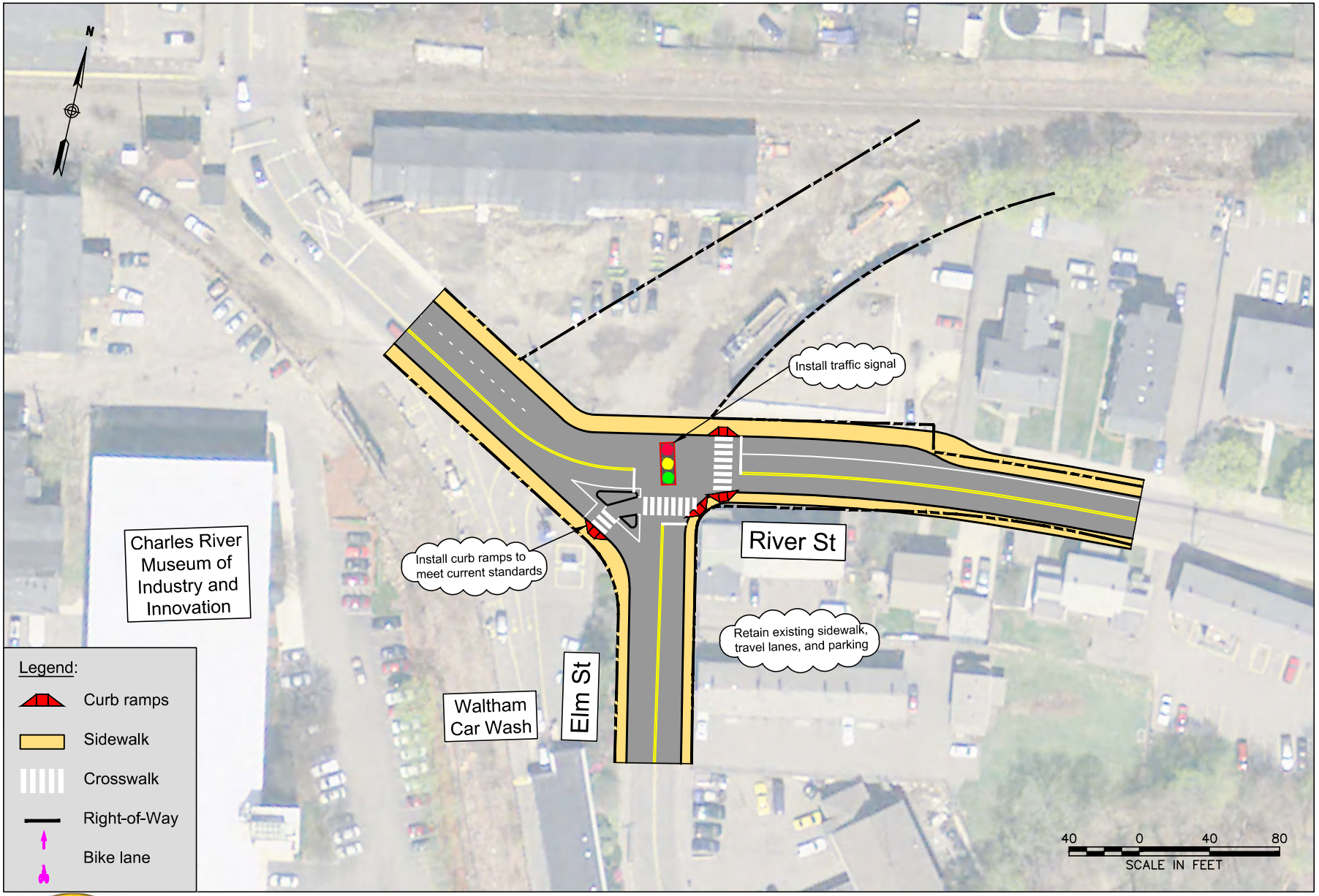

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Figure 5-28
Elm Street at River Street Preferred Concept
City of Waltham Transportation Master Plan
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Newton Street at River Street/Grove Street

Several alternatives were reviewed to improve traffic operation and efficiency at the intersections of Newton Street at River Street and Newton Street at Grove Street, as shown in Table 5-15 and Table 5-16.

Table 5-15: Newton Street at River Street Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short-Term	Relocate eastbound bus stop on River Street to far side of crosswalk to allow both bus doors to open to the curb	Feasible	Low
Short-Term	Relocate westbound stop on River Street to rear side of driveway, to avoid blockage of through and right traffic at the intersection.	Feasible	Low
Short-Term	Move sign closer to intersection so both bus doors open to the curb at River Street WB stop.	Feasible	Low
Short-Term	Add a 4-section signal head for the westbound left turn	Feasible	Low
Short-Term	Replace all curb ramps to be ADA compliant	Feasible	Low
Short-Term	Add pedestrian countdown timers	Feasible	Low
Short-Term	Optimize traffic signal timings and update clearances	Feasible - Preferred	Low
Long-Term	Update traffic signal equipment for overhead mounted signal heads	Feasible	High
Long-Term	Make northbound approach two multi use lanes	Feasible	High
Long-Term	Add additional southbound lane to provide an exclusive right turn lane	Feasible	High

Table 5-16: Newton Street at Grove Street Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short-Term	Provide a crosswalk across Grove Street	Feasible	Low
Short-Term	Provide a bump out on Newton Street northbound	Feasible	Low
Long-Term	Eliminate or reduce height of stone wall in the northwest corner of the intersection to improve sight lines	Feasible	High
Long-Term	Provide a northbound right turn lane	Feasible	High
Long-Term	Add a traffic signal to be coordinated with River Street	Feasible	High

With some minor land acquisition to the east of Newton Street, the southbound approach to the intersection of River Street and Newton Street can be expanded to allow an additional exclusive right turn lane. This improvement with traffic signal optimization would improve the traffic operations to overall LOS C during the week day morning peak hour and LOS D during the weekday afternoon peak hour.

The unsignalized intersection of Newton Street at Grove Street operates at LOS F for the stop controlled westbound approach and sight distance is obstructed to the right from the adjacent stone wall. The preferred concept to mitigate both of these conditions is to signalize the intersection and coordinate the signal with the signal at the intersection of Newton Street and Grove Street or operate both intersections on a single controller. The preferred concept for both intersections is shown in Figure 5-29.

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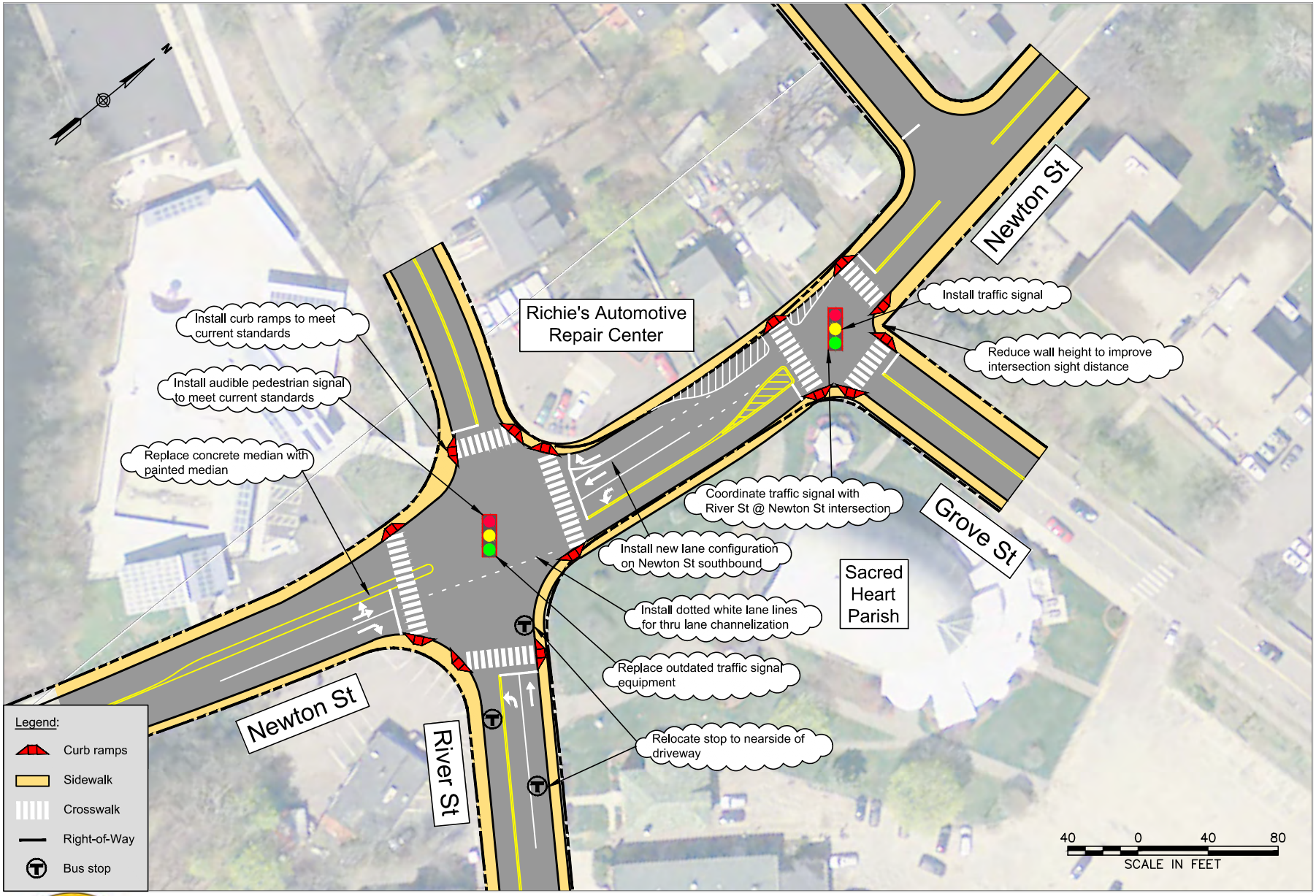

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Figure 5-29
Newton Street at River Street/Grove Street
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Waltham, Massachusetts

Grove Street at Gore Street/Seyon Street

The all-way stop condition at the intersection of Grove Street at Gore Street/Seyon Street results in poor operations for all approaches during both the weekday morning and weekday afternoon peak hours. Several alternatives have been considered to improve the traffic operations and to mitigate identified deficiencies, as shown in Table 5-17.

Table 5-17: Grove Street at Gore Street/Seyon Street Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short-Term	Two-Way stop controlled with Gore-Seyon as the major approach	Not Feasible - Poor Operations	Low
Short-Term	Stripe 6' Bike lanes on Gore/Seyon as a bike route connecting to the Charles River Greenway	Feasible	Low
Short-Term	Upgrade all curb ramps to ADA compliant ramps	Feasible	Medium
Short-Term	Include All-Way stop plaques under stop signs	Feasible	Low
Short-Term	Add stop sign warning signage in advance of the intersection	Feasible	Low
Short-Term	Add sharrows on both roadways	Feasible	Low
Short-Term	Add an exclusive right turn lane on northbound Seyon Street to Grove Street	Feasible	Low
Long-Term	Add a traffic signal with concurrent pedestrian signal phasing	Feasible	High
Long-Term	Add a traffic signal with exclusive pedestrian signal phasing	Feasible	High
Long-Term	Add a traffic signal with exclusive pedestrian signal phasing and exclusive northbound and southbound left turn lanes and phases	Feasible - cannot be combined with bike lane improvements	High

As shown, improvements to the unsignalized intersection alone do not mitigate the poor operations, and therefore, several signalized intersection alternatives were considered. Operations of the intersection are greatly improved with the addition of a traffic signal with a single multi-use lane in each direction. Alternatives with additional auxiliary left and right turn lanes were considered, but the inclusion of a bicycle facility to connect Main Street to the Charles River Greenway was prioritized while still allowing for improved operations at this intersection.

The preferred alternative is to signalize the intersection with two phases for vehicular traffic, including a phase for east/west traffic on Grove Street and a phase for north/south traffic on Gore Street/Seyon Street, as well as an exclusive pedestrian phase. This alternative would also allow for the inclusion of bicycle lanes on Gore Street/Seyon Street that would connect Main Street to the Charles River Greenway, as shown in Figure 5-30.

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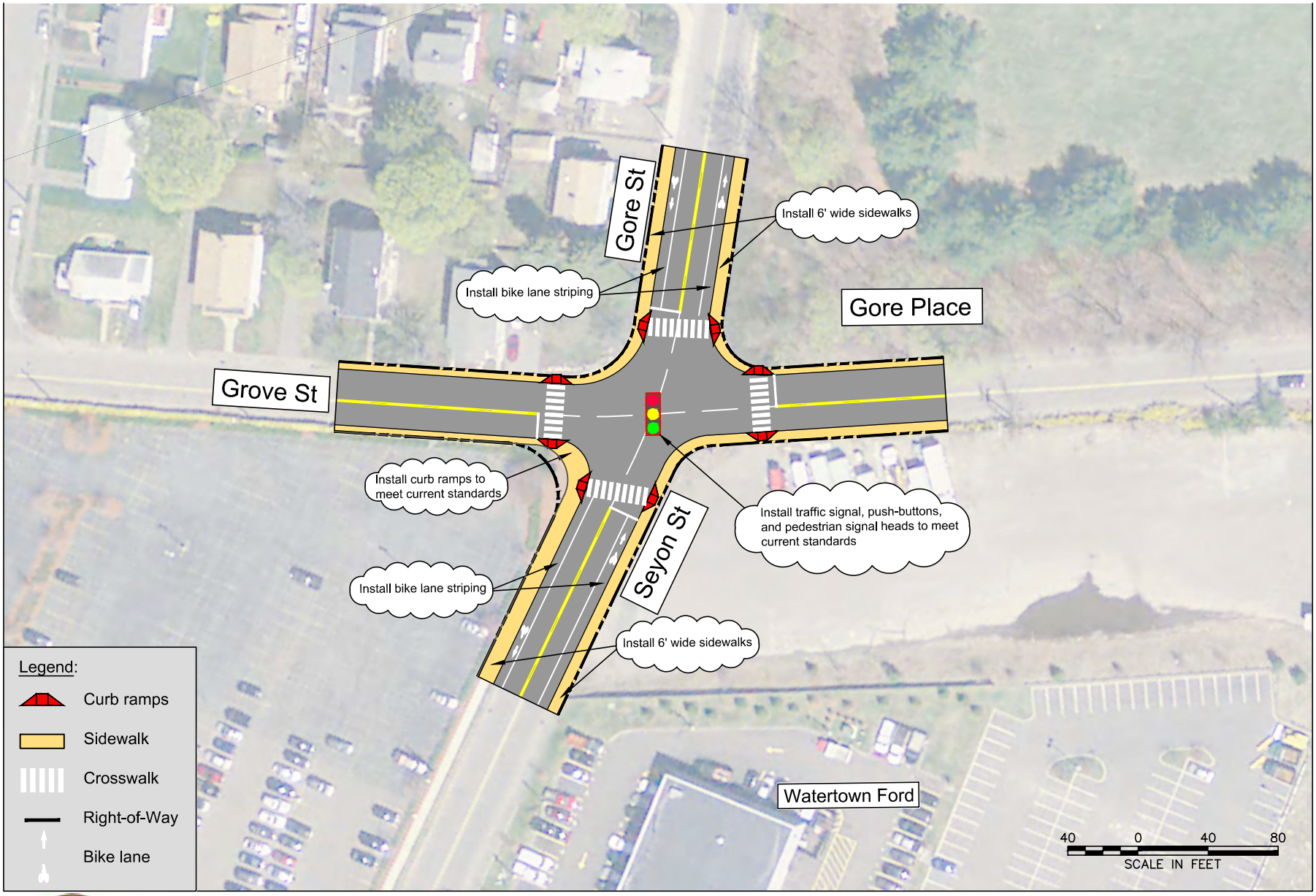

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Figure 5-30
Grove Street at Gore Street/Seyon Street Preferred Concept
City of Waltham Transportation Master Plan
Waltham, Massachusetts

Trapelo Road at Waverly Oaks Road

As previously noted, the intersection of Trapelo Road at Waverly Oaks Road operates at LOS F during the weekday morning and weekday afternoon peak hours. Several alternatives were evaluated to improve traffic operations and mitigate deficiencies, as shown in Table 5-18.

Table 5-18: Trapelo Road at Waverly Oaks Road Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short-Term	Taper the westbound left turn lane to mitigate left turn trap	Feasible	Low
Short-Term	Add "Signal Ahead" warning signage	Feasible	Low
Short-Term	Optimize traffic signal timings and update clearances	Feasible	Low
Short-Term	Replace missing handicap ramp on the east side northbound right turn lane crosswalk	Feasible	Low
Short-Term	Add a flashing yellow arrow for westbound left turn	Feasible	Low
Long-Term	Reduce northbound right turn radius	Feasible	Medium
Long-Term	Implement a roundabout	Not Feasible - Poor Operations	High
Long-Term	Replace traffic signal equipment and upgrade to current standards	Feasible	High
Long-Term	Add an exclusive eastbound right turn lane by reducing the sidewalk width	Feasible	High
Long-Term	Add a shared eastbound through and right turn lane by reducing the sidewalk width	Feasible	High

As shown, several alternatives were considered to improve the operations of the intersection as well as mitigate crashes, particularly in the eastbound direction. Currently there is one lane in the eastbound direction that operates at LOS F during the weekday morning and weekday afternoon peak hours. The queues also extend around a horizontal curve in the roadway attributing to rear-end collisions in the eastbound direction.

Two alternatives propose to reduce the sidewalk width on the southern side of Trapelo Road to the minimum standard to meet ADA standards, remove the existing grass buffer, and reallocate space to an additional eastbound travel lane. One alternative proposes to dedicate this additional space as an exclusive right turn lane. The second alternative proposes a shared through and right turn on the eastbound approach, which would consequentially require improvements on the east side of the intersection to create a receiving lane. Operations at the intersection are greatly improved for both of these alternatives with all movements operating under capacity.

The reduction of sidewalk, however, would deprioritize pedestrian travel along Trapelo Road and therefore were not advanced as a preferred alternative. The preferred alternative focuses on traffic signal timing improvements to facilitate vehicular traffic and improves the operations of the intersection from LOS F during both peak hours to overall LOS E during the weekday morning peak hour and LOS D during the weekday afternoon peak hour. This concept also maintains the existing pedestrian facilities while adding improvements such as sidewalk on the northern side of Trapelo Road and improved crosswalk connections. A bicycle lane is also proposed to be added to Waverly Oaks Road, as shown in the preferred concept in Figure 5-31.

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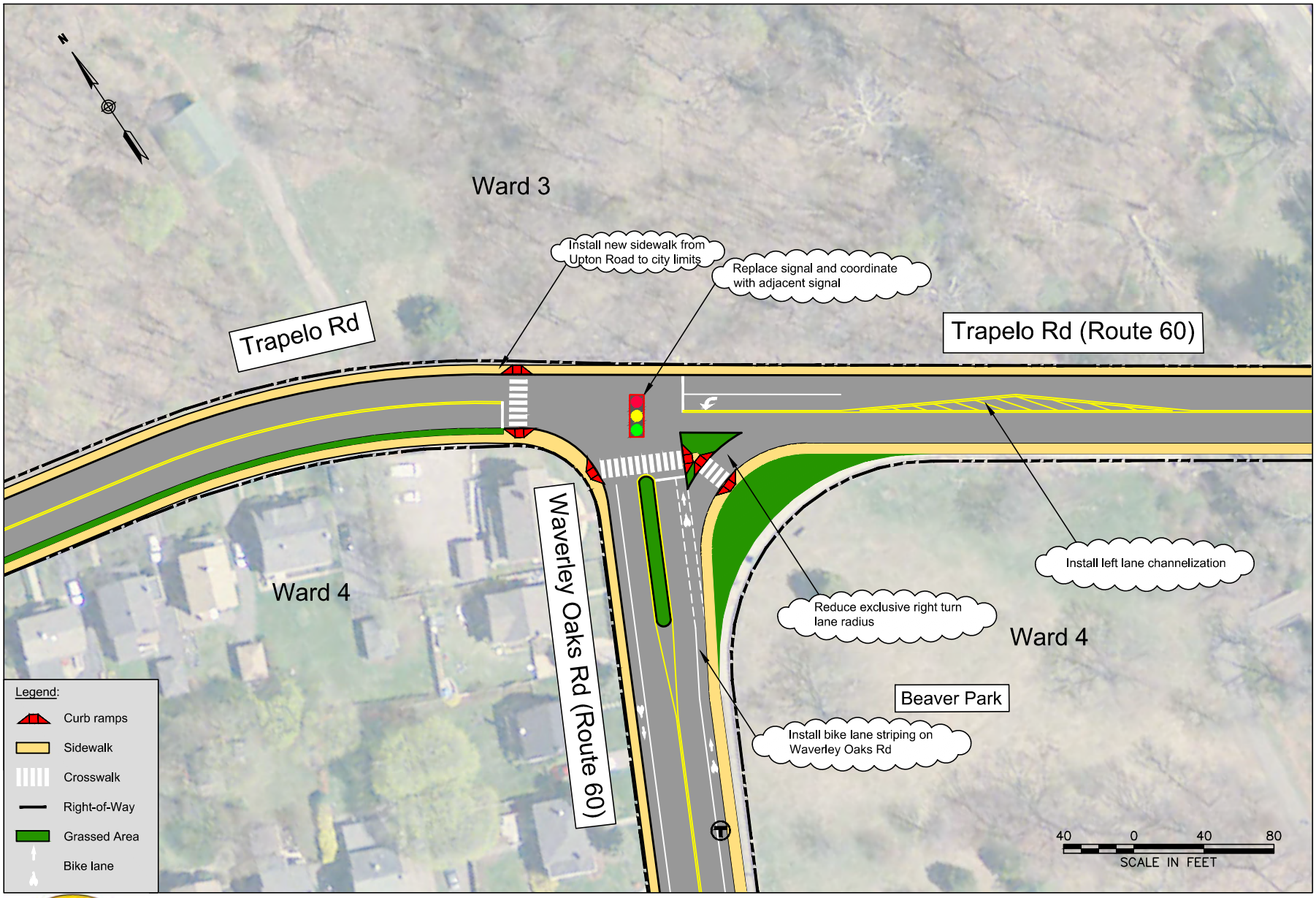

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Figure 5-31
Trapelo Road at Waverly Oaks Road Preferred Concept
City of Waltham Transportation Master Plan
Waltham, Massachusetts

Lexington Street at Dale Street

The stop controlled approach of Dale Street at the unsignalized intersection with Lexington Street currently operates at LOS F with high delays during both the weekday morning and weekday afternoon peak hours. Several alternatives were reviewed to improve traffic operations and to address deficiencies previously noted, as shown in Table 5-19.

Table 5-19: Trapelo Road at Waverly Oaks Road Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short-Term	Relocate eastbound bus stop on Dale Street closer to Lexington Street with improved definition of driveways	Feasible	Low
Short-Term	End TWLTL in left turn lanes at the intersection	Feasible	Low
Short-Term	Investigate access management opportunities	Feasible	Low
Short-Term	Upgrade all curb ramps to ADA compliant ramps	Feasible	Low
Short-Term	Restripe faded crosswalk striping	Feasible	Low
Long-Term	Signalize the intersection with protected northbound and southbound left turns	Feasible	High
Long-Term	Signalize the intersection with permissive northbound and southbound left turns	Feasible	High

As shown, the major long-term improvements to the intersection include signalizing the intersection, including the Domino's driveway that is opposite Dale Street. There are a low volume of left turns from Lexington Street, therefore permissive left turn phasing would provide the most appropriate treatment. The TWLTL on Lexington Street would be transitioned into exclusive left turn lanes at the intersection. The preferred concept is shown in Figure 5-32 below.

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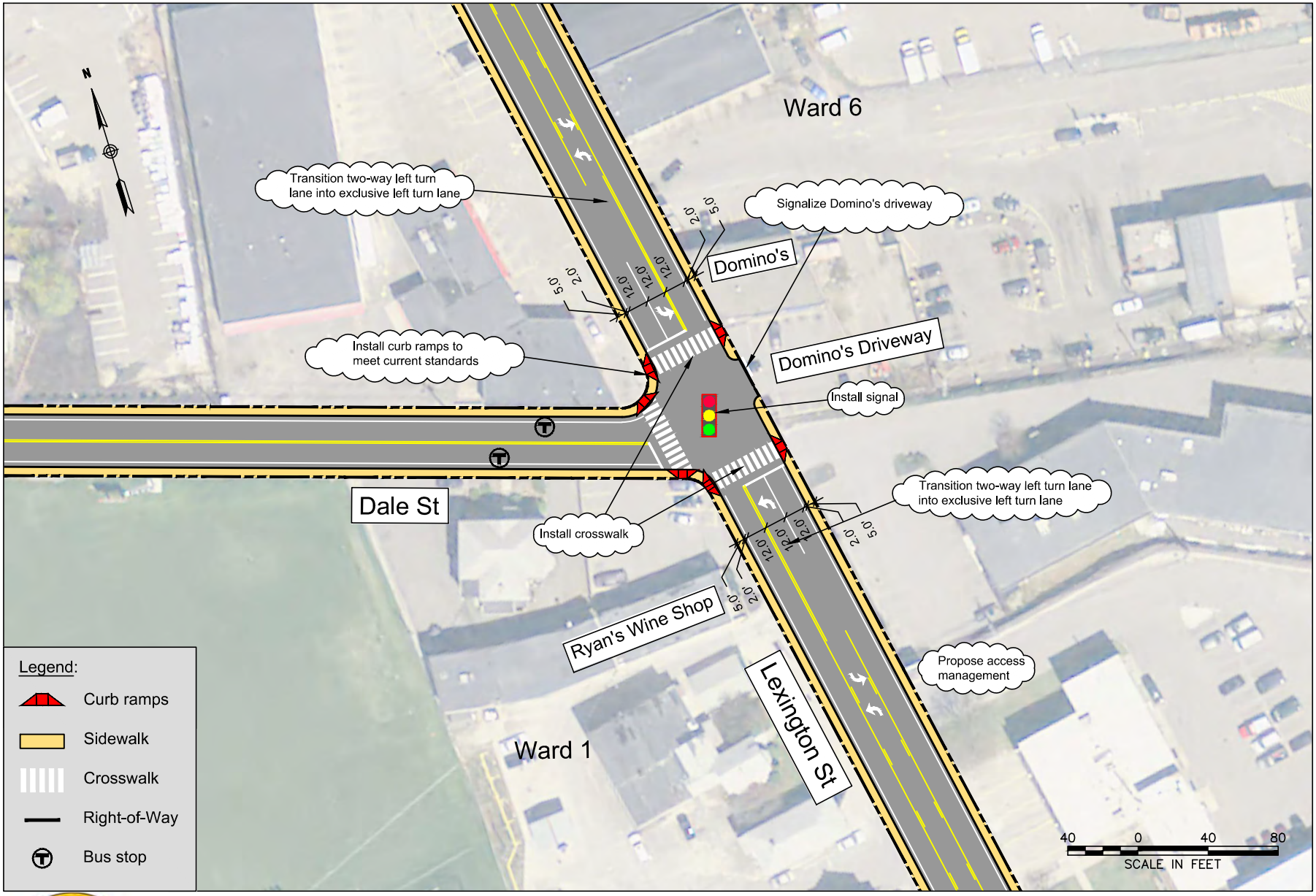

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Figure 5-32
Lexington Street at Dale Street Preferred Concept
City of Waltham Transportation Master Plan
Waltham, Massachusetts

High Street at Joyce Road/Hamblin Road

The stop controlled approaches from Joyce Road and Hamblin Road at the unsignalized intersection with High Street currently operates at LOS F during both the weekday morning and weekday afternoon peak hours. The geometry of the intersection also provides insufficient sight distance from the stop controlled approaches. Several alternatives were considered to improve intersection operations, as shown in Table 5-20.

Table 5-20: High Street at Joyce Road/Hamblin Road Improvement Summary

Time Frame	Improvement Description	Feasibility	Cost
Short-Term	Relocate westbound stop on High Street to far side of the Waltham Street midblock crosswalk	Feasible	Low
Short-Term	Relocate westbound bus stop on High Street to Waltham Street south of Joyce Street	Feasible	Low
Short-Term	Restripe bus stop pavement markings at westbound stop on High Street	Feasible	Low
Short-Term	Add a rear bus stop sign to westbound stop on High Street	Feasible	Low
Short-Term	Add an all way stop condition to the intersection to alleviate Joyce Road/Hamblin Road delays	Not Feasible - Poor Operations	Low
Short-Term	Convert Hamblin Street to a one-way roadway away from the intersection to improve operations and reduce conflict points	Feasible	Low
Short-Term	Add a crosswalk spanning High Street at the intersection	Feasible	Low
Long-Term	Add a traffic signal with spit phasing for the Joyce Road and Hamblin Road approaches	Feasible	High
Long-Term	Add a traffic signal and convert Hamblin Road to one-way away from the intersection	Feasible	High

An improvement that can be implemented in the short-term that would improve operations at the intersection is to reverse the direction of one-way travel on Hamblin Street. While reversing the direction of this roadway will alter traffic patterns for the vehicles utilizing this roadway, there is a parallel route to the south that connects to Joyce Road, so the new route consists of a one block diversion. Concerns over this improvement, however, were raised by the adjacent neighborhood during the draft report comment public comment period, including residents on Hamblin Road. The improvement may cause complications to the Whittemore Elementary School pick-up and drop-off operations as well as create a cut through route from High Street to Moody Street. Based on the public input, this improvement is not preferred.

To improve operations and mitigate sight distance deficiencies, a traffic signal is proposed for this location. Two alternatives were initially reviewed: a traffic signal with split phasing if Hamblin Street is not reversed in direction, and a traffic signal if Hamblin Street were reversed. Both traffic signals yield similar results, and both are a significant improvement compared to existing conditions. The intersection would be expected to improve to overall LOS B during both the weekday morning and weekday afternoon peak hours. Since the reversal on Hamblin Street is not preferred based on public comment, the preferred alternative would include Hamblin Street as an approach at the intersection, operating with split phasing from Joyce Road, as shown in Figure 5-33.

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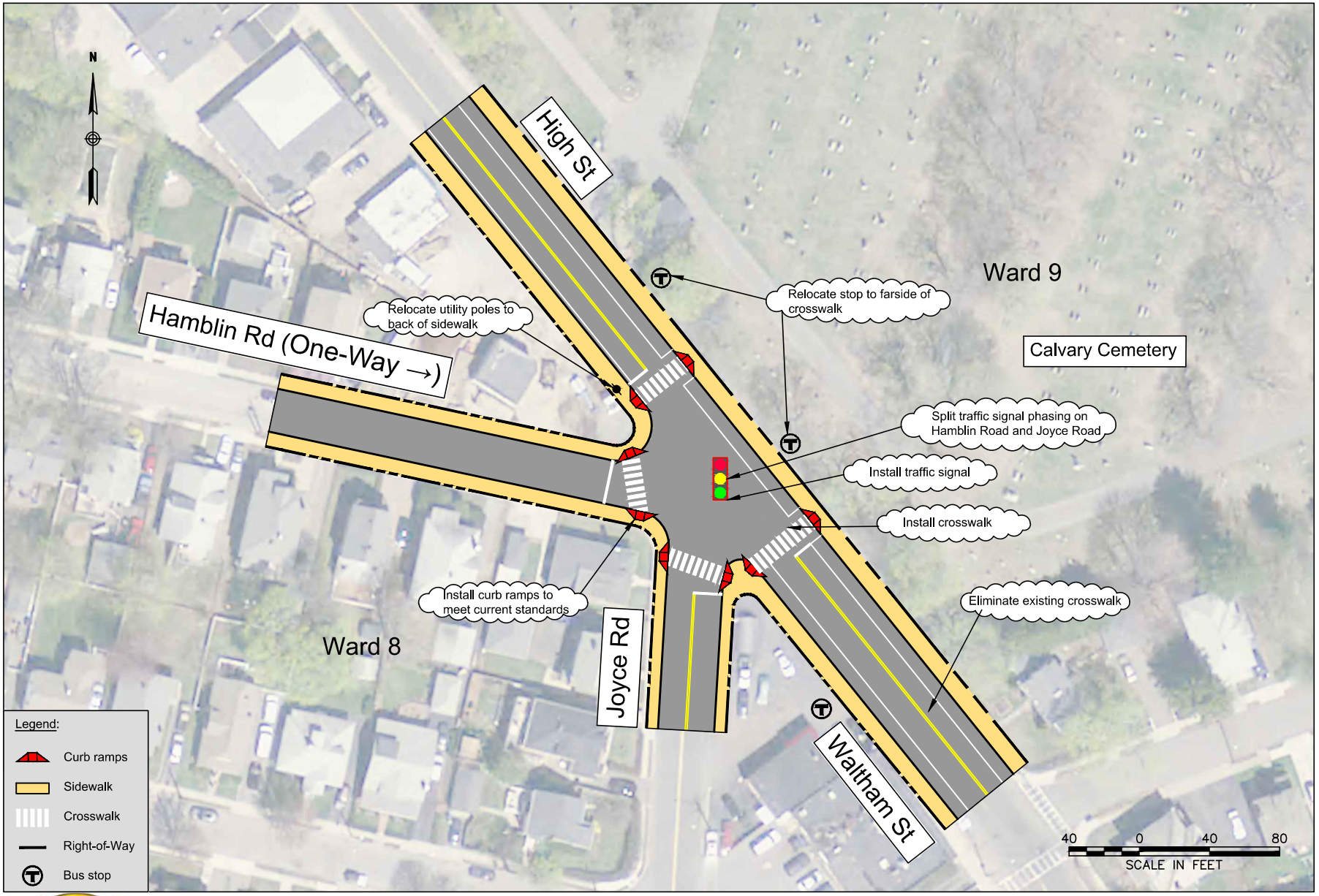

Figure 5-33
High Street at Joyce Road/Hamblin Road Preferred Concept
City of Waltham Transportation Master Plan
Waltham, Massachusetts