



# Corridor Study



## Route 107 Corridor Study:

Analysis and Multimodal Design of Recommendations Along Route 107 in Salem and Lynn, MA

**FINAL REPORT**

**November 2016**



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## EXECUTIVE SUMMARY

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The Massachusetts Department of Transportation (MassDOT) initiated the Route 107 Corridor Study to evaluate existing transportation conditions along the corridor, assess the potential of future development and economic growth in the corridor, and to develop both short term and long-term improvements for all modes of travel. The study corridor runs between Chestnut Street in Lynn and Essex Street in Salem, with the study area including land falling within one-mile of the corridor in all directions. Within the study area are 3.7 miles of Route 107 roadway and fifteen study area intersections.

The Route 107 corridor provides regional connections as well as access to local land uses. In the Lynn section, the study area begins with residential neighborhoods and properties abutting Route 107. As the roadway extends towards Salem, the land use changes to large retail commercial buildings. The middle of the study area has the heaviest congestion, with Marlborough Road and Swampscott Road both providing north-south access into Swampscott and Peabody. The intersections with Route 107 at Marlborough Road and Swampscott Road are part of the “zig zag” movement that is one of the traffic challenges for the study area. Continuing north, Route 107 passes Salem High School and the Salem Hospital, referred to as “Salem Hospital” throughout this report, before terminating at Essex and Boston Street.

Three goals were developed to guide the study towards its purpose of balancing local and commercial traffic with regional connections. Each goal has a set of objectives. The project goals include:

- Improve mobility, connectivity and safety for all transportation modes and users within the Route 107 study area
- Support local economic development goals
- Improve the quality of life for residents and businesses in the Route 107 study area

Evaluation Criteria were developed to analyze the goals and objectives, and as a way to evaluate alternatives and determine if the project is meeting its intended purpose. The evaluation criteria serve as measures of effectiveness used to assess the benefits and impacts of alternatives.

The project involved an extensive public outreach program that included Working Group meetings, public meetings and a public survey. The Working Group met at four strategic points in the project and offered valuable input to shape the project outcome. The public survey, which was initiated early in the project, drew input from over 1,600 participants on the existing issues and desired solutions. Two series of public meetings were held in each of the two communities, Salem and Lynn. The public meetings were intended to inform the public and seek input on the issues, opportunities, solutions and recommendations.

The existing conditions within the study area were assessed through field reviews, data collection, and local input. Field reviews were conducted along both sides of Route 107. Traffic count data was collected in the forms of automatic traffic recordings, manual turning movement counts, and license plate matching. Peak hour traffic volumes by transportation mode, vehicle speeds, vehicle classification and queue lengths were derived from the data collection. Crash data for the study area was reviewed and analyzed. Crash rates were calculated and high crash locations were identified. Bicycle and pedestrian amenities in the study area were cataloged and assessed in terms of their adequacy. The existing transit in the study area consists primarily of four MBTA bus routes that run along Route 107, routes 424, 434, 450 and 456. The ridership, route frequency, span of service, efficiency and bus stop locations were inventoried and assessed.

The demographics of the study area were studied including population and environmental justice population. Information on land use and zoning was collected and mapped. This information along with environmental elements such as floodplains, wetland and water resources, open space and conservation areas, rare species habitat, hazardous material sites and historic and cultural resources was documented in the form of constraint mapping.

Deficiencies in the study area were noted based upon travel mode (vehicle, pedestrian, bicyclist and transit user) and by location (corridor or segment deficiencies and intersection deficiencies). From a traffic operations perspective, the predominant deficiencies include a lack of turn lanes in the Lynn segment, extensive queues, congestion particularly in the center of the project where the zig zag traffic movements occur, and ambiguous travel lanes in the northern segment. Pedestrian amenities are inadequate throughout the corridor. Sidewalks, crosswalk, curb ramps, and pedestrian signals are not consistently provided and the ones that exist are in poor condition. Bicyclists have virtually no facilities under the current conditions. Transit users encounter limited service, long bus rides, and bus stops that lack shelter and adequate pedestrian amenities. Detail of the deficiencies at each of the study area intersections is documented herein.

The 2015 existing peak hour traffic volumes were projected to the year 2035 to determine future traffic demands on the study area roadways. Proposed developments in Lynn and Salem were reviewed to identify potential future traffic generators along the corridor. The traffic generators identified consisted of the proposed Cinema complex in Salem and proposed changes to the Salem Hospital. In addition to specific traffic generators, changes in regional travel demands were estimated based upon information from the Central Transportation Planning Staff's regional traffic demand model.

Roadway improvements for motor vehicles, bicyclists, pedestrians and transit users were considered for the Route 107 study area corridor. The process of developing and evaluating the improvements is summarized below.

- Review existing conditions, survey results & working group input
  - Right-of-Way Constraints
  - Multi-modal Accessibility & Connectivity
  - Environmental Constraints
  - Vehicular Operations
  - Survey Results Working Group Feedback
- Identify study area-wide improvements to meet corridor goals
- Discuss with Working Group and get feed back
- Evaluate feasibility
- Select preferred alternative

In developing the alternatives, study area-wide improvements were developed, particularly for transit. Transit improvements were aimed at improving service by modifying the bus stop locations along Route 107, ensuring that stops are located at locations that provide the desired connections, have a stop pair for the return trip, and have adequate pedestrian and bus stop amenities. From a bicycle perspective, a bicycle lane was recommended throughout most of the study area. Pedestrian improvements include new sidewalks, crosswalks, curb extensions, and pedestrian signals, where appropriate.

Roadway cross-sections were developed for each of three roadway segments. The cross-section options were presented to the Working Group, and general consensus was reached on the selection of a preferred roadway cross-section for each of the three roadway segments. In the Lynn segment, the preferred cross-section maintained the existing curb line, on-street parking was provided on both sides of the roadway, and bicycle lanes were added, as shown in Figure I. In the retail segment, the roadway cross-sections were designed to change the roadway atmosphere to be less “freeway style” and more of a boulevard. Four travel lanes were maintained, bicycle lanes were added, and the median was changed to a raised grass median lined with trees. See Figure II. In the northern segment, the cross-sections generally maintained two travel lanes, with a center two-way left turn lane, and bicycle lanes as shown in Figure III.

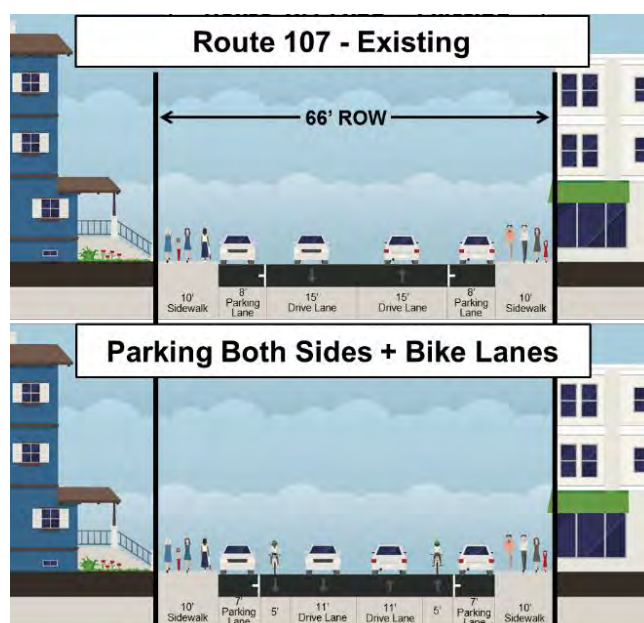


Figure I: Lynn Segment Preferred Option



Particular attention was given to the zig zag area and 17 alternatives were developed. Two of the alternatives involved added capacity along Route 107 only, but these alternatives had substantial right of way impacts and were eliminated. The remaining alternatives involved utilizing First Street and Traders Way to implement travel pattern changes. This is accomplished by signaling the intersection of Swampscott Road/First Street and implementing turn restrictions. The alternative that restricts the zig zag movement from traveling on Route 107 by implementing turn restrictions was found to be the most effective at reducing congestion. Motorists turning right from Swampscott Road northbound would not be permitted to then turn left onto Marlborough Road. Instead this maneuver would be made by traveling on First Street and Traders Way. Conversely, similar turn restrictions would be set up for movements southbound on Marlborough Road and destined to Swampscott Road, as shown in Figure IV.

This zig zag proposal received considerable attention from members of the public during the second public meeting in Salem on September 13, 2016, as well as during the public comment period. Concerns were raised about the efficacy of both lane barriers within the Route 107 roadway and the value of redirecting Marlborough-Swampscott movements off Route 107 and onto Traders Way and First Street. These concerns are addressed in Chapter VI of this report. The project team recommends further study to more comprehensively evaluate the traffic operations along Traders Way and First Street in peak periods, including to project the amount of traffic likely to be re-routed and identify improvements along Traders Way and First Street which may be necessary to handle the added traffic. Specific improvements proposed at each intersection are noted in section 5.

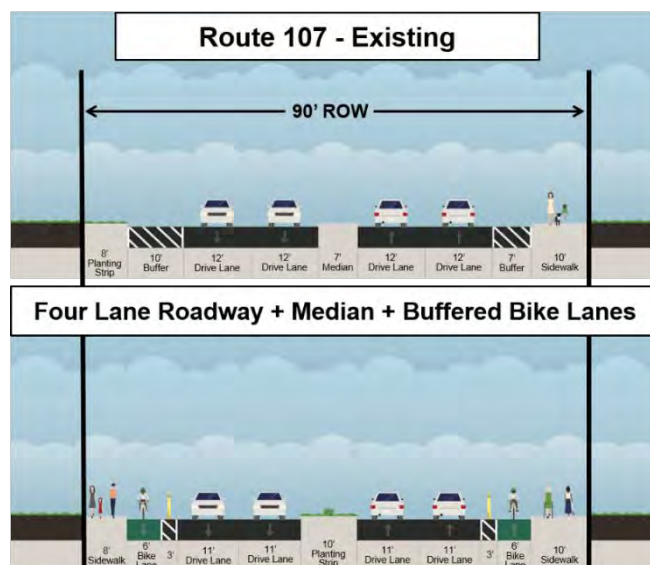


Figure II: Retail Segment Preferred Option

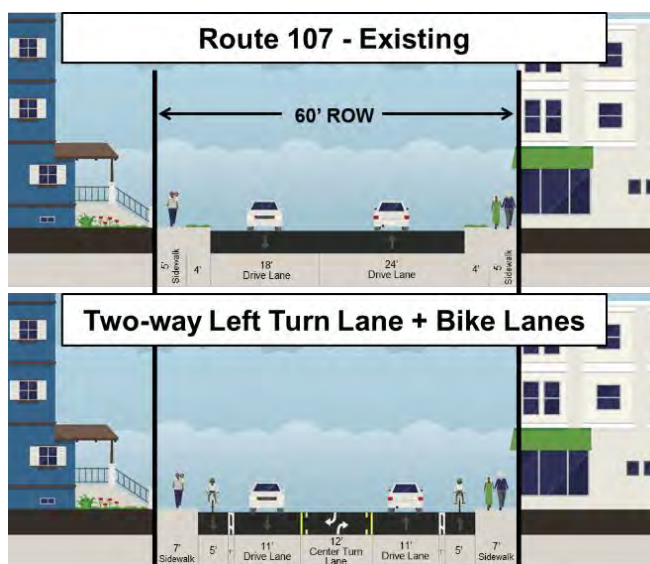
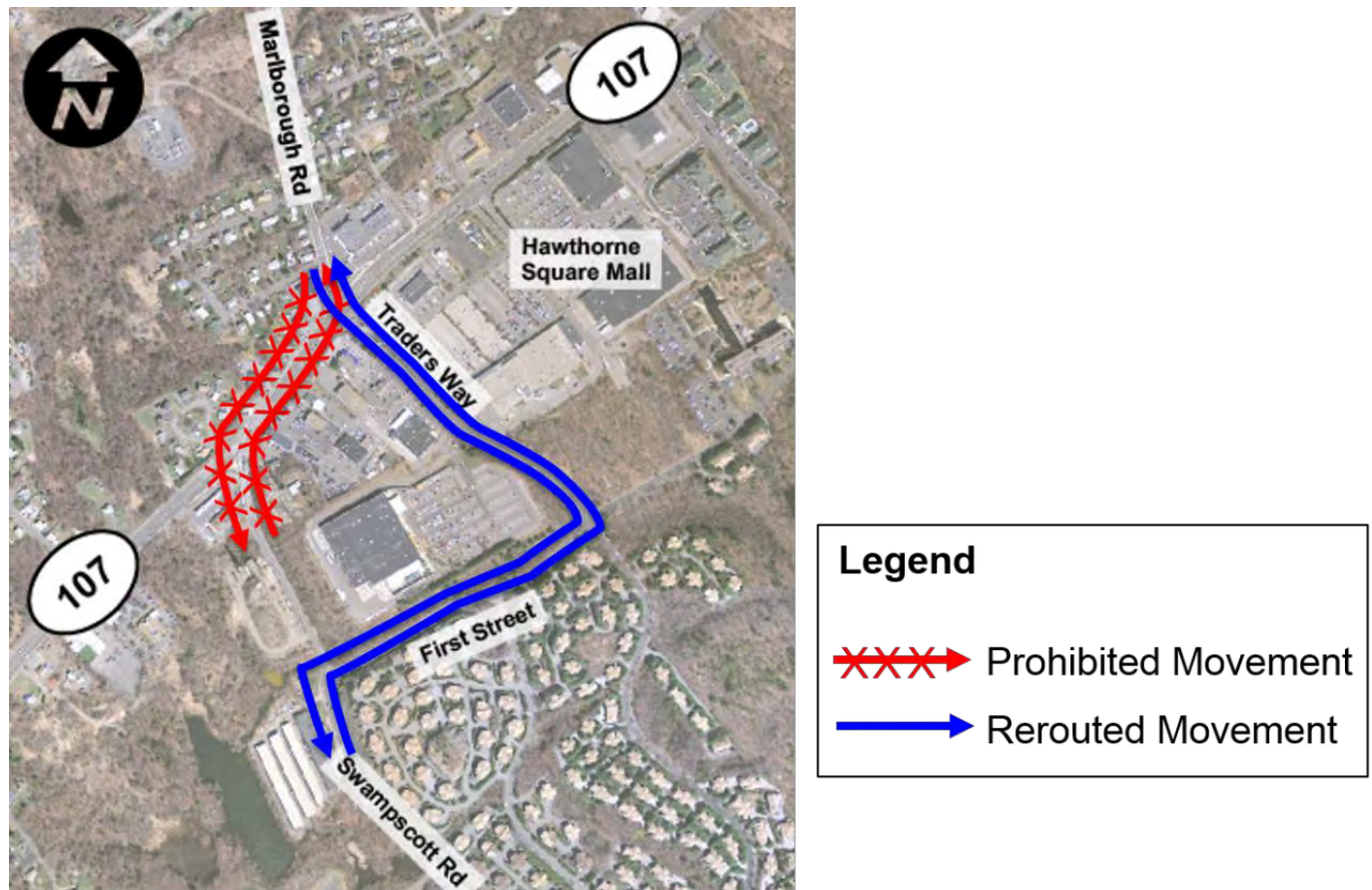


Figure III: Northern Segment Preferred Option



**Figure IV: Turn Restrictions for Movements Southbound On Marlborough Road to Swampscott Road**

Specific improvements were developed for each of the fifteen study area intersections. The improvements include features such as added turn lanes, access management, improved signal timing, phasing and coordination, added crosswalks, relocated bus stops, curb ramps, bike boxes, and curb extensions.

In the Lynn segment, the intersection improvements were aimed at improving safety. Due to high crash rates at the intersections of Route 107 at Chestnut Street and Route 107 at Chatham Street, exclusive left turn lanes were added. A new traffic signal is recommended for the intersection of Route 107/Eastern Avenue. This signal would operate in conjunction with the existing signal at Route 107 and Waitt Avenue and proposed turn restrictions at both of these intersections would serve to better manage vehicle conflicts.

In the retail segment, there are a number of key signalized intersections and proposed improvements including modifications to the lane arrangements and improved signal timings and coordination. A new traffic signal is recommended at Swampscott Road and First Street and capacity was added at the intersections Route 107 at Marlborough Road and Traders Way and Swampscott Road at First Street.

In the northern segment, intersection improvements were focused on defining the street space to better organize the traffic maneuvers, both on Route 107 and on the side street approaches. For example, proposed modifications to the medians between the side street approaches at the Route 107 and Dalton Parkway/Jackson Street intersection serve to better define travel routes and reduce conflicts. Turn lanes were added or maintained at key intersections. The installation of a traffic signal is recommended at the intersection of Route 107 with the lower driveway of Salem Hospital. Realignment of the Route 107 and Boston Street intersection is proposed to allow the Route 107 traffic to flow as the major movements at this intersection. A shared road concept has been recommended in space surrounding this intersection to accommodate pedestrians and bicyclists, to enhance access management and to provide an opportunity for landscaping and/or the relocation of an existing monument at this intersection.

Collectively, the recommended improvements would transform Route 107 in the study area from a major vehicle thoroughfare to a boulevard type of roadway, serving multiple users and offering a calmer traffic environment.

## I. OVERVIEW

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### A. INTRODUCTION

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The Massachusetts Department of Transportation (MassDOT) initiated the Route 107 Corridor Study to evaluate existing transportation conditions within the study area. The main purpose of the study is to understand existing traffic, transit, bicycle, and pedestrian issues and deficiencies, and incorporate each of these modes into recommended improvements. Assessing the potential of future development and economic growth is also a central component to the study. Future year projections were evaluated to understand traffic and development impacts within the study area. The recommendations provide both short-term and long-term improvements for all modes, and are intended to facilitate the creation of a more multimodal transportation corridor, while alleviating the existing transportation deficiencies. The recommendations also balance local traffic and mobility with the need to sustain regional transportation connections.

The study encompasses six tasks:

- Task 1 – Public Involvement Plan
- Task 2 – Field Reconnaissance and Data Collection
- Task 3 – Evaluate Existing Conditions and Identify Transportation Issues
- Task 4 – Develop Improvement Alternatives
- Task 5 – Alternatives Analysis and Recommended Improvements
- Task 6 – Report

This report is divided into six chapters. Chapter 1 provides an overview of the study purpose, process, and public involvement plan. The study goals and objectives and the study area and intersections are also defined in Chapter 1.

### B. BACKGROUND

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Route 107 is a regional and local roadway that stretches from Revere to Salem in the North Shore area of Massachusetts. It is an arterial roadway running in the northeast-southwest direction through the municipalities of Revere, Saugus, Lynn and Salem, with the corridor serving as a vital link to commercial activities and regional employment centers. The study area runs between Chestnut Street in Lynn and Boston Street in Salem, with the study area including land within one-mile of Route 107 in all directions. Within the study area are 3.7 miles of Route 107 roadway and fifteen study area intersections. Route 107 is known locally as Western Avenue in Lynn and Highland Avenue in Salem until Jackson Street, after which it becomes Essex Street.



## C. STUDY PURPOSE

The purpose of the study is to balance local and commercial traffic with regional connections along the Route 107 study area. The current roadway and intersection configurations have a number of operational issues and poorly accommodate pedestrian, bicycle, and transit users. In this study, the existing deficiencies have been documented, the development potential along the study area has been recognized and recommended solutions have been proposed. The study identifies short-term and long-term improvements to address the three main needs of the study area:

- Enhance the current conditions and mitigate or address deficiencies
- Provide accommodations for additional modes of travel
- Accommodate expected growth within the study area

## D. GOALS AND OBJECTIVES

Three goals were developed to guide the study towards its purpose of balancing local and commercial traffic with regional connections. Each goal has a set of objectives, which serve to outline specific elements of meeting that goal. Table I.1 provides an overview of the goals and objectives.

**Table I.1: Study Goals and Objectives**

Goals	Objectives
<b>Improve mobility, connectivity and safety for all transportation modes and users within the Route 107 study area</b>	<ul style="list-style-type: none"> <li>• Reduce traffic congestion within the study area</li> <li>• Improve safety for vehicles, pedestrians, and bicycles</li> <li>• Improve pedestrian, bicycle, and transit facilities, improve cross-corridor connections</li> </ul>
<b>Support Local Economic Development Goals</b>	<ul style="list-style-type: none"> <li>• Improve traffic operations to support additional development in the study area</li> <li>• Improve access to parcels for all modes</li> </ul>
<b>Improve the Quality of Life for Residents and Businesses in the Route 107 study area</b>	<ul style="list-style-type: none"> <li>• Provide opportunities for enhancing the attractiveness of the study area</li> <li>• Minimize air quality impacts</li> <li>• Provide fair and equitable treatment for Environmental Justice populations</li> </ul>



## E. STUDY PROCESS

The study process was divided into six tasks, illustrated in Figure I-1. The process began with a public involvement plan and data collection, and ended with a final report. Analysis consisted of evaluating the existing conditions, identifying transportation issues, and developing and analyzing improvement alternatives. Throughout the process there were opportunities for public involvement, described in detail below.

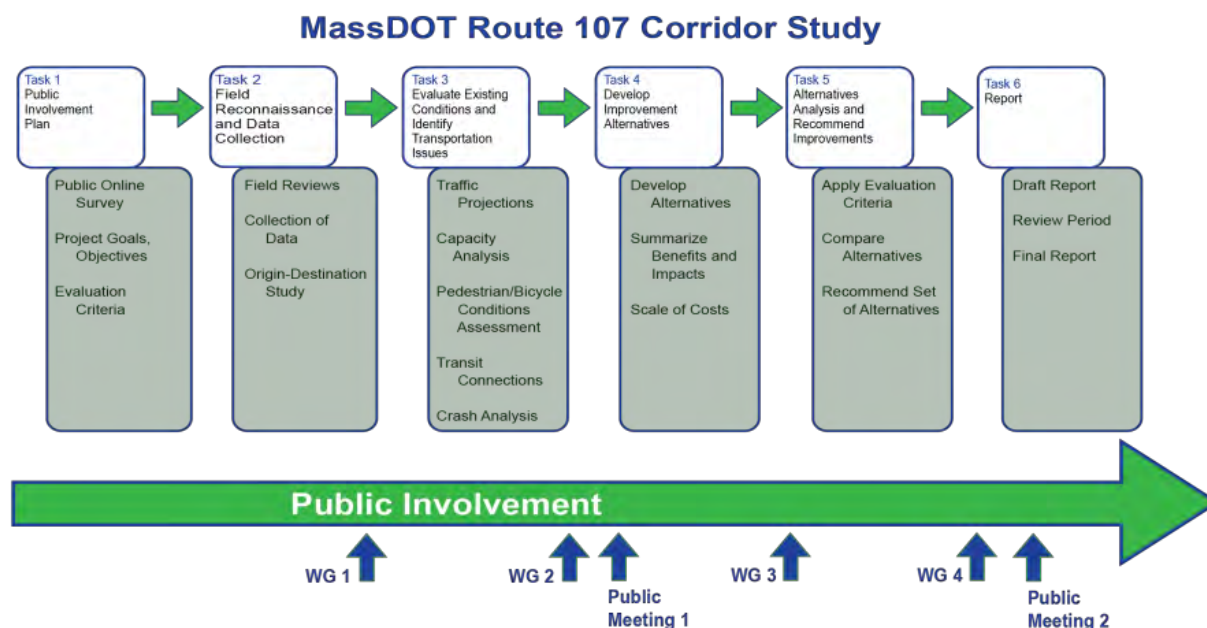


Figure I-1: Study Process

## F. EVALUATION CRITERIA

Evaluation Criteria were developed to analyze the goals and objectives, and as a way to evaluate alternatives and determine if the study is meeting its intended purpose. The evaluation criteria serve as measures of effectiveness used to assess the benefits and impacts of alternatives. They provide a way to measure which solutions best achieve the goals and objectives, outlined in Table I.2, through either quantifiable or more subjective qualitative measures. The evaluation criteria were shared with the Working Group prior to becoming finalized.

The criteria were developed with the study purpose in mind as a way to improve the multimodal connectivity and access to business activity within the study area, and improve safety and quality of life. The evaluation criteria are presented in Table I.2

Table I.2: Evaluation Criteria and Measures of Effectiveness

Evaluation Criteria	
<b>Multimodal Mobility</b>	<ul style="list-style-type: none"> <li>• Reduce Traffic Congestion (LOS)</li> <li>• Cross-corridor mobility</li> <li>• Improve transit, bike, and pedestrian modes</li> </ul>
<b>Safety</b>	<ul style="list-style-type: none"> <li>• Vehicular safety</li> <li>• Bike and pedestrian safety</li> </ul>
<b>Land Use and Economic Development</b>	<ul style="list-style-type: none"> <li>• Supports development</li> <li>• Improves access for all modes</li> </ul>
<b>Environmental Effects</b>	<ul style="list-style-type: none"> <li>• Air quality</li> <li>• Environmental resources</li> </ul>
<b>Community, Health, and Social Equity</b>	<ul style="list-style-type: none"> <li>• Enhance attractiveness for residents and businesses</li> <li>• Health</li> <li>• Environmental Justice</li> </ul>
<b>Constructability</b>	<ul style="list-style-type: none"> <li>• Minimize impacts to private property, drainage &amp; utilities, ledge</li> </ul>
<b>Cost</b>	<ul style="list-style-type: none"> <li>• Construction cost</li> </ul>

## G. PUBLIC OUTREACH

The public outreach process is outlined in Figure I-1 above. Public involvement was on-going throughout the study and consisted of three major components including Working Group meetings, public meetings and a public survey.

The goals of the public involvement program are to:

- Reach out early and frequently to invite the public to participate in the study process.
- Distribute timely and accurate information to ensure transparency.
- Provide continuous and meaningful opportunities for public involvement and respond promptly to inquiries.

- Develop and maintain positive relationships with city officials, Working Group members, community leaders, business owners, residents and other stakeholders.
- Collaborate with the Working Group to gather data on intersections along the study area and develop a set of feasible improvement alternatives that best address existing problems.
- Communicate study updates and announcements across several platforms in easy-to-understand and accessible formats. Translations into Spanish and specific communication strategies will be necessary to engage all affected communities (including minority, low-income, and limited-English proficiency populations).

The elements of the public outreach process are listed below and some of the elements are described in more detail in the sections to follow:

- **Electronic database**; which included contact information of property and business owners, relevant agency departments, community and neighborhood organizations, chambers of commerce, cultural and religious organizations, schools, bicycle and pedestrian advocacy groups, social services, and local publications.
- **Internet Communications**; which included the development and maintenance of a study website, email blasts announcing the study's activity, and use of social media to share the study's information. The study website is found at <http://www.massdot.state.ma.us/planning/Main/CurrentStudies/Route107CorridorStudy.aspx>
- **Print materials**; including meeting handouts.
- **Press Outreach**
- **Working Group Meetings**
- **Public Meetings**
- **Online Survey**

## 1. WORKING GROUP

A Working Group was essential to the public outreach and stakeholder engagement process of the study. The membership of the Working Group is listed in Figure I-2. The goals for the Working Group were to:

- Provide local knowledge and perspective
- Convey community ideas and suggestions
- Learn historical context
- Seek out a variety of representation

<b>Local</b>	Lynn Housing Authority & Neighborhood Development	Lynn City Council
Salem Commission on Disabilities	Lynn Area Chamber of Commerce	<b>Regional</b>
City of Lynn	Lynn Department of Public Works	North Shore Medical Center
Lynn Police Department	Lynn Department of Community Development	Essex County Community Organizations
Economic Development & Industrial Corporation (EDIC) Lynn	Lynn Disability Commission	North Shore Community Development Coalition
The Salem Partnership	City of Salem	Metropolitan Area Planning Council
Salem Chamber of Commerce	Salem Public Schools	North Shore TMA
Inspectional Services Department and Lynn Planning Board	Lynn Council On Aging	<b>State</b>
Department of Planning and Community Development (DPCD)	Salem Mass in Motion Program Coalition	Massachusetts House of Representatives
Salem Bicycling Advisory Committee	Salem Police Department	Massachusetts Senate
Salem City Council	Salem Education Foundation / Salem Latino Leadership Coalition	
Salem Council on Aging	Salem Planning Board	

**Figure I-2: Working Group Members**

A series of four Working Group meetings were held at strategic points during the study and the Working Group input shaped the content and direction of the study. The Working Group meetings were well attended and the group was engaged in the process. The group offered input throughout and the study recommendations are reflective of the group's input.

Each of the four Working Group meetings is briefly described below and meeting notes for each Working Group meeting is provided in the Appendix of this report.

#### Working Group Meeting 1, June 10, 2015

The first Working Group meeting was held at the Salem City Hall Annex, 120 Washington Street, in Salem, Massachusetts. The topics covered included:

- Study purpose
- Study process
- Role of the Working Group
- Goals and objectives
- Data collection including roadway jurisdiction, traffic counts by mode, and trip origins and destinations
- Field review information regarding the amenities by mode
- Existing land use conditions (zoning, land use, environmental justice, environmental considerations, historic resources)

### Working Group Meeting 2, October 20, 2015

The second Working Group meeting was also held at the Salem City Hall Annex, 120 Washington Street, in Salem, Massachusetts. The topics covered included:

- Public survey outreach
- Expanded study area
- Traffic operations
- Transportation issues and deficiencies by travel mode and presented both from a corridor and intersection perspective
- Design constraints

### Working Group Meeting 3, March 2, 2016

The third Working Group meeting was held at Lynn City Hall at 3 City Hall Square, Lynn, Massachusetts. The topics covered included:

- Public survey results
- Future traffic volumes
- Overall improvement alternative concepts for vehicles, pedestrians, bicycles and traffic calming
- Improvement alternative concepts by segment; Lynn segment, retail segment including concepts for the movements between Swampscott Road and Marlborough Road (commonly referred to as the “zig zag”), and the northern segment

### Working Group Meeting 4, June 30, 2016

The fourth Working Group meeting was held at the Salem City Hall Annex, 120 Washington Street, in Salem, Massachusetts. The topics covered included:

- Segment by segment improvements including both study area segment improvements and improvements at key intersections within each segment
- Additional design concepts for the zig zag area

Following the fourth Working Group meeting and prior to the second set of public meetings, the following information was made available to the Working Group:

- Design concepts at the zig zag intersections
- Cost estimates for the recommended improvements



## 2. PUBLIC MEETINGS

Public meetings were held in each of the two communities; Lynn and Salem. Two series of public meetings were conducted. The first set of public meetings occurred towards the end of the third study task and were held January 27, 2016 at Salem High School Auditorium and March 9, 2016 at Lynn English High School Auditorium. A briefing was held at the Fairweather Apartments located at 40 Highland Avenue, Salem, Massachusetts in advance of each of the public meetings. The briefings were arranged in response to a request to share the study information with house-bound residents.

The content at the first public meetings included the following:

- Study framework
- Existing transportation conditions including:
  - roadway jurisdiction,
  - vehicle/pedestrian/bicycle count information,
  - origin-destination data for the “zig zag” movement
  - existing transit conditions
  - mapping of land use, zoning, environmental resources, environmental justice areas, and cultural and historic resources
- Existing traffic operations
- Projected traffic volumes
- Transportation issues and deficiencies identified by mode and for the study area and key intersections

The second set of public meetings occurred on September 7, 2016 at Lynn English High School Auditorium and on September 13, 2016 at the Collins Middle School Auditorium.

The content at the second public meetings included the following:

- Study process
- Public survey results
- Overall improvement concepts
- Segment by segment improvements including recommendations for cross-sections and specific intersection improvements

Both sets of public meetings were well attended and participants were engaged in the discussion. The public meeting materials including the presentation and summary notes are posted on the MassDOT website. Summaries of the public meetings are included in the Appendix.

### 3. ONLINE SURVEY

An online survey was conducted to obtain users input on issues and recommendations. The survey was available from October 14, 2015 to February 1, 2016 in both English and Spanish. The survey was distributed using a variety of methods:

- Bilingual email distribution to study email list
- Bilingual flyers were distributed to residences and businesses on Route 107
- Shared by the Working Group
- Advertised in newspapers and media advisory

The survey generated over 1,600 responses. The survey questions and results are provided in the Appendix.

Survey respondents were mainly comprised of residents of the study area (47%) and workers of the study area (20%). The average age of survey respondents is slightly older than the age group profile of Essex County, with over 45% of respondents between the ages of 45 and 64.<sup>1</sup>

The top three study area destinations for respondents are Walmart, the Hawthorne Square Mall, and the Salem Hospital. Over 90% of respondents own a private automobile. With many drivers within the study area, it is not unexpected that the majority of respondents also reported experiencing traffic congestion “frequently” or “usually” in all parts of the study area. The segments of the study area between Walmart and Hawthorne Square Mall in Salem and Chestnut Street to Eastern Avenue in Lynn had higher rates of experienced congestion among respondents. Safety improvements were also seen as most needed on the segment from Walmart to the Hawthorne Square Mall.

The majority of respondents report that they use a personal vehicle to commute to work and for recreation. Very few respondents ever take public transportation, walk, or bicycle in the study area. Over 70% of respondents “never” walk in the Route 107 area to commute to school or work, and 43% never walk for recreation purposes. Barriers to walking include crossings that are too few and inconvenient, a lack of sidewalks, lack of sidewalk maintenance/clearance of snow, and failure to enforce laws to protect pedestrians from traffic.

Although about 30% of respondents are “casual” or “experienced” bicyclists, over 90% of respondents report “never” using a bicycle to access public transit, or to commute to school or work. The segment where respondents are least likely to bicycle is from Chestnut Street in Lynn to Walmart in Salem.

Public transportation use is also minimal within the study area. Recreation was the most common reason to use public transit, but even for that use, 76% of respondents reported

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<sup>1</sup> 2010 U.S. Census

“never” using it. The largest barriers to using public transportation were reported as that it is not as convenient as a personal vehicle, it does not go where respondents want to go, and that respondents make multiple stops during trips.

Survey respondents also provided input on suggested improvements. These included:

#### Roadway Improvements:

- The addition of left-turn lanes
- A median separation with U-turn provisions
- Right-in, right-out driveway access (no left turns in and out)
- Sidewalk bump-outs for traffic calming

#### Pedestrian Improvements:

- Better sidewalk maintenance
- Better lighting and security measures
- Increased buffer between the sidewalk and vehicle traffic
- Improved curb ramps and accessibility

#### Bicycle Improvements

- Increased maintenance
- Off-road bicycle paths
- Improved buffers between bicyclists and vehicles
- Enforcement and education

## H. STUDY AREA

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The Route 107 study area, displayed in Figure I-3, extends 3.7 miles between the City of Lynn and the City of Salem. The Route 107 corridor provides regional connections as well as access to local land uses. The land uses surrounding Route 107 influence the roadway character and function. In Lynn, the study area begins with residential neighborhoods and properties abutting Route 107. As the roadway extends towards Salem, the land use changes to large retail commercial buildings. Continuing north, the study area passes Salem High School and the Salem Hospital before terminating at Essex and Boston Street.



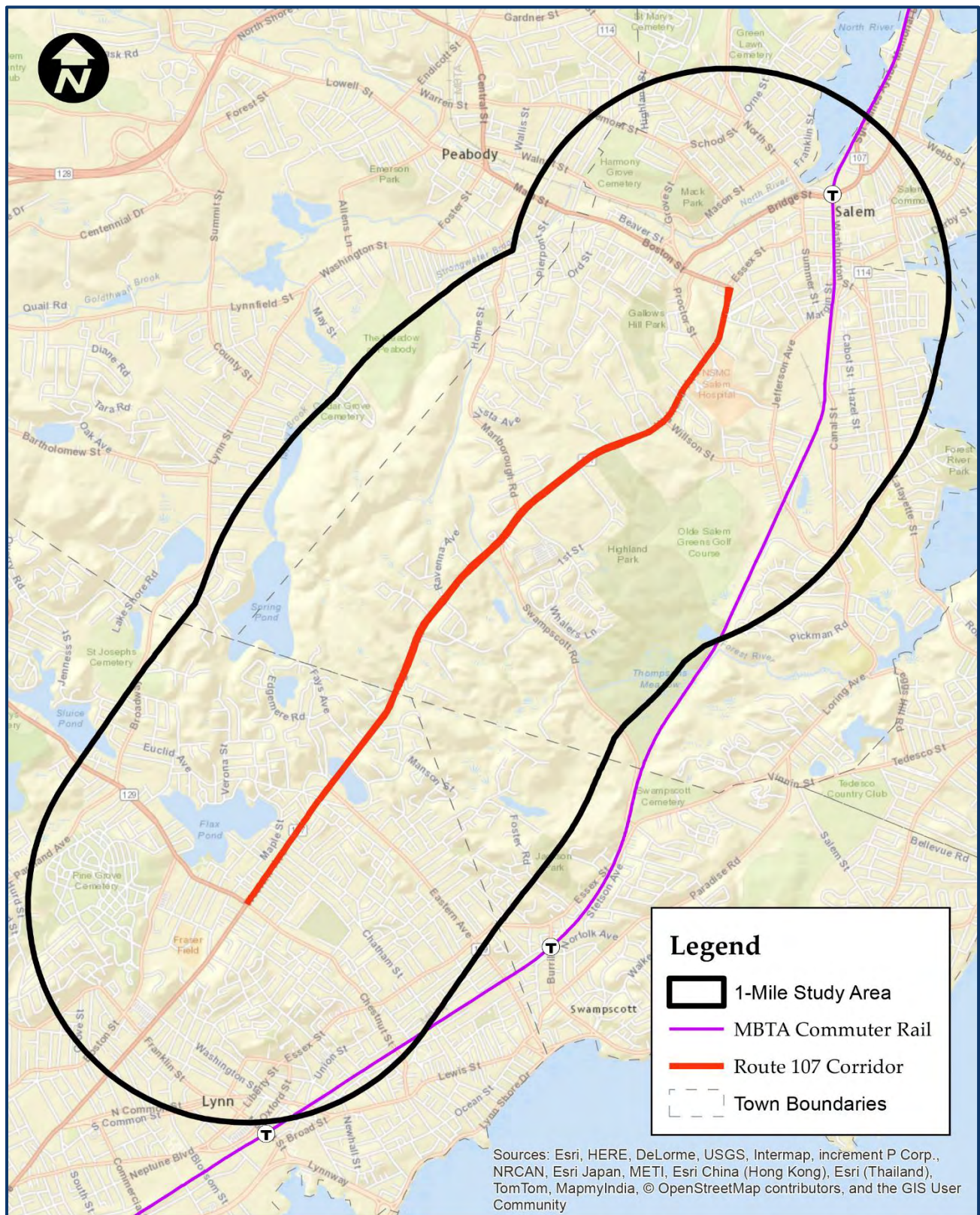


Figure I-3: Route 107 Study Area

Initially, the study area included ten key intersections. At the suggestion of the Working Group, the study area was expanded northerly and southerly to include five additional key intersections; two in Lynn and three in Salem. The fifteen intersections included in the study area are shown in Figure I-4 and listed below:

## Intersections in Salem

1. Essex Street (Route 107) at Boston Street (Route 107)
2. Essex Street/Highland Avenue (Route 107) at Jackson Street/ Dalton Parkway
3. Highland Avenue (Route 107) at Hospital Lower Driveway
4. Highland Avenue (Route 107) at Willson Street/Cherry Hill Avenue
5. Highland Avenue (Route 107) at the Hawthorne Square Mall Shopping Center Driveway
6. Highland Avenue (Route 107) at Marlborough Road/Traders Way
7. Highland Avenue (Route 107) at Swampscott Road/Dipietro Avenue
8. Highland Avenue (Route 107) at Barnes Road/Ravenna Avenue
9. Highland Avenue (Route 107) at Olde Village Drive
10. Highland Avenue (Route 107) at the Wal-Mart Driveway

## Intersections in Lynn

1. Western Avenue (Route 107) at Fays Avenue
2. Western Avenue (Route 107) at Eastern Avenue
3. Western Avenue (Route 107) at Maple Street/Waitt Avenue/President Street
4. Western Avenue (Route 107) at Chatham Street
5. Western Avenue (Route 107) at Chestnut Street (Route 129A)





Figure I-4: Study Area Intersections



## II. EXISTING CONDITIONS

### A. INTRODUCTION

The Route 107 study area extends from the south at Chestnut Street in Lynn approximately 3.7 miles to the north to Boston Street in Salem. The study area has three fairly distinct roadway segments that are characterized by the overall right-of-way width and adjacent land uses. The southern roadway segment of the Route 107 study area extends from Chestnut Street to the Salem/Lynn City line. This segment features a 66-foot right-of-way and is primarily one lane in each direction providing access to adjacent residential housing and small commercial properties. The central roadway segment from the Lynn/Salem City line to Freeman Road features a 90-foot right-of-way and is primarily characterized by two travel lanes in each direction with large commercial properties along both sides of the roadway. The northernmost segment of the Route 107 study area from Freeman Road to Boston Street features a 60-foot right-of-way and provides access to schools, hospitals and residential uses via one or two travel lanes in each direction. The roadway segments as described here are depicted in Figure II-1.

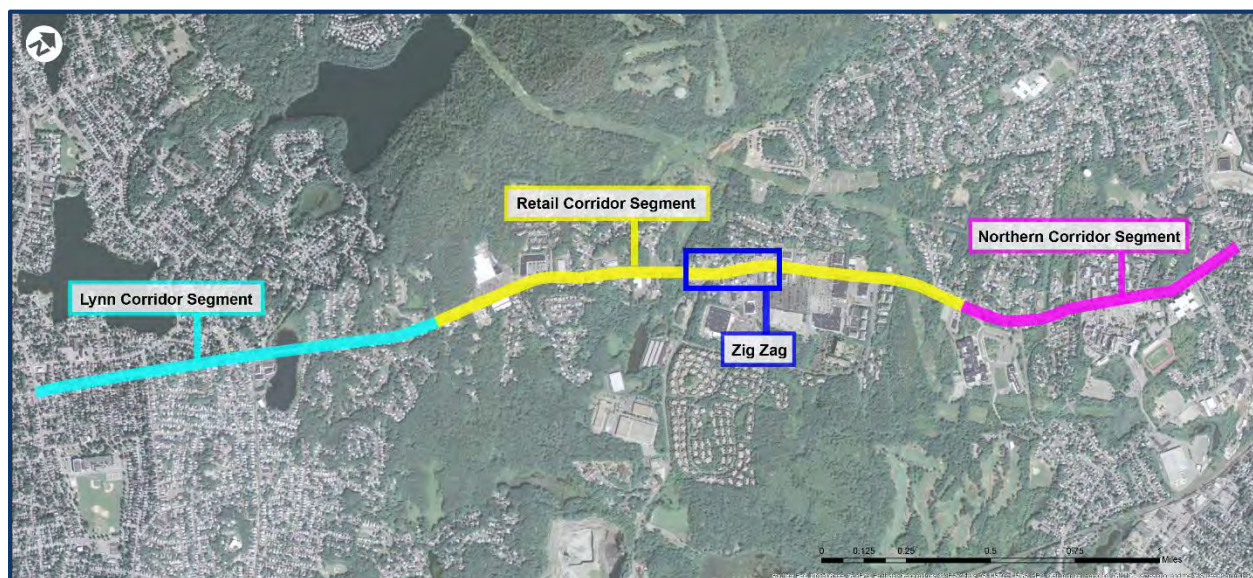


Figure II-1: Route 107 Segments

The jurisdiction of Route 107 varies, with MassDOT jurisdiction extending from the southern end of the Buchanan Bridge to Greenway Road and the remainder of the study area falling under the jurisdiction of the local municipalities, as depicted in Figure II-2. The study area of the Route 107 study includes 15 intersections, of which thirteen are signalized and two are unsignalized, as shown in Figure I-4 in Chapter 1. Table II.1 below summarizes the location, jurisdiction, and traffic control for each of the 15 study area intersections.



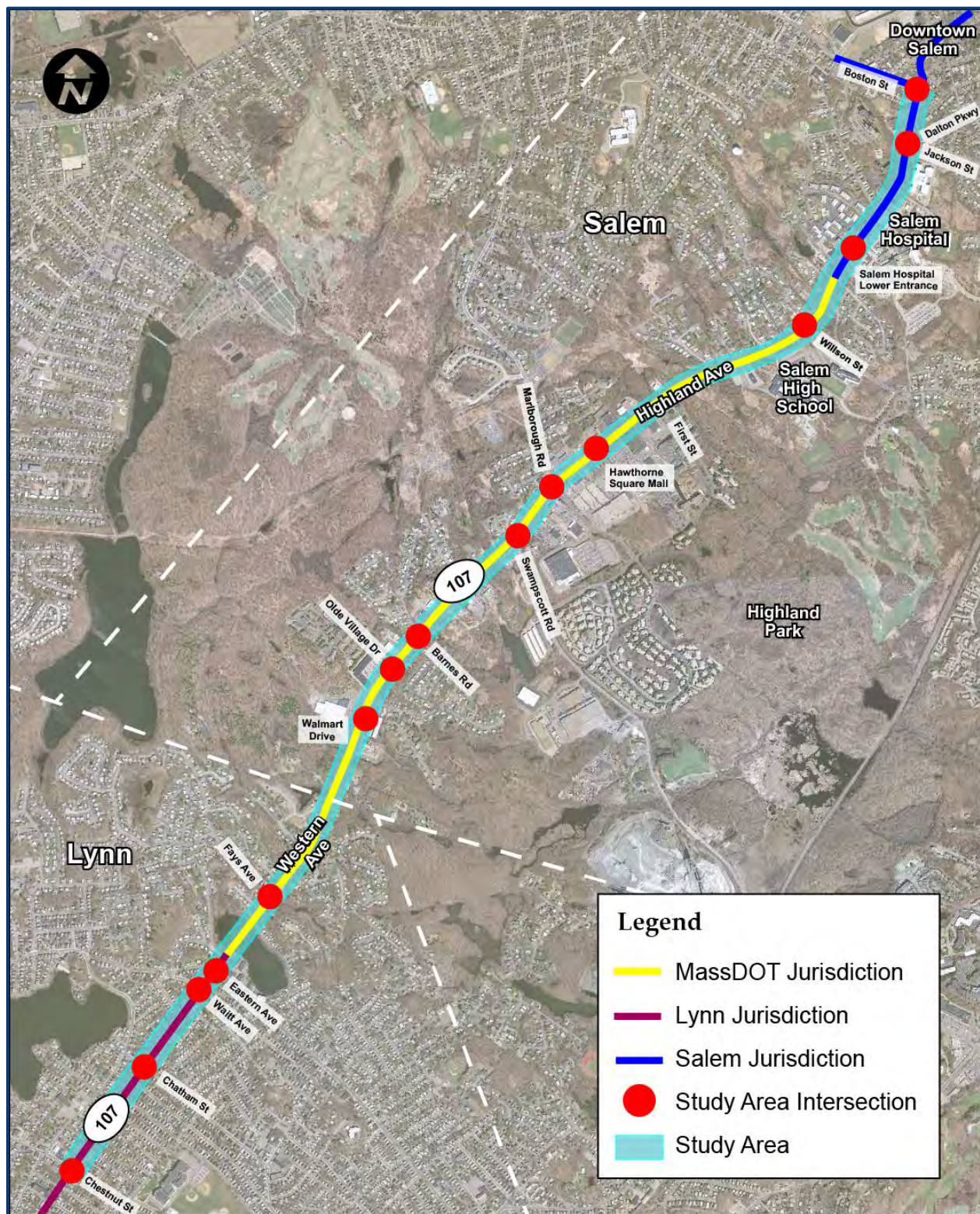


Figure II-2: Route 107 Jurisdictions

Table II.1: Intersection Summary

Intersection	City	Jurisdiction	Control
Chestnut Street	Lynn	Local	Signalized
Chatham Street	Lynn	Local	Signalized
Maple Street/Waitt Avenue	Lynn	Local	Signalized
Eastern Avenue/Stamwood Street	Lynn	Local	Unsignalized
Fays Avenue	Lynn	MassDOT	Signalized
Walmart Driveway	Salem	MassDOT	Signalized
Olde Village Drive	Salem	MassDOT	Signalized
Barnes Road/Ravenna Avenue	Salem	MassDOT	Signalized
Swampscott Road/Dipietro Avenue	Salem	MassDOT	Signalized
Marlborough Road/Traders Way	Salem	MassDOT	Signalized
Hawthorne Square Mall/Site Drive	Salem	MassDOT	Signalized
Cherry Hill Avenue/Willson Street	Salem	MassDOT	Signalized
Lower Driveway of Salem Hospital	Salem	Local	Unsignalized
Jackson Street/Dalton Parkway	Salem	Local	Signalized
Boston Street (Route 107)	Salem	Local	Signalized

## B. TRAFFIC CONDITIONS

### 1. DATA COLLECTION

#### Turning Movement Counts

In order to determine peak hour traffic volumes within the Route 107 study area, turning movement counts were collected at the fifteen study area intersections, shown in Figure II-3. To assess peak hour traffic conditions, manual turning movement counts were conducted at each of the study area intersections, during the weekday morning (7:00AM-10:00AM), weekday afternoon (3:00PM-7:00PM), and Saturday midday (10:00AM-2:00PM) peak periods. The intersection counts were collected on fair weather days and collected the volume of motor-vehicles, heavy vehicles, bicyclists, and pedestrians during each of the peak periods studied.



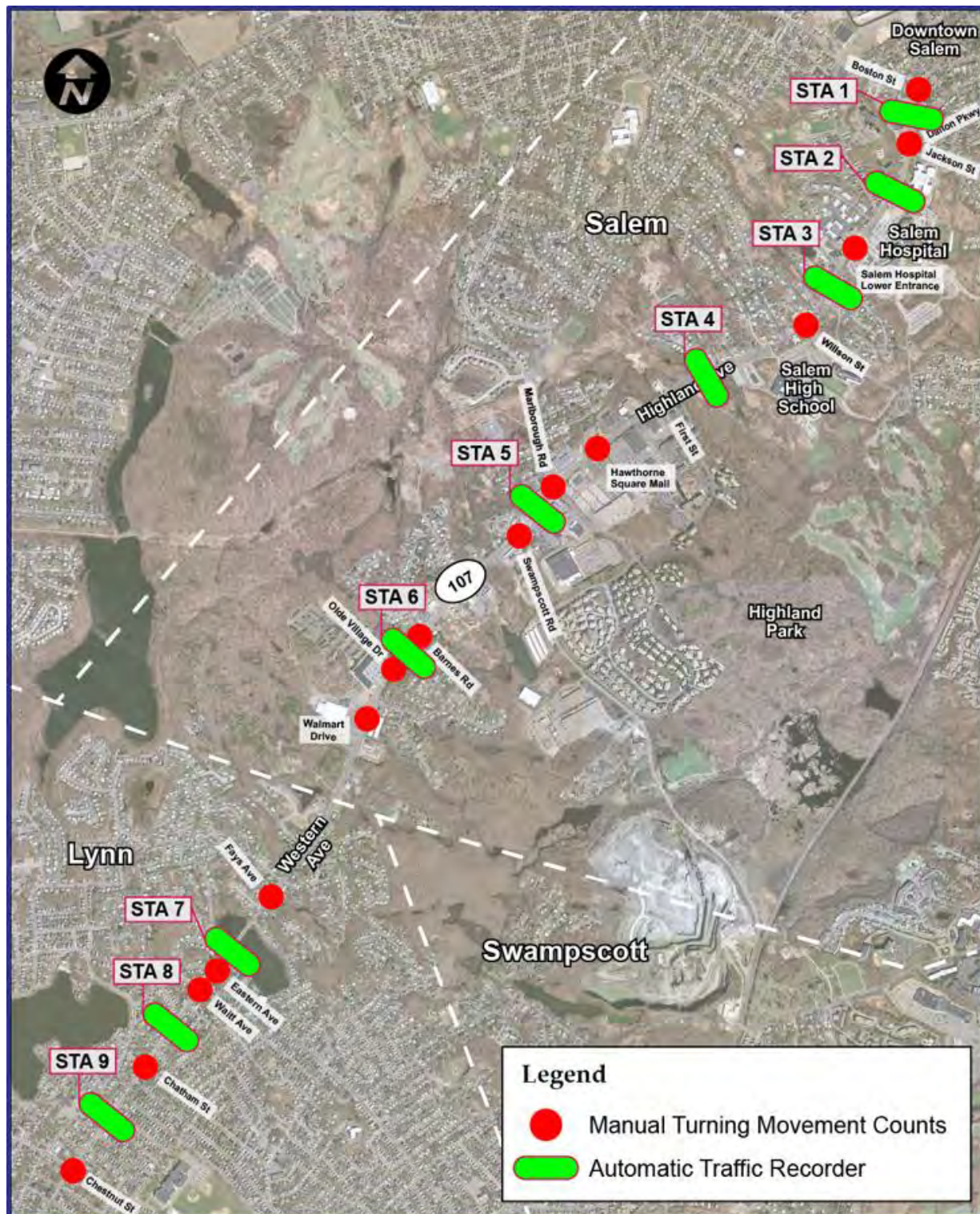


Figure II-3: Route 107 Turning Movement Counts

Turning movement counts were collected on Thursday, April 2, 2015 and on Saturday, April 11, 2015 for the original ten intersections as listed below:

#### Intersections in Lynn

- Route 107 (Western Avenue) at Maple Street/Waitt Avenue
- Route 107 (Western Avenue) at Eastern Avenue/Stamwood Street
- Route 107 (Western Avenue) at Fays Avenue

#### Intersections in Salem

- Route 107 (Highland Avenue) at Walmart Driveway
- Route 107 (Highland Avenue) at Olde Village Drive
- Route 107 (Highland Avenue) at Barnes Road/Ravenna Avenue
- Route 107 (Highland Avenue) at Swampscott Road/Dipietro Avenue
- Route 107 (Highland Avenue) at Marlborough Road/Traders Way
- Route 107 (Highland Avenue) at Hawthorne Square Mall Shopping Center Driveway
- Route 107 (Highland Avenue) at Cherry Hill Avenue/Willson Street

Additional intersection turning movement count data was collected for the expanded study area intersections on Thursday, July 30, 2015 and Saturday, August 1, 2015 at the following locations:

#### Intersections in Lynn

- Route 107 (Western Avenue) at Chestnut Street
- Route 107 (Western Avenue) at Chatham Street

#### Intersections in Salem

- Route 107 (Highland Avenue) at Salem Hospital Lower Driveway
- Route 107 (Highland Avenue/Essex Street) at Jackson Street/Dalton Parkway
- Route 107 (Essex Street) at Boston Street (Route 107)

The results of the manual turning movement counts are tabulated by 15-minute periods and are provided in the Appendix of this report. Based on the traffic counts, the study area-wide weekday morning peak hour occurs between 7:15 AM and 8:15 AM, the study area-wide weekday afternoon peak hour occurs between 3:30 PM and 4:30 PM and study area-wide the Saturday midday peak hour occurs between 12:15 PM and 1:15 PM.



### Automatic Traffic Recorders

Automated traffic recorder (ATR) data was collected at nine locations along Route 107 within the study area, as depicted in Figure 2.3 above. Traffic volume data was collected for a seven-day period to provide average daily traffic volumes at each location within the study area. The ATR data collection was completed from Tuesday, March 31, 2015 through Monday, April 6, 2015 and from Wednesday, July 29, 2015 through Tuesday, August 4, 2015. Traffic volumes recorded along Route 107 by the ATRs are shown in Figure II-4. The ATR data is provided in the Appendix.

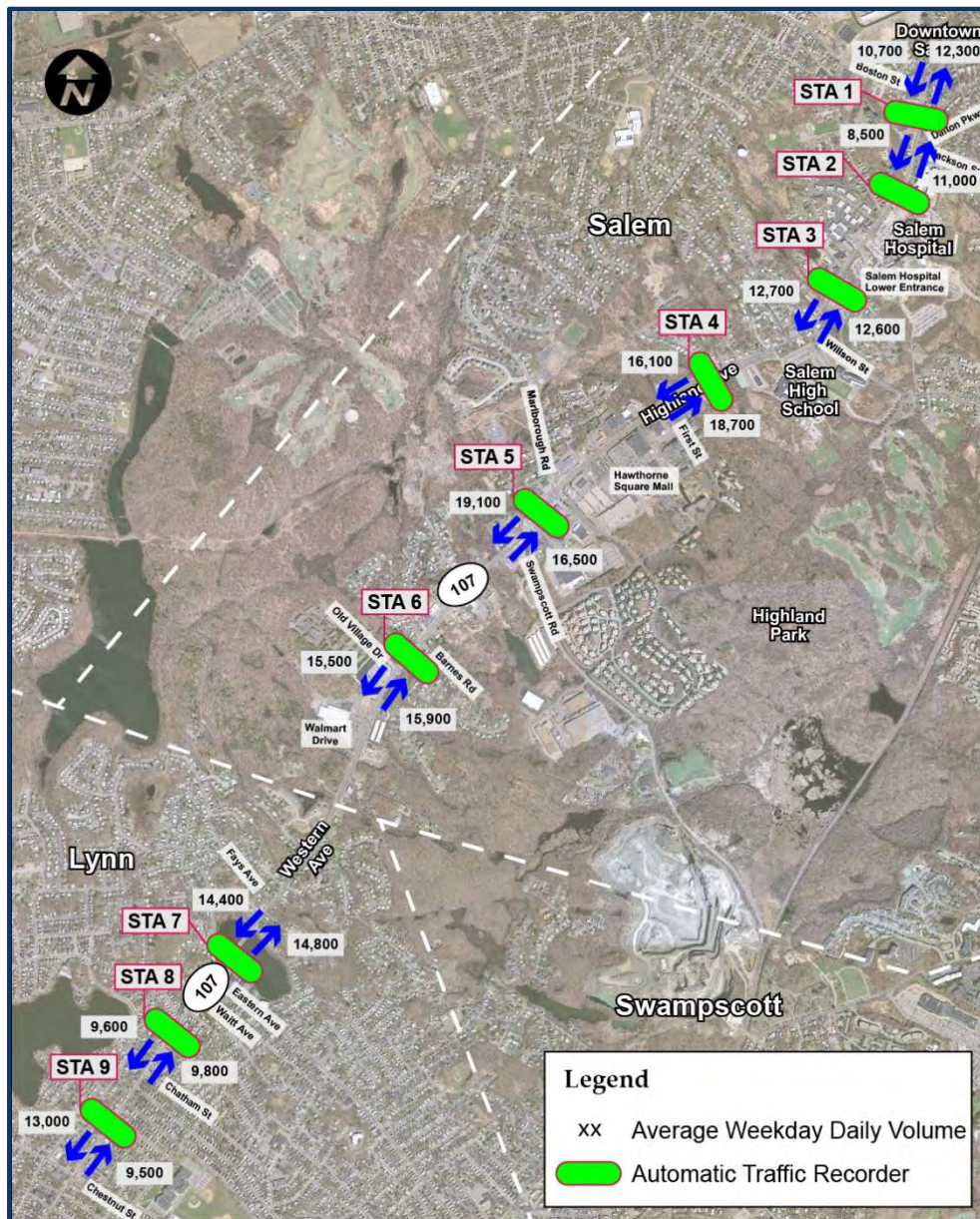


Figure II-4: Route 107 ATR Volumes

### Origin-Destination

An origin-destination (O-D) study was completed between the intersections of Route 107 and Marlborough Road/Traders Way and Route 107 and Swampscott Road. The O-D survey was used to determine the amount of traffic using Route 107 to travel between Marlborough Road and Swampscott Road, also known as the zig zag. To determine the number of vehicles traveling from Swampscott Road to Marlborough Road via Route 107, license plates were recorded for westbound vehicles turning right from Swampscott Road onto Route 107 and for northbound vehicles turning left from Route 107 onto Marlborough Road from Route 107. To determine the number of vehicles traveling from Marlborough Road to Swampscott Road via Route 107, license plates were recorded for the eastbound right turn from Marlborough Road onto Route 107 and for the southbound left turn from Route 107 onto Swampscott Road. The license plate data was then matched to determine the number of vehicles completing the zig zag movement in each direction.

The O-D data was collected for two consecutive hours during each of the peak periods on Thursday, April 9, 2015 from 7-9 AM and 4-6 PM and on Saturday, April 11, 2015 from 11:30 AM to 1:30 PM. The results of the O-D study are depicted in Figure II-5. The results of the zig zag movement were fairly consistent in each direction. Nearly half of the traffic turning left from Route 107 northbound to Marlborough Road originated on Swampscott Road. Similarly nearly half of the traffic turning left from Route 107 southbound onto Swampscott Road originated from Marlborough Road.

### Deficiency Audit

The roadway conditions were cataloged throughout the study area to identify deficiencies for each mode within the study area. Operational observations were conducted at each study area intersection during the peak periods of travel. The findings of the deficiency audit are discussed in further detail in subsequent sections of this study.

### Vehicles

Data collected for vehicles was used primarily to model vehicle delays and queues within the study area. Lane configurations, traffic volumes, and queue calibration were utilized to set up the existing conditions in Synchro, a computerized capacity analysis program.



### NB Left @ Marlborough from WB Right @ Swampscott



**Weekday AM**  
(155)



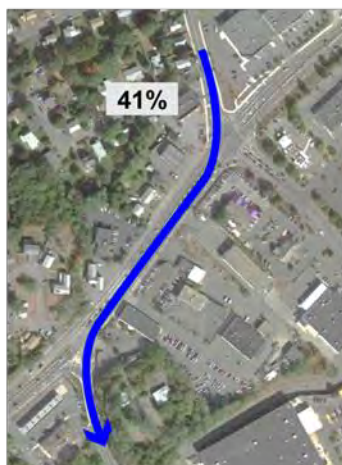
**Weekday PM**  
(174)



**Saturday Midday**  
(175)

Time Period  
(# Vehicles)

### SB Left @ Swampscott from EB Right @ Marlborough



**Weekday AM**  
(144)



**Weekday PM**  
(167)



**Saturday Midday**  
(144)

Time Period  
(# Vehicles)

Figure II-5: Results of O-D Study

### Traffic Lane Configurations

Lane configurations at each of the study area intersections within the Route 107 study area were inventoried using existing traffic signal plans and record plans and then were verified in the field. In the southern Lynn section, Route 107 typically provides one travel lane in each direction with on-street parking on both sides of the street. North of Fays Avenue, through the commercial section in Salem, Route 107 provides two lanes travel lanes with auxiliary turn lanes in each direction with no on-street parking. North of the lower Salem Hospital driveway, the Route 107 study area reduces to one travel lane in each direction with auxiliary turn lanes at signalized intersections and limited on-street parking. The lane configurations for each for the study area intersections are presented in Figure II-6.

### Seasonal Adjustment

Traffic count data varies throughout the year due to seasonal activities. Based upon continuous count data in the vicinity of the study area, traffic volumes collected during the months of April and July are higher than traffic volumes for the average month by approximately 1% to 7%. Therefore, to provide a conservative analysis, the existing peak hour traffic volumes were not seasonally adjusted.

### Traffic Volume Summary

Based on a review of the traffic count data, the weekday morning and weekday afternoon peak hours on Route 107 occur between 7:15 AM and 8:15 AM and 3:30PM and 4:30PM, respectively. The Saturday midday peak hour is shown to occur between 12:15 PM and 1:15 PM. The existing peak hour traffic volumes are shown graphically in Figure II-7, Figure II-8, and Figure II-9 for the weekday morning, weekday afternoon, and Saturday midday peak hours, respectively. Detailed traffic volume schematics are provided in the Appendix.

Truck percentages along Route 107 were calculated based upon vehicle classification data collected for this study. The daily truck percentages along Route 107 are generally two percent of the total traffic.

Trucks are permitted to travel along Route 107 in the study area. There are truck exclusions on roadways that intersect with Route 107 in the study area including the following:

- Marlborough Road
- Colby Street
- Proctor Street
- Dalton Parkway
- First Street



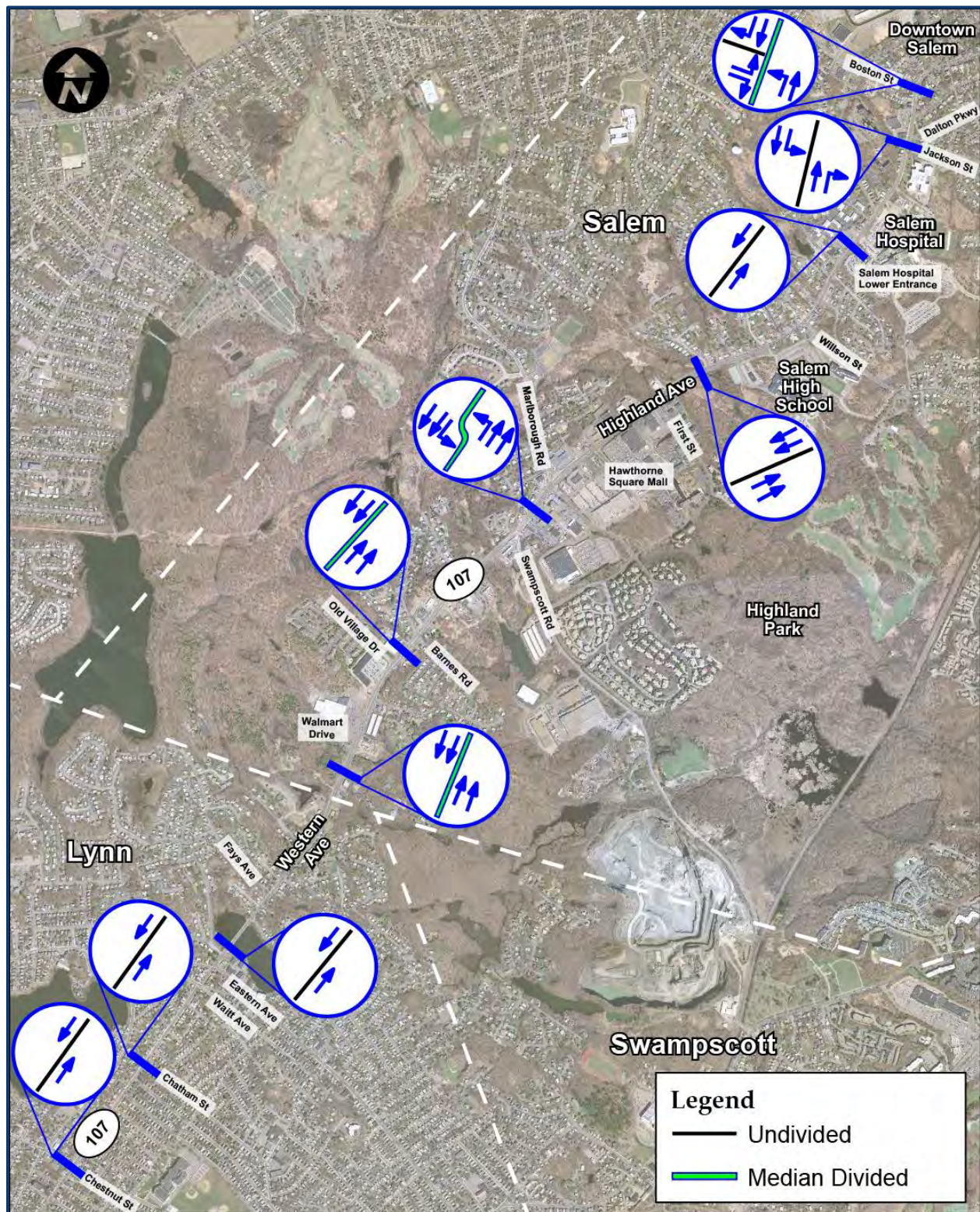


Figure II-6: Route 107 Lane Configurations



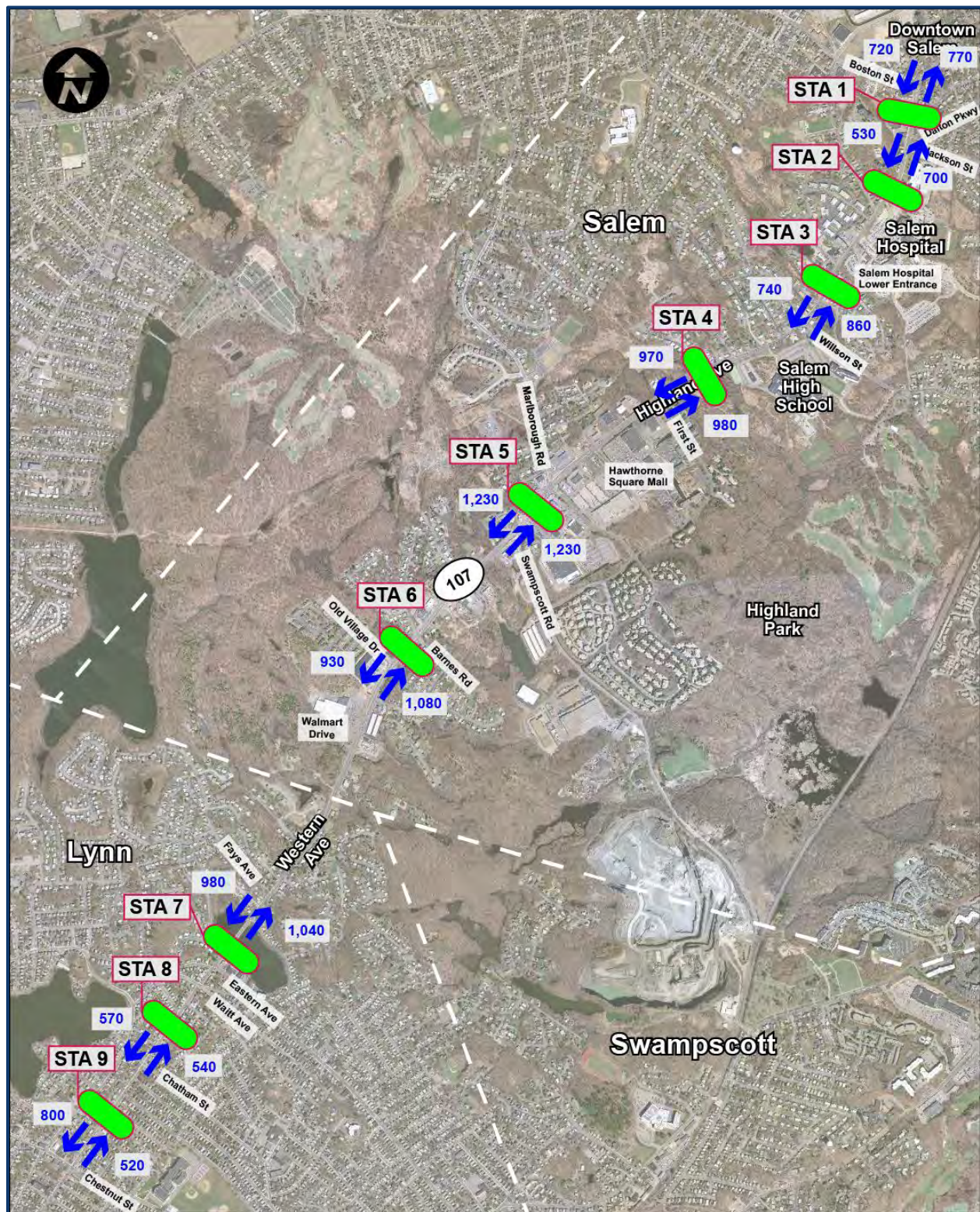


Figure II-7: Existing AM Peak Hour Traffic Volumes



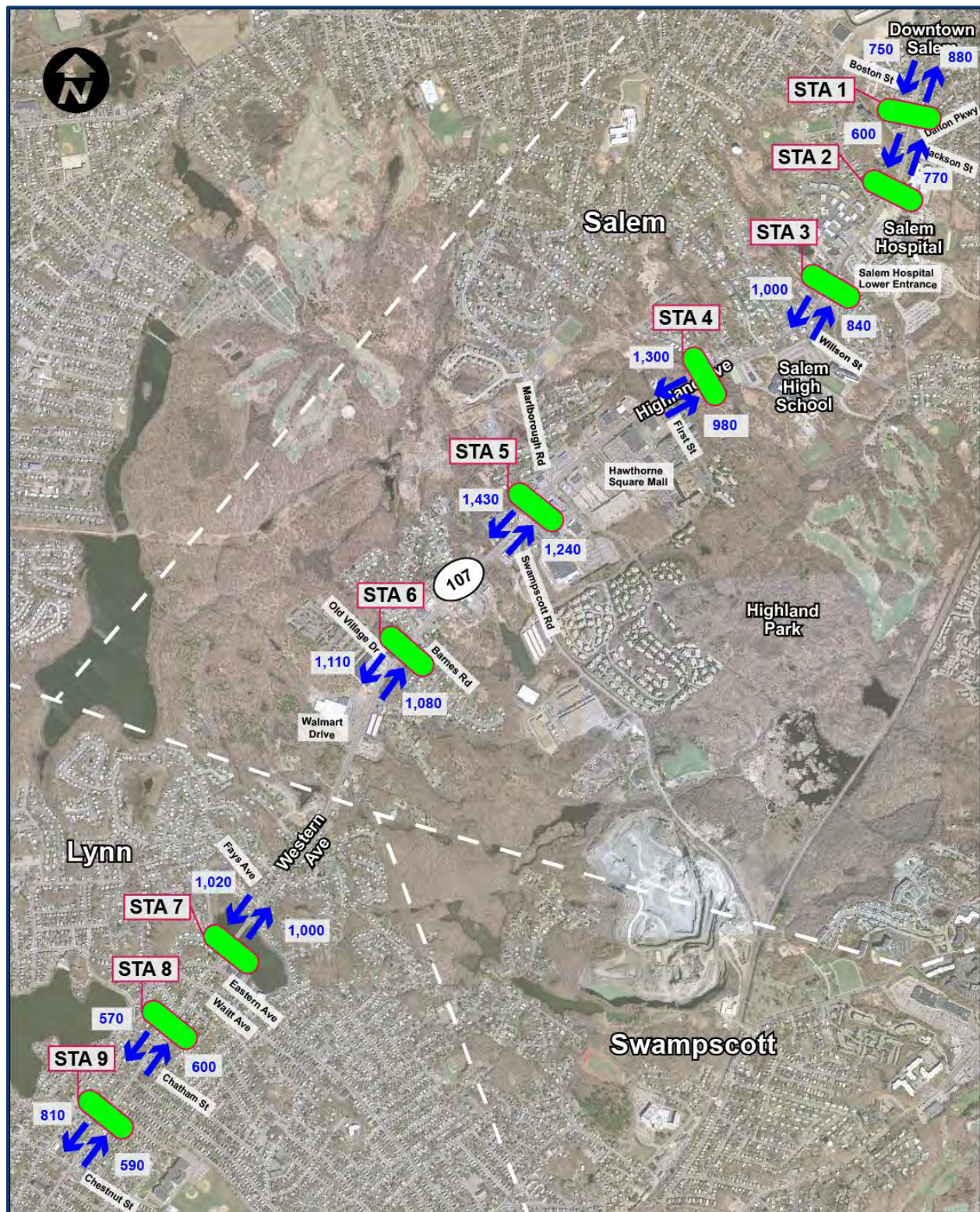


Figure II-8: Existing PM Peak Hour Traffic Volumes



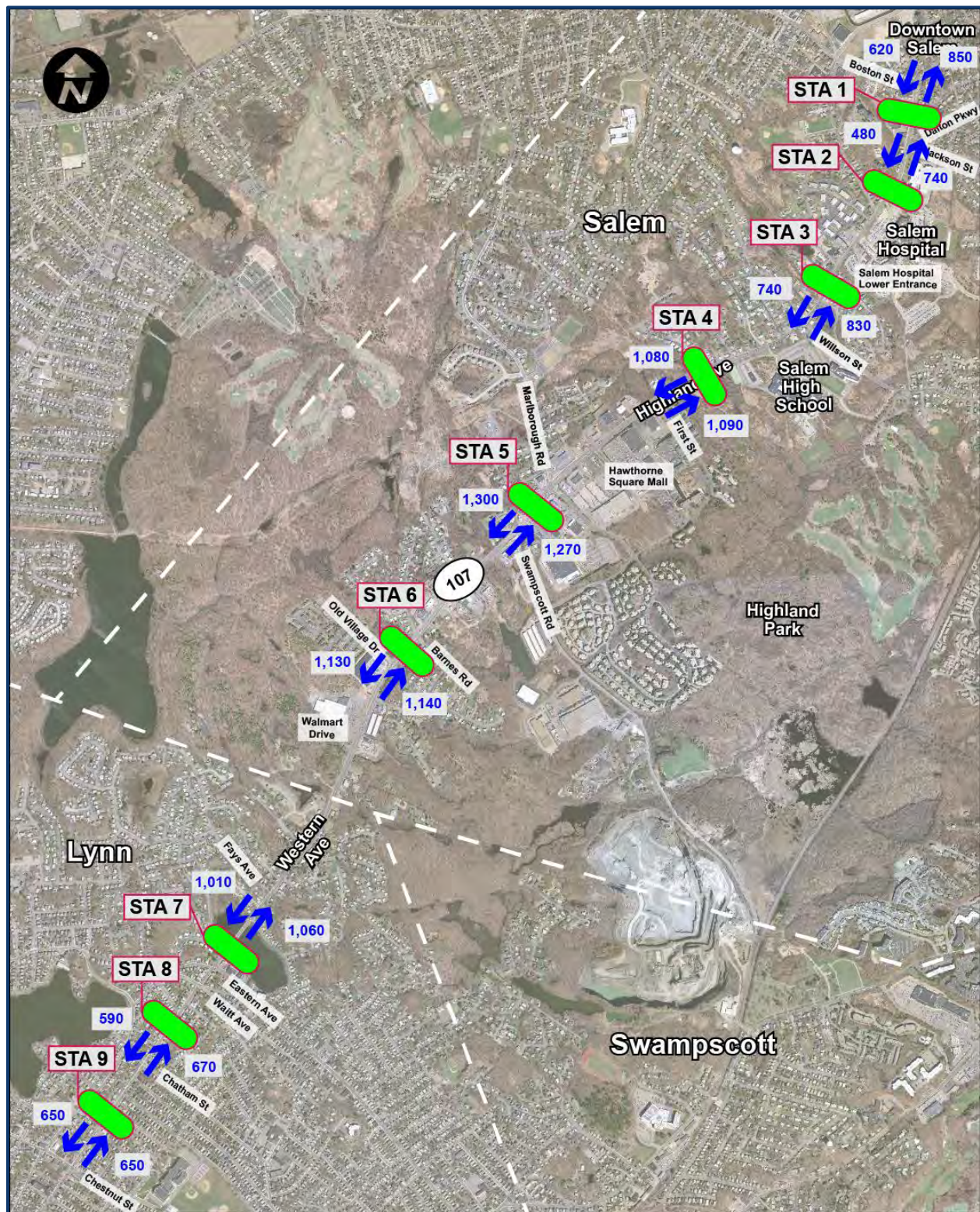


Figure II-9: Existing SAT Peak Hour Traffic Volumes



Each of the roadways listed above have a 24 hour exclusion on all vehicles 2.5 tons and over.

In addition to the vehicular volumes, pedestrian and bicycle volumes were also recorded. Pedestrian volumes are shown in Figure II-10 for the weekday morning, weekday afternoon, and Saturday midday pedestrian volumes occurring during the vehicular peak hour. Figure II-11 depicts hourly bicycle volumes for the weekday morning, weekday afternoon, and Saturday midday vehicular peak hours.

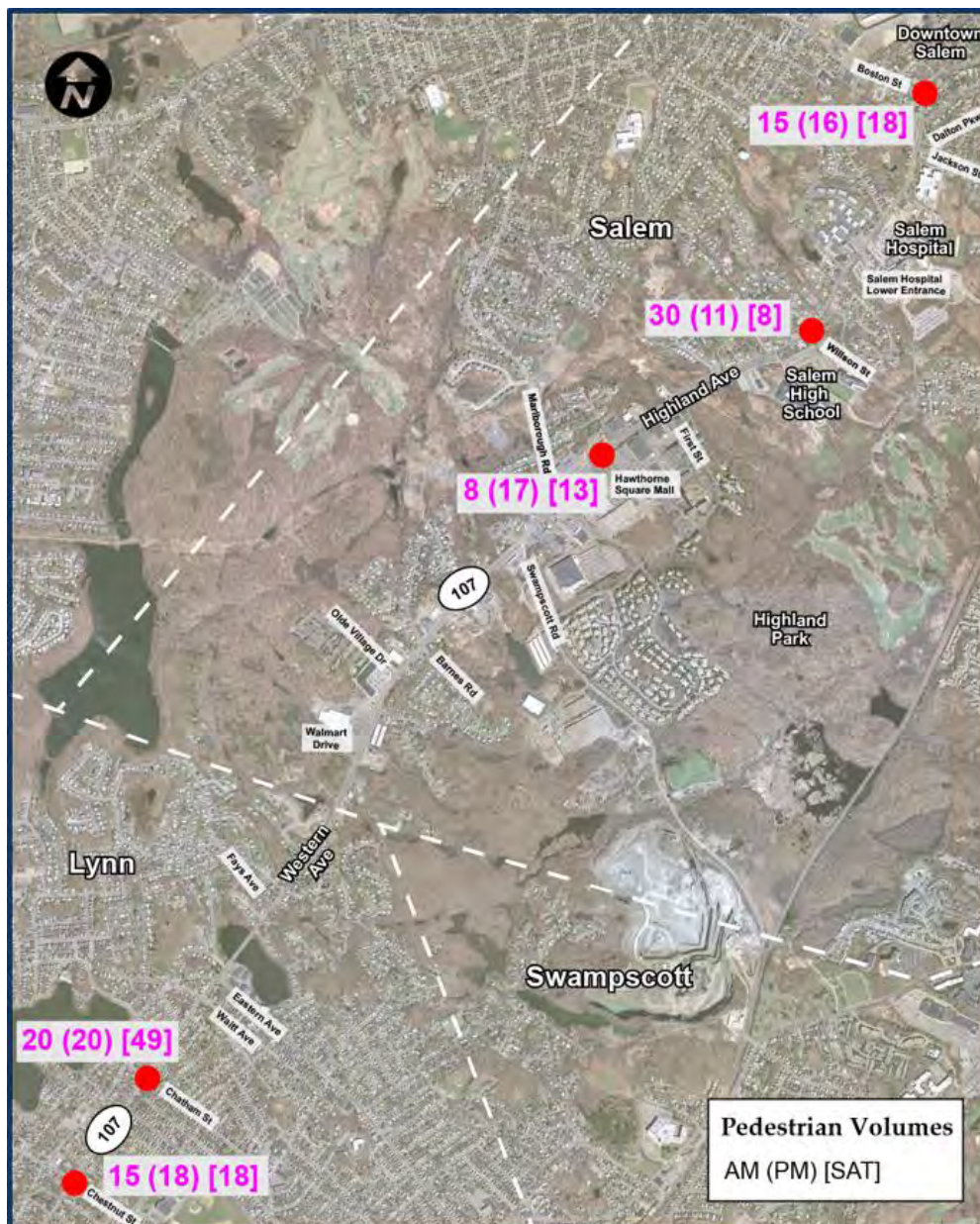


Figure II-10: Pedestrian Volumes



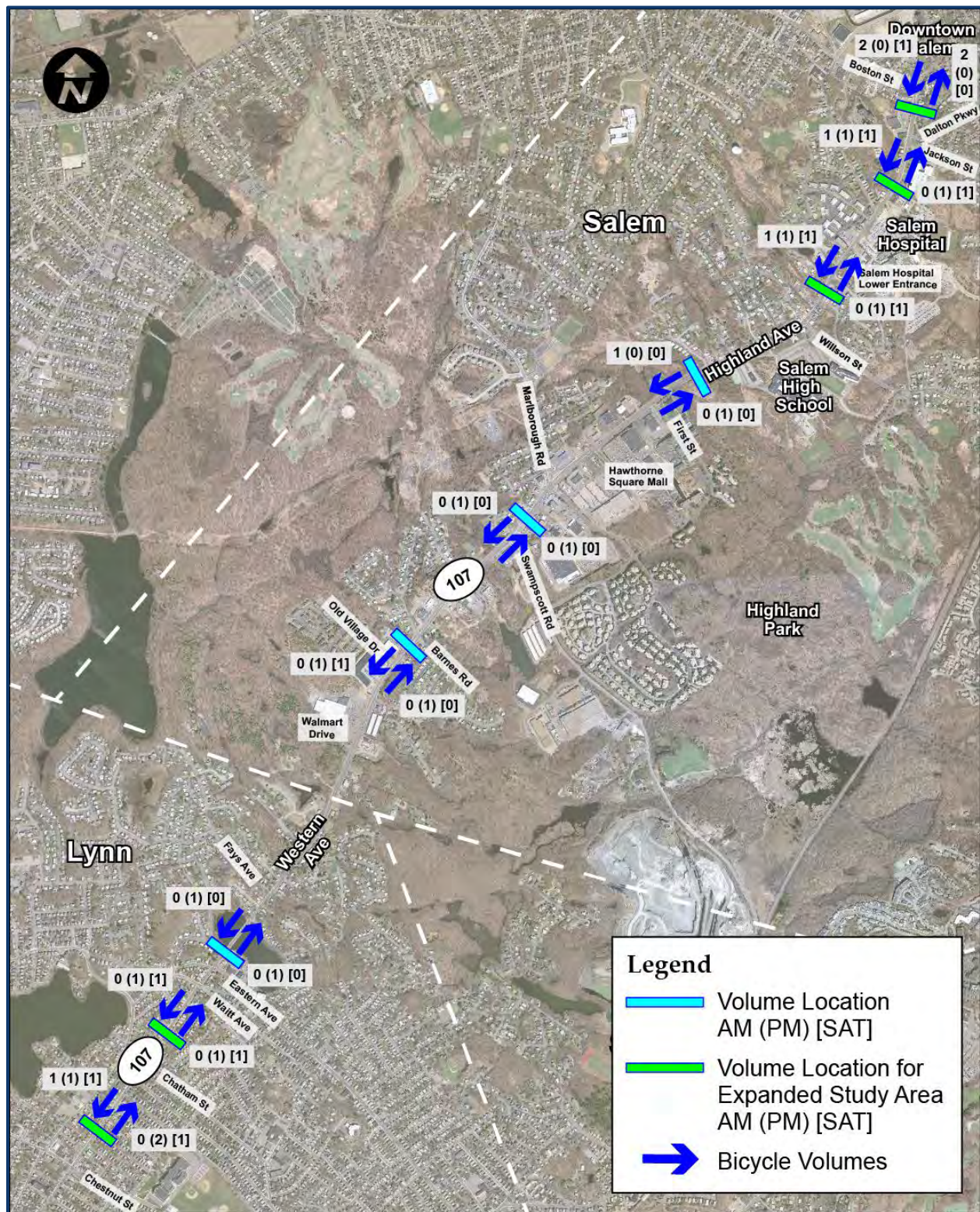


Figure II-11: Bicycle Volumes



## Vehicle Speeds

Vehicle speeds were measured by the ATRs placed along Route 107. The speed limits within the study area range from 30 miles per hour to 45 miles per hour. Figure II-12 depicts the posted speed limits along Route 107 and 85<sup>th</sup> percentile speeds calculated at each of the ATR locations. The 85<sup>th</sup> percentile speed is the speed that 85 percent of the vehicles do not exceed, and is generally recognized as a reasonable speed for prudent drivers. In the southern and retail segments of the study area, the 85<sup>th</sup> percentile speeds were within reasonable range of the posted speed limits. In the northern segment of the study area, the 85<sup>th</sup> percentile speeds were found to be in excessive of 10 miles over the posted speed limits.



Figure II-12: Route 107 Weekday Speeds



## Vehicle Queue Observations

Vehicle queue observations were completed at each of the 15 study area intersections during the weekday morning, weekday afternoon and Saturday midday peak periods. Queues measured in the field were then utilized to evaluate the results of the existing conditions capacity analysis. Minor modifications to the intersection capacity analysis were completed in order to more accurately reflect the field observed traffic operations.

## Capacity Analysis

Intersection capacity analyses were completed as part of this study in order to review traffic flow at each of the study area intersections for the given travel demands. As a basis for this assessment, intersection capacity analyses were conducted using Synchro capacity analysis software for the study area intersections under the 2015 existing peak hour traffic conditions. The analyses are based on procedures contained in the 2010 Highway Capacity Manual (HCM) for the weekday morning, weekday afternoon and Saturday midday peak hours. 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). Typically LOS D and above are considered acceptable. More detail on the capacity/level of service analysis methodology is provided in the Appendix. As noted previously, the existing year capacity analyses were calibrated in order to more accurately reflect observed traffic operations in the field. Figure II-13 illustrates weekday morning, afternoon, and Saturday LOS at each study intersection.

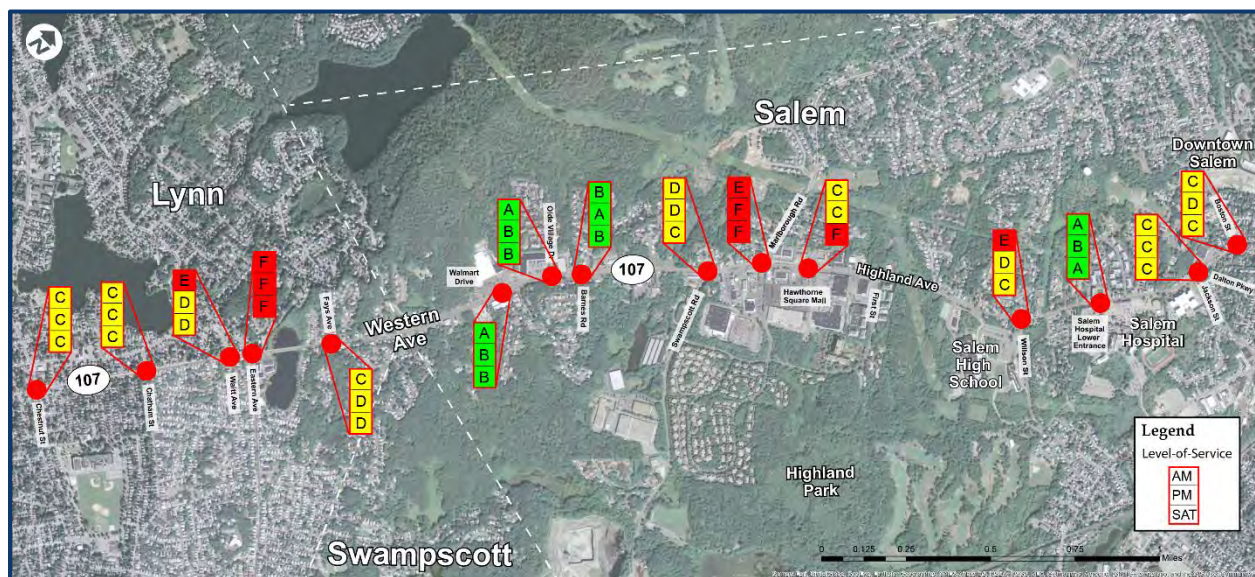


Figure II-13: Route 107 Intersection LOS

The detailed Synchro capacity analysis worksheets for the existing conditions are presented in the Appendix of this study. A full summary of capacity and queue analyses for each of the study area intersections during the weekday morning, weekday afternoon and Saturday midday peak hours are also presented in the Appendix for reference.

## 2. PEDESTRIAN ACCOMMODATIONS

The Route 107 study area is 3.7 miles long, providing for the potential of approximately seven miles of sidewalk, with sidewalk on each side of the road. Of the seven potential miles of sidewalk along Route 107, approximately two miles of roadway is currently not covered by sidewalk. The missing sidewalk is primarily on the western side of Route 107 adjacent to Walmart and north of the Hawthorne Square Mall Shopping Center. The average sidewalk width within the study area is five feet. The narrowest portion of clear space along the sidewalk is two feet in Salem, just east of the Lynn city line and the widest portion of the sidewalk system is ten feet in Lynn, between Chatham Street and President Street.

Pedestrians of all ages and abilities were observed traveling within the Route 107 roadway itself and not in a sidewalk area, presumably because of the width and/or poor condition of the sidewalk, as seen in Image II.1. There are several areas where the sidewalk is not well defined, and blends into driveways and abutting parking lots, enabling parked and moving vehicles to encroach upon the pedestrian realm, as seen in Image II.2. There are many examples of locations where there is a lack of definition between pedestrian space and vehicular space such as in the vicinity of the following Salem locations: Tropical Products at 220 Highland Avenue, Highland Avenue Auto Body at 455 Highland Avenue and 86 Highland Avenue. There are also several abandoned curb cuts, including one at the Salem Hospital parking lot. Another recurring condition throughout the study



**Image II.1: Sidewalks are so poor that wheelchair user opts to travel in the roadway, westside opposite Salem Hospital.**



**Image II.2: Vehicles parked across driveway entrance, impeding pedestrian travel outside Highland Ave Auto Body.**





**Image II.3: Long pedestrian crossing with no refuge island, or pedestrian signal heads, at entrance to Target/Market Basket.**

area is the presence of debris on sidewalks. The debris is often an obstruction to pedestrians and contributes to the lack of a pedestrian-oriented environment.

Pedestrian crossings within the study area are varied. Crosswalks are intermittently provided throughout the study area, but there is generally a lack of crosswalks across the side street approaches to Route 107. There are also several pedestrian crossings that are long; requiring pedestrians to cross four to five lanes of traffic without refuge and without appropriate pedestrian control, as is seen in Image II.3, at the entrance to Hawthorne Square Mall Shopping Center. Where crosswalks do exist within the study area, many of the curb ramps associated with the crosswalks are either in poor condition or missing entirely. There is one elevated pedestrian crossing just north of Crowdis Street next to Salem High School, shown in Image II.4.



**Image II.4: Elevated pedestrian crossing northbound approaching pedestrian bridge at school.**

Pedestrian volumes at select sites within the study area are shown in Figure II-14.



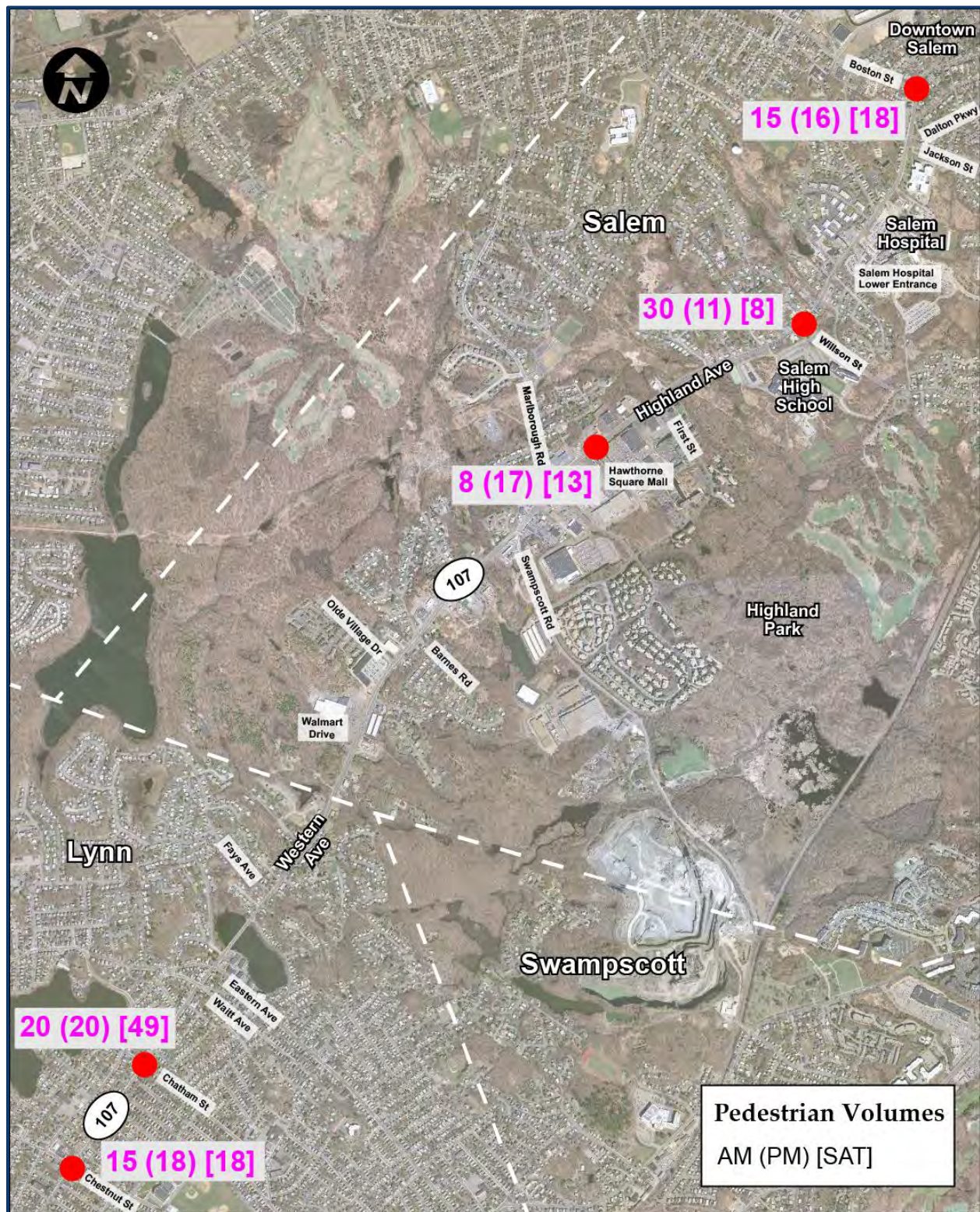


Figure II-14: Pedestrian Volumes Along the Corridor



### 3. BICYCLE ACCOMMODATIONS

In general, bicycle facilities within the study area are lacking. Although some sections of the study area contain wide shoulders where bicyclists may travel, there are no designated bicycle amenities. The lack of bicycle amenities causes bicyclists to utilize the sidewalk, as shown in Image II.5. Bicycle signal actuation signs are provided at several intersections. These signs instruct bicyclists to wait on the bicycle symbol pavement marking to request a green indication.



**Image II.5: Bicyclists riding on the sidewalk, eastside north of Chestnut.**

The northern end of the study area in Salem contains the majority of bicycle facilities in the study area. The City of Salem has both multiuse trails and on-road bicycle facilities. All public roads in Salem can be used as a shared route facility except for the Essex Street Pedestrian Mall between Washington and Liberty Streets in downtown Salem. A recommendation of the 2010 Bicycle Circulation Master Planning Study is for the City of Salem to continue improving multiuse paths and on street bicycle facilities.<sup>2</sup>

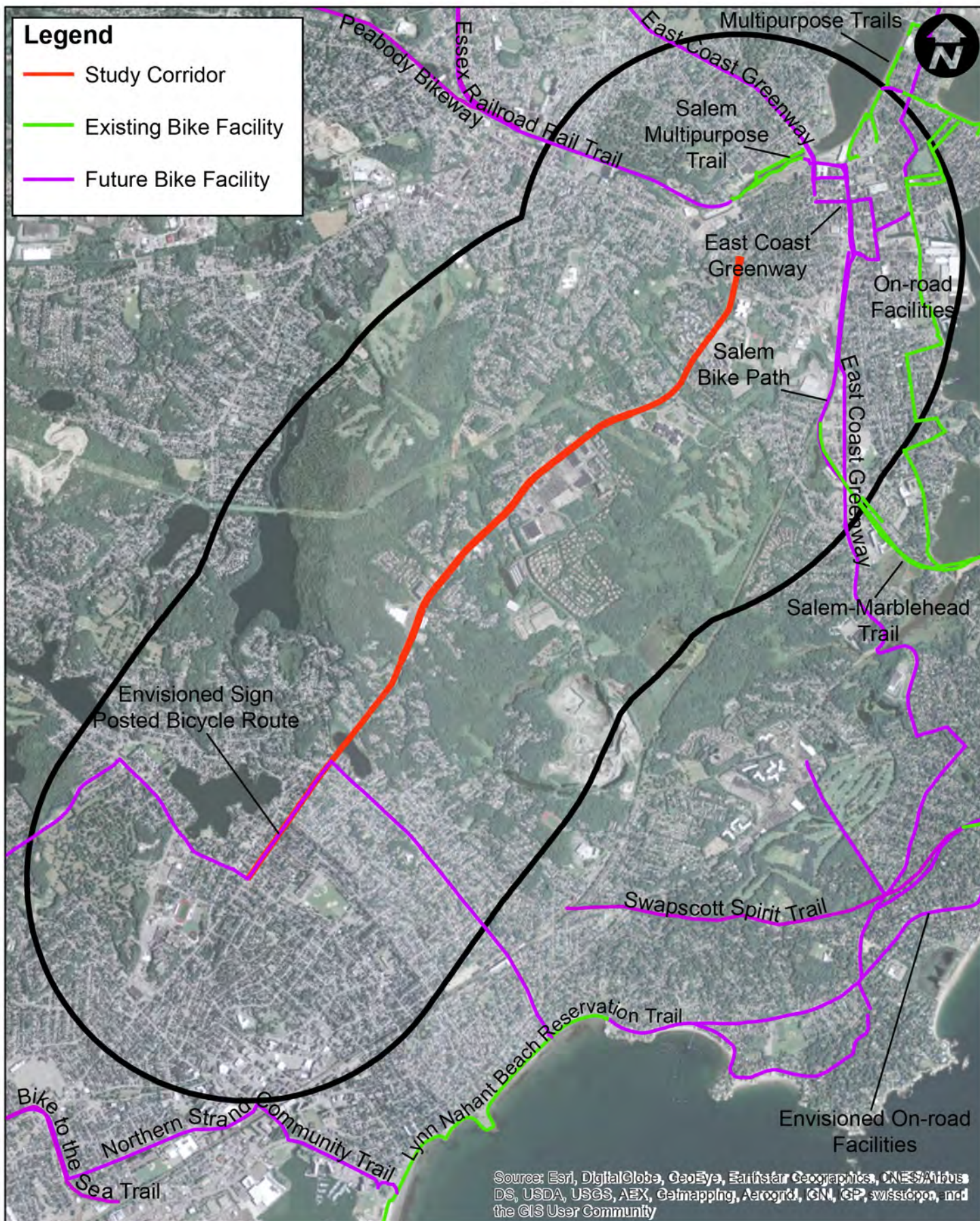
The existing and future bicycle facilities within and in close proximity to the study area are depicted in Figure II-15. The map illustrates the existing bicycle infrastructure on the northern end of the study area in Salem, and the lack of bicycle infrastructure surrounding the study area in Lynn. Route 107 is located between existing, and envisioned bicycle facilities, making it a major gap in the regional bicycle network. The existing infrastructure includes:

- Lynn Nahant Beach Reservation Trail (shared use path), to the southeast,
- East Coast Greenway/Independence Greenway Path (shared use path), in Peabody, to the northwest (completed segments not pictured), and
- Salem-Marblehead Trail
- Several on-road bicycle lanes and multipurpose trails in downtown Salem to the north east.

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<sup>2</sup> Bicycle Circulation Master Planning Study, Fay, Spofford & Thorndike and Salem Bike Path Committee, 2010







Bicycle trails that are in the planning stages and envisioned for the future include:

- Bike to the Sea Trail
- Northern Strand Community Trail
- Swampscott Spirit Trail
- East Coast Greenway through Salem
- Essex Railroad Rail Trail
- Peabody Bikeway

Lincoln Avenue and Parkland Avenue, in Lynn, are envisioned to be sign-posted bicycle routes that would directly connect Route 107 to the regional bicycle network via Route 129A/Eastern Avenue. Route 107 would be connected to regional trails connecting Lynn to Marblehead and Salem to Peabody.

The Bike to the Sea/Northern Strand Community Trail runs through Everett, Malden, Revere, Saugus, and Lynn. The construction of the trail is almost complete, except for the connection in the City of Lynn. The Northern Strand Trail Communities Bicycle and Pedestrian Network Plan prioritizes the completion of this trail, as well as bicycle connections from the trail to major destinations such as schools, central retail districts, and other off-road trails.<sup>3</sup> Currently, there are many gaps in the Lynn bicycle network. The plan identifies the following roadway segments in Lynn that could incorporate a cycle track:

- Boston Street (Ford Street to North Franklin Street)
- Boston Street (Saugus line to Cottage Street)
- Broad Street (Nahant Street to Chestnut)
- Commercial Street (Alley Street to Bennett Street)
- Hanover Street (Chase Street to North Common Street)
- Neptune Boulevard (Blossom Street to Commercial Street)

Bicycle volumes within the study area are shown in Figure II-16.

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<sup>3</sup> Northern Strand Trail Communities Bicycle and Pedestrian Network Plan, July 2013





Figure II-16: Bicycle Volumes Along Corridor



## 4. TRANSIT CONDITIONS

### Bus Routes and Service:

Four MBTA bus routes run along Route 107, within the study area, including routes 424, 434, 450 and 456, as shown in Figure II-17. In addition, Route 436 traverses the study area at Chestnut Street in Lynn. Image II.6 displays Route 456 serving the study area in Salem. The MBTA bus route maps and timetables for these routes are included in the Appendix. Inbound transit rides along Route 107 are traveling southbound and outbound rides are traveling northbound. The ridership data collected for this study is current as of fall 2014.



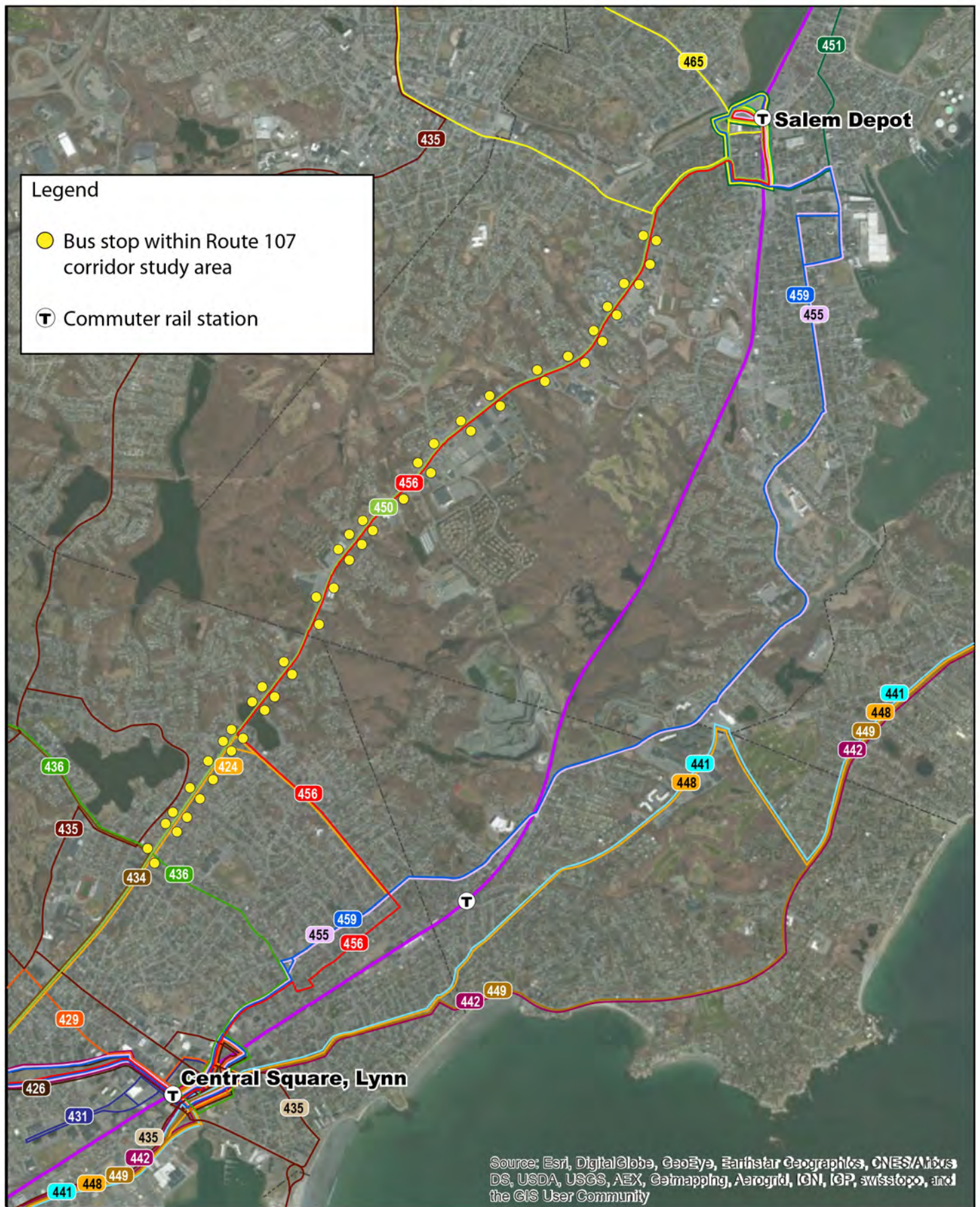
Image II.6: Route 456

Route 424 provides limited service operating from Lynn to Wonderland Station in Revere during the weekday morning peak period, and from Haymarket Station in downtown Boston to Lynn during the weekday afternoon peak period. The average weekday ridership (combined boardings and alightings) on the route was 286 inbound and 183 outbound. Route 424 runs every 30 minutes during the weekday peak period in the morning from 5:50 AM to 8:35 AM and in the afternoon from 4:10 PM to 6:35 PM. The route operates to/from Eastern Avenue and Essex Street in Lynn, and along Western Avenue in the southerly end of the study area.

Route 434 runs once per weekday in each direction, between Peabody Square in Peabody, and Haymarket Station, along Western Avenue south of Chestnut Street. The average weekday ridership on the route was 62 inbound and 48 outbound. The outbound bus stop on Route 107 is nearside of Chestnut Street, meaning that it is located along Route 107 south of Chestnut Street. The inbound bus stop is located on Route 107 north of Chestnut Street. The inbound trip leaves Peabody Square at 6:45 AM and arrives at Haymarket Station at 8:00 AM. The outbound trip departs Haymarket Station at 5:20 PM and arrives at Main Street in Peabody at 6:30 PM.

Route 436 operates between the Lynn Commuter Rail Station and the Liberty Tree Mall in Danvers, traversing Route 107 at the southerly end of the study area on Chestnut Street. Over the course of a typical weekday, approximately 270 riders travel inbound and 355 riders travel outbound. On Saturdays approximately 134 riders traverse Route 107 inbound, and 223 riders travel outbound. Route 436 operates every 20 minutes during the weekday peak periods and every 60-75 minutes during the off-peak periods. The first trip departs Central Square in Lynn at 6:10 AM and the last trip departs the Liberty Tree Mall at 6:40 PM. The route also provides Saturday service from 6:20 AM to 7:15 PM, with service approximately every 70 minutes.







Route 450 provides a more comprehensive regional connection between Boston and the North Shore, running between Haymarket Station in downtown Boston or Wonderland Station in Revere, and the Salem Commuter Rail Station, in downtown Salem. The average weekday ridership on the route is 1,639 inbound and 1,816 outbound. During the weekday peak period, Route 450 provides service every 30 minutes, and during the off-peak service Route 450 operates every 80 minutes. Weekend service generally runs hourly, from 6:30 AM to 12:30 AM on Saturdays, and from 8:30 AM to 11:50 PM on Sundays.

Route 456 provides a local connection between Salem and Lynn, running between the Salem Commuter Rail Station and the Lynn Commuter Rail Station. The average weekday ridership on the route is 230 inbound and 318 outbound. Route 456 provides limited service, only running on weekdays during the daytime. Buses run every 80 minutes, with the first bus departing from Western Avenue, opposite the MBTA Lynn Bus Garage, at 6:52 AM and the last bus departing the Lynn Commuter Rail Station at 3:35 PM. The first bus departs the Salem Commuter Rail Station at 9:40 AM and the last bus departs at 4:20 PM. The combined routes 450 and 456 provide service every 40 minutes during the weekday midday period, throughout the study area.

A summary overview of the predominant bus routes servicing Route 107 within the study area is provided in Table II.2 below.

**Table II.2: Route 107 Primary Bus Service Overview**

		MBTA Route 424 Eastern Ave. /Essex St. - Haymarket or Wonderland	MBTA Route 450 Salem Depot- Haymarket	MBTA Bus Route 456 Salem Depot- Central Sq. Lynn
Average Weekday Ridership (Fall 2014)		240	1,734	275
Span of Service (weekday)		5:50 AM – 6:35 PM	4:45 AM – 1:30 AM	7:00 AM – 5:00 PM
Frequency	Peak	30 minutes	30 minutes	80 minutes
	Off-Peak	n/a	80 minutes	
	Combined	-	40 minutes mid-day on Route 107 corridor	

## Bus Stop Ridership

Bus routes 450 and 456 service the same stops along Route 107 from Warren Street at the northern end of the study area to Waitt Avenue at the southern end. Bus routes 424 and 450 service the same stops along Route 107 at the southern end of Route 107 between North Maple Street and Chestnut Street, as shown in Figure II-17.

As of Fall 2015, there were 52 bus stops along the study area, 25 inbound stops and 27 outbound stops<sup>4</sup>. Bus stops are spaced between 287 feet and 1,486 feet of one another. The average spacing within the study area is 790 feet on the west side and 730 on the east side. The longer bus stop spacing is located within segments with few side streets and minimal land-use activity.

Figure II-18 summarizes bus stop boardings and alightings, and the distance between stops. The boardings and alightings for the top five bus stops in the study area are listed in Table II.3.

The majority of bus stops have low ridership, with many stops having less than 20 daily trips. The stops with the highest ridership are the pair of stops at the Hawthorne Square Mall Shopping Center, which represent 18% of total study area boardings. Low ridership at several bus stops is likely a result of limited pedestrian access to/from and through the study area, and limited transit-trip generating land uses. These access deficiencies will be discussed in the following section.

**Table II.3: Ridership at Top Five Bus Stops in the Corridor**

Top Five Bus Stops		
Stop Location	Boardings & Alightings	
	Inbound	Outbound
1. Hawthorne Square	100	114
2. Salem Hospital	85	79
3. Western Ave/Chestnut St	60	62
4. Marlborough Rd/Greenledge Rd	44	49
5. Western Ave/Chatham St	42	41
Total Top Five Ridership	331	345
Total Ridership on Corridor	585	615
Percent Top Five Ridership	57%	56%

## Commuter Rail

The MBTA Newburyport/Rockport Commuter Line runs parallel and approximately one mile to the east of Route 107, as shown in Figure II-17. Although there are no stations within the study area, there are three stations along the line that indirectly serve the populations near the Route 107 study area. These include Lynn Station 1.5 miles to the south, Swampscott Station 1.2 miles to the southeast, and Salem Station 1 mile to the north. Each of these stations provide direct access to North Station, in downtown Boston. The stations can be accessed via the bus routes on Route 107.

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<sup>4</sup> Following correspondence with MBTA in July 2015, the bus stop located nearside of Cain Road that was observed in the field, but did not exist in MBTA records, was removed, in addition to the Clark Street outbound stop.



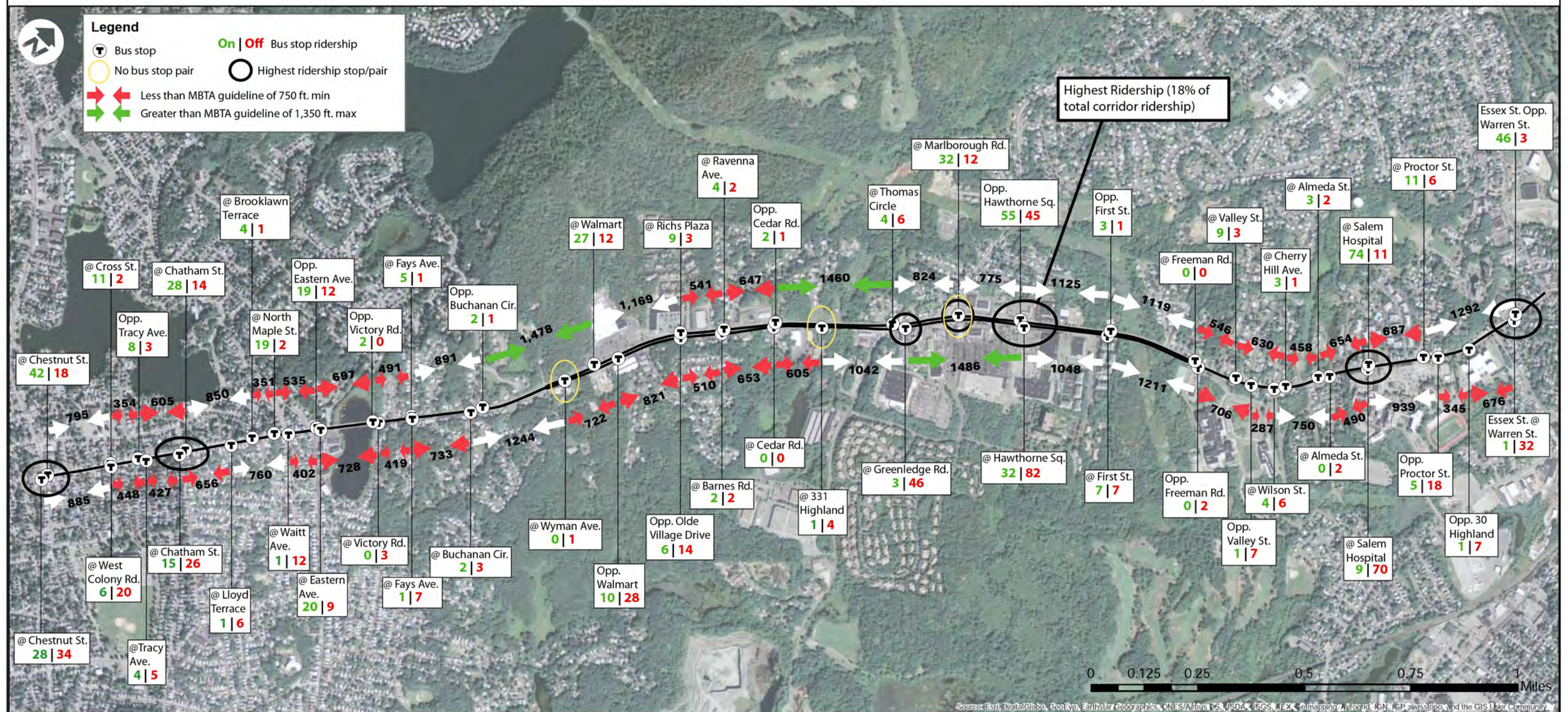


Figure II.18  
Existing bus stop ridership and spacing  
Route 107 Corridor Study  
Lynn/Salem, MA



## C. CRASH ANALYSIS

### 1. MASSDOT DATA

Crash data for the study area intersections was obtained from MassDOT for the most recent five-year period available. This data includes complete yearly crash summaries for the years 2008-2012. A summary of the crash data at each of the study area intersections is provided in the Appendix of this study. Although a majority of the crashes in the study area involved motor vehicles only, there were five accidents that involved a bicyclist, with one at Route 107 and Chatham Street, two at Route 107 and Maple Street/Waitt Avenue, and two at Route 107 and Willson Street. Nine pedestrian-related accidents were recorded during this time period within the study area, with four at Route 107 and Chestnut Street, one at Route 107 and Chatham Street, three at Route 107 and Marlborough Road/Traders Way, and one at Route 107 and Boston Street.

The MassDOT Crash Rate Worksheet was used to determine whether the crash frequencies at the study area intersections were unusually high given the vehicular volumes at each location. The MassDOT Crash Rate Worksheet calculates a crash rate expressed in crashes per million entering vehicles. The calculated crash rate was then compared to the average crash rate for signalized and unsignalized intersections within Massachusetts. The average crash rate for MassDOT District 4, in which the study area resides, is 0.77 crashes per million entering vehicles for signalized intersections and 0.58 crashes per million entering vehicles for unsignalized intersections. The statewide average crash rate is 0.80 crashes per million entering vehicles for signalized intersections and 0.60 crashes per million vehicles for unsignalized intersections. A comparison of the individual crash rates for each of the study area intersections with the statewide average crash rates is depicted in Figure II-19 below.

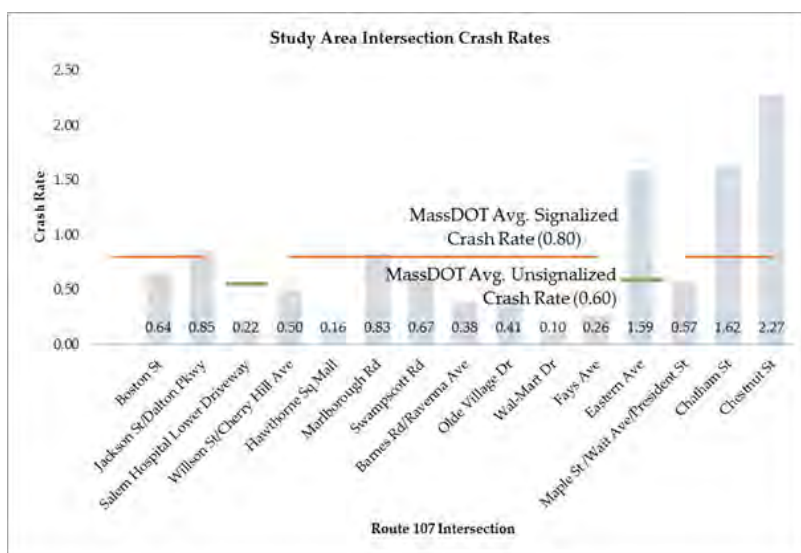


Figure II-19: Study Area Intersection Crash Rates



Within the area of study, there are five intersections with crash rates exceeding the MassDOT District 4 and statewide averages:

- Route 107 at Chestnut Street
- Route 107 at Chatham Street
- Route 107 at Eastern Avenue/Stanwood Street
- Route 107 at Marlborough Road/Traders Way
- Route 107 at Jackson Street/Dalton Parkway

As shown in Figure 2.20 each of the remaining study area intersections experienced a crash rate below both the MassDOT District 4 and statewide averages for signalized and unsignalized intersections. Intersections with a crash rate below the MassDOT District 4 and statewide averages are not considered to have significant safety deficiencies.

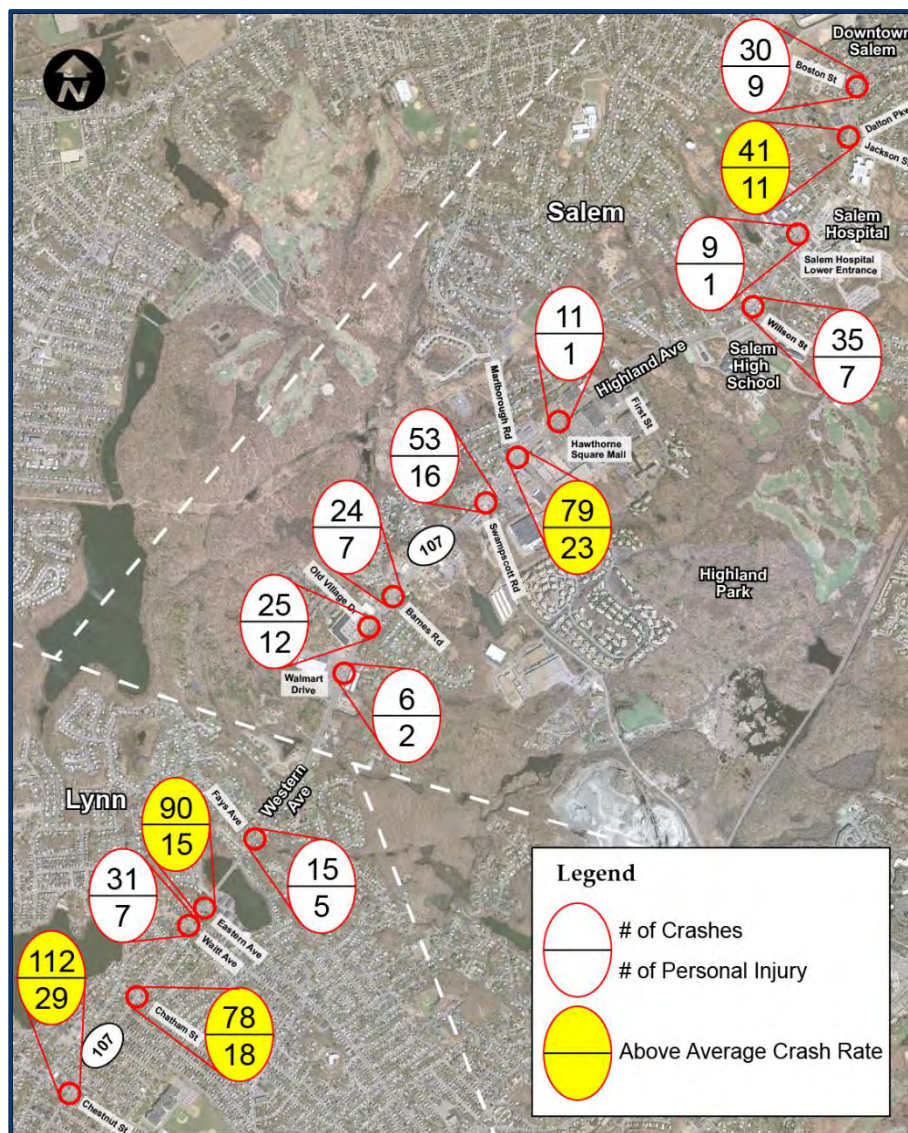


Figure II-20: Intersection Crash Rates

Of the five high crash rate locations, four of the intersections were also identified as Highway Safety Improvement Program (HSIP) intersections for 2011-2013. Under HSIP, high crash locations are targeted for safety improvements, with particular emphasis on locations with fatal and injury crashes. The four locations include the intersection of Route 107 with Chestnut Street, Chatham Street, Eastern Avenue, and Marlborough Road. Crash reports were obtained from the local police departments for these four intersections to identify trends and patterns of the crashes at each location. Further review of these four locations is discussed below.

## 2. LOCAL POLICE DATA

Crash reports were obtained from both the Lynn and Salem police departments for the following HSIP and high crash rate intersections:

- Route 107 at Chestnut Street
- Route 107 at Chatham Street
- Route 107 at Eastern Avenue/Stanwood Street
- Route 107 at Marlborough Road/Traders Way

The narratives and details of the crash reports obtained from the police departments were reviewed to identify specific trends and patterns at each of the intersections noted above. The local data from Salem covered the five year period from 2008 to 2012 and the Lynn data covered from 2009-2013. Crash diagrams were created for each of the locations based on the crash reports and are provided in the Appendix of this study.

### Route 107 at Chestnut Street

Based on the local crash reports, 82 crashes were reported by the Lynn Police Department at the intersection of Route 107 and Chestnut Street during the five-year period analyzed. As seen in the crash diagram provided in the Appendix, many of the crashes at this location were reported as angle or rear-end crashes. Traffic congestion is the most likely contributor to rear-end crashes, while a number of existing safety deficiencies may contribute to the angle crashes at the intersection. Insufficient clearance intervals and lack of exclusive left-turn lanes may be leading to the angle crashes.

### Route 107 at Chatham Street

54 crashes were reported by the Lynn Police Department at the intersection of Route 107 and Chatham Street between 2008 and 2012. Similar to the intersection of Route 107 at Chestnut Street, approximately 41% of the locally reported crashes were angle collisions. Based on the summaries provided in the police reports, many angle collisions occurred as a result of left-turning vehicles misjudging the gap in traffic or vehicles driving in the opposite direction switching lanes to travel around vehicles making a left turn. The second highest type of crash was a rear-end crash, with approximately 37% of the total crashes being reported as rear-end. The majority of the rear-end collisions occurred on the northbound and southbound Route 107 approaches to the intersection.



### Route 107 at Eastern Avenue/Stanwood Street

The unsignalized intersection of Western Avenue and Eastern Avenue experienced 82 locally reported crashes during the five-year period of analysis between 2009 and 2013. The offset approaches of Stanwood Street and Eastern Avenue is a major safety issue for this location. Available sight distance for both the eastbound and westbound stop controlled approaches is insufficient, contributing to a number of crashes for vehicles exiting Stanwood Street and Eastern Avenue. Crashes in the southbound direction on Route 107 are likely attributed to the southbound left turn movement causing conflict with northbound traffic or blocking the southbound lane resulting in rear-end collisions.

### Route 107 at Marlborough Road/Traders Way

The Salem Police Department reports indicated that there were 47 reported crashes at the intersection of Route 107 with Marlborough Road and Traders Way during the five-year period analyzed. The majority of the crashes at this intersection were rear-end collisions resulting in property damage. The extensive queues and congestion experienced at this intersection may be the cause of the high number of rear-end collisions both approaching and departing the intersection. The second highest occurrence of crash were angle collisions (approximately 19%) primarily involving the westbound left-turn from Traders Way.

Based on the safety analysis completed as part of this study, a number of signal and geometric improvements can be implemented at the intersections with safety deficiencies. Subsequent chapters of this study document potential safety improvements in detail.

## **D. DEMOGRAPHICS**

Salem and Lynn contain major destinations in the North Shore region. Demographic factors affect the travel behavior and demand on and surrounding the study area. An understanding of the existing demographic characteristics of the study area, including population and, environmental justice communities help inform the development of study area alternatives.

### **1. POPULATION**

According to the 2010 US Census, the City of Lynn has a population of 90,329, making it more than twice as large as the City of Salem, with a population of 41,340. Lynn is projected to experience a population growth of 25%, to 112,884 people, while Salem is projected to experience population growth of 15%, to 47,720 people, by the year 2035.<sup>5</sup>

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<sup>5</sup> Massachusetts Population Projections, UMass Donahue Institute Population Estimates Program

The study area has a population of approximately 111,450 people and includes 43,650 households.<sup>6</sup> The study area's inclusion of relatively densely populated study areas of Salem and Lynn to the north and south of the Route 107 study area account for the relatively large study area population, compared to each municipalities' total population. Population, household, and employment data for the study area, City of Salem, and City of Lynn, is summarized in Table II.4.

In both municipalities one and two-person households make up over 50% of households. Out of approximately 47,000 housing units, 93% are occupied and 7% are vacant. Of the occupied units, there is an even split between those owner occupied and those rented. The study area has a fairly even age distribution. The largest cohorts are 20 to 24 and 25 to 29 years (8% of population each), and smallest cohorts are 65 to 69 and 70 to 74 years (3% of population each). The age breakdown of the study area is illustrated in Figure II-22.

The majority of the population in the study area is white, non-Hispanic, at 61%, while persons of Hispanic ethnicity comprise 25% of the population, as seen in Figure II-21.

**Table II.4: Population, Households, and Employment along the Study Area**

	Study Area		
	Total <sup>7</sup>	Within Salem	Within Lynn
<b>Average Population</b>			
2010 Census	111,450	39,250	55,600
2040 Projection	122,400	43,000	61,300
Growth 2010-2040	10%	9%	10%
<b>Average Households</b>			
2010 Census	43,650	16,900	20,100
2040 Projection	51,850	19,650	24,000
Growth 2010-2040	19%	17%	19%
<b>Employment</b>			
2010 Census	34,800	17,100	14,200
2040 Projection	37,400	19,550	14,350
Growth 2010-2040	7%	14%	1%

*Source: Central Transportation Planning Staff Demographic Profile and TAZ data based on 2010 Census and projections based on MassDOT's State Community Control Totals for population and employment forecasts based on the Donahue Institute and MAPC.*

<sup>6</sup> CTPS Demographic Profile TAZ level data based on 2010 U.S. Census and projected based on MassDOT's State Community Control Totals for population and employment forecasts based on the Donahue Institute and MAPC.

<sup>7</sup> Total study area also includes population, household and employment data from areas of Swampscott and Peabody that fall within the one-mile study area.



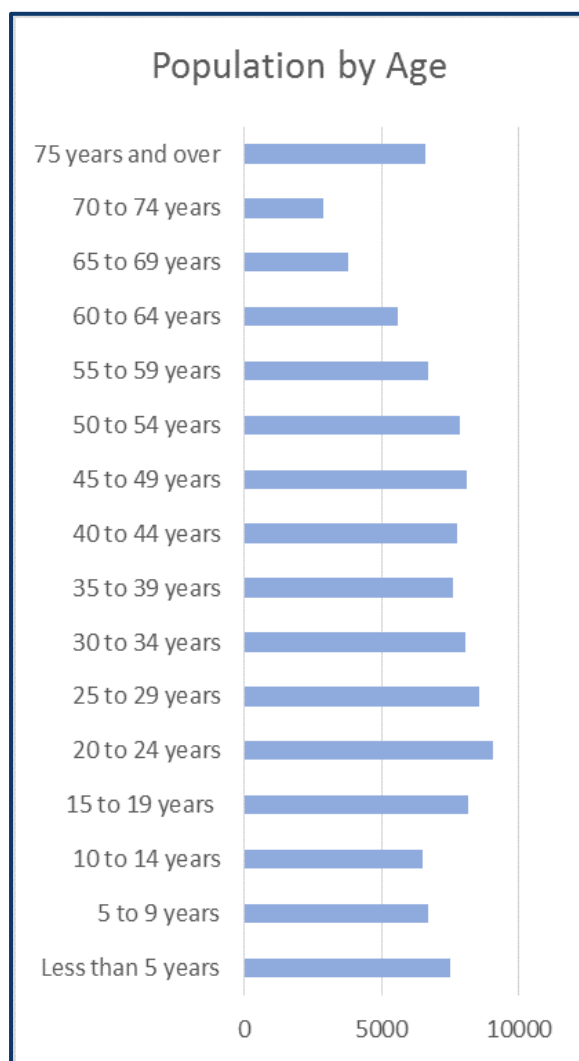


Figure II-22: Population by Age Chart

Overall, the City of Lynn has larger Hispanic and Black or African American populations, suggesting the study area is slightly less diverse than the City of Lynn as a whole, but more diverse than Salem as a whole.

The median household income in Salem and Lynn in 2010 was \$56,979 and \$43,200 respectively. Salem had an unemployment rate of 8.3% and Lynn had an unemployment rate of 9.7%. The vast majority of workers in both communities commute by car truck or van, 95% in Salem and 83% in Lynn. Most residents in both communities have one vehicle available, with 24% of households in Salem and 21% in Lynn having no vehicle available.<sup>8</sup>

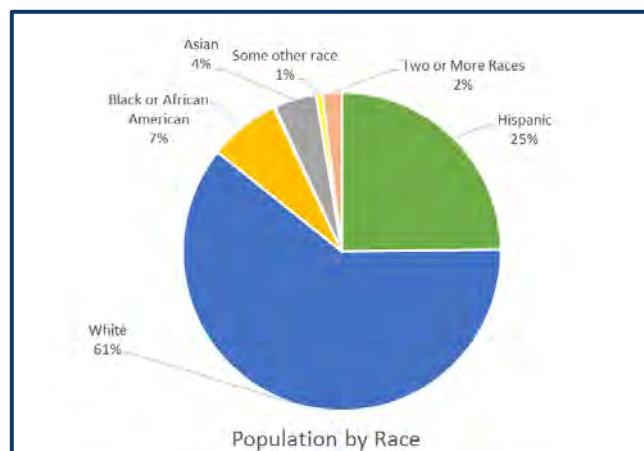


Figure II-21: Population by Race Chart

## 2. ENVIRONMENTAL JUSTICE

Executive Order 12898, “Federal Actions to Address Environmental Justice (EJ) in Minority Populations and Low Income Populations” of February 11, 1994 lays the groundwork for the Boston Region Metropolitan Planning Organization’s (MPO) transportation equity program. The program insures that EJ populations are provided equal opportunity to participate in the transportation planning and decision-making process. It also insures that EJ populations share equitably in the benefits and burdens of transportation projects and services. Engaging EJ populations in transportation decisions is important, as historically low-income and minority

<sup>8</sup> 2010 U.S. Census

populations have experienced many negative effects and few benefits of transportation projects. Involving EJ communities helps to avoid, minimize, or mitigate disproportionate adverse health and environmental effects on these populations.

The Boston Region MPO defines Environmental Justice communities for analysis and outreach purposes. It measures environmental justice populations at the transportation analysis zone (TAZ) level and defines criteria for both the minority and low-income thresholds. These areas are defined where a cluster of TAZs contain a non-white or Hispanic population that is greater than 27.8% and/or when a population's income is less than 60% of the MPO Region's median household income (\$42,497 in 2010). Since Lynn and Salem are within the Boston Region MPO, the same definition of EJ populations was used for consistency in the transportation planning process.

Within the study area there are several defined Environmental Justice populations, yet only one abuts the Route 107 study area, as shown in Figure II-23. This population is located on the southern end of the study area in East Lynn and meets the minority threshold. Further south towards Central Square in Lynn there is an identified Environmental Justice population that meets both the minority and income thresholds. On the northern end of the one-mile study area east of downtown Salem there is a small area meeting the income threshold and a small area meeting both the income and minority thresholds. There is also a low-income neighborhood in Peabody that touches the northwest border of the one-mile study area.

## E. LAND USE AND ZONING

### 1. LAND USE

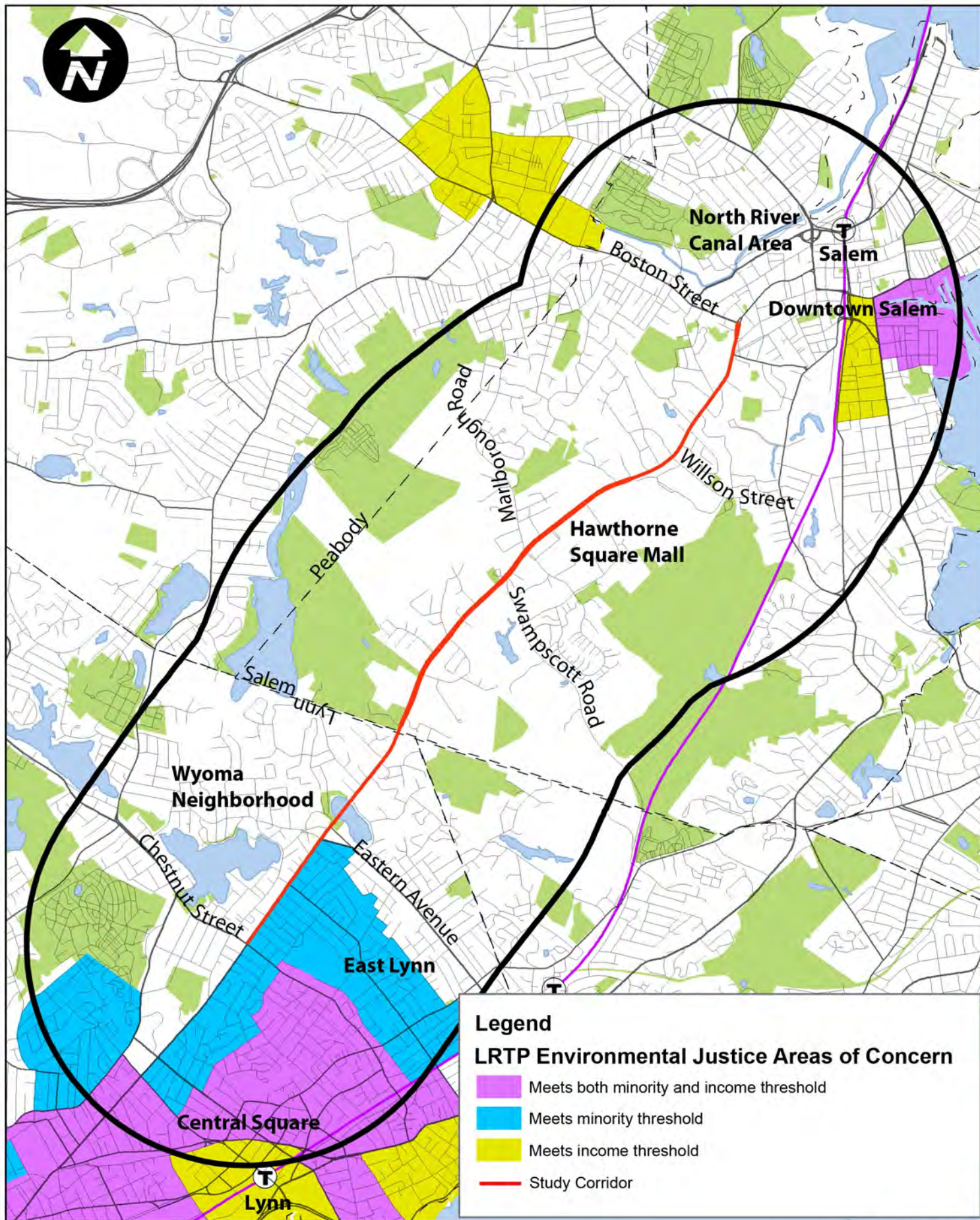
Land uses within the study area are depicted in Figure II-24. The study area within Lynn is primarily residential, with the majority of residences being either multi-family or high density housing. Residential land classified as high density includes housing located on lots of  $\frac{1}{4}$  an acre or less.<sup>9</sup> The residential area of Lynn contains a few institutional and commercial uses interspersed throughout, which are mainly schools and retail stores.

The northern end of the Route 107 study area in Salem, is a mix of residential, commercial, and institutional uses. Major institutions include the Salem Hospital, Salem High School, and Collins Middle School. Opposite these uses is a residential neighborhood with a mix of high density and multi-family residential homes. There is also open space on either side of the study area within a mile radius.

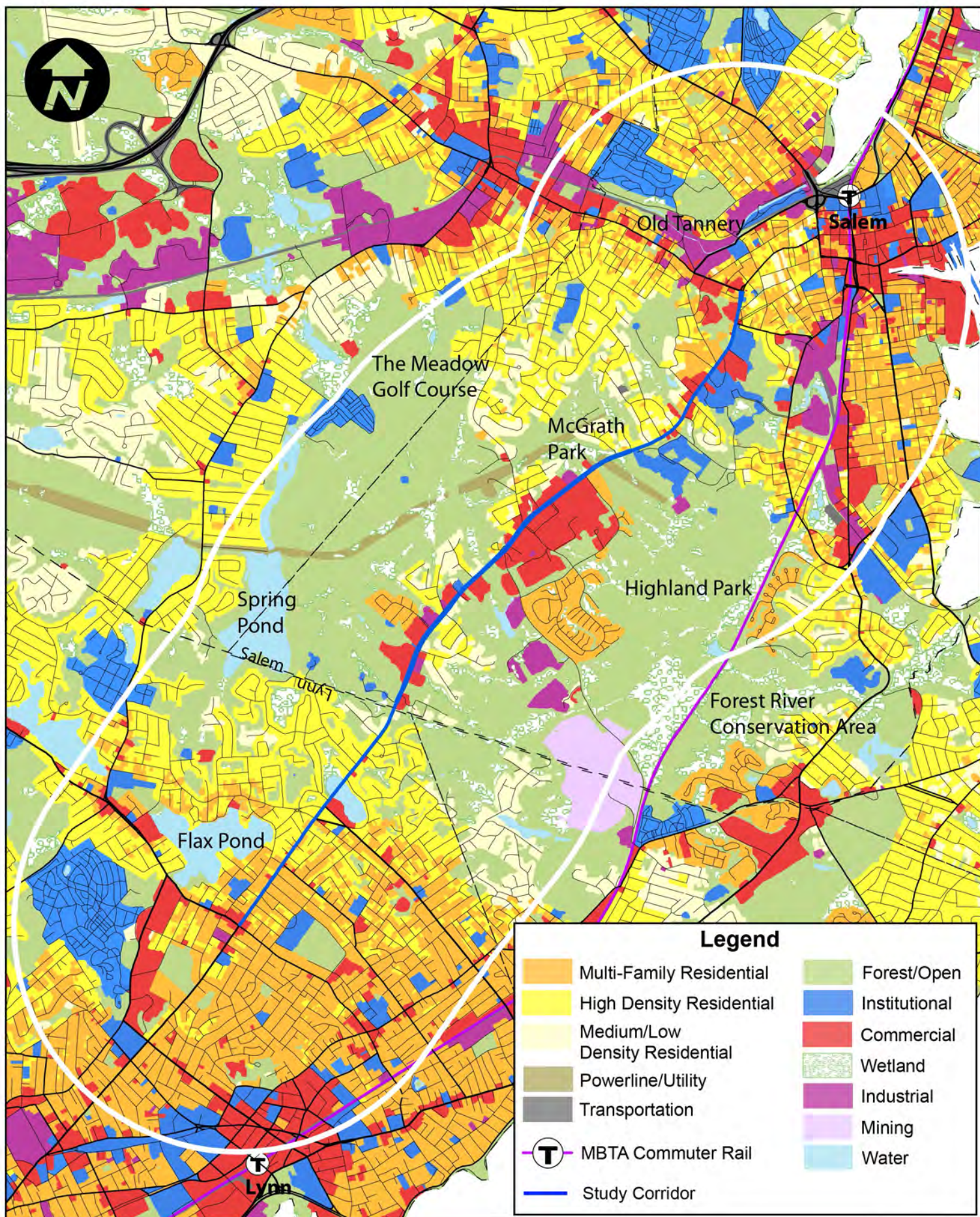
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<sup>9</sup> MassGIS Land Use data (2005)











The central portion of the Route 107 study area in Salem is characterized by large-lot retail and commercial uses. Retailers such as Walmart, The Home Depot, and Market Basket are located in shopping complexes along the route. Swampscott Road, which travels southeast from Route 107, contains several industrial uses as well as a multi-family residential complex, and a gravel mining facility, Aggregate Industries which produces aggregate-based construction materials. Industrial uses along Swampscott Road include North Shore Self Storage, Salem Fitness Center, Doyle Sailmakers Inc, Salem Glass, and Groom Construction. The majority of land in Swampscott near the Route 107 is open space, with some roads coming from the Lynn border leading to medium/low density residential areas.

A section of Peabody is included in the one-mile study area to the northwest. Most of the land uses within the study area in Peabody is comprised of open space such as the Meadow Golf Course, McGrath Park, and Spring Pond. It should be noted that Marlborough Road in Salem provides access to residential areas in Peabody, and indirectly to the Centennial Park industrial park located just west of the one-mile study area along Route 128. (See the following section for additional information on Centennial Office Park)

### Employment

The 107 study area is within close proximity to many major employers in the North Shore region. There are 104,654 people who work in Salem and Lynn combined. The majority of jobs are provided in the healthcare, government, and education sectors.

The top five employers in Salem and Lynn are listed in Table II.5. Notable employers in Salem include the Salem Hospital, City of Salem, and Salem State University, with over 1,000 employees each. The Salem Hospital is a vital site to consider when examining growth along Route 107 as it is located just north of Willson Street and is undergoing plans for expansion. Just over 130,000 SF of new space will be constructed on the hospital's campus. The expansion is expected to include 48 new inpatient beds, a 65-bay emergency department, and new

**Table II.5: Top Five Employers in Salem and Lynn**

Top Five Employers in Salem <sup>10</sup>	Top Five Employers in Lynn <sup>11</sup>
Salem Hospital 3100 employees	GE Aviation 1,000-4,999 employees
City of Salem 1780 employees	Salem Hospital 1,000-4,999 employees
Salem State University 1443 employees	All Care Visiting Nurses Association 500-999 employees
Spaulding Hospital for Continuing Medical Care 576 employees	Eastern Bank 500-999 employees
Market Basket 475 employees	Garelick Farms 500-999 employees

<sup>10</sup> Salem City Hall, Salem's Top Employers

J:\Analysis\Mass DOT\Route 107 Salem Lynn\Analysis\Demographics\City of Salem, MA - Salem's Top Employers.htm

<sup>11</sup> Mass.gov Labor and Workforce Development, Largest 200 Employers in Lynn

[http://lmi2.detma.org/lmi/Top\\_employer\\_list.asp?gstfips=25&areatype=05&gCountyCode=000251](http://lmi2.detma.org/lmi/Top_employer_list.asp?gstfips=25&areatype=05&gCountyCode=000251)

main lobby. The study also includes changes to on-site circulation and parking, with a loss of almost 90 parking spaces.<sup>12</sup>

The largest employer in Lynn is GE Aviation, which is located at 1000 Western Avenue, south of the one-mile study area towards downtown Lynn. Other major employers in Lynn include, the North Shore Medical Center Union Hospital, the All Care Visiting Nurses Association, Eastern Bank, Garelick Farms, Greater Lynn Social Services and the Lynn Council of Aging.<sup>13</sup> North Shore Medical Center Union Hospital is proposed to be closed, with services to be consolidated at the Salem Hospital<sup>14</sup>

### Zoning

The southern portion of the study area in Lynn from Chestnut Street to the Salem/Lynn city line, is comprised mainly of residential zoning. Differences in zoning illustrates the changing nature of the Route 107 study area as it travels from Lynn northwards into Salem. The central portion of the study area, running from the Salem/Lynn city line to Freeman Street, in Salem contains several zoning types: business park development, business highway, industrial, and residential multi-family. The northern portion, from Freeman Street to Boston Street in Salem, is comprised mainly of one-family residential, followed by residential conservation (intended to conserve the existing housing stock), residential multi-family, and residential two-family zones. There is also a small portion of business neighborhood residential zoning at the very northern end of the Route 107 study area, where Salem transitions into its denser downtown area.<sup>15</sup> A zoning map is provided in Figure II-25.

Salem's zoning ordinance includes an entrance corridor overlay, which covers the majority of Route 107. Not all of the existing development along Route 107 conforms to the entrance corridor overlay requirements. This overlay applies outwards 150 feet from the road centerline or rear lot line (whichever is less) and regulates curb cuts, storage areas, fences, parking lot landscaping, and signage with a purpose to "project and enhance the major entrance ways into the city." The overlay provides standards for future redevelopment along the study area to improve the aesthetics and create a more welcoming entrance to the City of Salem.

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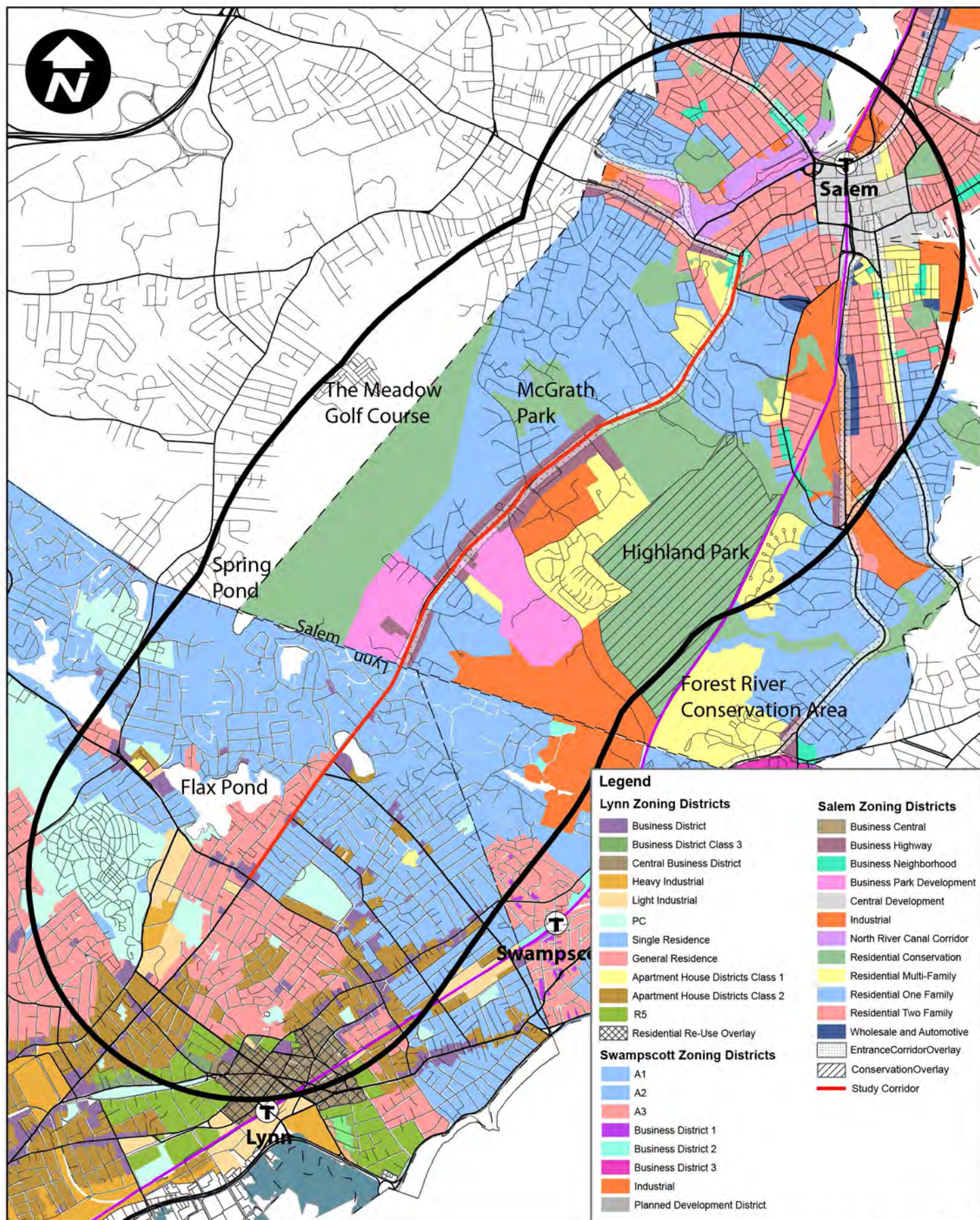
<sup>12</sup> Proposed Expansion at Salem Hospital, Vanasse Hangen Brustlin, April 2016

<sup>13</sup> Massachusetts Executive Office of Labor and Workforce Development website  
[http://lmi2.detma.org/lmi/Top\\_employer\\_list.asp?gstfips=25&areatype=05&gCountyCode=000251](http://lmi2.detma.org/lmi/Top_employer_list.asp?gstfips=25&areatype=05&gCountyCode=000251)

<sup>14</sup> Boston Globe, June 30, 2015

<sup>15</sup> City of Salem and City of Lynn Zoning GIS data provided by city staff







## F. ENVIRONMENTAL CONDITIONS

### 1. ENVIRONMENTAL CONSIDERATIONS

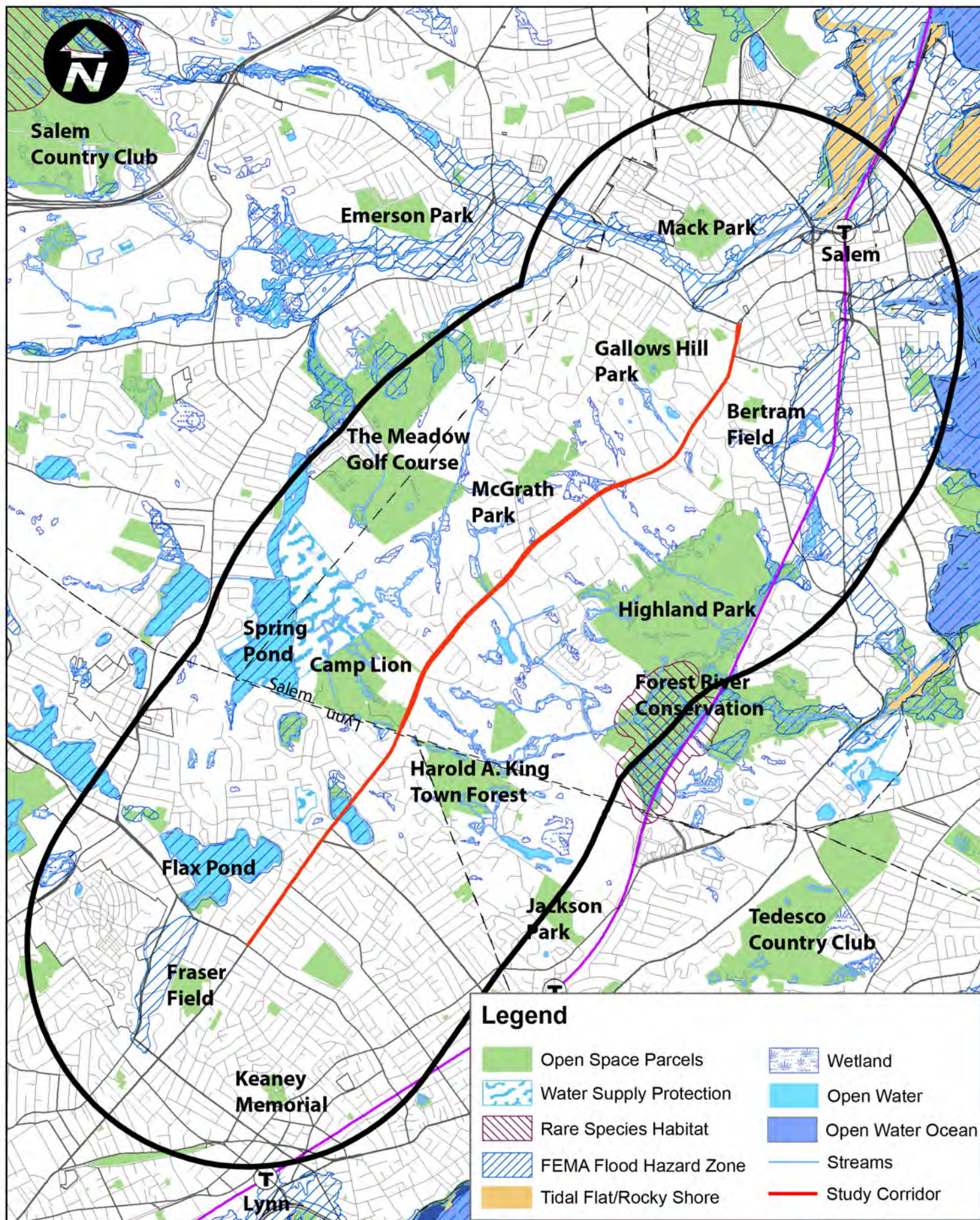
There are multiple environmentally sensitive areas along the Route 107 study area. Environmentally sensitive areas are shown in Figure II-26. Open space sites, wetlands, open water, and rare species habitat all fall within the study area, but most are located at least a half-mile away from Route 107 itself. The closest open space areas to Route 107 are Camp Lion in Salem, which borders Lynn, and Harold A. King Town Forest in Swampscott. Camp Lion is a nonprofit organization used for supervised youth camps and community recreation. These two areas are across Route 107 from each other where the three towns intersect. Floating Bridge Pond is approximately half-mile south from these open spaces in Lynn; Route 107 crosses over the pond on the Buchanan Bridge. Potential impacts to environmental resources are a consideration in the development of transportation improvements for the Route 107 study area.

#### **Wetlands and Water Resources**

Information about wetlands and water resources was obtained from the Massachusetts Department of Environmental Protection (MassDEP) wetlands data. Wetlands present in the study area include open water such as Spring Pond, Flax Pond, and Floating Bridge Pond. Spring Pond is located on the southern edge of Salem, on the Lynn border, one mile from Route 107. Flax Pond is located on the southwestern end of the study area in Lynn, one quarter-mile from Route 107. Areas of wooded swamp are dispersed throughout the area, mainly to the east and west of Route 107 between the Salem/Lynn city line and Willson Street. There are also several small streams that run through this area. Two main rivers are Strongwater Brook that flows from Peabody into Salem adjacent to Marlborough Road, and Forest River, which flows under Route 107 and adjacent to Swampscott Road, south of the Hawthorne Square Mall Shopping Center.

The water supply protection area to the west of the study area on the Peabody/Salem line is another important water resource to consider. It is adjacent to both Spring Pond and Camp Lion and is managed by the City of Peabody, although half of its area is located in Salem. The water supply protection area is approximately 0.4 miles from Route 107.







## Flood Plain

Areas susceptible to flooding are identified by the National Flood Hazard (NFHL) dataset created by the Federal Emergency Management Agency (FEMA). Areas in the flood plain are dispersed throughout the study area. All three of the open water bodies fall into the flood plain, as well as an area on the southern border of the study area next to Fraser Field in Lynn and a large area in the northeastern end of the study area in Salem, north of Highland Park. Spring Pond and the area in Lynn west of Fraser Field are identified to have a 0.2% annual flood hazard, the Forest River Conservation Area is identified to have a 1% annual flood hazard, Flax Pond in Lynn and the northern section of the study area along the North River in Salem are identified as regulatory floodways. Aside from the flood plain located on Buchanan Bridge Pond, none are directly on Route 107 in the study area.

## Open Space and Conservation Areas

Recreational and conservation open space information is provided by MassGIS and maintained by the Executive Office of Energy and Environmental Affairs. There are several open space parcels within the study area, but few about the Route 107 study area. Open spaces areas within the one mile study area are described below:

### Salem:

- *Thompson's Meadow*: Located approximately one mile from Route 107, this area is both a flood plain and rare species habitat.
- *Forest River Conservation Area*: The City of Salem Conservation Commission owns this open space, located right outside of the study area to the east of Highland Park.
- *Highland Park/Old Salem Green Municipal Golf Course*: This open space occupies 255 acres one half-mile from Route 107. It is located directly east of major destinations in the Route 107 study area such as the Hawthorne Square Mall Shopping Center.
- *Bertram Field, Gallows Hill Park, Mack Park, McGrath Park*: These parks are found in the northern half of the study area in Salem. Bertram Field is in close proximity to the Salem Hospital.
- *Camp Lion*: Camp Lion is the only open space directly abutting the Route 107 study area. Although located mainly in Salem, it is owned by the City of Lynn and used as a community recreational facility.

### Lynn:

- *Fraser Field and Keaney Memorial Park*: These two parks are maintained by the Lynn Public Works Department and are located in the southern portion of the study area. Fraser Field abuts Route 107 south of the study area.
- *Frog Pond Conservation Area*: This is a conservation area maintained by the City of Lynn and located one half-mile from Route 107.



### Swampscott:

- *Harold A. King Town Forest*: The Town of Swampscott Conservation Commission manages this town forest, located where Lynn, Salem, and Swampscott intersect. It is located only .08 miles from Route 107.
- *Jackson Park Woods Conservation Area*: The Town of Swampscott Conservation Commission also manages this conservation area, located 1.2 miles from Route 107, east of Harold A. King Town Forest.

### Peabody:

- *The Meadow Golf Course*: This open space recreational area occupies 213 acres .58 miles west of Route 107. The area is both in Salem and Peabody.
- *Spring Pond*: The Spring Pond water supply protection area is owned by the City of Peabody. It is located approximately .44 miles from Route 107 west of Camp Lion on the Salem/Lynn border.

## **Rare Species Habitat**

The Natural Heritage and Endangered Species Program (NHESP), obtained through MassGIS, provides data on the priority habitats of rare species in Massachusetts. Priority habitats include wetlands, uplands, and marine habitats. There is only one identified rare species habitat in the study area. This area is located approximately one mile east of Route 107 in Salem south of Highland Park and west of the Forest River Conservation Area. The habitat identified is mainly wooded swamp, but also includes some open space. Areas identified as priority rare species habitats must be reviewed by the NHESP for compliance with the Massachusetts Endangered Species Act (MESA).

## **Hazardous Materials Sites**

MassGIS provides data on Hazardous Material Sites. These sites must be reported to the Massachusetts Department of Environmental Protection's Bureau of Waste Site Cleanup, as they release oil and/or other hazardous material to the environment. The presence of Hazmat sites may constrain the redevelopment and transportation improvements of affected areas.

Four Hazmat sites are located within the study area. They are all located in Salem along the mid-section of the study area.

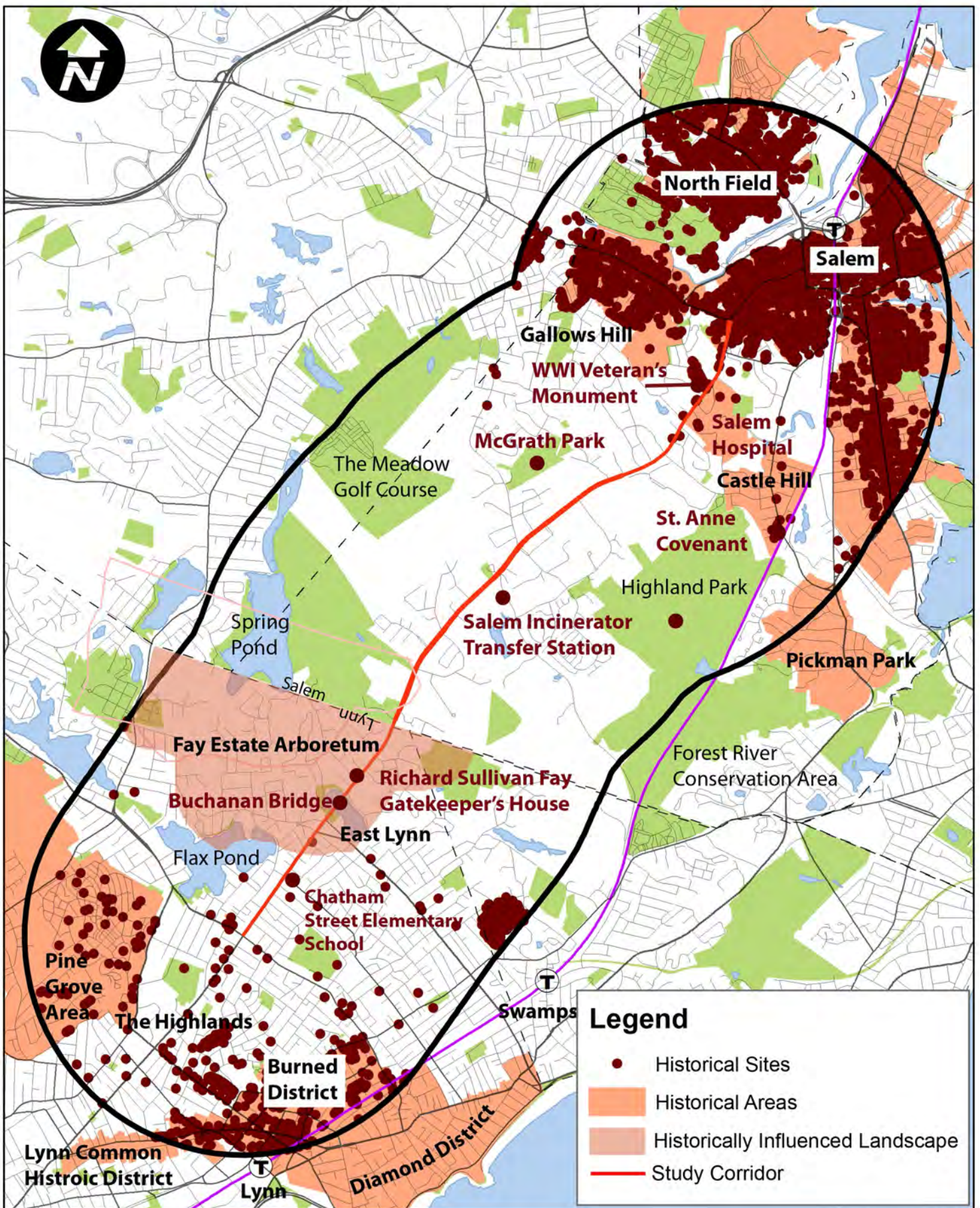
- Service Station, 435-443 Highland Avenue
- Salem Honda, 347 Highland Avenue
- Loyal Order of the Moose 313-323 Highland Avenue
- 342 Highland Avenue

## 2. HISTORIC AND CULTURAL RESOURCES

Areas of historic and cultural significance were identified using the Massachusetts Historical Commission Historic Inventory data available through MassGIS, and are shown in Figure II-27. Although Lynn and Salem both contain numerous historic landmarks, notably in their downtown areas, few fall directly on Route 107 within the study area. Those that do fall directly on Route 107 are the Richard Sullivan Fay Gatekeeper's House and Buchanan Bridge, both in Lynn. The City of Lynn also maintains a historic resources map, which identifies the Fay Estate Arboretum as a historic resource. This area abuts the Route 107 study area south of the Salem/Lynn city line and is the closest area to potential redevelopment along the study area.

Other historic resources close to the Route 107 study area are the Chatham Street Elementary School in Lynn, as well as the Salem Incinerator Transfer Station, McGrath Park, Salem Hospital, and St. Anne Covenant in Salem. Several historic areas also fall within the study area, particularly in the northern portion of the study area, towards downtown Salem.







### III. DEFICIENCIES

#### A. STUDY AREA

Deficiencies in the study area were cataloged as study area-wide deficiencies and intersection-related deficiencies. The deficiencies, noted for each mode of traffic, were identified based upon field reviews, data collection and operational analysis. Following are the descriptions of study area-wide deficiencies by transportation mode.

##### 1. PEDESTRIAN

Overall the Route 107 study area does not provide adequate pedestrian facilities. Maintenance is generally lacking, in terms of striping of pedestrian crosswalks, overgrowth on the sidewalk or from abutting properties, and debris. The following pedestrian deficiencies are noted within the study area and further described below:

- Missing sidewalks
- Poor condition of existing sidewalks including cracked pavement, debris, and obstructions
- Lack of buffer between the travel way and the pedestrian walkways
- Poor curb reveal which minimizes the vertical separation between pedestrians and motor vehicles
- Lack of crosswalks
- Lack of curb ramps
- Obstructions in walkways
- Poor signage relative to crosswalks
- Lack of accessible pedestrian signals
- Missing sidewalks and crosswalks reduce pedestrian connectivity at desire lines and at bus stops



**Image III.1: Degraded sidewalk at 233 Western Ave.**

Despite the presence of sidewalks along the majority of the Route 107 study area, there are large gaps in the sidewalk network, particularly on the western side adjacent to Walmart and Highland Place, between Cain Road and Ravenna Avenue. Of the approximately six miles of sidewalk, approximately two miles is considered good, approximately 2.5 miles is considered fair, and approximately 1.5 miles is considered poor. Good sidewalk conditions have few, if any, cracks and a level surface. Fair sidewalk conditions have some cracking, and may be patchy and uneven. Poor sidewalk conditions are characterized by cracking, are covered in debris, and have a low or no curb reveal between the sidewalk surface and the travel way. Typically a six inch curb reveal is desirable between the sidewalk area and the travel way. Sidewalks within driveways are particularly poor in several locations, such as at 233 Western Avenue in Lynn, as shown looking northerly in Image III.1.



The absence of curb ramps, both at crosswalks and driveways, also contributes to the sidewalk's discontinuous nature. Several intersections have some form of curb ramp connection, between the sidewalk and the roadway, but they are typically too narrow and do not conform to the requirements of the Americans with Disabilities Act (ADA) requirements. An example is shown in Image III.2, at the northeast corner of the intersection of Route 107 with the Salem Hospital. Other curb ramps are severely degraded and have cracks within and/or on the approach to the ramp, as seen in Image III.3. Obstructions on the sidewalk, such as utility poles, signal cabinets, fire hydrants, emergency call boxes, and street trees, narrow the pedestrian path of travel to less than a desirable 4 foot minimum clear space or to the extent that ADA requirements are not met, as illustrated in Image III.4, which was taken looking north at the intersection of Route 107 and Walmart and Image III.5, which is taken on the northbound side of Route 107, north of Willson Street. There is an overall lack of buffers as only approximately 0.12 miles of sidewalk have a grass buffer between the sidewalk and the street. The buffer occurs intermittently along Route 107 between Waitt Avenue and Dalton Parkway. There is also a lack of standard curb reveal, and features like street trees, which put pedestrians in close proximity to the busy roadway, as Image III.6 illustrates. Image III.7 shows how a small stretch of sidewalk, on the west side of Route 107, opposite of the Salem Hospital is terraced, with no protection or warning signs.



**Image III.2: Narrow ramp (3') at entrance to Salem Hospital.**



**Image III.3: Crumbling curb ramp - eastside, north of Chestnut.**



**Image III.4: Utility pole in the middle of a narrow sidewalk, opposite Walmart driveway.**



**Image III.5: Tree pit narrows southwest to 2'.**



**Image III.6: Pedestrians walking in the roadway due to the absence of a sidewalk (Pedestrians observed crossing the median from Dunkin Donuts to Walmart) west side South of Olde Village Pl.'**



**Image III.7: Terraced sidewalk – westside, north & opposite Salem Hospital driveway.**

Of the crosswalks along the study area, most are not well signed. Pedestrian crossing signs are either non-existent, or signs are faded and do not conform to MassDOT standards. The lack of pedestrian facilities at longer pedestrian crossings with high traffic volumes, such as at the entrance to Hawthorne Square Mall Shopping Center, presents safety issues. This location lacks a pedestrian refuge island and signalized crosswalk, both of which would aid in safe pedestrian crossings. In addition, there are no Accessible Pedestrian Signals at any intersections in the study area. Sidewalk characteristics and deficiencies are detailed in a series of sidewalk maps provided in the Appendix. An example of the deficiency maps is provided in Figure 3.1.



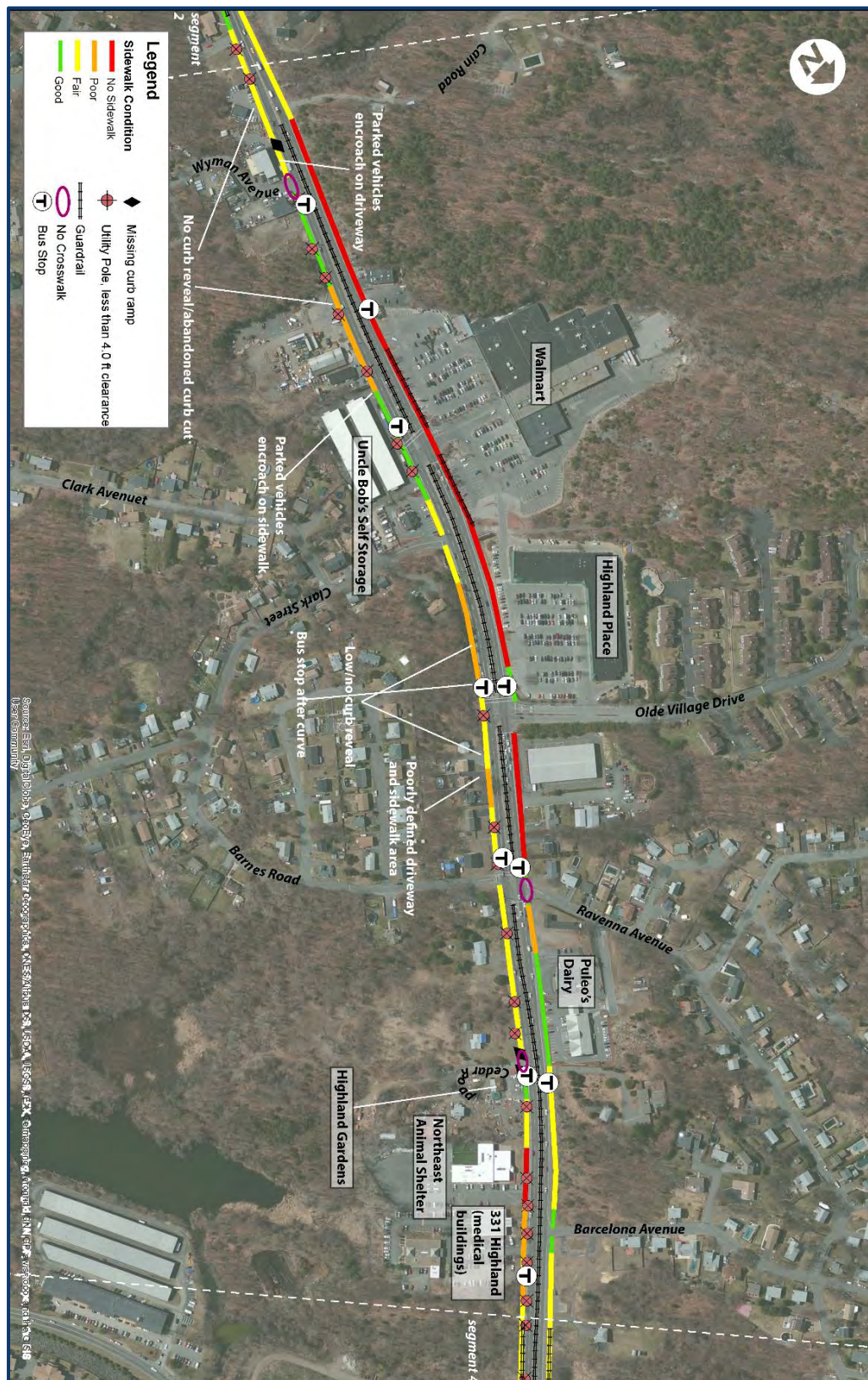


Figure III-1: Example of deficiency - Segment 3

## 2. BICYCLE

As discussed in the existing conditions sections, the entire study area lacks bicycle lanes or on-road bicycle markings. There is also a lack of connections to the existing regional bicycle network paths and trails. Based on feedback from the public survey, 60% of respondents are interested, but concerned about cycling. This matches nationally published information on the types of cyclists in the general population, whereby approximately one-third of the population is not interested in cycling, 60% is interested by concerned, 7% is enthused and confident and less than one percent falls into the strong and fearless category of cyclist. A lack of bicycle infrastructure and safety measures likely prevents many people from cycling within the Route 107 study area.

To evaluate the impediments to cycling along Route 107, a Level of Traffic Stress (LTS) was conducted. The levels are evaluated in the following categories:

- LTS 1: Suitable for a relaxing bicycle ride with little cyclist attention required. Children may need to be supervised at intersections.
- LTS 2: Suitable to most adults, but more demanding than what a child may be expected to handle.
- LTS 3: More traffic stress than LTS 2, acceptable for most cyclists currently riding in the US.
- LTS 4: A level of stress beyond LTS 3.

The entirety of the study area received a rating of LTS 4, meaning that cycling on it is only suitable for “fearless adults.” Figure III-2 displays the LTS rating, along with factors that contributed to it, such as speed limits, shoulders, and turning lanes. Image III.8 illustrates typical biking conditions along Route 107 and the presence of a fearless cyclist traveling southbound at Walmart.



Image III.8: Typical biking conditions.





Figure III-2: Study Area-Wide LTS

### 3. TRANSIT

Transit deficiencies were assessed along the Route 107 study area, with particular emphasis on the bus routes that run along Route 107 including bus routes 424, 450 and 456. Less focus was given to bus routes that cross Route 107 such as bus routes 434 and 436. Transit deficiencies were noted on the basis of the general service and capacity as well as the physical bus stops and locations.

**Service Provision and Capacity.** Routes 424 and 450 are long bus routes, covering 12 miles one-way between Lynn and Boston, and 15 miles one-way between Salem and Boston, respectively. Both travel along local roads, highways and tunnels, and therefore experience varying/high levels of congestion, which affects the service reliability and on-time performance. Even the local variation of Route 450, between Salem Station and Wonderland Station, is almost 11 miles long. These long bus routes have a tendency to be less reliable, when compared to shorter routes. These two routes also require a transfer to the Blue Line at Wonderland Station to complete a trip to Boston during certain time periods. The bus routes and time tables are provided in the Appendix.

Route 456 operates on weekdays only, and just one bus provides 80 minute headways for a total of six inbound trips and eight outbound trips per day. This limited bus service provides few options for riders travelling to/from the study area. Riders are at a further disadvantage on the weekends when Route 456 does not operate and Route 450W only operates hourly or less.

On-board passenger capacity generally does not appear to be an issue within the Route 107 study area, with the exception of Sunday mornings. The MBTA's Fall 2014 automatic passenger counter (APC) data shows maximum passenger loads of 40 on the first outbound trip from Wonderland at 7:45 A.M. The passenger load exceeds the MBTA's Service Delivery Policy for vehicle load standards on weekends, which is about 35 passengers. The load issue is experienced for about 24 stops, across 3 miles, and a travel time of at least 10 minutes. Review of the boardings and alightings by location suggests that retail employees are likely using this service to get to work. The limited service may contribute to the high volume on the first outbound trip, since users have limited options for arrival times.

Some bus stop descriptions could be more appropriately named to the corresponding side street, such the stop opposite Buchanan Circle is at the intersection of Belleaire Avenue, and the stop opposite Alameda Street is at the intersection of Greenway Road. This would provide clearer direction on the actual stop location for riders and MBTA service planners.



**Bus Stop Location and Spacing.**

Upon review and evaluation of the existing bus stop locations, the following deficiencies are noted:

- Some bus stops lack a bus stop pair, meaning that a bus stop is not provided in the same location for the opposite direction of travel.
- More than half of the bus stops lack connection to a crosswalk that traverses Route 107, as shown in Image III.9, which shows Eastern Avenue looking north at Buchanan Bridge.
- Several bus stops lack curb ramps entirely or have curb ramps that are inadequate.
- Connectivity at bus stops is often limited. Ten bus stops are located opposite of medians with guardrail, eliminating connectivity across Route 107. Curbside guardrail at the Buchanan Circle outbound stop in Lynn, as shown in Image III.10, creates pedestrian obstacles.
- Some bus stop locations are poorly placed in terms of roadway geometry, resulting in sight distance issues. For example, the inbound bus stops at Valley Street and outbound bus stop opposite Olde Village Road in Salem, as shown in Image III.11, are located after a curve in the road, limiting sight distance for bus operators and bus riders.



**Image III.9: No crosswalk across Eastern Ave, to rear of outbound bus stop.**



**Image III.10: Bus stop behind guardrail outbound at Buchanan Circle.**



**Image III.11: Bus stop after curve in road, outbound opposite Olde Village Rd.**

- The inbound Marlborough Road stop, as shown in Image III.12, is located in a right turn only lane, requiring the bus to merge with general traffic in the middle of the intersection, as there is no receiving lane on the other side of the intersection.
- Some bus stops have inadequate length. For example, opposite Victory Road, as shown in Image 3.13, a bus that pulls to the bus stop sign will block the abutting crosswalk.

Bus stop spacing is summarized in Table 3.1. Several bus stops are located close together, some as close as 287 feet, while others are quite far apart, up to 1,486 feet. The MBTA's Bus Stop Design Guidelines call for bus stops to be located between 750 and 1,350 feet apart, so improved bus stop spacing and consolidation should be considered at strategic points. Bus stops spaced closely together add to the overall trip time and result in additional sidewalk and sign maintenance, ultimately adding to service and operation costs. Furthermore, several bus stops experience very low ridership and could be potential candidates for bus stop removal.



**Image III.12: Bus stop in right turn lane, inbound at Marlborough Rd.**



**Image III.13: Bus stop too short, stopped bus blocks crosswalk access opposite Victory Rd.**



Table III.1: Bus Stop Spacing and Ridership (Fall 2014)

Inbound Stops	Distance to next stop (feet)	Weekday Ridership (Ons)	Weekday Ridership (Offs)	Stop located opposite median guardrail	Stop abuts a perpendicular crosswalk
Essex St. Opp Warren St.	1292	46	3		x
Highland Ave @ Proctor St.	687	11	6		X
Highland Ave @ Salem Hospital	654	74	11		X
Highland Ave @ Alameda St.	485	3	2		X
Highland Ave @ Cherry Hill Ave.	630	3	1		X
Highland Ave @ Valley St.	546	9	3		
Highland Ave @ Freeman Rd.	1119	0	0	X	
Highland Ave Opp First St.	1125	3	1	X	
Highland Ave @ Hawthorne Sq.	775	55	45		
Highland Ave @ Marlborough Rd.	824	32	12		X
Highland Ave @ Thomas Circle	1460	4	6		
Highland Ave Opp Cedar Rd.	647	2	1	X	
Highland Ave @ Ravenna Ave.	541	4	2		X
Highland Ave @ 400 Highland Place	1169	9	3		X
Highland Ave @ Walmart	1478	27	12	X	
Highland Ave Opp. Buchanan Circle	891	2	1		
Western Ave Opp Fays Ave.	491	5	1		
Western Ave Opp Victory Rd.	679	2	0		X
Western Ave Opp Eastern Ave.	535	19	12		
Western Ave @ North Maple St.	351	19	2		X
Western Ave @ Brooklawn Terrace	850	4	1		
Western Ave @ Chatham St.	605	28	14		
Western Ave Opp Tracy Ave	354	8	3		X
Western Ave @ Cross St.	795	11	2		X
Western Ave @ Chestnut St.		42	18		X
<b>TOTAL</b>		<b>422</b>	<b>162</b>	<b>4</b>	<b>13</b>

Table III.1 (Continued): Bus Stop Spacing and Ridership (Fall 2014)

Outbound Stops	Distance to next stop (feet)	Weekday Ridership (Ons)	Weekday Ridership (Offs)	Stop located opposite median guardrail	Stop abuts a perpendicular crosswalk
Western Ave @ Chestnut St.	885	28	34		X
Western Ave @ West Colony Rd.	448	6	20		X
Western Ave @ Tracy Ave.	427	4	5		
Western Ave @ Chatham St.	656	15	26		X
Western Ave @ Lloyd Terrace	760	1	6		
Western Ave @ Waitt Ave.	402	1	12		X
Western Ave @ Eastern Ave.	728	20	9		
Western Ave @ Victory Rd.	419	0	3		
Western Ave @ Fays Ave.	733	1	7		
Western Ave @ Buchanan Circle	1244	2	3		X
Highland Ave @ Wyman Ave.	722	0	1	X	
Highland Ave Opp Walmart	821	10	28		X
Highland Ave Opp Olde Village Dr.	510	6	14		X
Highland Ave @ Barnes Rd.	653	2	2		X
Highland Ave @ Cedar Rd.	605	0	0	X	
331 Highland Ave.	1042	1	4	X	
Highland Ave @ Greenledge Rd.	1486	3	46	X	
Highland Ave @ Hawthorne Sq.	1048	32	82		
Highland Ave @ First St.	1211	7	7	X	
Highland Ave Opp Freeman Rd.	706	0	2	X	
Highland Ave Opp Valley St.	287	1	7		
Highland Ave @ Wilson St.	750	4	6		X
Highland Ave @ Almeda St.	490	0	2		X
Highland Ave @ Salem Hospital	939	9	70		X
Highland Ave Opp Proctor St.	345	5	18		X
Highland Ave Opp 30 Highland Ave.	676	1	32		X
Essex St. @ Warren St.					X
<b>TOTAL</b>		<b>159</b>	<b>446</b>	<b>6</b>	<b>14</b>



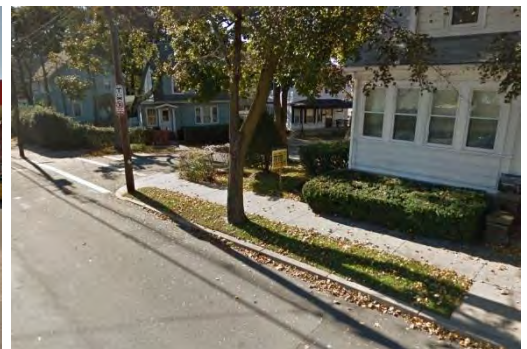
**Physical Condition of Bus Stops.** Many of the bus stop deficiencies have been noted in the under the pedestrian deficiencies and include missing sidewalks, narrow or obstructed sidewalks, and missing curb ramps and crosswalks. The required landing area for a bus stop is eight feet in depth and most of the sidewalks are less than eight feet wide. The absence of a sidewalk, as shown in Image III.14, means that there are no good pedestrian connections to the stop, nor is there a level concrete landing area (at least a five ft. by eight ft. clear, level space) for boarding/alighting. Landing areas at driveways are equally undesirable since they are not level and block access to the driveway, such as at the outbound stop at Eastern Avenue, which is located between the driveway to a gas station, and a driveway to a strip mall, per Image III.15. Image III.16 shows the lack of a landing area at the inbound stop at Brooklawn Terrace.



**Image III.14: No sidewalk at or connecting to bus stop, inbound at opposite First St.**



**Image III.15: Eastern Avenue outbound stop located between two busy driveways with no landing area or safe/defined waiting area.**



**Image III.16: No concrete landing area at bus stop, inbound at Brooklawn.**

**Bus Stop Signage and Amenities.** One bus stop sign was provided at the majority of bus stop locations. At locations where on-street parking is permitted, the lack of a second bus stop sign makes it difficult to identify and enforce the no parking zone at the bus stop. Signs are missing at some stops, such as opposite Walmart and on both sides of the road at Procter Street.

None of the current bus stop signs meet the most current standards, based upon the MBTA Bus Stop Design Guidelines (2016). Numerous signs are faded, non-reflective, and/or don't show the bus stop identification number. Many signs are positioned incorrectly vertically, making them difficult to read or a potential obstacle. Other bus stop signs are poorly positioned horizontally, resulting in obstructed sight lines or signs damaged by moving traffic. Various issues with bus stop signage within the study area are displayed in Images III.17 – III.21.



**Image III.17: Inbound at Walmart – 3rd highest inbound stop in corridor.**



**Image III.18: Sign position too low, should be on own post, without obscuring pedestrian crossing sign bus stop sign, inbound at Belleaire/opposite Buchanan.**



**Image III.19: Sign not visible – set too low, on pedestrian signal, set back from curb and obscured by a tree, inbound at Fays.**



**Image III.20: Bus stop sign faded & posted much too high for pedestrian visibility and set back too far from the curb, essentially on the side street, inbound at Thomas Circle.**



**Image III.21 Bus stop sign located about 50 feet from the bus shelter.**

There is a major lack of street furniture and amenities at bus stops in the study area. Only four shelters were identified as follows:

- MBTA standard bronze shelter is located at Hawthorne Square Mall Shopping Center (the highest ridership inbound stop).
- Custom stone shelter is provided at Salem Hospital – upper (south) driveway.
- CEMUSA standard shelter is provided at the Salem Hospital – lower (north) driveway.
- Custom narrow shelter is provided near Boston and Essex streets, outside of CVS.





**Image III.22:** No level path from bus stop to shelter; concrete pad for shelter is raised above the sidewalk.

The shelters are generally in good condition although there is no compliant path of travel between the landing area and shelter at both Salem Hospital shelters, as shown in Image III.22. The shelter at Salem Hospital – Upper Driveway is on a raised platform and is not flush with the sidewalk, and there is a grass strip along the roadway edge at Salem Hospital – Lower Driveway. The path of travel from the shelter to the landing area of the Hawthorne Square shelter is in poor condition.

Aside from benches in the shelters, just one stand-alone bench was identified, at Marlborough Road, Image III.23, but it is old, vandalized, in poor disrepair, and needs replacement.



**Image III.23:** Poorly maintained bench, inbound at Marlborough.

## 4. VEHICLES

There were a number of vehicle-related deficiencies noted throughout the study area. In terms of the physical infrastructure, the pavement is generally in poor condition, as are the medians. Much of the pavement exhibits cracking. In the Lynn portion of the study, on-street parking is allowed but not delineated. As such, vehicles were observed parked in close proximity to the intersections, hindering sight distance and adding conflict. The Lynn segment also lacks turn lanes at key intersections.

Route 107 in the retail portion in Salem has a freeway style atmosphere with the four travel lanes and median divide with guardrail. Much of the median is not aesthetically pleasing due to the rusted condition and the weeds that have protruded along the curb line. The roadway layout lends to encourage travel speeds and prioritizes the vehicle travel over other modes.

Continuing northerly, Route 107 reduces to two travel lanes in the northern portion of the study area. However, there are areas that lack pavement markings to define the travel lanes and motorists were observed traveling as if there were two travel lanes in one direction.

Traffic operations were described in a prior section, with some study area deficiencies highlighted. In the Lynn segment, a repeated condition exists at signalized intersections with a lack of turn lanes, contributing to the safety issues at these locations. Similarly, curb cuts located close to key intersections is problematic and adds to the conflicts. Queueing between key intersections is noted as problematic, particularly in the retail segment.

The existing signal equipment throughout the study area is mostly outdated and in need of replacement. The pedestrian signals do not meet current standards and the majority of pedestrian signals lack countdown features. Signal coordination is poor or missing entirely throughout the study area.

## B. INTERSECTION

As indicated previously, the deficiencies were identified on both a study area-wide and intersection basis. The intersection deficiencies were identified based upon field reviews, data collection, traffic operations and include issues that relate to each mode of transportation. The specifics of each of the fifteen key intersections is noted below beginning at the southern end of the study area and proceeding northerly.

### Intersections in Lynn

#### Route 107 (Western Avenue) at Chestnut Street

The signalized intersection of Route 107 (Western Avenue) at Chestnut Street is a four-way intersection with Route 107 running in the north/south direction and Chestnut Street running in the east/west 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 Route 107 phase and an eastbound and westbound Chestnut Street phase. There is also an exclusive pedestrian phase with crosswalks spanning each intersection approach and sidewalks provided on both sides of Route 107 and Chestnut Street. On-street parking is available and mostly unregulated and there are no bicycle amenities along Route 107 or Chestnut Street. The intersection has a high crash rate, exceeding the District and state averages.



Existing aerial of Western Ave at Chestnut St.



The following deficiencies have been identified:

- Sight lines are obstructed by parked, on street vehicles and by the adjacent commercial property in the southwest quadrant to the intersection.
- The traffic signal equipment is outdated and a number of the signal heads are mounted on posts, which are less visible to motorists. The signal lacks coordination with adjacent signals.
- The eastbound and westbound approaches have long queues of traffic.
- Several businesses have multiple curb cuts that create additional conflict points along the two roadways.
- The tight geometry of this intersection makes it difficult for heavy vehicles to execute a turning movement, causing additional delays.
- Frequent congestion during peak periods with the current clearance intervals for vehicular traffic do not provide enough time to clear the intersection.
- The sidewalks adjacent to the signal and pavement are in need of maintenance. There are a number of fixed objects at the back of curb.
- The existing apex style curb ramps are outdated and not ADA accessible.
- There are no bicycle amenities at this intersection or adjacent roadways.



Signal-heads mounted on pedestrian poles.

### Route 107 (Western Avenue) at Chatham Street

The signalized intersection of Route 107 (Western Avenue) at Chatham Street is a four-way intersection with Route 107 running in the north/south direction and Chatham Street running in the east/west 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 Route 107 phase and an eastbound and westbound Chatham Street phase. There is also an exclusive pedestrian phase with crosswalks spanning each intersection approach and sidewalks provided on both sides of Route 107 and Chatham Street. On-street parking is available and unregulated along this section of Route 107 and on Chatham Street and there are no bicycle amenities on Route 107 or Chatham Street. This intersection has a high crash rate.



Existing aerial of Western Ave at Chatham St.

The following deficiencies have been identified:

- Obstructed sight lines occur due to parked vehicles and buildings in the southwest quadrant.
- The traffic signal equipment is outdated with post mounted signal heads, and the intersection is not coordinated with nearby signals.
- The presence of multiple curb cuts in close proximity to the intersections adds conflict points.
- The intersection geometry lacks turn lanes which likely contributes to the high crash rate. It includes tight turn radii which are difficult for heavy vehicles to navigate.
- Long queues occur at this location, there is congestion during peak periods, and the current clearance intervals for vehicular traffic are insufficient.
- The sidewalks adjacent to the signal and pavement are in need of maintenance.
- The existing apex style curb ramps are outdated and not ADA accessible.
- During field observations, it was noted that two of the four pedestrian signal push-buttons were unresponsive when pushed. This creates a potential safety hazard for pedestrians attempting to cross the intersection during a vehicular phase.
- There are no bicycle amenities at this intersection or adjacent roadways.



Damaged signal head mounted on pedestrian poles.

### Route 107 (Western Avenue) at Maple Street/Waite Avenue

The signalized intersection of Route 107 (Western Avenue) at Maple Street/Waite Avenue is a four-way intersection with Route 107 running in the north/south direction and Maple Street/Waite Avenue running in the east/west 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 Route 107 phase and an eastbound and westbound Maple Street/Waite Avenue phase. There is also an exclusive pedestrian phase with crosswalks spanning each intersection approach and sidewalk provided on both sides of Route 107 and Maple Street/Waite Avenue. On-street parking is available on Route 107 and Maple Street/Waite Avenue. There are no bicycle amenities on Route 107 or Maple Street/Waite Avenue.



Existing aerial of Western Ave at Maple St/Waite Ave.



The following deficiencies have been identified:

- The traffic signal equipment is outdated and a number of the signal heads are mounted on posts, which are less visible to motorists.
- There is currently no emergency pre-emption at the intersection, hindering emergency response time and increasing crash risks.
- Frequent congestion during peak periods with the current clearance intervals for vehicular traffic do not provide enough time to clear the intersection as noted in the field; vehicles turning left at any approach are often left over at the all-red phase. The eastbound Maple Street approach is over capacity with high delays in peak periods.
- The sidewalks adjacent to the signal and pavement are in need of maintenance.
- The existing apex style curb ramps are outdated and non-ADA compliant.
- There are no bicycle amenities at this intersection or adjacent roadways.



Signal heads mounted on pedestrian poles.

### Route 107 (Western Avenue) at Eastern Avenue/Stanwood Street

The unsignalized intersection of Route 107 at Eastern Avenue/Stanwood Street is a four-way intersection with Route 107 running in the north/south direction, Stanwood Street connecting from the west, and Eastern Avenue, a major residential road, connecting from the east. Stanwood Street and Eastern Avenue are under stop-control and Route 107 runs uncontrolled. There is sidewalk available on both sides of Stanwood Street and Eastern Avenue and on both sides of Route 107 for the majority of the roadway. There is a crosswalk spanning Stanwood Street and a crosswalk spanning Route 107 directly between the offset of Stanwood Street and Eastern Avenue. There are no bicycle amenities on Route 107, Stanwood Street or Eastern Avenue. This intersection has a high crash rate.



Existing aerial of Western Ave at Eastern Ave/Stanwood St.

The following deficiencies have been identified:

- A high number of crashes were reported at this intersection, many to do with poor sight lines for the minor road approaches and the unconventional offset of the minor roads across Route 107.
- The intersection has poor levels of service with high delays experienced on the side street approaches.
- There are wide lanes along this section of Route 107, which make it unclear if the roadway is intended to be one large lane or two lanes. Motorists have been observed passing (stopped vehicles?) in these single lane segments due to the width of the roadway.
- While there is a crosswalk spanning Route 107 and Stanwood Street, there is a missing crosswalk spanning Eastern Avenue at the intersection with Route 107.
- The existing apex style curb ramps are outdated and non-ADA compliant.
- Several businesses have multiple curb cuts that create additional conflict points along Route 107 and Eastern Avenue.
- The sight distance is poor for the Eastern Avenue approach.
- There are no bicycle amenities at this intersection or adjacent roadways.



Northbound vehicles passing on the right side along Route 107.

### Route 107 (Western Avenue) at Fays Avenue

The signalized intersection of Route 107 (Western Avenue) at Fays Avenue is a three-way intersection with Route 107 running in the north/south direction and Fays Avenue running in the westbound direction. The northbound approach on Route 107 provides an exclusive left-turn lane and a through lane. The Route 107 southbound approach and the Fays Avenue westbound approach to the intersection provide a single multi-use lane. The traffic signal operates with three phases for vehicular traffic including a lead protected phase for the northbound left-turn and through movements, followed by a northbound and southbound through phase where northbound left-turns are permissible, and a protected Fays Avenue westbound phase for left and right turn movements. There is also an exclusive pedestrian phase with crosswalks spanning the westbound and southbound approaches and sidewalks provided on both sides of Route 107 and Fays Avenue. There are no bicycle amenities on Route 107 or Fays Avenue.



Existing aerial of Western Ave and Fays Ave.



The following deficiencies have been identified:

- The intersection operates poorly during the weekday morning and afternoon peak hours. The southbound approach in particular operates with high delays and is often over capacity during peak hours.
- The traffic signal equipment is outdated, some of the signal heads are pedestal mounted, and therefore less visible to motorists. There is a driveway within the signalized intersection.
- The Fays Avenue westbound signals mounted on posts are also blocked by overgrown vegetation, hindering visibility of the signal.
- The sidewalks adjacent to the signal and pavement are in need of maintenance.
- The existing apex style curb ramps are outdated and non-ADA compliant.
- There are no bicycle amenities at this intersection or adjacent roadways.



Signal head mounted on a post and blocked by overgrown vegetation.

## Intersections in Salem

### Route 107 (Highland Avenue) at Walmart Driveway

The signalized intersection of Route 107 (Highland Avenue) at the Walmart Driveway is a three-way intersection with Route 107 (Highland Avenue) running in the north/south direction and the Walmart Driveway running in the westbound direction. The northbound approach on Route 107 provides an exclusive left-turn lane and two through lanes while the southbound approach provides an exclusive right-turn lane and two through lanes. The Walmart Driveway westbound approach to the intersection currently provides an exclusive left-turn lane and an exclusive right-turn lane.



Existing aerial of Western Ave at Walmart Drive.

The traffic signal operates with three phases for vehicular traffic including a lead protected left-turn phase for the northbound left-turn movement on Route 107 with overlapping eastbound right turns, a shared northbound and southbound phase for through and right-turn movements, and a phase for the eastbound approach with protected left turns and with an overlapping right-turn movement for the southbound approach. There is also an exclusive pedestrian phase with a crosswalk spanning the northbound approach and a sidewalk provided on the eastern side of Route 107. There are minimal bicycle amenities along this section of Route 107.

The following deficiencies have been identified:

- The signal detection on the Walmart approach is not working properly.
- Observations from the field noted that vehicles entering the intersection from the northbound approach often stopped past the stop bar, leading to detection issues and causing vehicle phases to be skipped during the cycle (mainly the northbound left-turn).
- The intersection is very wide and requires high clearance intervals to clear traffic and pedestrians in the intersection.
- There are limited pedestrian amenities in the form of a sidewalk on only one side of Route 107 and only one pedestrian crosswalk spanning Route 107.
- The pavement and sidewalks currently provided adjacent to the signal are in need of maintenance.
- There are minimal bicycle amenities in the form of bicycle detection at the signal.



Vehicle waiting past the stop bar for northbound left turn phase.

### Route 107 (Highland Avenue) at Olde Village Drive

The signalized intersection of Route 107 (Highland Avenue) at Olde Village Drive is a three-way intersection with Route 107 (Highland Avenue) running in the north/south direction and Olde Village Drive connecting from the west. The northbound approach on Route 107 provides an exclusive left-turn lane and two through lanes while the southbound approach provides an exclusive through lane and a shared through and right-turn lane. The Olde Village Drive eastbound approach currently provides an exclusive left-turn lane and an exclusive right-turn lane. The



Existing aerial of Highland Ave at Olde Village Drive.

traffic signal operates with three phases for vehicular traffic including a lead protected left-turn phase for the northbound left-turn movement on Route 107 with overlapping eastbound right turns, a shared northbound and southbound phase for through and right-turn movements, and a phase for the eastbound approach with protected left turns. There is also an exclusive pedestrian phase with a crosswalk spanning the northbound approach and sidewalks provided on the eastern side of Route 107 and on the southwest corner of the intersection. There are minimal bicycle amenities along this section of Route 107.



The following deficiencies have been identified:

- Queuing on the Route 107 southbound approach is long during peak periods. Despite signs that prohibit U-turns, there are a number of U-turns occurring at this intersection.
- There are limited pedestrian amenities in the form of a sidewalk on the eastern side and southwestern corner of Route 107 with only one pedestrian crosswalk spanning Route 107.
- The sidewalks currently provided adjacent to the signal are in need of maintenance.
- Aside from shoulder area, there are no bicycle amenities at this intersection or adjacent roadways.



**Signal head mounted on a post and unprotected from oncoming traffic by curb or rail.**

### Route 107 (Highland Avenue) at Barnes Road/Ravenna Avenue

The signalized intersection of Route 107 at Barnes Road/Ravenna Avenue is a four-way intersection with Route 107 running in the north/south direction and Barnes Road running in the west direction and Ravenna Avenue running in the east direction. The westbound and eastbound approaches each provide a single multi-use lane, while the northbound and southbound direction each provide an exclusive left-turn lane and an exclusive through lane and a shared through and right-turn lane. The traffic signal operates with four phases for vehicular traffic including a lead protected left-turn movement and through phase for the southbound approach, a phase for southbound and northbound through movements with left-turn movements prohibited, followed by a lagging protected left-turn and through phase for the northbound approach and a phase for eastbound and westbound traffic on Ravenna Avenue and Barnes Road, respectively. There is also an exclusive pedestrian phase and a crosswalk spanning the westbound and northbound approaches at this intersection. North of the intersection sidewalks are currently on both sides of Route 107 and south of the intersection sidewalks are provided on the eastern side only of Route 107. Sidewalks are present on both sides of Ravenna Avenue and on the northern side of Barnes Road. There are minimal bicycle amenities in the form of bicycle detection at both approaches of Route 107 and the Barnes Road approach. However, field observations noted that the signal was unresponsive to bicycle detection.



**Existing aerial of Highland Ave at Barnes Rd/Ravenna Ave.**

The following deficiencies have been identified:

- The traffic signal equipment lacks pedestrian signals.
- The intersection is very wide and requires high clearance intervals to clear traffic and pedestrians in the intersection.
- The existing curb ramps at the corners of Barnes Road are apex style curb ramps that do not comply with ADA standards.
- There are no bicycle amenities at this intersection or adjacent roadways.
- The median is in poor condition.
- Route 107 southbound left queue exceeds the storage in peak periods.

### Route 107 (Highland Avenue) at Swampscott Road/Dipietro Avenue

The signalized intersection of Route 107 (Highland Avenue) at Swampscott Road/Dipietro Avenue is a four-way intersection with Route 107 running in the north/south direction and Swampscott Road running in the northwest direction and Dipietro Avenue running in the west direction. The northbound approach on Route 107 provides an exclusive through lane, a shared through and right-turn lane and a channelized right-turn lane under yield control while the southbound approach provides two exclusive through lanes and an exclusive left-turn lane. The Swampscott Road approach currently provides an exclusive left-turn lane and an exclusive right-turn lane. The Dipietro Avenue approach provides a single multi-use lane. The traffic signal operates with four phases for vehicular traffic including a northbound and southbound Route 107 through phase with a lagging protected phase for the southbound left-turn and through movements, a westbound Dipietro Avenue phase and a phase for the Swampscott Road approach. There is also an exclusive pedestrian phase with crosswalks spanning the eastern side of Route 107, crossing the northbound channelized right-turn and the Swampscott Road/Dipietro Avenue approaches. Sidewalks are provided on the eastern side of Route 107 and both sides of Swampscott Road.



Existing aerial of Highland Ave at  
Swampscott Rd/Dipietro Ave.

The following deficiencies have been identified:

- The traffic signal equipment is outdated and the signal coordination is not functioning properly.
- There is currently no emergency preemption at the intersection, hindering emergency response time and increasing crash risks.



- Frequent congestion during peak periods with the current clearance intervals for vehicular traffic do not provide enough time to clear the intersection.
- Despite prohibitory signage, U-turns are made at this intersection.
- The Swampscott Road northwestbound approach operates over capacity. The intersection suffers from long delays and long queues.
- The sidewalks adjacent to the signal and pavement are in need of maintenance. The intersection lacks a crosswalk on Route 107
- There are minimal bicycle amenities in the form of bicycle detection at all approaches of the intersection.
- This intersection is part of the “zig zag” movement that occurs with motorists seeking east-west connections utilizing Swampscott Road, Route 107 and Marlborough Road.

### Route 107 (Highland Avenue) at Marlborough Road/Traders Way

The signalized intersection of Route 107 (Highland Avenue) at Marlborough Road/Traders Way is a four-way intersection with Route 107 running in the north/south direction and Marlborough Road running in the west direction and Traders Way running in the east direction. The northbound and southbound approaches along Route 107 each provide an exclusive left-turn lane, two through lanes and an exclusive right-turn lane. The Marlborough Road approach provides a shared through and left-turn lane and an exclusive right-turn lane. The Traders Way approach provides an



Existing aerial of Highland Ave at Marlborough Rd/Traders Way.

exclusive left-turn lane, a shared left-turn and through lane and a channelized right-turn lane under stop control. The traffic signal operates with five phases for vehicular traffic including a lead protected left-turn movement and through phase for the northbound approach with an overlapping right-turn movement from the Marlborough Road approach, followed by a phase for northbound and southbound through movements where left-turn movements are prohibited, a lagging protected left-turn and through phase for the Route 107 southbound approach and split phasing between the eastbound and westbound approaches. There is also an exclusive pedestrian phase with crosswalks spanning all approaches at this intersection. South of this intersection sidewalks are provided on the eastern side of Route 107. Continuing north sidewalks are provided on both sides of Route 107. Sidewalks are present on both sides of Marlborough Road and the northern side of Traders Way. The intersection has a high crash rate.

The following deficiencies have been identified:

- The traffic signal equipment is outdated and there is currently no emergency preemption at the intersection, hindering emergency response time and increasing crash risks.
- Frequent congestion during peak periods with inadequate coordination and clearance. The intersection operates at an overall level of service E during the weekday morning peak hour and at level of service F during the weekday PM peak hour and the Saturday midday peak hour.
- The sidewalks adjacent to the signal and pavement are in need of maintenance.
- The intersection is very wide and requires high clearance intervals to clear traffic and pedestrians in the intersection.
- There are minimal bicycle amenities in the form of detection at all approaches of the intersection.
- Travel patterns reveal that shopping center cut-thru traffic occurs at this location, as well as U-turn traffic.

### Route 107 (Highland Avenue) at Hawthorne Square Mall Shopping Center/Site Drive

The signalized intersection of Route 107 (Highland Avenue) at Hawthorne Square Mall Shopping Center/Site Drive is a four-way intersection with Route 107 running in the north/south direction and Hawthorne Square Mall Shopping Center connecting from the east and the Site Drive connecting from the west. The northbound approach provides an exclusive left-turn lane, a through lane and a shared through and right-turn lane. The Route 107 southbound approach provides an exclusive left-turn lane, two through lanes and an exclusive right-turn lane. The Hawthorne Square Mall Shopping



Existing aerial of Highland Ave at Hawthorne Square Mall Shopping Center/Site Drive.

Center approach provides a shared left-turn and through lane and a channelized right-turn lane under yield control. The eastbound site drive approach currently provides a single multi-use lane. The traffic signal operates with three phases for vehicular traffic including a lead protected left-turn movements phase for the northbound and southbound approaches, followed by a phase for northbound and southbound through movements where left-turn movements are prohibited, and a phase for the eastbound and westbound approaches with permissible left-turns. There is also an exclusive pedestrian phase with crosswalks spanning the southbound and westbound approaches at this intersection. Sidewalks are provided on both sides of Route 107 and on the northern side of Hawthorne Square Mall Shopping Center.



The following deficiencies have been identified:

- The traffic signal equipment is outdated and lacks emergency preemption.
- Frequent congestion during peak periods with southbound approach experiencing long delays and queues. The intersection operates at level of service F in the Saturday peak period.
- Despite prohibitive signage, U-turns occur at this location.
- Pavement markings are faded at this location.
- Travel patterns reveal that Route 107 southbound lefts are likely routed towards Swampscott Road and are using this intersection to avoid signals downstream.
- The sidewalks adjacent to the signal and pavement are in need of maintenance.
- The existing Route 107 crosswalk is very long with no refuge area midway and there is no crosswalk on the northbound and eastbound approaches.
- Bicycle amenities consist solely of bicycle detection at all approaches of the intersection.

### Route 107 (Highland Avenue) at Cherry Hill Avenue/Willson Street

The signalized intersection of Route 107 (Highland Avenue) at Cherry Hill Avenue/Willson Street is a four-way intersection with Route 107 running in the north/south direction and Cherry Hill Avenue running in the west direction and Willson Street running in the east direction. The northbound approach provides a through lane and a shared through and right-turn lane while the southbound approach provides a shared left-turn and through lane and an exclusive through lane. The westbound approach on Willson Street provides an exclusive left-turn lane and a shared left-turn and right-turn lane. The eastbound approach on Cherry Hill Avenue is one-way in the eastbound direction and provides an exclusive left-turn lane and a shared through and right-turn lane. The traffic signal operates with four phases for vehicular traffic including a lead southbound phase, a northbound and southbound phase with permissible southbound left-turns and a split phase between the eastbound and westbound approaches. There is also an exclusive pedestrian phase and crosswalks spanning each approach at this intersection and sidewalk on both sides of Route 107 and Willson Street.



Existing aerial of Highland Ave at Cherry Hill Ave/Willson St.

The following deficiencies have been identified:

- The traffic signal equipment is outdated, lacks emergency preemption, has poor timing, and inconsistent audible accessibility.

- Frequent congestion during peak periods with westbound queues extending towards Salem High School, which is on the south side of Willson Street. Route 107 southbound approach operates with a defacto left turn lane, and encounters long delays during peak hours. The intersection operates at an overall level of service E in the morning peak period.
- Pavement markings are faded at this location.
- The clearance intervals for vehicular traffic and pedestrians are inadequate.
- There are no bicycle amenities at this intersection or adjacent roadways.

### Route 107 (Highland Avenue) at Lower Driveway of Salem Hospital

The unsignalized intersection of Route 107 (Highland Avenue) at the Lower Driveway of Salem Hospital is a three-way intersection with Route 107 running in the north/south direction and the Lower Driveway of the Salem Hospital connecting from the east. The westbound approach is under stop-control and Route 107 runs uncontrolled. Along this section of roadway, Route 107 provides one-lane of travel in each direction while the westbound approach provides an exclusive left-turn lane and an exclusive right-turn lane. There are sidewalks available on both sides of Route 107



Existing aerial of Highland Ave at Lower Driveway of Salem Hospital.

and a sidewalk located on the southern side of the Lower Driveway of Salem Hospital. There is a crosswalk spanning the Lower Driveway of Salem Hospital approach.

The following deficiencies have been identified:

- There is significant delay for the westbound approach.
- There are wide lanes and faded pavement markings along this section of Route 107, 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.
- The existing curb ramps are outdated and non-ADA compliant.
- There are no bicycle amenities at this intersection or adjacent roadways.



## Route 107 (Highland Avenue/Essex Street) at Jackson Street/Dalton Parkway

The signalized intersection of Route 107 (Highland Avenue/Essex Street) at Jackson Street/Dalton Parkway is a four-way intersection with Route 107 running in the north/south direction, Jackson Street running in the westbound direction and Dalton Parkway running in the northwest direction. The northbound approach on Route 107 provides a through lane and an exclusive right-turn lane while the southbound approach provides an exclusive left-turn lane and a through lane. The Jackson Street approach currently provides an exclusive left-turn lane and a through lane. The Dalton Parkway approach is uncontrolled by the signal but provides an exclusive right-turn only under yield control. The traffic signal operates with three phases for vehicular traffic including a lead protected phase for the southbound left-turn and through movements, followed by a northbound and southbound through phase where southbound left-turns are permissible, and a protected Jackson Street westbound phase for left and right-turn movements. There is also an exclusive pedestrian phase with crosswalks spanning the northbound approach and the Jackson Street/Dalton Parkway approaches. Sidewalks are provided on both sides of Route 107, Jackson Street and Dalton Parkway. There are no bicycle amenities on Route 107, Jackson Street or Dalton Parkway. The intersection has a high crash rate.



Existing aerial of Highland Ave/Essex St at Jackson St/Dalton Parkway.

The following deficiencies have been identified:

- The traffic signal equipment is outdated and a number of the signal heads are mounted on posts, which are less visible to motorists.
- The signal lacks emergency preemption.
- Frequent congestion occurs during peak periods with inadequate clearance intervals, illegal left turns made from the right turn lane, and long queues on Route 107.
- The sidewalks adjacent to the signal and pavement are in need on maintenance.
- The existing apex style curb ramps are outdated and non-ADA compliant.
- There are no bicycle amenities at this intersection or adjacent roadways.
- The “no left turn” signs on Dalton Parkway are inadequate and frequently ignored. Dalton Parkway lacks wayfinding signage.

### Route 107 (Essex Street) at Boston Street (Route 107)

The signalized intersection of Route 107 (Essex Street) at Boston Street (Route 107) is a four-way intersection with Route 107 running in the northbound and eastbound direction (Boston Street) and Essex Street running in the southbound direction and a private driveway running in the westbound direction. The northbound approach provides an exclusive left-turn lane and a through lane and the southbound approach provides a through lane and an exclusive right-turn lane. The eastbound approach provides exclusive left-turn and right-turn lanes. The westbound



Existing aerial of Essex St at Boston St.

approach is a one-way direction towards the intersection and provides a multi-use lane. There is a wide median on the northbound and southbound approaches and a number of driveways enter the roadways in close proximity to the intersection. The traffic signal operates with four phases for vehicular traffic including a lead protected northbound phase with an overlapping eastbound right-turn movement, a northbound and southbound through phase where northbound left-turns are prohibited and a split phase between the westbound and eastbound approaches. There is also an exclusive pedestrian phase and crosswalks spanning the northbound and eastbound approaches at this intersection and sidewalks on both sides of Route 107, Boston Street and Essex Street.

The following deficiencies have been identified:

- 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 driveway approach lacks detection.
- Pavement markings are inadequate for the left turn lane.
- The existing curb ramps are apex style ramps that do not provide sufficient guidance to sight impaired users.
- There are no bicycle amenities at this intersection or adjacent roadways.



## IV. FUTURE YEAR PROJECTIONS

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### A. INTRODUCTION

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The 2015 existing peak hour traffic volumes were projected to the year 2035 to determine future traffic demands on the study area roadways. Traffic growth is primarily a function of changes in motor vehicle use and land development in the region. Proposed developments in Lynn and Salem were reviewed to identify any potential future traffic generators along Route 107 in the study area. In addition to specific traffic generators, changes in regional travel demands were reviewed with the assistance of the Central Transportation Planning Staff (CTPS). CTPS maintains a regional traffic demand model that uses land use and socioeconomic inputs to forecast future traffic volumes. CTPS reviewed the Route 107 study area and adjacent land uses to develop annual traffic growth rates utilizing the model. The developments and growth rates are discussed in greater detail below.

### B. FUTURE LAND USE DEVELOPMENT

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Several parcels, shown in Figure IV-1, are identified for redevelopment. Those abutting Route 107 include 355-373 Highland Avenue, which comprise the Cinemaworld Development. This development has not been permitted. Preliminary plans propose a movie theater, bowling arcade, and family entertainment center. Other areas of potential redevelopment include Walmart in Salem near the Lynn border, and the expansion of the Salem Hospital on the northern segment of the study area. No significant impacts are anticipated for the expansion of the Salem Hospital, based upon the Environmental Notification Notice.

Future land use changes are expected to impact the amount of traffic traveling on Route 107 in the study area. To understand the anticipated land use changes, planned developments were identified by the cities of Lynn and Salem to be:

- Salem Hospital expansion
- Transfer Station on Swampscott Road
- Residential developments along the study area
- Cinemaworld Complex on Route 107 south of Swampscott Road

The developments identified by Lynn and Salem were shared with CTPS to determine if the regional model accounted for the noted developments. All of the developments except for the proposed Cinemaworld Complex were accounted for in the regional traffic demand model. Traffic associated with the proposed Cinemaworld Complex was added to the study area roadways in addition to the background traffic growth identified by CTPS.

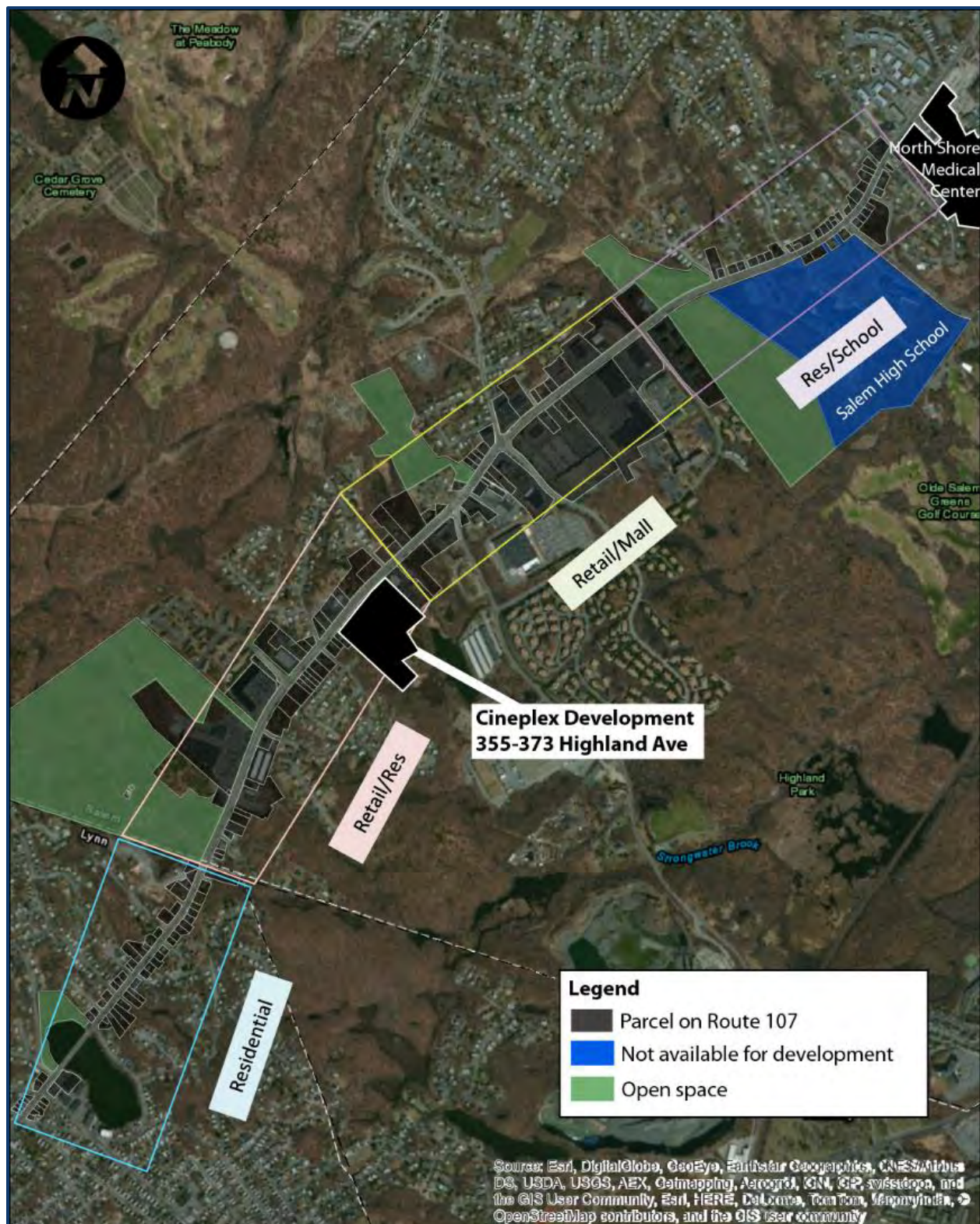


Figure IV-1: Future Development



The proposed Cinemaworld Complex project is located south of Swampscott Road on the east side of Route 107, as depicted in Figure IV-2. As part of the project, mitigation within the Route 107 study area is currently proposed to include the addition of a traffic signal with auxiliary left turn lanes on Route 107 at the currently unsignalized Cedar Road intersection. The process for developing the future 2035 traffic volumes including the CTPS traffic projections and traffic expected to be generated by specific developments is discussed in detail below.

In addition to the known developments, the land use within the study area was reviewed to identify developable land. The land surrounding the study area is already largely developed with mainly residential or residential conservation zoning. The Lynn segment of the study area in particular is densely developed, and almost all of it is residential, with little redevelopment potential. The Salem segment contains more potential for the redevelopment of existing commercial space, such as the Cinemaworld Complex development noted above.

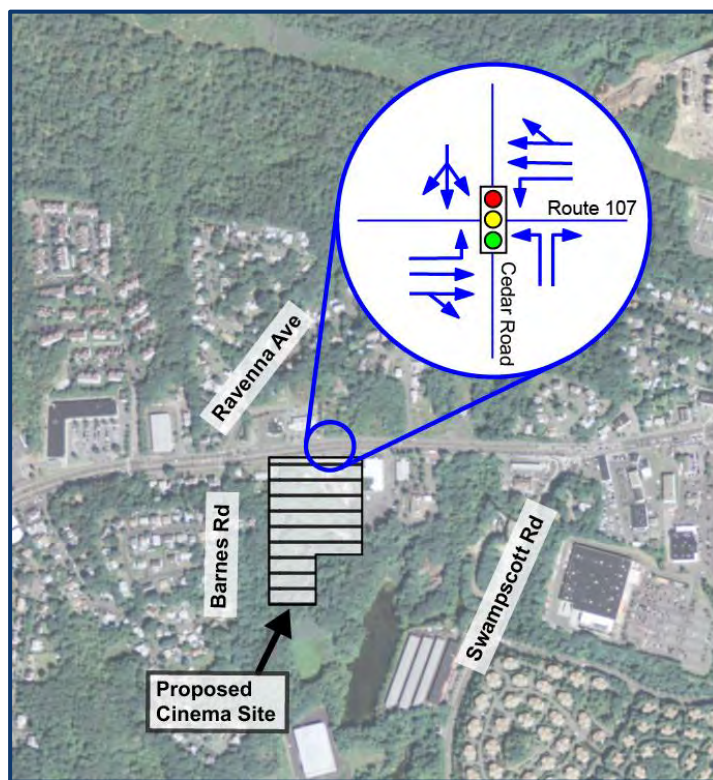


Figure IV-2: Proposed Cinema Site

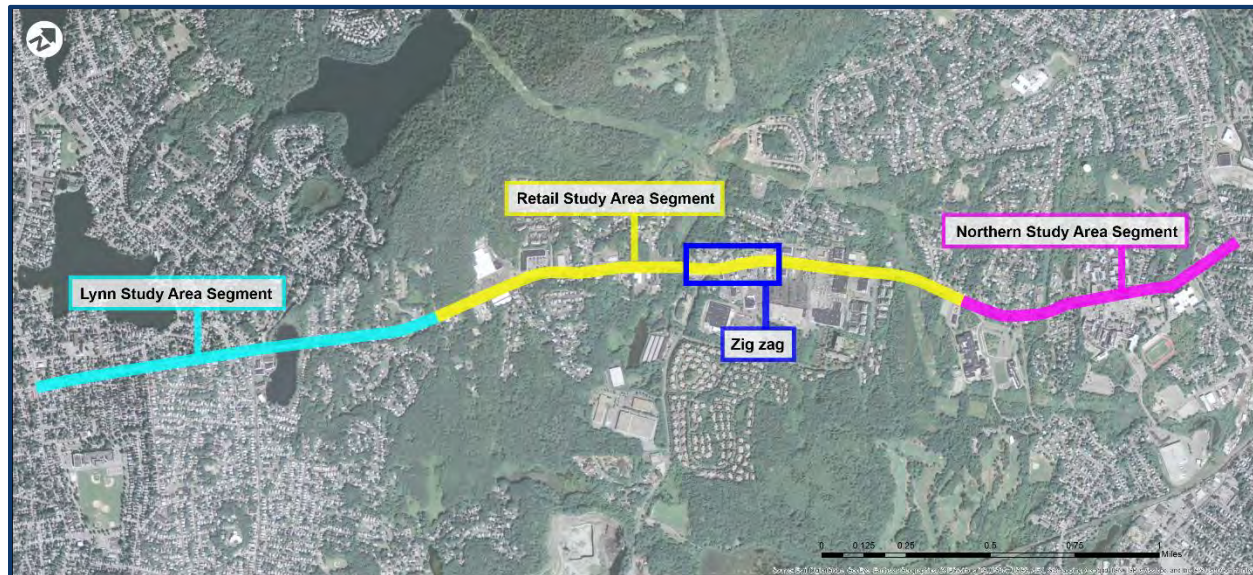
The northern end of the study area, characterized by older industrial buildings, is the area with the most redevelopment potential. This area is likely to see the redevelopment of older, existing structures into new residential/mixed use buildings. The North River Canal Park area, just north of the study area, has been targeted as a location by the city for its redevelopment potential due to its old industrial buildings and underutilized, auto-oriented space along the railroad tracks. North River Canal Park falls between Bridge Street and Mason Street with the North River in between. The proximity of the Salem commuter rail station gives the area further redevelopment potential. Other neighborhoods in Salem, The Point, to the east of the study area, and the Salem/Peabody border, have also been targeted as areas for future growth and development.

### C. DEVELOPMENT OF 2035 TRAFFIC VOLUMES

The 2035 traffic volumes were forecasted by reviewing developments included within the CTPS model, applying growth rates from the regional traffic demand model, and adding expected traffic associated with other noted developments to the roadway network. A memorandum provided by CTPS titled *Route 107 Corridor Traffic Growth Estimates* was used to determine the future traffic growth rates to be applied to existing traffic volumes throughout the study area. Traffic growth rates from the regional traffic demand model for projection from the existing year

2015 to the future year 2035 were provided for the three segments of the study area noted here and depicted in Figure IV-3:

- Western Avenue from Chestnut Street to the Lynn/Salem border
- Highland Avenue from the Lynn/Salem border to the west of Willson Street
- Highland Avenue from Willson Street to Essex Street



**Figure IV-3: Route 107 Study Area Segments**

Growth rates were provided for the weekday morning and weekday afternoon peak periods. The CTPS model did not provide growth projections for the Saturday midday peak period. Therefore, for the purpose of the study, the weekday afternoon peak period growth rates were applied to the Saturday midday peak period. The growth rates provided by CTPS and applied to the existing volumes are summarized in Table IV.1 below. These growth rates are expected to account for future traffic generators including local residential developments, the Salem Hospital expansion, and Swampscott Road transfer station. The CTPS memorandum is provided in the Appendix of this report for reference.

**Table IV.1: Peak Period Traffic Growth (2015-2035)**

Route 107 Corridor Sections	AM	PM	SAT
Western Ave in Lynn	2.0%	2.0%	2.0%
Highland Ave (west section)	2.0%	3.0%	3.0%
Highland Ave (east section)	6.0%	5.0%	5.0%



The regional traffic model did not account for the trips associated with the proposed Cinemaworld Complex. After the growth rate was applied to the study area intersections, the traffic volumes provided in the Cinema Traffic Impact Study were distributed to the study area roadways.

The resulting traffic volumes represent the 2035 future conditions which are depicted in Figure IV-4 for the weekday morning, weekday afternoon, and Saturday midday peak hours, respectively.

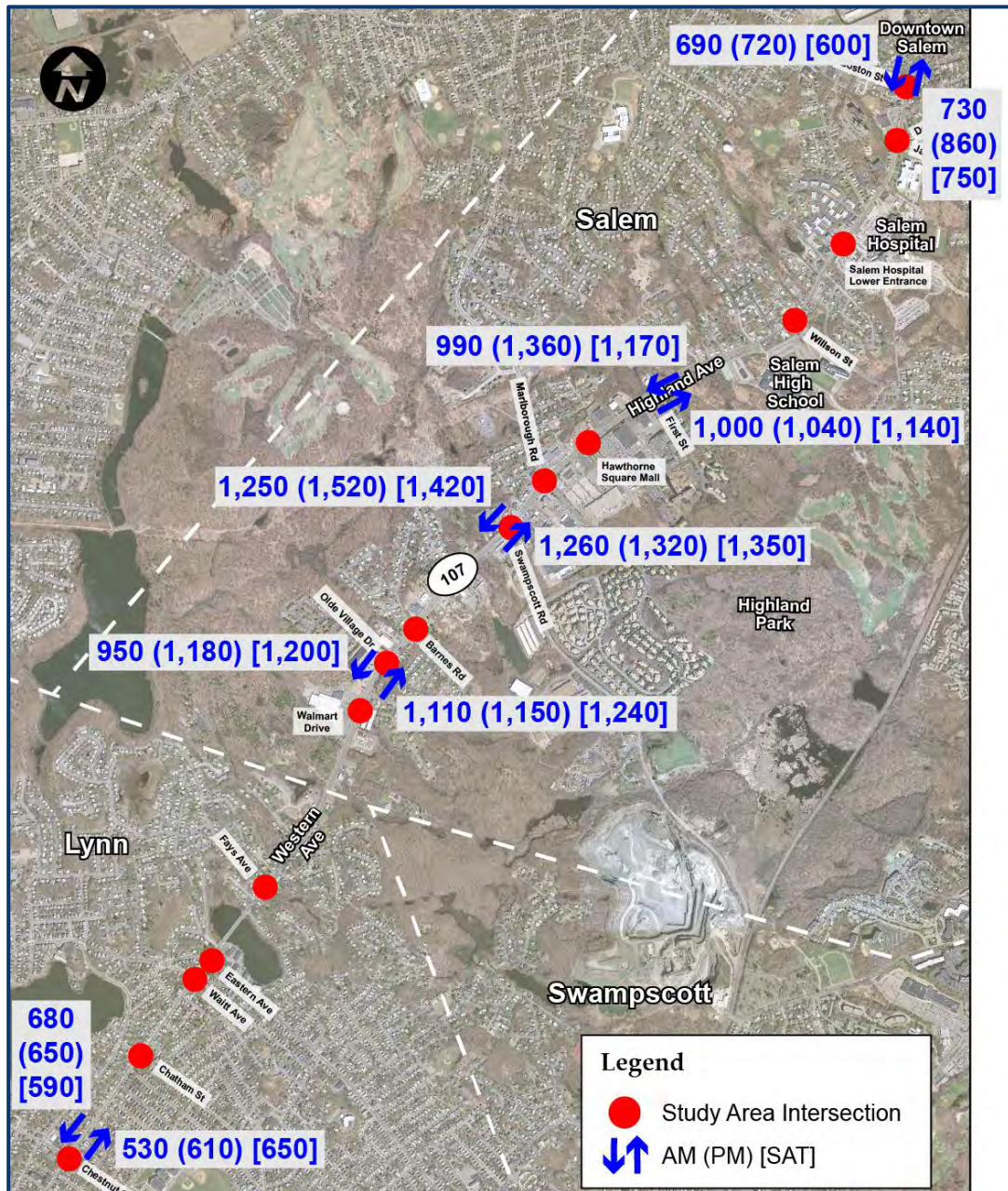


Figure IV-4: Future Vehicle Counts

## V. IMPROVEMENT ALTERNATIVES DEVELOPMENT AND ANALYSIS

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### A. INTRODUCTION

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The previous chapters of this study presented the goals and objectives, a review of existing conditions and transportation issues and concerns. The following chapter documents the iterative process of developing specific roadway and intersection improvements to address the issues and concerns while pursuing the study goals and objectives. The steps taken to develop multi-modal improvements for the Route 107 study area are also documented in the chapter below.

### B. ALTERNATIVE DEVELOPMENT APPROACH AND PROCESS

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Based on the work and outputs of the existing conditions review, the public outreach survey and the Working Group discussions, concepts and ideas for improving the Route 107 study area were developed. The Route 107 Study was tasked with evaluating opportunities to improve all modes of transportation including vehicles, pedestrians, bicyclists and transit users. The concepts developed in this process present the opportunity to improve operations and potentially change the general atmosphere of the roadway. The process of developing and evaluating these alternatives is outlined below:

- Review existing conditions, survey results & Working Group input
  - right-of-way constraints
  - multi-modal accessibility & connectivity
  - environmental constraints
  - vehicular operations
  - survey results working group feedback
- Identify study area-wide improvements to meet corridor goals
- Discuss with Working Group and get feedback
- Evaluate feasibility
- Select preferred alternative

Based on the steps outlined above, a preferred alternative was ultimately selected. The preferred concept includes both study area-wide and intersection specific improvements for implementation along the Route 107 study area and is discussed in further detail below.

### C. IMPROVEMENT ALTERNATIVES

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#### 1. STUDY AREA-WIDE IMPROVEMENTS

A number of improvements can be implemented on the entirety of the Route 107 study area to improve operations for all modes of transportation. This section discusses the overarching improvements that were considered for the study area.



## Transit Alternative Improvements

As discussed in the existing conditions chapter of this study, transit service along the Route 107 study area is primarily provided by MBTA bus routes 424, 450 and 456. In order to address identified transit deficiencies and improve transit service along Route 107, this study investigated the following summary of potential improvements:

- Alterations to frequency, and span of service
- Improved reliability
- Connectivity and transfers between bus routes
- Access to rider origins and destinations
- Visibility and marketability of bus service in the study area through improved signage, pavement markings and bus stop names
- Optimized bus stop locations, while considering local transit generators and existing bus stop amenities
- Bus stop accessibility issues including clear and level landing areas and clear zones, and sufficient bus stop length.
- Pedestrian conditions, including sidewalk, crosswalk and curb ramp access improvements
- Provision of passenger amenities such as shelters, benches, bicycle racks, and trash receptacles
- Creation of bus stop curb extensions
- Transit priority measures at intersections

Based on the potential improvements summarized above, preferred alternatives include development of a bus stop optimization plan, consideration for the addition of bus stop amenities, and signage and pavement marking improvements. Other improvements such as bus stop curb extensions, transit priority measures and provision of real-time information displays were also considered. These are not recommended at this time due to the relatively low ridership and low frequency of service within the study area.

These focused improvements were considered at the corridor-level, rather than on a segment-by-segment basis, due to the recurring issues and opportunities for improvements throughout the study area. Recommendations specific to individual bus stops are described in the following chapter.

## Bus Stop Optimization Plan

The purpose of a bus stop optimization plan is to improve travel times, reliability, and accessibility of bus service, while maintaining and or enhancing access to rider destinations and amenities along the study area. Numerous factors are considered when creating a bus stop optimization plan, as outlined in Table V.1 from the MBTA Bus Stop Design Guidelines.

Table V.1: Bus Stop Modification Criteria

Criteria for Bus Stop Modification			
<b>Bus Route Connections</b>	Retain or improve connections to other bus routes.		
<b>Ridership</b>	Maintain high ridership stops and stops with existing amenities.	Concentration of sensitive riders.	
<b>Access</b>	Improve access to rider origins and destinations.		
<b>Pedestrian Connections &amp; Safety</b>	Improve connections to crosswalks with curb ramps.	Consider existing sidewalk condition and network, and landing area.	Maintain stops that provide safe pedestrian crossings.  Adjust stop locations that obstruct driveway access.
<b>Spacing</b>	Adjust bus stop spacing to meet <i>MBTA Bus Stop Design Guidelines</i> , and in consideration of local transit generators, and existing bus stop amenities.		

Source: MBTA Bus Stop Design Guidelines (2014)

A potential bus stop optimization plan is depicted in Figure V-1 and summarized in the Bus Stop Consolidation Summary Table in the Appendix. The next step recommended is a review of the plan by MBTA and a series of community meetings held to gather community input on proposed significant changes. The municipal approval process for alterations to bus stops would also need to be determined. Proposed final bus stop locations are depicted in Figure V-1. Details of the bus stop consolidation are summarized in tabular format in the Appendix.

**Bus route connections** were important considerations and they have been maintained or improved. Under certain circumstances the relocation of a bus stop may have increased the distance for riders transferring between routes, but the stops are still within close proximity to their former location, and thereby the added distance is minimized.



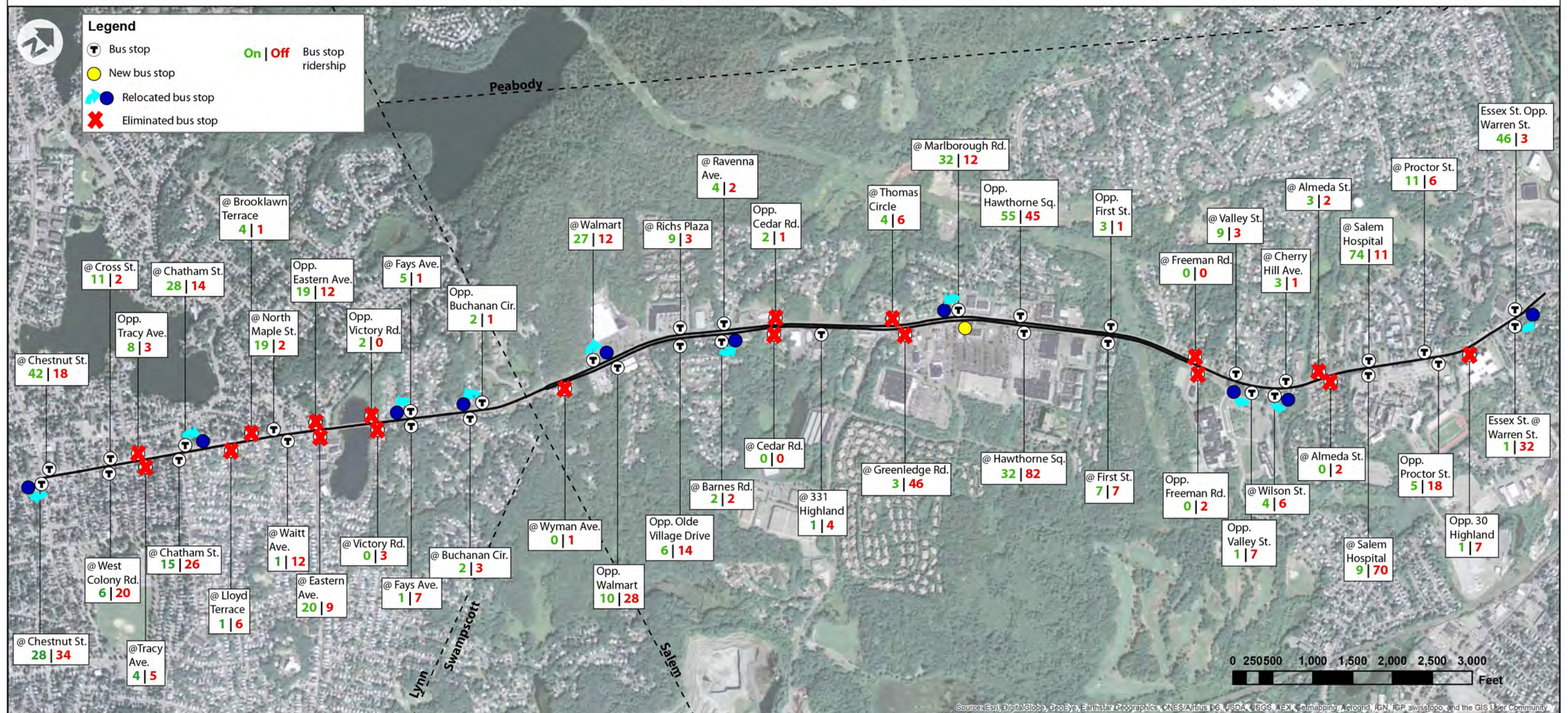


Figure V.1  
Bus Stop Consolidation Plan  
Route 107 Corridor Study  
Lynn/Salem, MA



**Ridership** is one of the key criteria for modifying bus stops. Low ridership is considered to be about 20% of the total ridership on a given route. Within the study area, 50% of stops have less than 10 riders per day. Existing high ridership stops are generally located in the center of retail areas, but no bus stop ridership is more than 20% of the average total. Efforts were made to retain existing bus stops with amenities.

Several bus stops are proposed for relocation or for a slight adjustment to their location in order to improve their **pedestrian connections** and/or conditions. This may include connection to improved sidewalk areas, in order to accommodate an eight-foot landing area. They may also be proposed for relocation to connect to a designated pedestrian crossing, particularly signalized crossings. Other stop locations have been adjusted to ensure that the stop is more visible, addressing safety concerns.

The proposed optimization plan reduces the overall number of stops and makes spacing more uniform, which results in the following:

- increases efficiency of the service
- reduces conflicts associated with entering and exiting bus stops
- minimizes parking impacts resulting from bus stops

The bus stop locations have been modified in consideration of the MBTA spacing guidelines provided in Table V.2. In this type of suburban area, four to five stops per mile, or one every 1,000 feet to 1,300 feet, is recommended. Currently, average spacing along the study area is about 700 feet, with about 30 stops spaced shorter than the MBTA's guidelines.

**Table V.2: Bus Stop Spacing Guidelines**

Bus Operating Environment	Average # of Stops per Mile	Average Distance Between Stops
Central Business District (CBD)	4-5	1,000-1,000 feet
Urban outside CBD and Key Bus Routes	4-7	750-1,300 feet
Suburban	4-5	1,000-1,300 feet
Bus Rapid Transit/Limited Stop Service	2-4	1,300-2,600 feet

Source: MBTA Bus Stop Design Guidelines (2014)



The stop consolidation plan recommends reducing the total number of stops from 52 to 35, with an average spacing of about 1,000 feet between stops. Six stops are recommended for relocation, 17 stops are proposed for removal and one new stop is recommended to be installed outside of the Hawthorne Square Mall Shopping Center, which will create an outbound stop pair for the inbound stop at Marlborough Road. Before an existing stop is relocated or a new bus stop is created, it must meet the bus stop accessibility requirements, including the presence of a sidewalk, an ADA landing area and clear zone, and adequate curb space for the stop must be provided.

The total ridership in the study area is not anticipated to change with the implementation of the proposed optimization plan, as riders who currently use a stop that is slated for relocation or removal could walk the short distance to the next closest stop in either direction. Figure V-2 shows the final recommended bus stop locations and projected ridership at the proposed stops.

### **Passenger Amenity Improvements**

Adding amenities, such as shelters and benches, to bus stops improves the passenger waiting experience and provides comfort and protection from the elements. Bicycle racks can provide riders with an alternative mode choice to travel the remaining distance between their origin/destination and the bus stop. Amenities can help to retain and attract additional transit riders to the service. Standardization of the amenities will provide continuity and consistency and improve the overall visual aesthetic of the Route 107 bus stops. ADA compliance is required prior to the installation of passenger amenities.

### **Shelters**

As previously mentioned, existing shelters within the study area comprise a mix of shelter sizes and styles, although the number of stops at which shelters are provided is rather limited. The installation of shelters at more stops with significant ridership, and stops serving sensitive land uses should be explored. The size and style of shelters pursued will largely be dependent upon the amount of available sidewalk space. Standard shelters are typically five feet deep, but narrower shelters, two to three feet deep, are available with full size roofs. The length of shelters is more variable. Shelters can include lighting, powered by a direct connection, battery or solar energy. Customer service information, including maps and schedule information should also be integrated. New shelters can be standard or custom designs, and advertising panels offer revenue options.



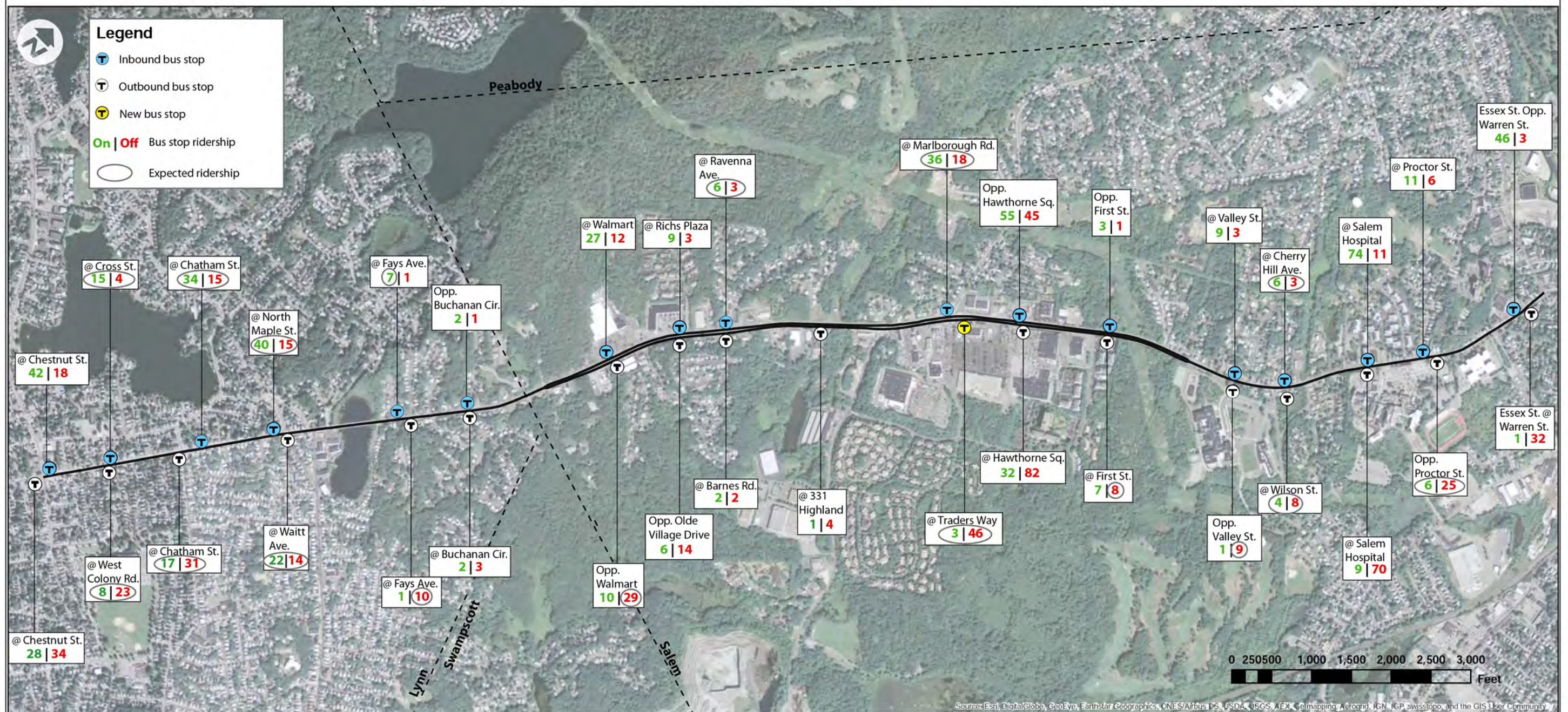


Figure V.2  
Proposed Final Bus Stop Location Plan and Projected Ridership  
Route 107 Corridor Study  
Lynn/Salem, MA



## Benches

Freestanding benches are a relatively low-cost bus stop amenity that can provide riders with an improved level of comfort, especially on bus routes with low frequency and low ridership. Benches are relatively easy to install and more easily accommodated on narrower sidewalks, where a shelter might not be feasible. The size of the bench could still vary to provide seating between one and four seats.



**Benches at an MBTA bus stop in Brookline.**



**Simme Bus Stop Seat**  
(<http://simmeseat.com/portfolio/pairedseats/>).

The orientation of benches is an important consideration, so as to allow users a view of the oncoming bus. Considerations when selecting the position of the bench within the sidewalk space include user safety, maintenance of a five-foot clear zone, and view sheds.

## Trash Containers

Only one container for trash management is provided along the study area, at the Salem Hospital outbound stop; however, it is not affixed to the sidewalk. The addition of trash/recycling receptacles, and or trash/recycling solar compactors should be explored, particularly at higher ridership stops, and at stops close to retail. Solar-powered compactors can be Wifi-enabled and notify refuse collection departments when the receptacle needs to be emptied.



**Improved amenities for trash management, including solar powered trash receptacles.**

Trash containers should be sited in shady areas away from seating areas, but in close proximity to boarding/alighting areas.

## Bicycle Racks

The installation of bicycle racks at bus stops would expand rider connections to and from origins/destinations outside of the study area and can incentivize transit users to ride their bicycle to access transit. Furthermore, they provide a bicycle parking option for riders if the bicycle rack on the bus is already at capacity.



**Bike rack at a bus stop on Mass Ave in Cambridge.**

## Bus stop signs and pavement markings

All bus stops should be anchored with at least one bus stop sign at the front of the stop. In parking areas within the Route 107 study area bus stop signs should be provided at both the front and the rear of the bus stop zone, to clearly delineate the bus stop and no parking area. The appropriate bus stop lengths for locating signs are provided in Table V.3. Newer MBTA bus stop signs indicate the \$100 fine for illegal parking in a bus stop. All bus stop signs should be updated to meet current MBTA standards shown in Figure V-4, which include sign reflectivity for better night time visibility, and include the bus stop ID number, which passengers can use to call, text, or use with a mobile app to obtain real-time information.

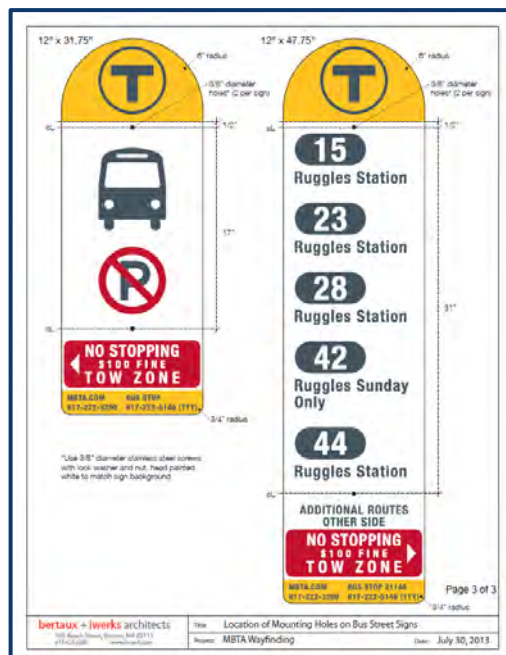
Bus stop pavement markings could be added to enhance the visibility of bus stops for bus drivers and riders, and re-inforce the bus stop zone in on-street parking areas. Pavement markings consistent with MBTA standards, as shown in Figure V-3 would be preferred. Markings should be adjusted accordingly when bus stops are located adjacent to bicycle accommodations.

**Table V.3: Bus Stop Lengths**

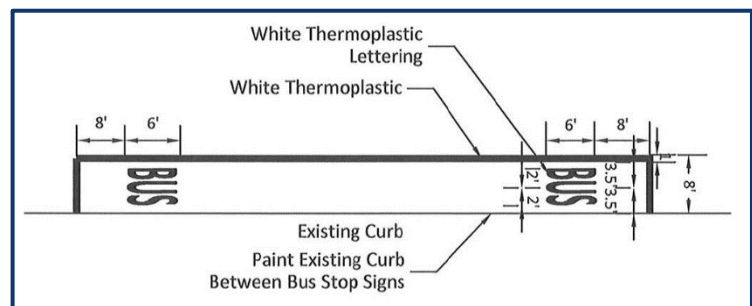
Stop Placement	40' Bus		60' Bus	
	Standard	Minimum	Standard	Minimum
Near-side	100'	90'	120'	110'
Far-side	90'	70'	110'	90'
Far-side, after left turn	120'	100'	140'	120'
Midblock	120'	100'	140'	120'

Source: MBTA Bus Stop Design Guidelines (2014)





**Figure V-4: Current MBTA Bus Stop Sign Standard**



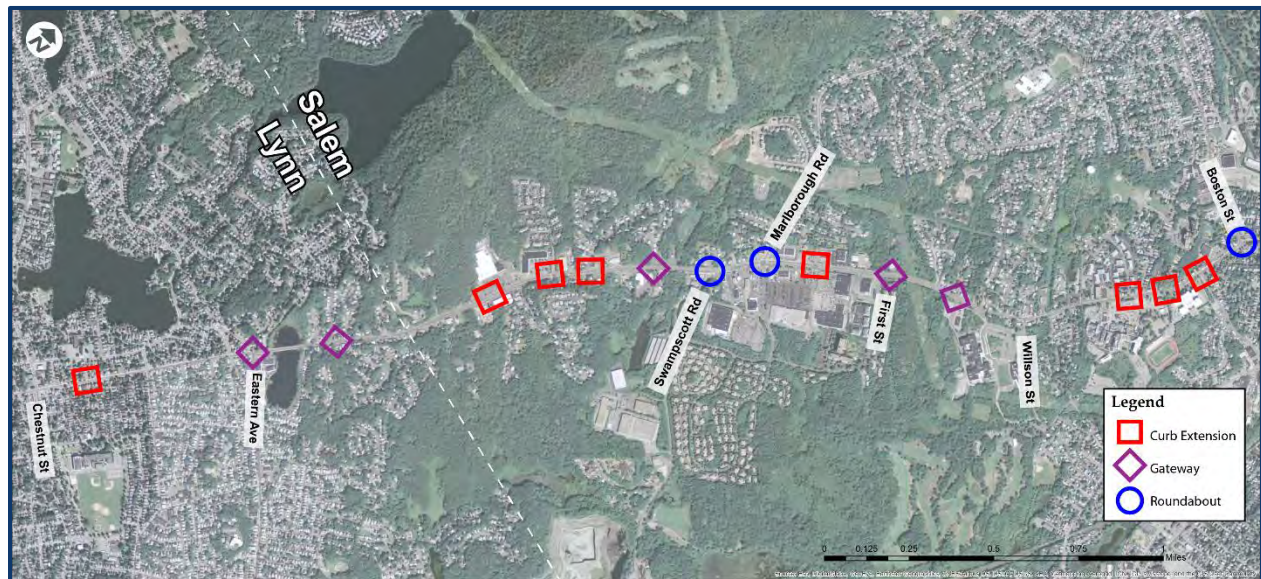
**Figure V-5: Bus Stop Pavement Markings Detail**

## Pedestrian Improvements

Although some of the existing study area has sidewalks, much of Route 107 lacks an ADA compliant path on both sides of the roadway. In order to achieve an improved experience for pedestrians along Route 107, the following improvements have been explored as part of this study.

- Proposed sidewalks where none exist today
- Wider sidewalks where the right of way allows
- ADA compliant curb ramps at intersections and crossings
- Improved unsignalized crossings
- Curb extensions
- Crosswalks at signalized intersections
- Countdown pedestrian signal heads
- Accessible pedestrian signal push buttons

Improved pedestrian facilities will also improve transit connectivity and overall user experience. Implementation of additional elements such as traffic calming, gateways, and roadway landscaping are expected to further improve safety and the overall pedestrian experience. Figure V-5 depicts potential locations for implementation of various traffic calming techniques.



**Figure V-5: Route 107 Potential Pedestrian Improvements**

Curb extensions would shorten crossings for pedestrians and could also facilitate bus stops by providing additional waiting area and room for transit amenities. Gateways are designed to call attention to a roadway transition and can include a range of options such as curb extensions, roundabouts, signage and landscaping.

### Bicycle Improvements

Within the study area, Route 107 does not currently provide separated facilities for bicycles. With the lack of separated facilities and high vehicle speeds, bicyclists on the roadway experience a high level of traffic stress (LTS) for the entirety of the study area. LTS for bicycles rank from 1 to 4, with LTS 4 being the worse. In order to reduce the LTS from its current ranking of LTS 4 along Route 107, the following bicycle improvements were investigated:

- Separated bicycle lanes
- Shared use paths



**Separated Bicycle Lanes**





### Shared Use Paths

Separated bicycle lanes often result in LTS 1 or 2, depending on separation from vehicular traffic and intersection configuration. The lanes can be one-way or two-way, and should be continuous to provide for a uniform application and use along the roadway. The bicycle lanes can be separated by curbs, raised medians, parking lanes or bollards. Shared use paths are classified as off road facilities that provide a shared space between both pedestrians and bicyclists. With the physical separation from the roadway, this type of facility results in LTS 1. Consolidating pedestrian and bicycle facilities may provide for more opportunity for landscaping within the right-of-way or additional separation from vehicular traffic. Adjacent to parking, consideration should be given to additional buffer space. Doorings, when a car user opens their door into the bicycle lane, striking a bicyclist, can be prevented by adding a protected buffer space between the bicycle lane and parking lane. Additionally, on roadways with heavy truck traffic, adding a buffer between the bicycle lane and travel lane will increase the safety and comfort of bicyclists.

### Vehicular Improvements

Extensive queuing and high delay is experienced by vehicles within the Route 107 study area under existing conditions. The study seeks to improve these traffic operations by implementing some of the following roadway enhancements:

- Revised cross-sections
- Evaluation of on-street parking
- Traffic calming
- Access management
- Traffic signals
- Roundabouts
- Exclusive turn lanes
- Signal timing, phasing and coordination improvements

The study area intersections of Route 107 at Eastern Avenue/Stanwood Street and Route 107 at Salem Hospital Lower Driveway were evaluated for the installation of traffic signals. Route 107 at Eastern Avenue/Stanwood Street was considered in conjunction with the signal at Maple Street/Waitt Avenue. By utilizing the connection at Maple Street/Waitt Avenue, the westbound left turn from Eastern Avenue onto Route 107 could be re-routed to Maple Street/Waitt Avenue. The Working Group identified the lower driveway to Salem Hospital as a potential location for a traffic signal.

The intersection of Swampscott Road at First Street was also evaluated for signal installation, since this intersection was considered as part of the zig zag analysis.

To improve cross-connection access, potential turning lanes were investigated. Exclusive left turn lanes were investigated on all approaches to the Route 107 intersections with Chestnut Street, Chatham Street, and Maple Street/Waitt Avenue. A southbound left turn lane was investigated for Route 107 at Eastern Avenue, at Willson Street, and Salem Hospital Lower Driveway. At Willson Street, an exclusive northbound right turn lane was also considered.

Modern roundabouts were considered within the study area to promote efficient traffic circulation and introduce traffic calming elements to the study area. Roundabouts were considered for the Route 107 intersections at Swampscott Road, Marlborough Road, and Boston Street/Essex Street.

As with any review of alternatives, there are trade-offs between the different concepts for each mode of transportation. The following sections describe a more specific application of the improvements outlined above and how the implementation of each improvement may affect the multimodal operations of Route 107.

As discussed in the existing conditions review, the Route 107 study area has been broken in three primary roadway segments (and one sub-segment) in order to more easily discuss potential improvements as they apply to the different segments of the roadway. The discussion of alternatives are broken into the roadway segments as depicted in Figure V-6.

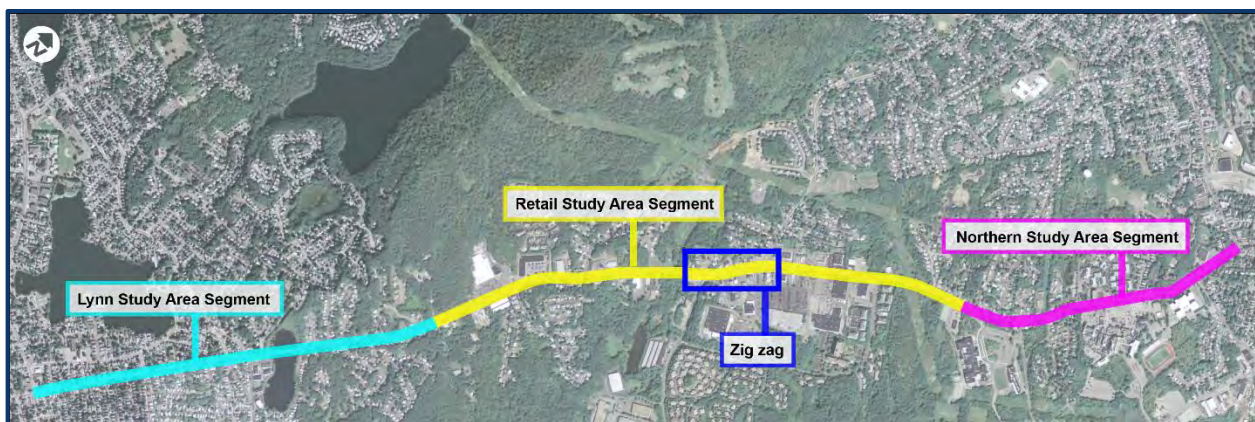


Figure V-6: Route 107 Roadway Segments



For each roadway segment, a series of roadway cross-sections have been considered. As depicted in Figure V-7, the roadway cross-section consists of the components of the roadway and may include:

- Vehicle travel lanes
- Parking
- Pedestrian facilities
- Bicycle facilities
- Medians
- Landscaping



Figure V-7: Cross-Section Elements

The pros and cons of the cross sections considered are identified in the following discussion. In developing the cross-sections, efforts were made to balance the transportation modes, to remain within the existing right-of-way, and to reflect the specific desires of each roadway segment. The existing right-of-way varies along Route 107 as shown in Figure V-8.



Figure V-8: Existing Right-of-Way Along Route 107

## 2. LYNN STUDY AREA ALTERNATIVES

In the Lynn study area segment of the study area, there is a 66-foot wide right-of-way in which Route 107 currently consists of one 15-foot travel lane in each direction, an eight-foot parking lane in each direction, and ten-foot sidewalks on both sides of the roadway. Efforts were made to maintain parking in this segment and to add bicycle accommodations. This segment of the study area is under the City of Lynn's jurisdiction from Chestnut Street to the southern end of the Buchanan Bridge before falling under MassDOT jurisdiction northwards to the Lynn/Salem line.

In order to accommodate a proposed bicycle facility, bicycle lanes, buffered bicycle lanes and a two-way separated bicycle lane were explored. However, the narrow right-of-way combined with the desire to maintain parking limited the range of bicycle amenities that could reasonably be added. By narrowing the travel and parking lanes, a narrow bicycle lane is able to fit within the existing curb-to-curb cross-section. To add a protected buffer to the bicycle lane, providing an added level of safety and comfort, on-street parking on one side of the roadway would need to be eliminated. To provide a two way separated bicycle lane with adequate separation between cyclists and pedestrians and cyclists and vehicles, both existing lanes of on-street parking would need to be eliminated. While this level of separation would create the most comfortable bicycle environment, the consequential impacts to parking were considered too severe for this roadway segment.

The pedestrian improvements in this segment were focused upon the following:

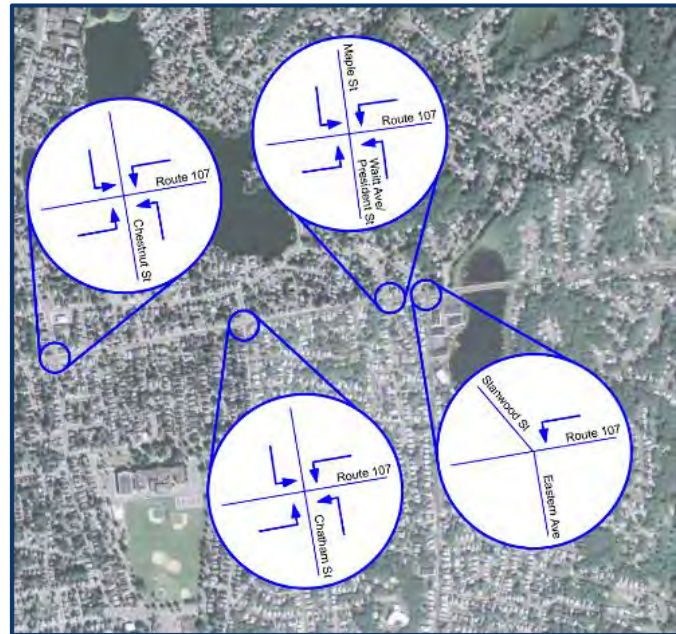
- Maintaining an ADA compliant path for the entirety of the segment
- Providing accessible curb ramps at intersections and crossings
- Providing crosswalks at all signalized intersections
- Improving unsignalized crossings
- Reevaluating signal timings to accommodate up-to-date pedestrian phase timings.

From a traffic operations perspective, two travel lanes are generally sufficient. However, left turn lanes are desirable at key intersections to improve safety conditions. Variations of travel lane widths were considered. Roadway modifications such as exclusive turn lanes, access management, improved intersection geometry and a review of existing and potential traffic signals were explored to enhance safety and operations within this segment of Route 107.

Many of the intersections within the Lynn study area segment are narrow and tight, creating issues for larger vehicles traveling along and turning to and from Route 107. In order to improve this configuration modifications at intersections such as repositioning stop bars, eliminating parking in close proximity to intersections and providing exclusive turn lanes were considered. The addition of the turn lanes would be expected to reduce the number of sideswipe collisions from vehicles attempting to pass on the narrow roadway and improve visibility of turning vehicles potentially reducing the number of angle collisions. Figure V-9 depicts the locations along the Lynn segment which were reviewed for the potential implementation of exclusive left-turn lanes. The intersection improvements are discussed in more detail in Chapter VI.



The existing signalized intersections along the Lynn segment were reviewed to identify improvements that could be proposed to improve traffic operations and safety including revised clearance intervals, updated phasing and improved traffic signal coordination. Updated clearance intervals are expected to help reduce the number of crashes occurring between conflicting movements by giving vehicles adequate time to complete movements at the end of a phase before the next conflicting phase starts. With the potential implementation of left-turn lanes at the signalized intersections, the phasing at each of the signalized intersections needed to be reviewed and updated accordingly. Based on a review of the existing signal operations, it was found that the coordination along Route 107 between the existing traffic signals could be improved to help manage queues along the study area.



**Figure V-9: Potential Implementation of Exclusive Left-Turn Lanes (Southern Corridor)**

The intersection of Route 107 and Eastern Avenue/Stanwood Street was identified as a key location for improvements within the Lynn study area segment. The unsignalized intersection experienced a high number of crashes, many to do with poor sight lines for the minor road approaches and the unconventional offset of the minor roads at Route 107. In order to alleviate some of the existing safety issues a number of improvements were investigated included the following:

- Prohibit Eastern Avenue left-turn movements due to impeded sight lines
- Reconfigure Stanwood Street to be one-way, redirecting traffic to the Maple Street intersection
- Signalize the intersection of Route 107 and Eastern Avenue/Stanwood Street
- Prohibit northbound and/or southbound left-turns from Route 107
- Provide an exclusive left-turn lane for southbound Route 107 approach

Figure V-10 and Figure V-11 depict two potential concepts of the combined improvements expected to make the most significant improvements to the safety and operations at the intersection of Route 107 and Eastern Avenue and Stanwood Street.



Figure V-10: Combined Improvements Concept 1



Figure V-11: Combined Improvements Concept 2



## Potential Roadway Cross-sections – Lynn Segment

After reviewing the existing issues within the Lynn study area segment and identifying potential improvements for each mode of transportation, a number of potential roadway cross-sections were identified. The following section describes the potential cross-sections and the issues and opportunities associated with each.

The first potential cross-section investigated for the Lynn study area segment of Route 107 included sidewalks, a two-way separate bicycle lane, landscape buffer and a travel lane in each direction, as depicted in Figure V-12.

### Opportunities

- Full separation of bicycles from vehicles and pedestrians
- Additional pedestrian separation
- Additional green space

### Issues:

- Removal of parking on both sides
- Loss of up to 145 spaces
- Change in curb line required to accommodate proposed left-turn lanes

The next cross-section explored as part of the study included the elimination of parking on one side of the street to accommodate a protected buffered bicycle lane in each direction, as depicted in Figure V-13.

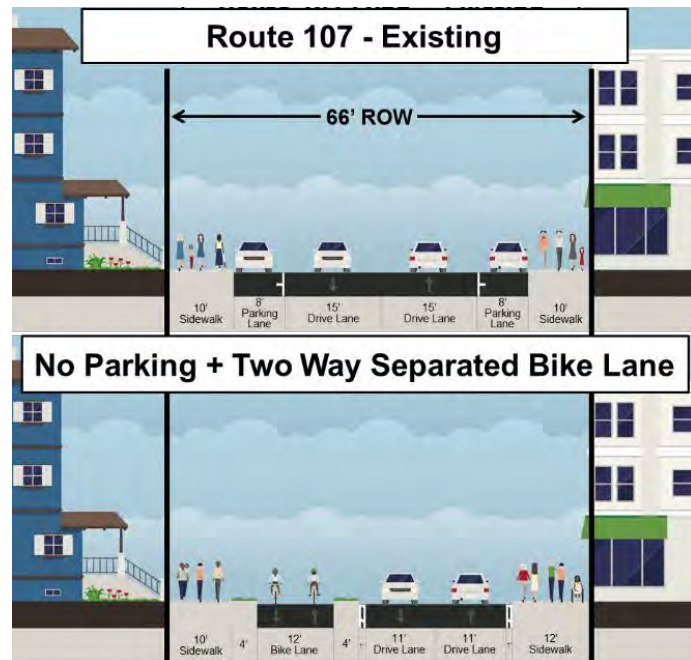


Figure V-12: Potential Cross-Section – No Parking + Two Way Separated Bike lane

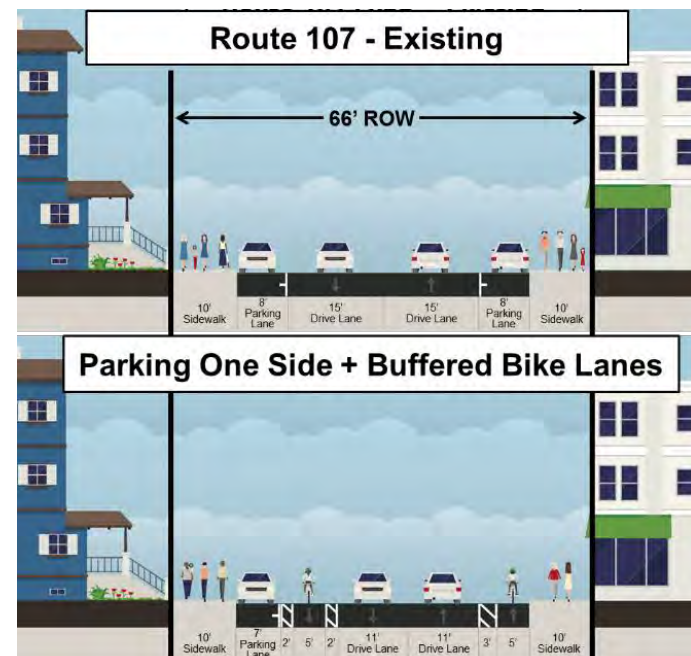


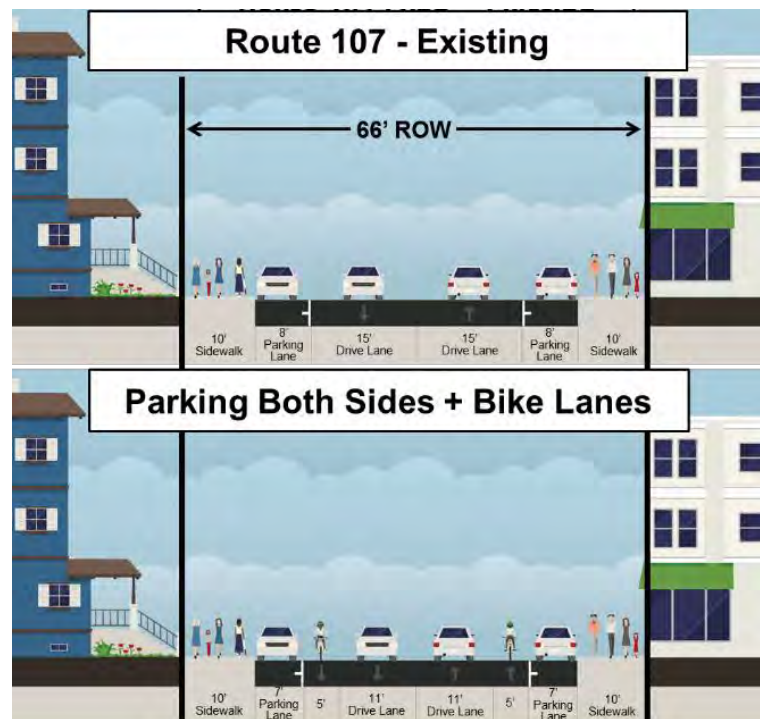
Figure V-13: Potential Cross-Section – Parking One Side + Protected Buffered Bike Lanes

#### Opportunities:

- On street protected buffered bicycle lane
- Ability to provide left-turn lanes at intersections

#### Issues:

- Removal of parking on one side
- East side – loss of up to 80 spaces
- West side – loss of up to 65 spaces
- Narrow bicycle lane
- Narrow protected buffer between bicycle lane and parking lane



**Figure V-14: Potential Cross-Section – Parking Both Sides + Bike Lanes**

The loss of parking on Route 107 through the Lynn study area segment was noted to be a significant disadvantage to moving these alternatives forward.

The final cross-section investigated for the Lynn study area segment of Route 107 included sidewalks, on-street parking on both sides, a narrow bicycle lane and a travel lane in each direction, as depicted in Figure V-14.

#### Opportunities

- Maintain existing parking both sides
- Ability to provide left-turn lanes at intersections
- Maintain existing sidewalk

#### Issues:

- Narrow on street bicycle travel
- No buffer between bicycles and parking or travel way
- High level-of-traffic stress for bicyclists
- The available 66 feet of right-of-way for potential improvements limits the space available to multimodal improvements. Maintenance of parking on both sides of the street was noted by the Working Group as an important feature to keep as part of the proposed improvements. The group generally agreed that it was very important to maintain parking on both sides of the roadway.



### 3. RETAIL STUDY AREA ALTERNATIVES

The segment of Route 107 from the Lynn/Salem city line to Freeman Street has been defined as the retail study area segment. Route 107 is under MassDOT jurisdiction in this segment (upwards to Greenway Road) with approximately 90 feet of available right of way. The available width creates a number of opportunities for implementing multi modal improvements. The roadway segment between Swampscott Road and Marlborough Road, which is commonly referred to as the “zig zag” due to east-west traffic movements accomplished via Route 107, is specifically discussed in more detail.

Currently this portion of Route 107 consists of four 12-foot travel lanes (two lanes in each direction) and a seven-foot wide median. On the east side of Route 107, there is a seven-foot shoulder and when a sidewalk is present it is generally ten feet in width. On the west side of the roadway there is a ten-foot shoulder and an eight-foot planting strip. Turn lanes are generally provided at key intersections.

The high traffic volumes and the number and placement of signalized intersections in this portion of Route 107 necessitate the four travel lanes, as reduction to two travel lanes would result in excessive delays and long queues at the key intersections.

Various bicycle amenities were considered in this segment of Route 107 including separated bicycle lanes, protected buffered bicycle lanes and a shared use path.

For pedestrians, efforts were made to complete the sidewalk system and provide sidewalks on the west side of the roadway, where they currently lack today. In addition to proposed sidewalks, the following would also be included in the potential pedestrian improvements:

- Maintaining an ADA compliant path for the entirety of the segment
- Providing accessible curb ramps at intersections and crossings
- Providing crosswalks at all signalized intersections for all approaches
- Improving unsignalized crossings
- Reevaluating signal timings to accommodate up-to-date pedestrian phase timings

#### **First Street**

At the intersection of Route 107 at First Street, north of the Hawthorne Square Mall Shopping Center, the Working Group identified the desire for an improved pedestrian connection across Route 107. There is currently a food pantry on the eastern side of Route 107 that is served by bus stops on both sides of the road. Unfortunately, there is a median dividing the roadway that prevents pedestrians from crossing to the western side of the roadway to catch the bus. An enhanced pedestrian crossing was investigated and it was determined that a median with flashing beacons would provide a safe crossing opportunity for pedestrians. By reviewing bus stop ridership information and nearby pedestrian volumes, it was determined that a high-intensity activated crosswalk beacon (HAWK) signal was unnecessary for the current level of

pedestrian demand. After the crossing is implemented, a future study could determine if pedestrian demand has risen and a HAWK signal is required.

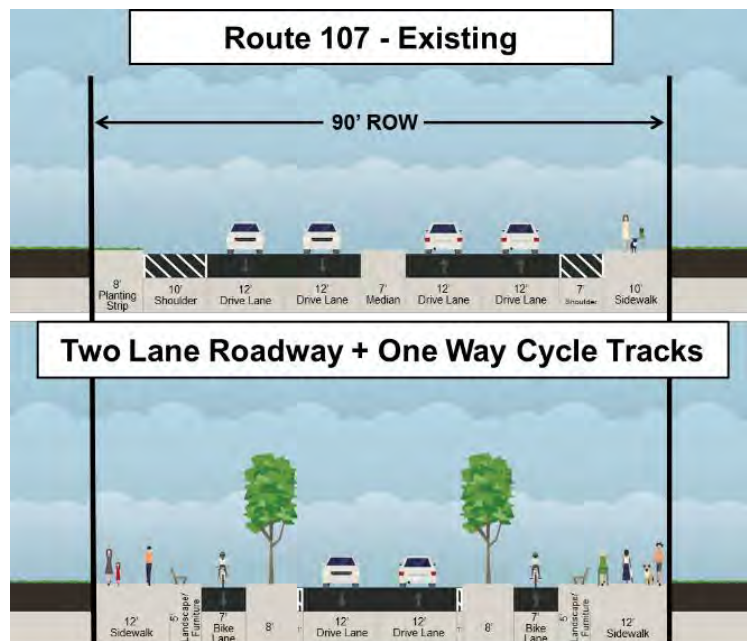
A number of alternatives were reviewed in order to identify if vehicular roadway capacity could be reallocated to other modes to change the overall character of the roadway. The following vehicular improvements were investigated:

- Maintenance of existing turn lanes
- Queue management
- Maintenance of median openings
- Review of additional access across Route 107
- Landscaped median and removal of guard rail to calm traffic
- Improved lane reduction at the Lynn/Salem city limit
- Improved signal coordination
- Improved signal timings, phasing and clearance intervals

Collectively, the investigation of each of these types of improvements resulted in the potential cross-sections discussed in the following section.

### Potential Roadway Cross-sections – Retail Segment

In order to provide a multimodal corridor that would greatly improve the experience of pedestrians and bicyclists within the retail study area segment, a cross-section was investigated to reduce vehicular capacity to one lane in each direction. As seen in Figure V-15, this creates extensive opportunity for physical separation between all modes and also provides the opportunity to beautify the study area. The eliminated roadway travel lane and shoulder area are replaced with landscaped buffers, wide bicycle lanes, and wide sidewalk areas. This helps redefine the character of the roadway resulting in lower vehicle speeds.



**Figure V-15: Potential Cross-Section – Two Lane Roadway + One Way Cycle Tracks**



#### Opportunities:

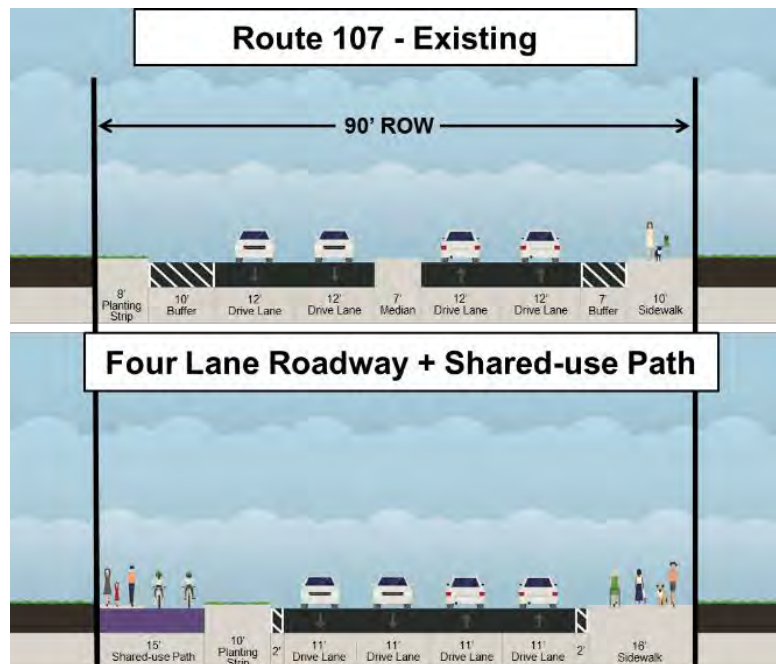
- Separation of all modes of transportation
- Grade separated bicycle lane
- Additional landscaping space to modify the roadway character, potentially resulting in lower vehicle speeds
- Wide proposed sidewalk on both sides of the roadway

#### Issues:

- Removal of vehicular capacity resulting in longer queues and excessive delays
- No separation between opposite travel lanes which may encourage additional crossover traffic from the side streets along Route 107. With the reduced capacity, the number of acceptable gaps would likely be reduced, resulting in extensive delay for unsignalized side streets and potentially creating dangerous vehicular interactions.

Due to the impacts to vehicular operations within this segment, this alternative was not selected as the preferred alternative.

The next cross-section evaluated for the retail study area segment includes maintaining the existing two travel lanes in each direction to help maintain existing traffic operations. The cross-section depicted in Figure V-16 removes the existing median in order to accommodate a wide sidewalk on one side and a shared use path on the other side with a proposed landscaping buffer.



**Figure V-16: Potential Cross-Section – Four Lane Roadway + Shared-use Path**

#### Opportunities:

- Shared-use path
- Wide sidewalks
- Additional landscaping space to modify the roadway character, potentially resulting in lower vehicle speeds
- Separation between shared use path and vehicles creating a more enjoyable user experience for pedestrians and bicyclists

#### Issues:

- No separation between opposite travel lanes which may encourage additional crossover traffic from the side streets along Route 107, potentially creating dangerous vehicular interactions.

The final cross-section explored as part of the retail study area segment included accommodations for vehicles, pedestrians and bicyclists while maintaining vehicular operations. The proposed cross-section includes two travel lanes in each direction, separated by a planted median, a protected buffered bicycle lane in each direction and sidewalks on both sides of the roadway, as depicted in Figure V-17.

#### Opportunities:

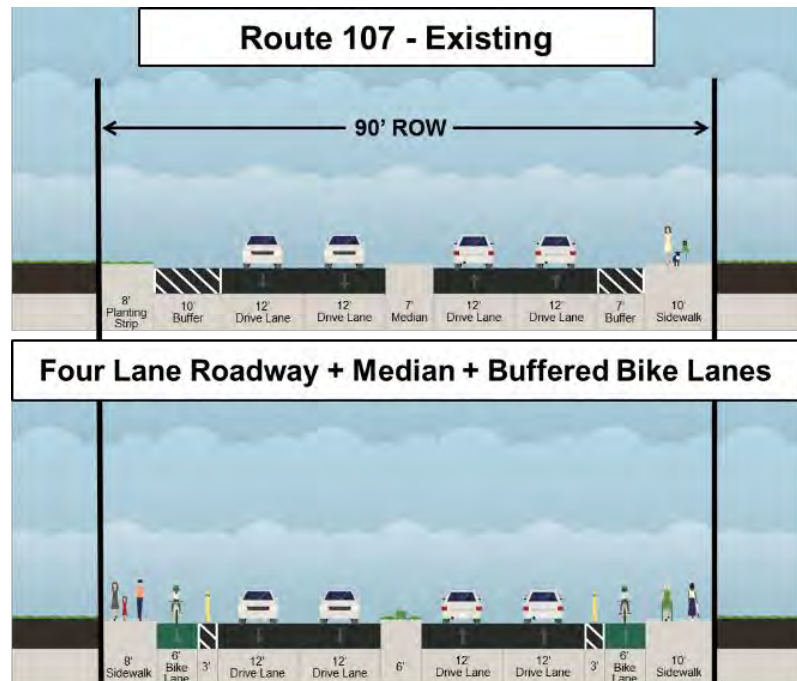
- Separation of bicycles from vehicular travel with a proposed protected buffer
- Proposed sidewalk on both sides of the roadway
- Replacement of guardrail with streetscape trees to induce traffic calming.

#### Issues:

- Minimal green space outside of the proposed median
- Minimal separation between pedestrians and bicyclists

The Working Group was not in favor of removing the median. The group was favorable towards changing the look of the median by removing the guardrail and adding street trees.

One topic that emerged during the public comment period was the choice between buffered and protected bicycle lanes as shown in Figure V-17. The project team showed renderings during Working Group and public meetings showing protected bicycle lanes with bollards to provide separation between bicyclists and vehicle traffic. However, the term “buffered” was used to describe the lanes, which is often interpreted as painted medians allowing for increased space between bicyclists and vehicle traffic without physical protection.



**Figure V-17: Potential Cross-Section – Four Lane Roadway + Median + Protected Buffered Bike Lanes**



This report ultimately recommends physical separation between bicyclists and vehicle traffic as exemplified in Chapter 3.4 of the MassDOT Separated Bike Lane Planning & Design Guide. For example flexible delineator posts can be placed in the roadway as a low-cost option to provide a visible barrier between bicyclists and vehicle traffic while allowing for temporary removal for snow plowing and passing of traffic by emergency vehicles when necessary. Other options as vertical objects include planter boxes and rigid, non-removable bollards. A decision of the most appropriate type of physical protection would be determined in the design phase of a project.

To clarify, the buffered bicycle lanes presented throughout the report are intended as protected buffered bicycle lanes. An opportunity for public input on the provision and design of bicycle lanes would be available during the design phase of a project.

## Zig Zag

As previously discussed, the zig zag segment refers to two intersections on Highland Avenue (Highland Avenue at Swampscott Road/Dipietro Avenue and Highland Avenue at Marlborough Road/Traders Way) and the movements between the two intersections. There is a strong desire line for vehicle connections in the east-west direction and these movements are currently achieved by using Highland Avenue for motorists to move between Swampscott Road and Marlborough Road.

Seventeen alternatives were explored to improve safety and operations for the intersections in the zig zag segment. Some of the alternatives propose diverting or rerouting traffic through two nearby intersections:

- Swampscott Road at First Street
- First Street at Traders Way

The study team considered several items throughout the analysis and evaluation of the zig zag segment alternatives including traffic operations and congestion, bicycle and pedestrian accommodations, roadside constraints, adjacent land use, and impacts to adjacent properties. Study objectives focused on reducing traffic congestion, improving traffic operations, and improving safety and facilities for bicycles and pedestrians. Roadside constraints can make constructability of

an alternative difficult or cost prohibitive. There are several instances of ledge throughout the zig zag segment as shown in Image V.1. There is a substantial cost to excavate ledge. At a few



Image V.1: Instances of ledge.

locations, tall walls abut the roadway. At the Swampscott Road/Dipietro Road intersection, a neighborhood's only roadway, Thomas Circle, abuts Route 107 (Figure V-18). In addition, there is a significant grade difference between Thomas Circle and the Swampscott Road/Dipietro Road intersection making the direct connection to the intersection impossible. Impacts to adjacent properties along Route 107 may include re-grading into the property, parking space removal and building demolition. The study aimed to recommend alternatives that limited these property impacts.

Some of the zig zag alternatives include the signalization of the First Street at Swampscott Road intersection. The signalization of this intersection is necessary to enhance safety and to improve operations for the alternatives with the re-routed zig zag movements. Currently the intersection is unsignalized with First Street under stop control and Swampscott Road free-flowing. Field observations during the weekday afternoon peak hour revealed that the intersection experiences large queues, long delays, and unsafe driver behavior exiting the First Street approach.

The study team evaluated the capacity of the proposed alternatives to handle the traffic volumes. The future weekday afternoon peak hour volumes were used to evaluate the scenarios because the afternoon volumes were the highest and they represented both the commuting and retail patterns on the study area.

The following is a summary of each of the zig zag alternatives considered. A detailed level of service summary (LOS) is provided in the Appendix for each of the alternatives. Note that some of the alternatives involve turn restrictions that would result in traffic being re-routed via First Street and Traders Way. Additional traffic analysis is required should these alternatives be advanced. Also, there is a local truck restriction posted on First Street, and this restriction should be reconsidered if turn restrictions are to be implemented.

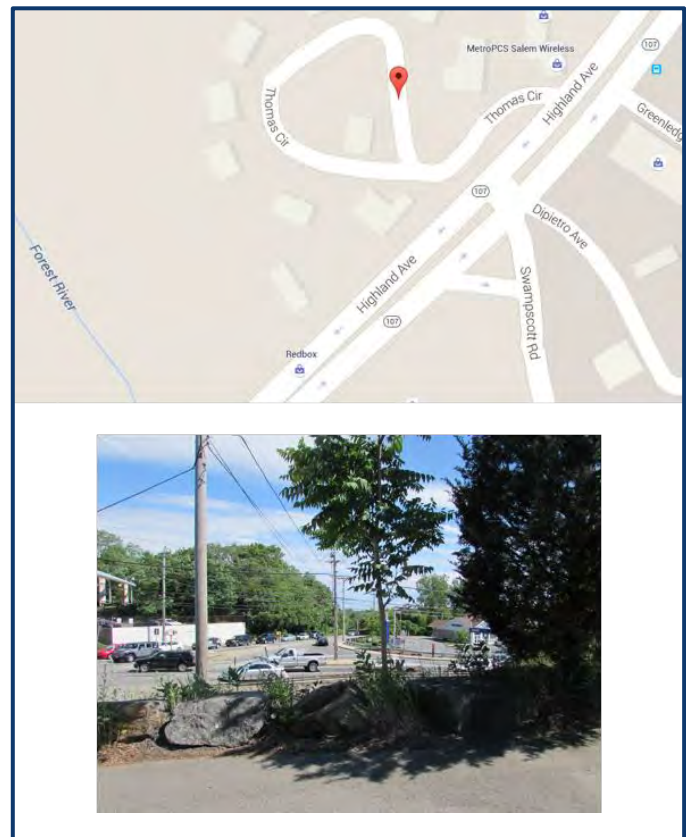


Figure V-18: Thomas Circle abuts Route 107



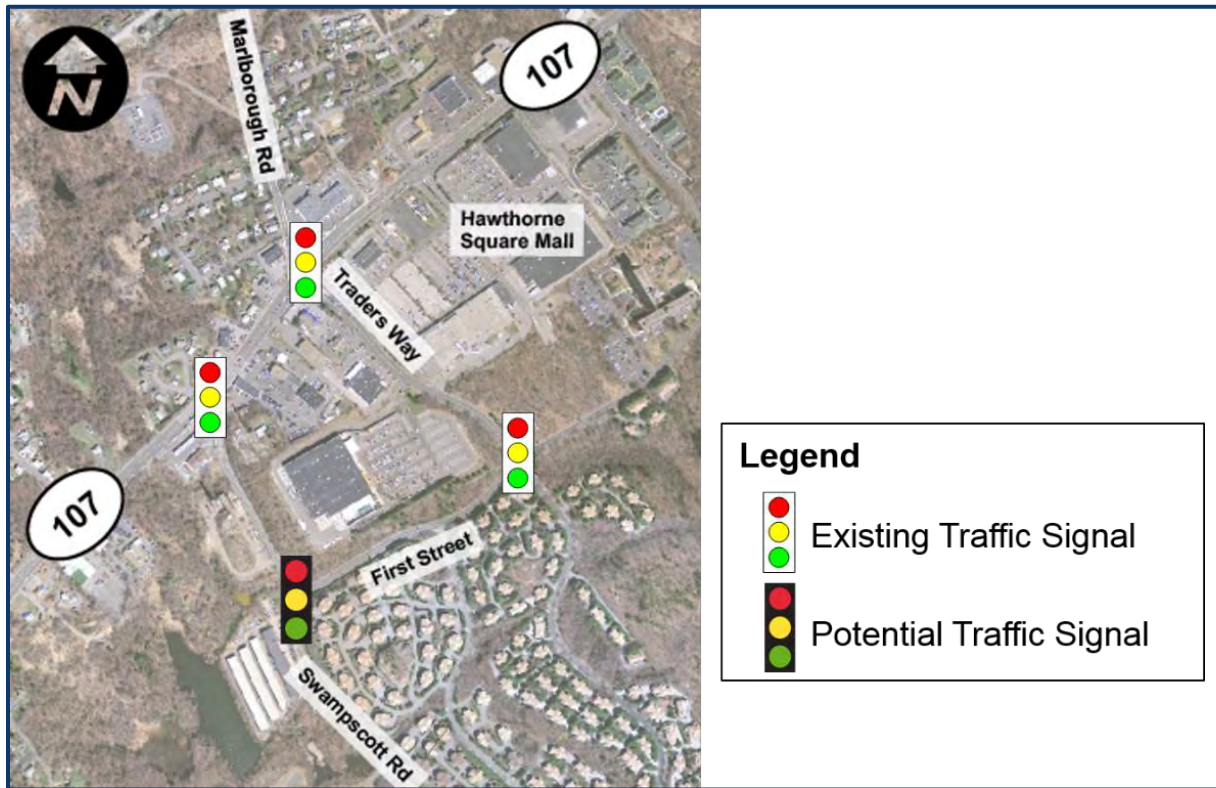


Figure V-19: Full Access

Full Access (Figure V-19)– This alternative involves adding a traffic signal at the intersection of First Street and Swampscott Road, improving signal coordination at all four intersections, and reallocation of green time to better accommodate the zig zag movement. As shown in LOS Table (Figure V-20), this option results in an overall LOS D for the Swampscott Road/Dipietro Road intersection and LOS F for the Marlborough Road/Traders Way intersection. At Swampscott Road and First Street, the LOS improved from an F to C with the signalization, which is a substantial improvement. This option would increase safety and improve operations. It is fairly simple to implement and should be considered for short-term improvements.

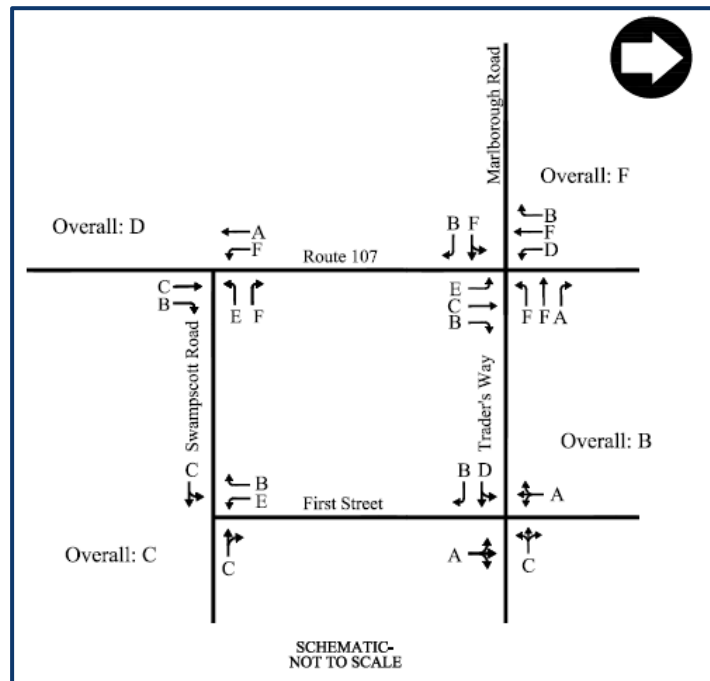


Figure V-20: Level of Service

No Left Turn onto Marlborough Road (Figure V-21) – The left turn movement from Highland Avenue onto Marlborough Road is restricted in this alternative. Motorists traveling northbound on Highland Ave to Marlborough Road would have to turn right onto Swampscott Road, left onto First Street, left onto Traders Way, then proceed straight through the Traders Way/Marlborough Road intersection. The left turn restriction results in a long alternative route as well as a large number of left turns onto First Street, and therefore, this alternative is not recommended.

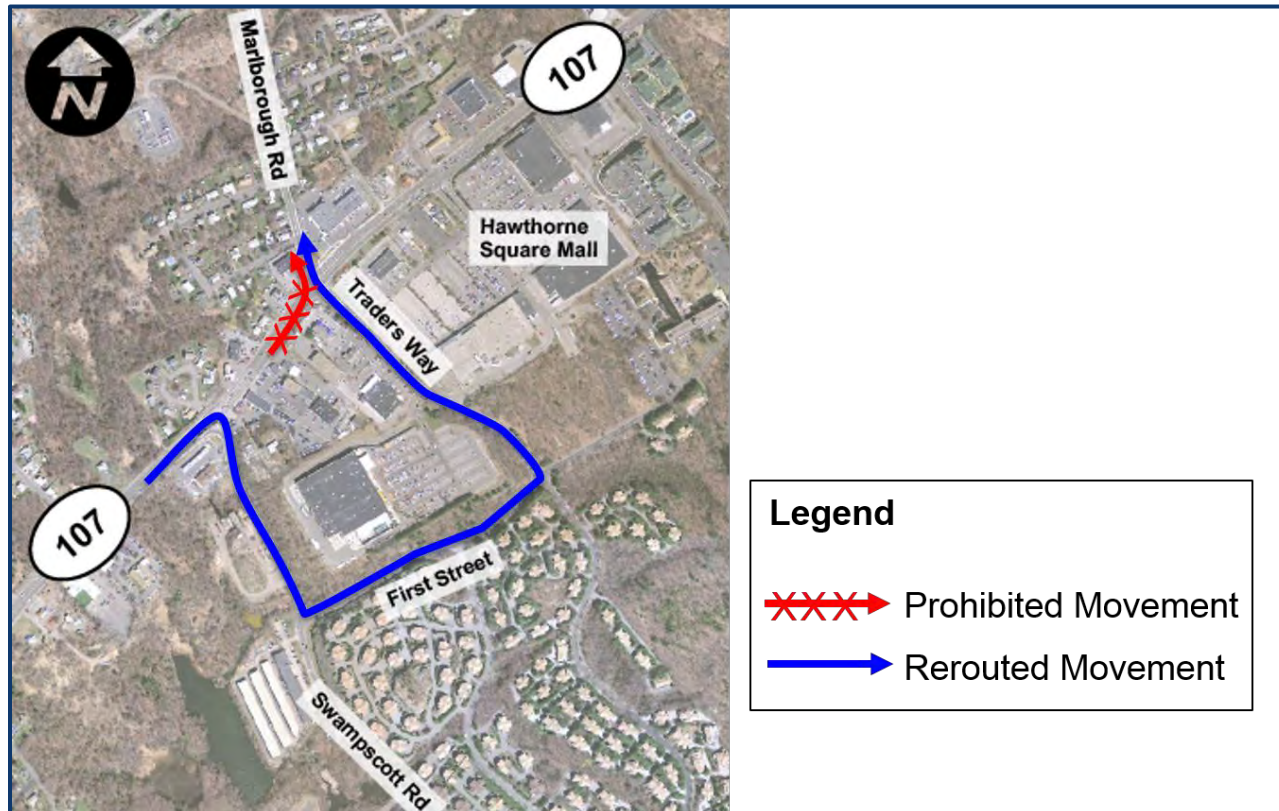


Figure V-21: No Left Turn onto Marlborough Road



No Right Turn from Marlborough Road (Figure V-22) – This alternative prohibits the right turn from Marlborough Road onto Highland Avenue. This will reroute traffic straight onto Traders Way, then a right turn onto First Street, another right turn onto Swampscott Road, followed by a left turn onto Highland Avenue. Once again, this option produces a long, alternative route for this movement. In addition, thru vehicles are added to the Marlborough Road approach. This alternative is not recommended.

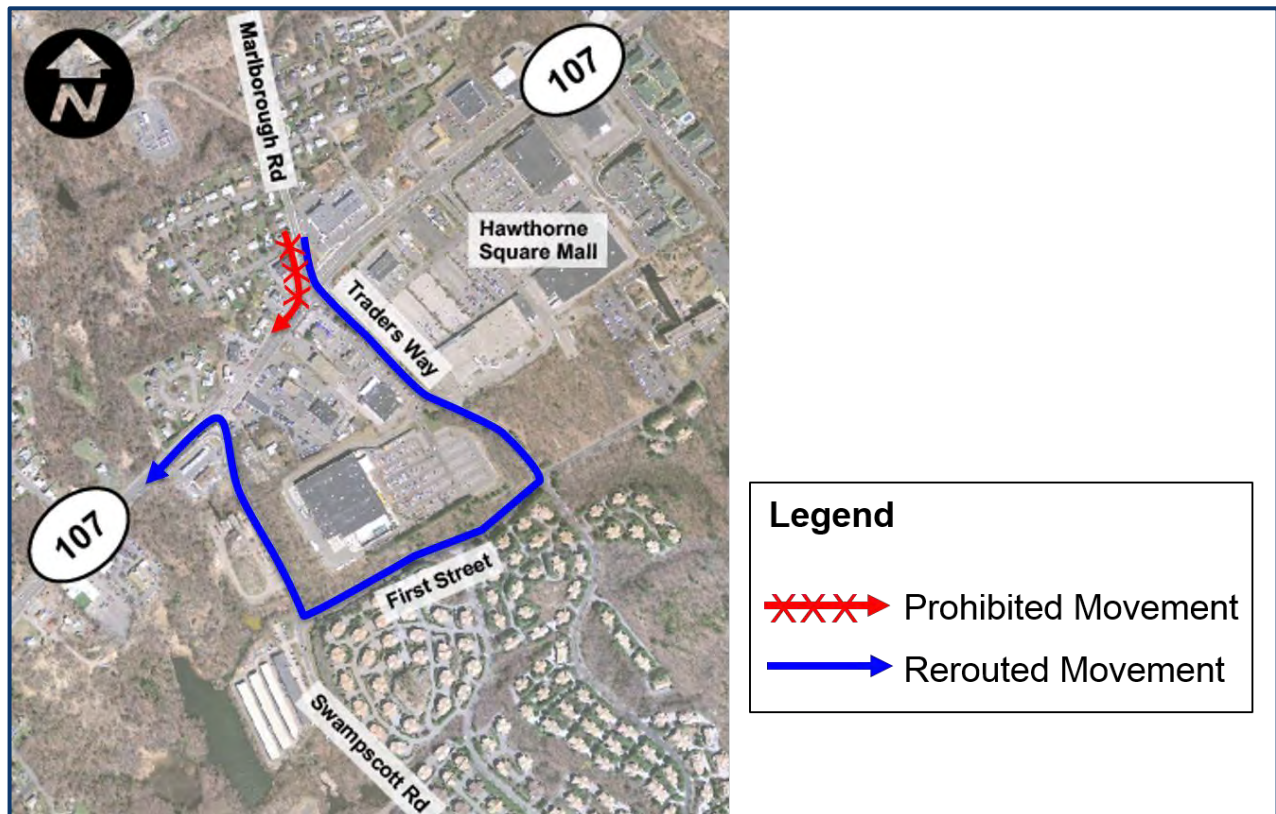


Figure V-22: No Right Turn onto Marlborough Road

No Left Turn onto Swampscott Road (Figure V-23) – The restricted movement for this option is the left turn from Highland Avenue onto Swampscott Road. Motorists wishing to travel eastbound on Swampscott Road from Marlborough Road or Highland Avenue southbound are rerouted onto Traders Way, then First Street, before turning left onto Swampscott Road. The benefit to this option is the elimination of the southbound queue at Swampscott Road. The drawback is the addition of left turns from Highland Avenue southbound to the Marlborough Road/Traders Way intersection which already operates poorly. This alternative is not recommended.

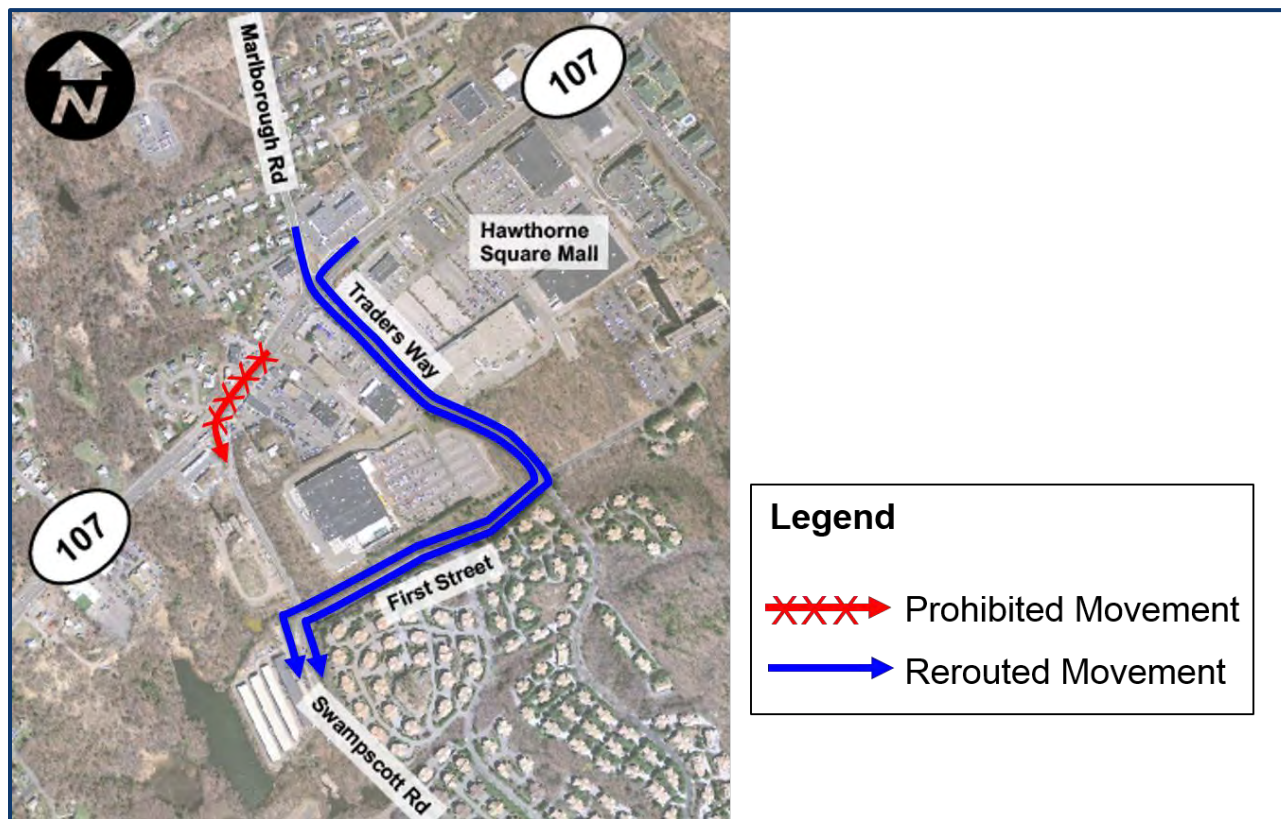
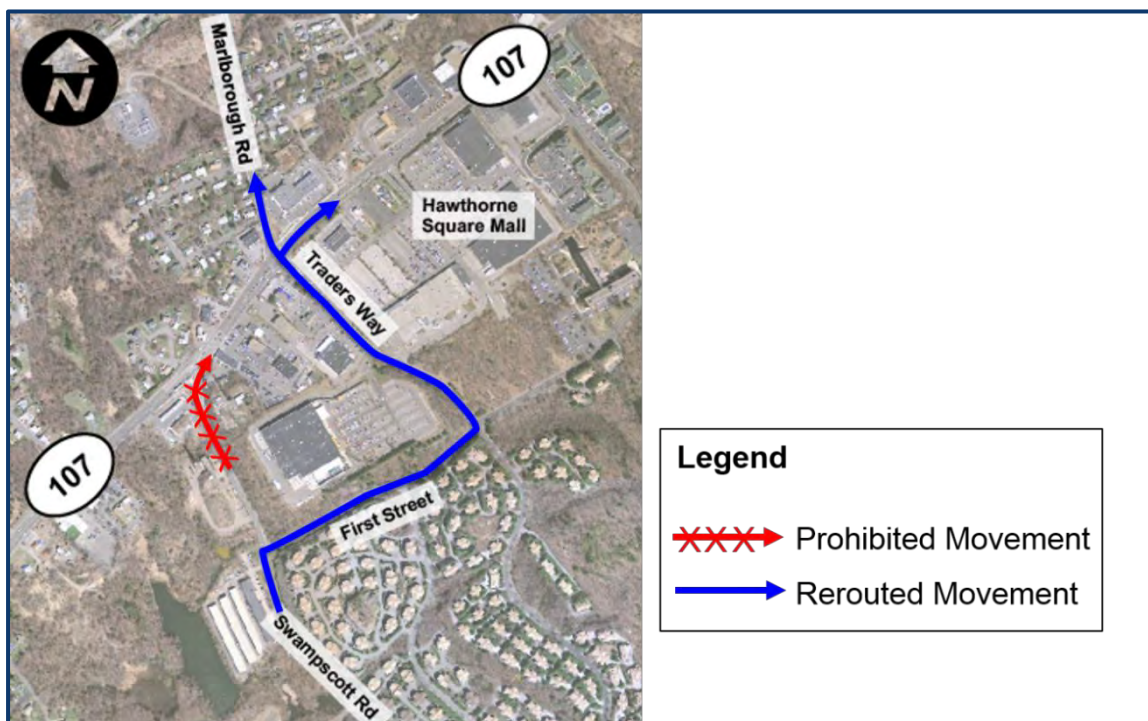


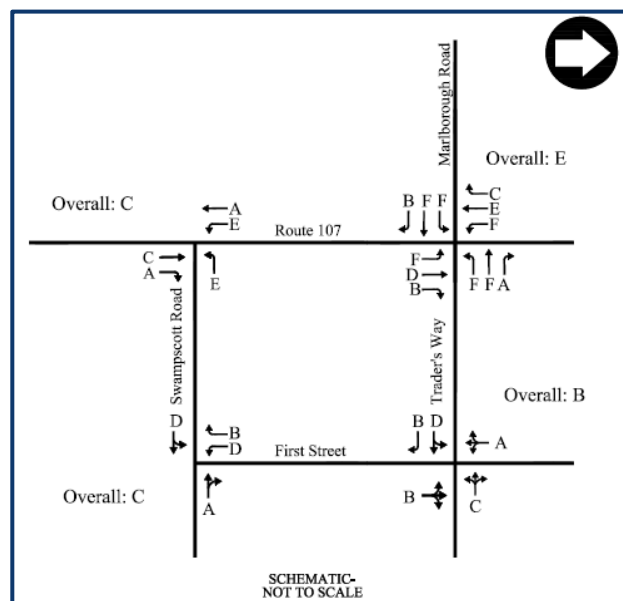
Figure V-23: No Left Turn onto Swampscott Road



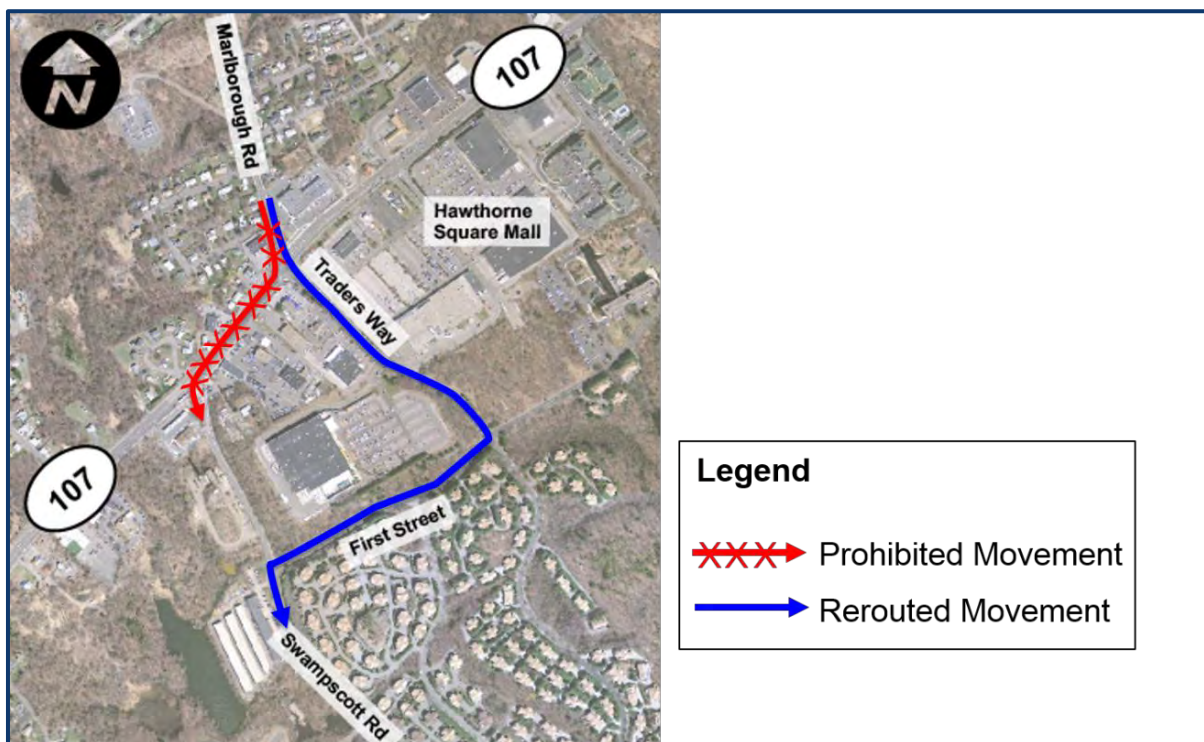


**Figure V-24: No Right Turn from Swampscott Road**

No Right Turn from Swampscott Road (Figure V-24) – Another alternative analyzed in this study involves preventing right turns from Swampscott Road onto Highland Avenue, creating a rerouted movement from Swampscott Road to First Street to Traders Way. It should be noted that many vehicles are currently using this route to bypass the large queues on Highland Avenue. The level of service improves at the Marlborough Road/Traders Way intersection from an F to an E, at the Swampscott Road/Dipietro Avenue from a D to a C, and at Swampscott Road and First Street from an F to a C as depicted in Figure V-25. The advantage of this concept is that the left turn queue from Highland Avenue onto Marlborough Road is shortened and the northbound vehicular traffic is reduced. The left turn queue from Highland Avenue onto Swampscott Road is not shortened. At a Working Group meeting, there was concern about the significant queueing on Traders Way on Saturdays. If this alternative is to move forward, the study team should consider adding an additional lane on Traders Way. This alternative was placed into continued consideration and ultimately discarded due to the limited benefit on Highland Avenue.

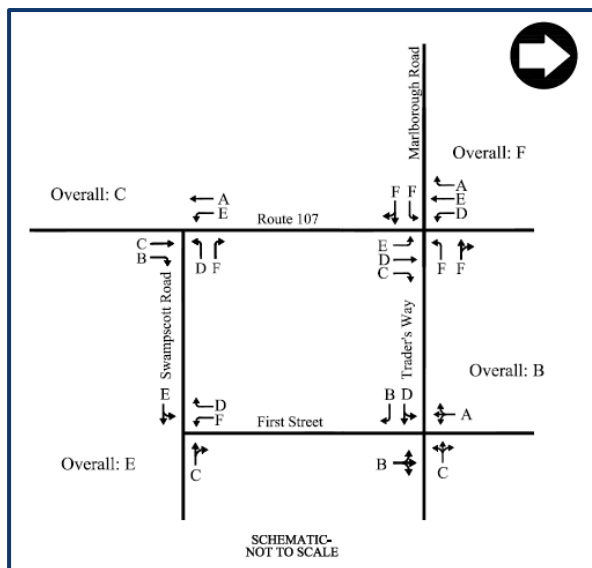


**Figure V-25: Level of Service**



**Figure V-26: Limited Marlborough Road to Swampscott Road Connection**

Limited Marlborough Road to Swampscott Road Connection (Figure V-26) – This option combines two previous options by restricting the movement from Marlborough Road to Swampscott Road. The restriction may be done through a physical barrier or lane markings. The redirected movements consist of a thru movement at Marlborough Road/Traders Way, a right movement at First Street, and a left movement onto Swampscott Road. As shown in Figure V-27, this option improved the level of service for the Swampscott Road/Dipietro Avenue intersection from a D to a C and the First Street at Swampscott Road intersection from an F to an E in the PM peak hour. There is no change in level of service for the other two intersections. This alternative shortens the left turn queue onto Swampscott Road; however, it does not shorten the left turn queue onto Marlborough Road. This option was placed into further consideration. After further consideration, the limited improvements to the left turn queue on Highland Avenue at Marlborough Road prevented this option from becoming the preferred option.



**Figure V-27: Level of Service**



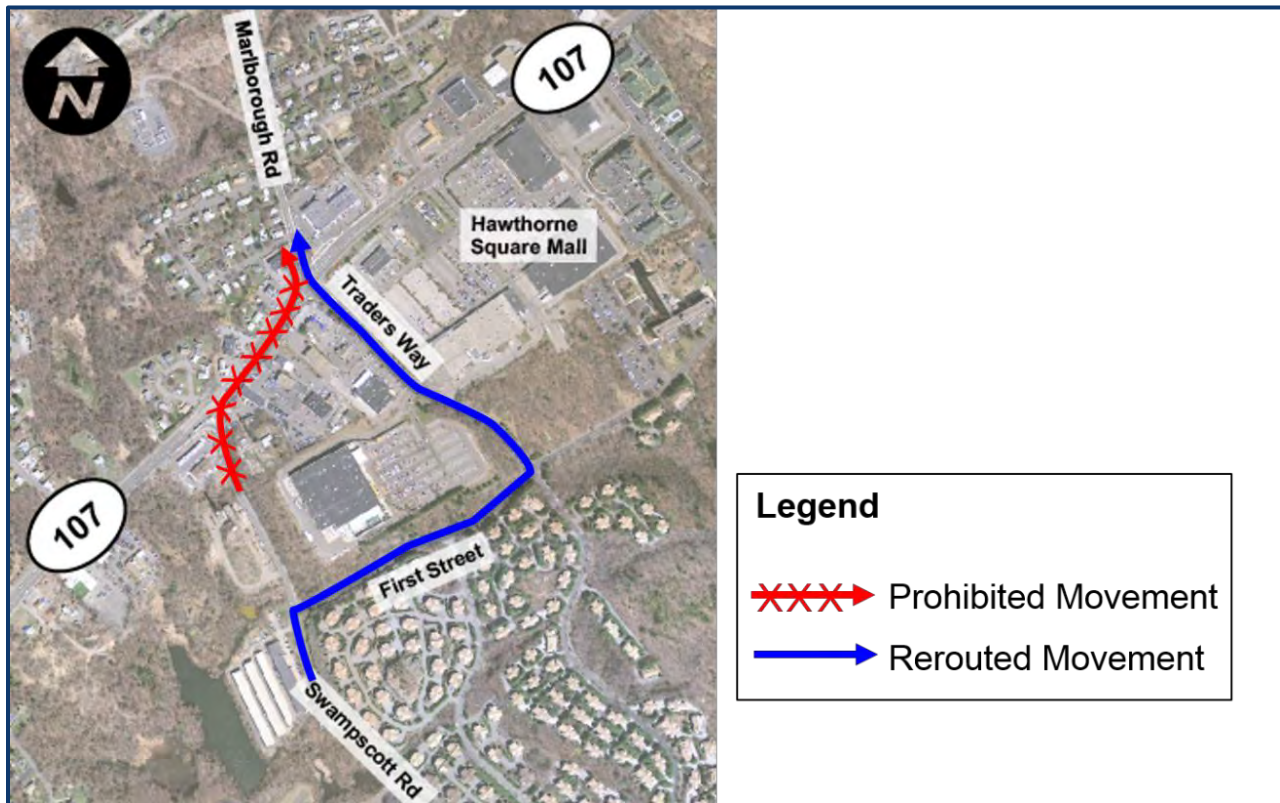


Figure V-28: Limited Swampscott Road to Marlborough Road Connection

Limited Swampscott Road to Marlborough Road Connection (Figure V-28) – Once again, two previous scenarios are combined to create this alternative which involves the restriction of the movement from Swampscott Road to Marlborough Road. Physical barriers or lane markings would be used to create this restriction. The rerouted movement consists of a right turn from Swampscott Road onto First Street, left turn onto Traders Way, and finally a thru movement at Marlborough Road. This alternative improves the level of service for the Marlborough Road/Traders Way intersection from an F to a D, the Swampscott Road/Dipietro Road from a D to a C, and Swampscott Road/First Street from an F to a C in the afternoon peak hour (See Figure V-29). This alternative shortens the left turn queue onto Marlborough Road. This option shortens the left turn queue onto Marlborough Road and does not change the left turn queue onto Swampscott Road. This alternative was not recommended as it resulted in limited improvement to queues and traffic operations on Highland Avenue.

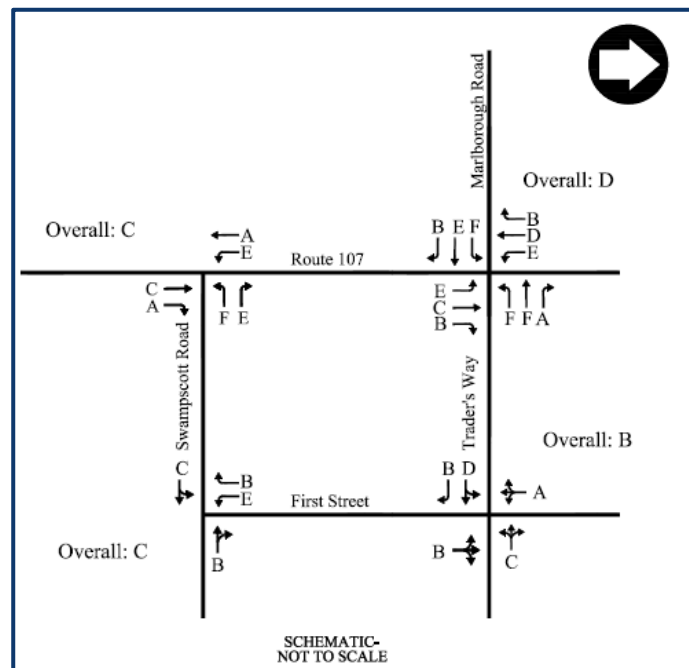


Figure V-29: Level of Service

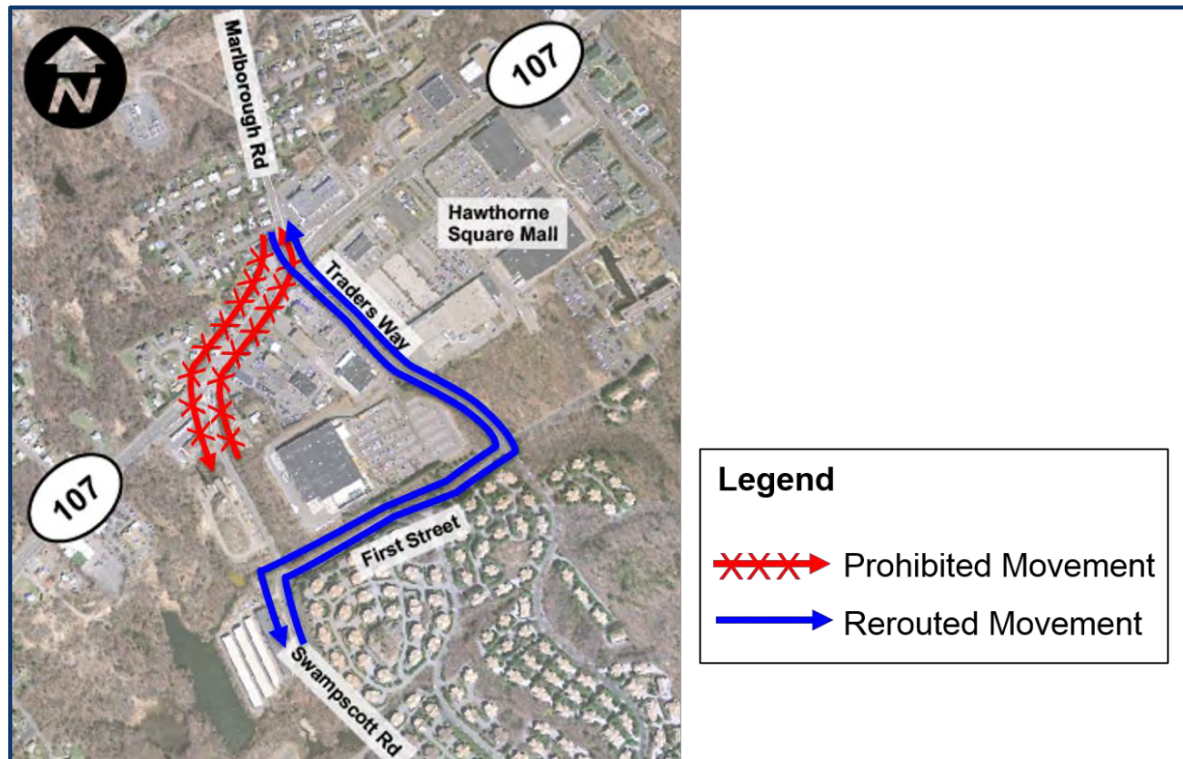


Figure V-30: No Connection Between Marlborough Road and Swampscott Road via Route 107

No Connection Between Marlborough Road and Swampscott Road via Route 107 (Figure V-30) – The combination of the two previous alternatives resulted in the reduction of queues at both the Marlborough Road and Swampscott Road intersections. Figure V-31 depicts that the level of service for this option improves from an F to an E at the Marlborough Road/Traders Way intersection, a D to a B at the Swampscott Road/Dipietro Road intersection, a B to an A at the Traders Way and First Street intersection, and an F to an E at the Swampscott Road and First Street intersection. This option was selected for continued consideration.

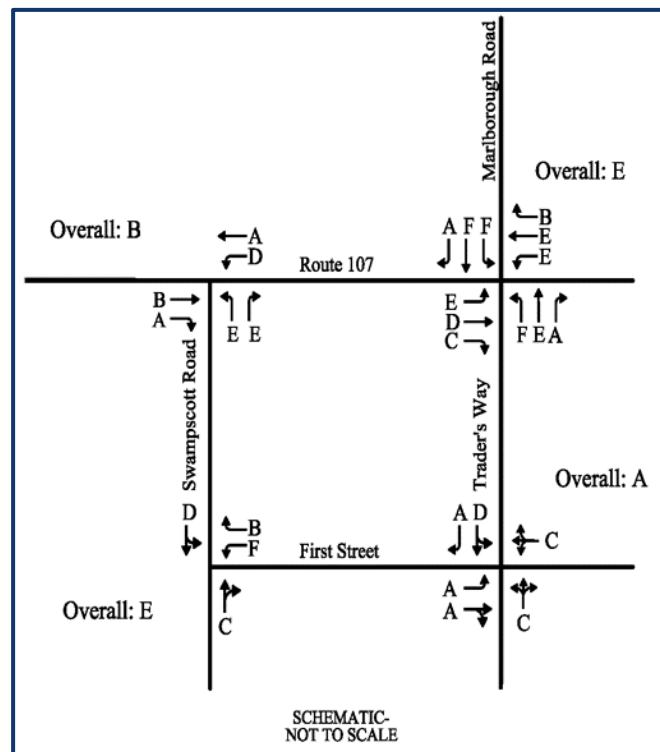


Figure V-31: Level of Service



Roundabout Alternatives (Figure V-32) – The feasibility of a roundabout was considered at both intersections of Swampscott Road/Dipietro Road and Marlborough Road/Traders Way. The benefits of roundabouts include shorter pedestrian crossings, traffic calming by slowing vehicles down, and delay distribution. There are significant safety benefits due to the slowing of traffic at roundabouts.

Swampscott Road/Dipietro Road Roundabout (Figure V-33) – This study reviewed traffic volumes and determined that if a roundabout were to be implemented at this intersection it would require two travel lanes. Roundabouts function best when roads enter at 90 degree angles; however, the current roadway alignment, specifically the alignment of Dipietro Road, prevents the 90 degree angle. In addition, the roadside constraints of ledge and large walls limits the feasibility of a roundabout at this intersection. Additional drawbacks include impacts to multiple adjacent properties and grading issues. As a result a roundabout at Swampscott Road/Dipietro Road is not recommended.

Marlborough Road/Traders Way Roundabout (Figure V-34) – Based on traffic volumes, a two-lane roundabout would be required at this intersection. The analysis considered additional right turn bypass lanes from Highland Avenue northbound onto Traders Way and Highland Avenue southbound onto Marlborough Road. This design would accommodate large heavy vehicles. While the roundabout concept has positive effects, the conversion of this intersection into a roundabout would have major impacts to adjacent properties. The property impacts imposed by the roundabout are not simply strip taking of adjacent lane but instead would require



Figure V-32: Roundabout Alternatives

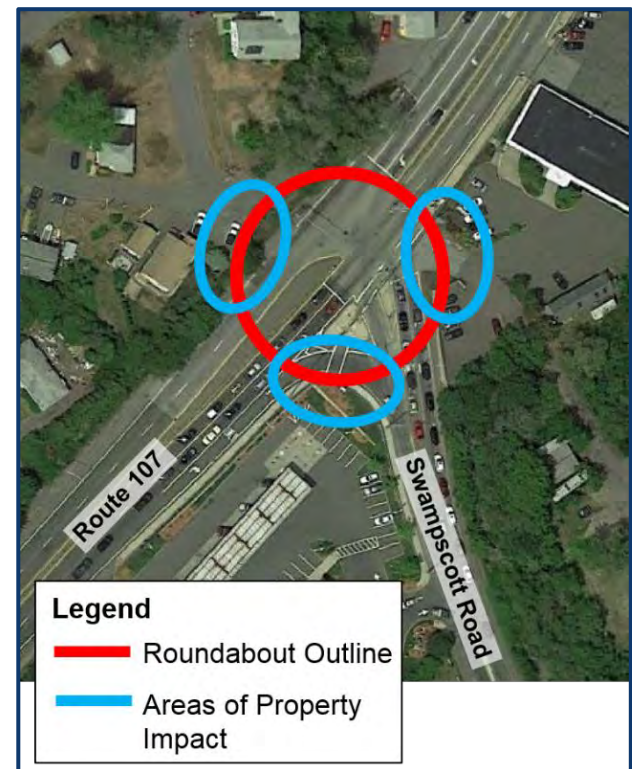
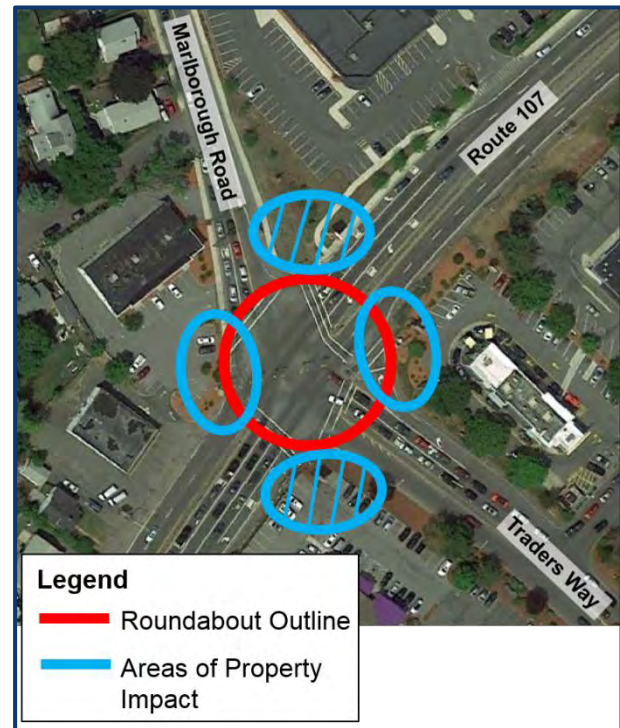


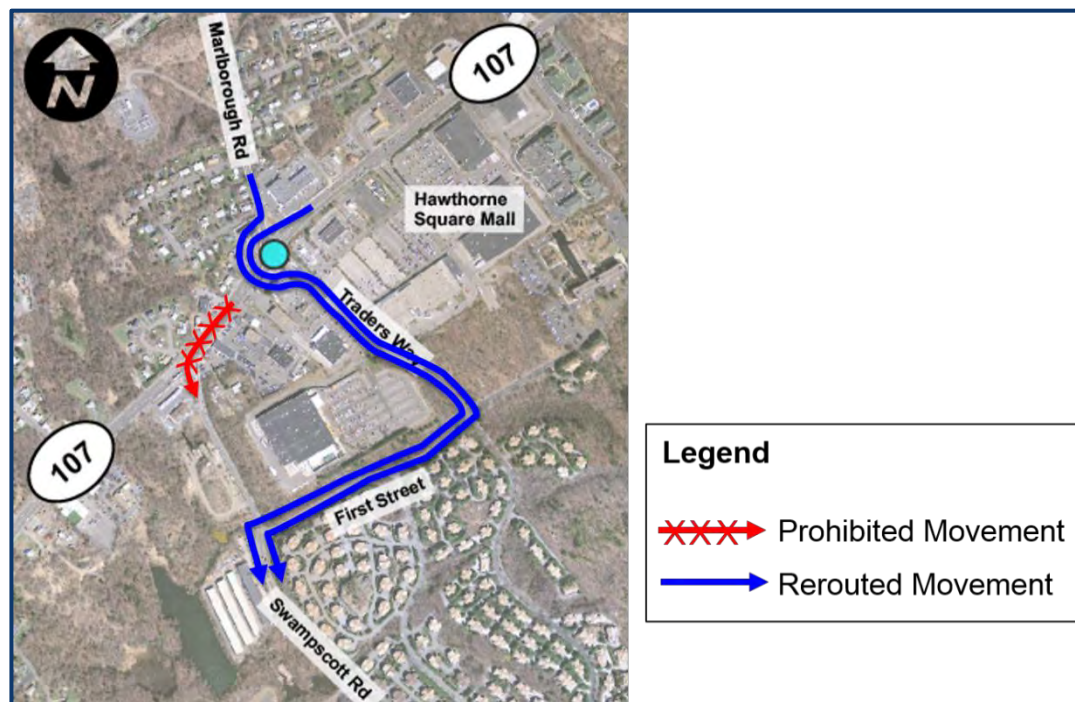
Figure V-33: Swampscott Road/Dipietro Road Roundabout

takings of entire parcels and relocations of the businesses or residences on the parcel. Initially, a roundabout at Marlborough Road/Traders Way was placed into continued consideration. This option was ultimately rejected due to the limited benefits on Highland Avenue versus the anticipated cost of the construction of the roundabout and the property impacts to construct the roundabout.

Marlborough Road Roundabout and No Left Turn onto Swampscott Road (Figure V-35) – By combining the Marlborough Road Roundabout with the No Left Turn onto Swampscott Road option, the rerouted movement from Marlborough Road or Highland Avenue to Swampscott Road consists of motorists traveling onto Traders Way, turning right onto First Street, and then a left turn onto Swampscott Road. The roundabout provides additional left turns. The left turn queue onto Swampscott Road is shortened through this option. This alternative was ultimately discarded due to the substantial right of way requirements for the roundabout, as discussed previously.



**Figure V-34: Marlborough Road/Traders Way Roundabout**



**Figure V-35: Marlborough Road Roundabout and No Left Turn onto Swampscott Road**



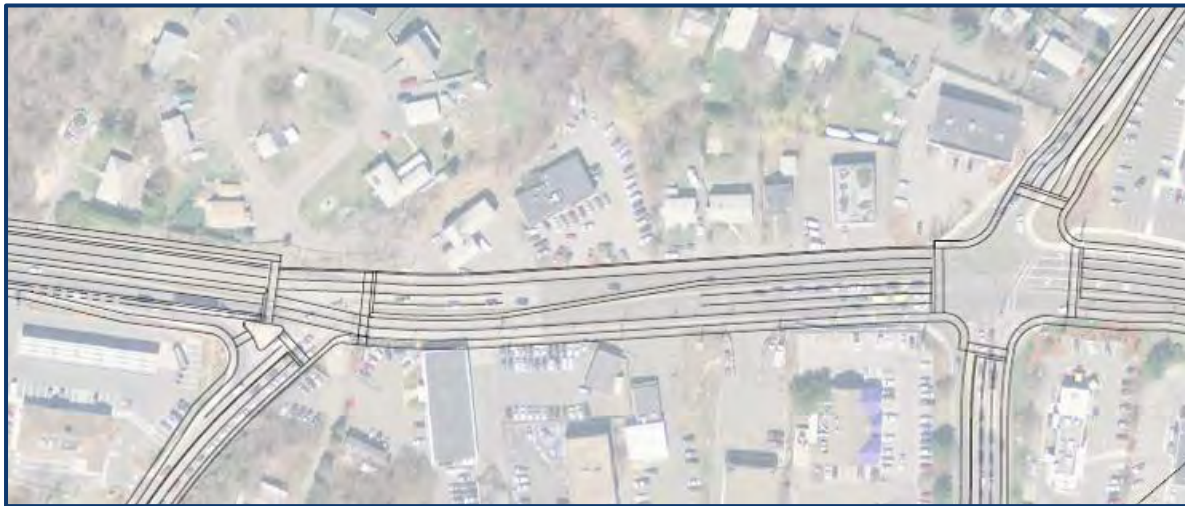


Figure V-36: Dual Left Turn at Swampscott Road and Marlborough Road

Dual Left Turn at Swampscott Road and Marlborough Road (Figure V-36) – This concept does not restrict any movements and keeps the traffic on Route 107. This option adds a left turn at both intersections to accommodate the zig zag movement, providing double left turn lanes onto Swampscott Road. Due to limited right-of-way, this option impacts most of the properties along Route 107 and requires at least three takings of commercial or residential buildings as shown in Figure V-37. This option does not include bicycle lanes or the addition of a sidewalk on the west

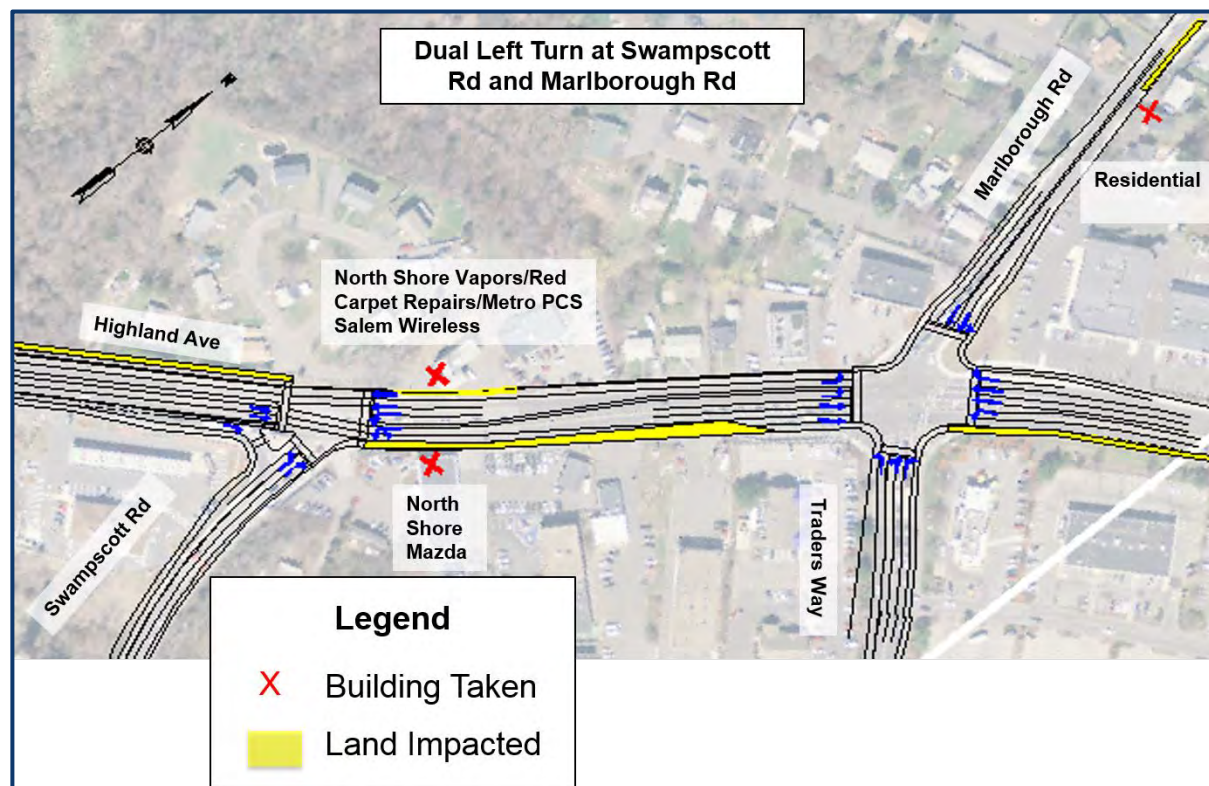


Figure V-37: Property Impacts

side of Route 107 to limit property impacts. The LOS table depicted in Figure V-38 demonstrates that this option does not improve the overall operation of both intersections during the PM peak hour. This alternative is not recommended since the limited benefits do not outweigh the property impacts.

Marlborough Road Roundabout and Dual Left Turn Lanes at Swampscott Road (Figure V-39) – Once again, this alternative does not prohibit any movements and keeps the traffic on Highland Avenue. This concept adds a left turn lane at the Swampscott Road intersection and converts the Marlborough Road intersection to a roundabout. Bicycle lanes and a sidewalk on the west side of Route 107 are shown in this option. Figure V-40 demonstrates the property impacts along Route 107 as at least five buildings or residences will be taken. The overall operation of both intersections for the PM peak hour does not improve as shown in the LOS table (Figure V-41). This scenario is not recommended since the limited benefits do not outweigh the property impacts.

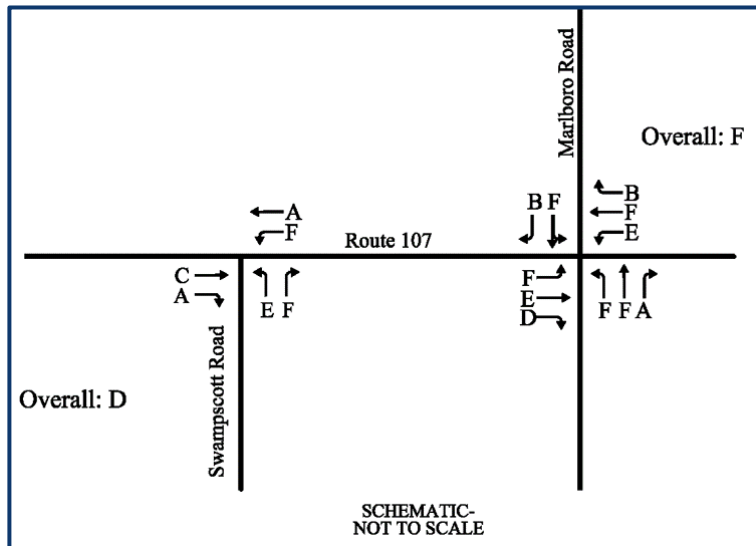


Figure V-38: Level of Service

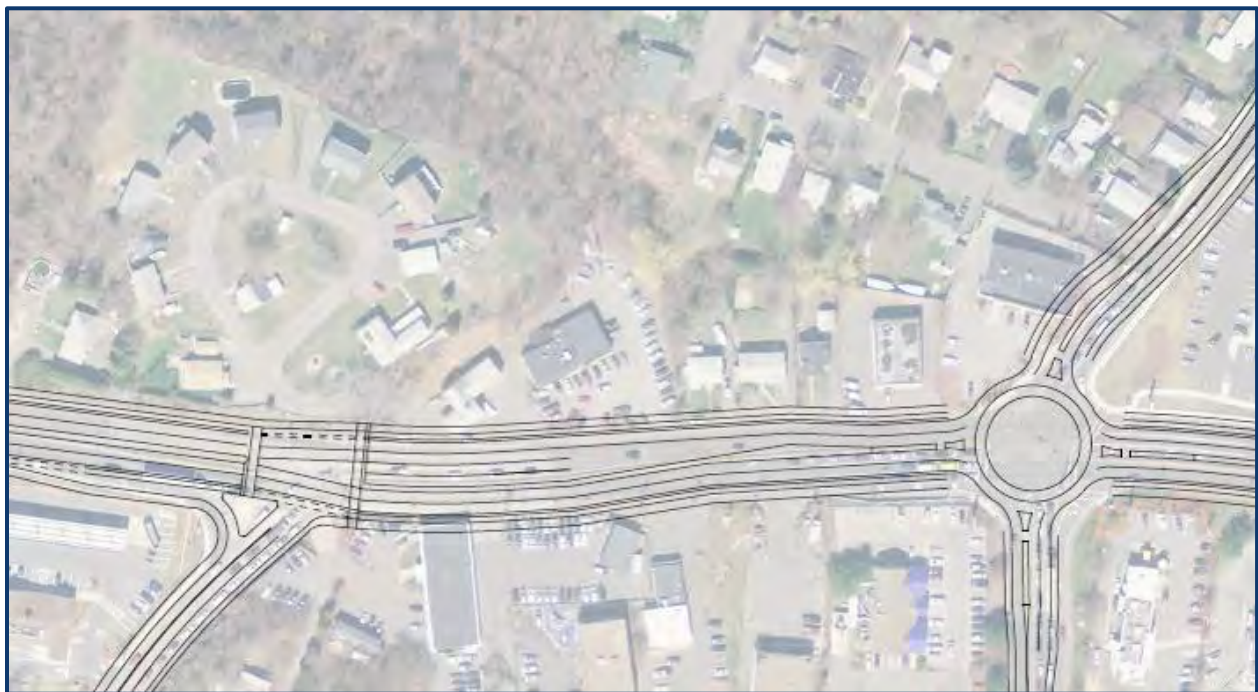


Figure V-39: Marlborough Road Roundabout and Dual Left Turn Lanes at Swampscott Road







**Figure V-42: Marlborough Road Roundabout Shifted Toward CVS with Northbound and Southbound Bypass Lanes and Dual Left Turn Lanes at Swampscott Road**

Marlborough Road Roundabout Shifted toward CVS with Northbound and Southbound Bypass Lanes and Dual Left Turn Lanes at Swampscott Road (Figure V-42) – This option modifies the previous one by shifting the location of the roundabout north to provide ample space for bypass lanes. Bicycle lanes and a sidewalk are depicted in this scenario. The property impacts are significant with at least four commercial buildings being taken along with land adjacent to Route 107 being impacted as shown in Figure V-43. The vehicular operation for both intersections in the PM peak hour remains the same as shown in the LOS table (Figure V-44). This alternative is not recommended since the limited benefits do not outweigh the property impacts.

Swampscott Road at Highland Road Relocation (Figure V-45) – The last alternative for the zig zag segment considered relocating the Swampscott Road at Highland Road intersection approximately 400 feet south. This concept increases the distance between the signalized intersections of Route 107 at Swampscott Road and Route 107 at Marlborough Road and provides increased storage length for the Route 107 left turn lanes. Currently the Route 107 left turn lanes overflow and block through traffic during peak periods. The increased storage for left turns will improve this situation. However, as shown in the figure, this option takes three businesses and impacts the Forest River, an environmental resource area. Due to the significant environmental and property impacts, no further analysis was performed for this scenario and it is not recommended.



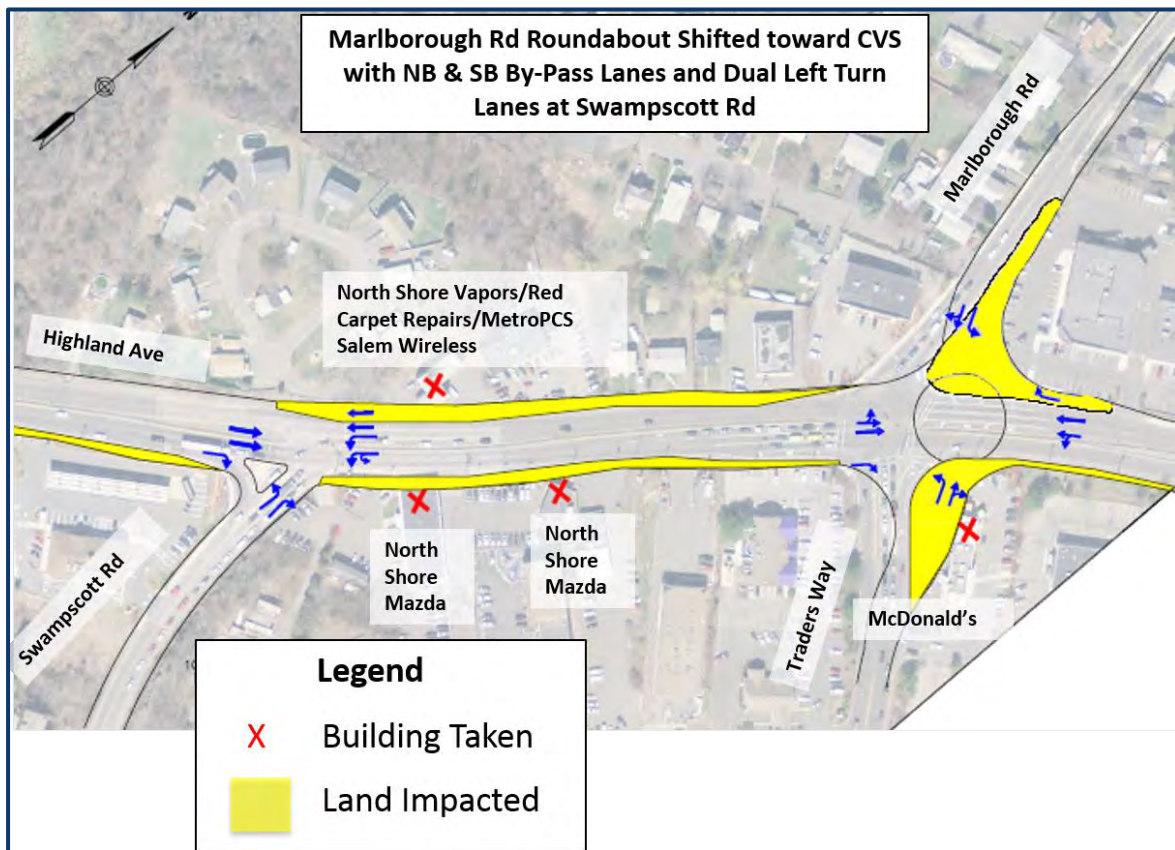


Figure V-43: Property Impacts

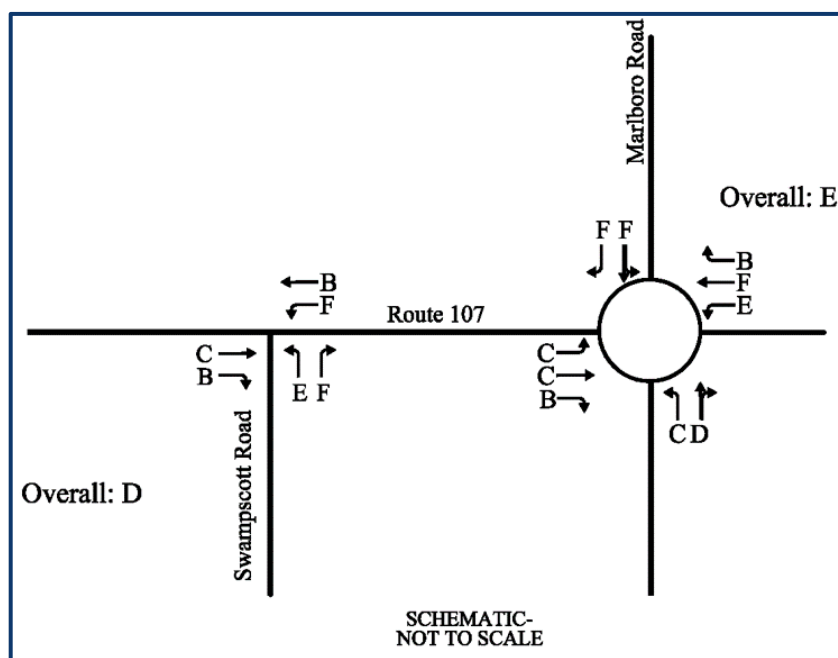
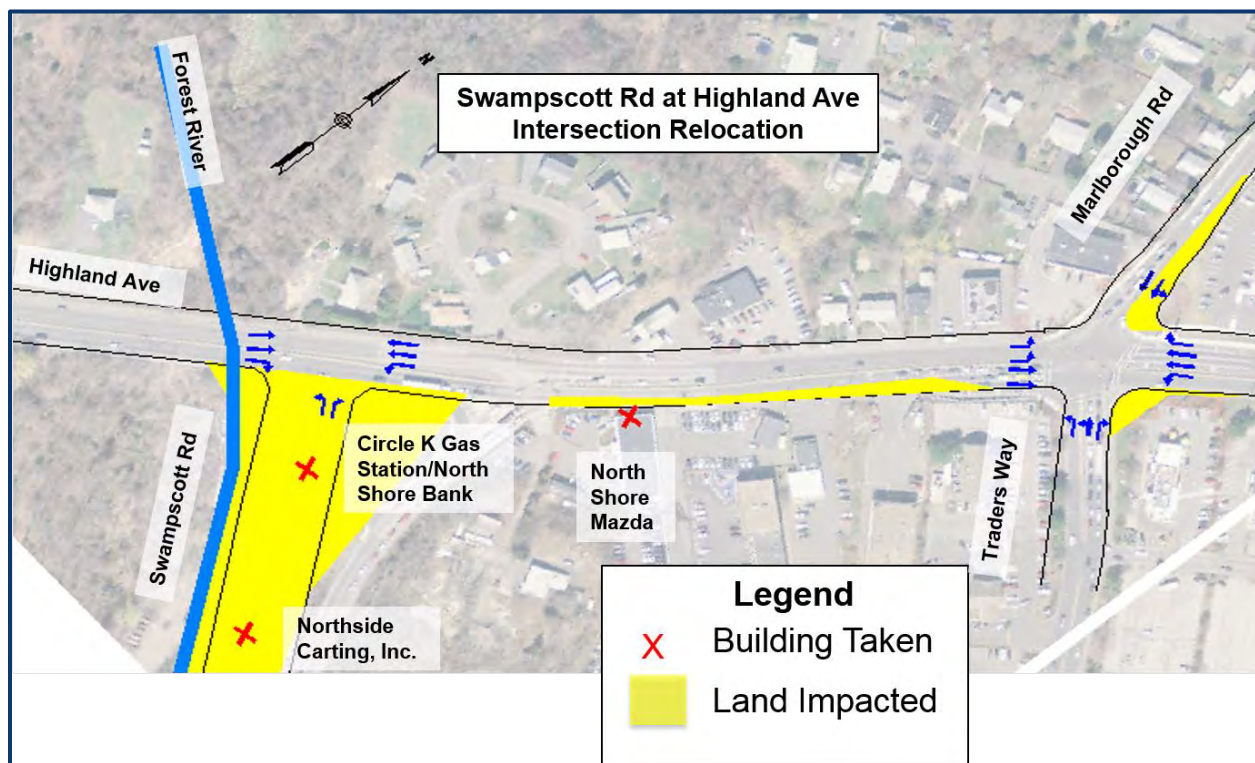


Figure V-44: Level of Service



**Figure V-45: Swampscott Road at Highland Road Relocation**

In reviewing the various options considered for the zig zag area, a number of options resulted in significant right of way impacts and therefore, were not considered feasible. There were also a number of options that addressed only one direction of the zig zag movement. Alternatives that addressed the zig zag movement in both directions and did not have significant consequential right of way impacts offered the most potential for future consideration. Therefore, the alternatives that remove connections between Marlborough Road and Swampscott Road via Route 107 remain under consideration. This option provides increased capacity and reduced congestion at both intersections on Route 107 while minimizing impacts to adjacent properties. In addition, there is adequate space for bicycle lanes and a sidewalk on the west side of Route 107.

As this option is studied further, there are several additional elements that should be evaluated:

1. Re-alignment of the First Street and Swampscott Road intersection to establish the Swampscott Road northbound and First Street as the through movement as shown in Figure V-46. This recommendation improves the level of service of the intersection from an F to a C as depicted in Figure V-47.
2. Adding another westbound lane on Traders Way at the Marlborough Road/Traders Way intersection.
3. Adding a free-right turn lane with a larger radius from Traders Way onto First Street.
4. Additional traffic analysis is suggested to estimate and evaluate the amount of traffic shifted from Route 107 onto Traders Way and First Street.





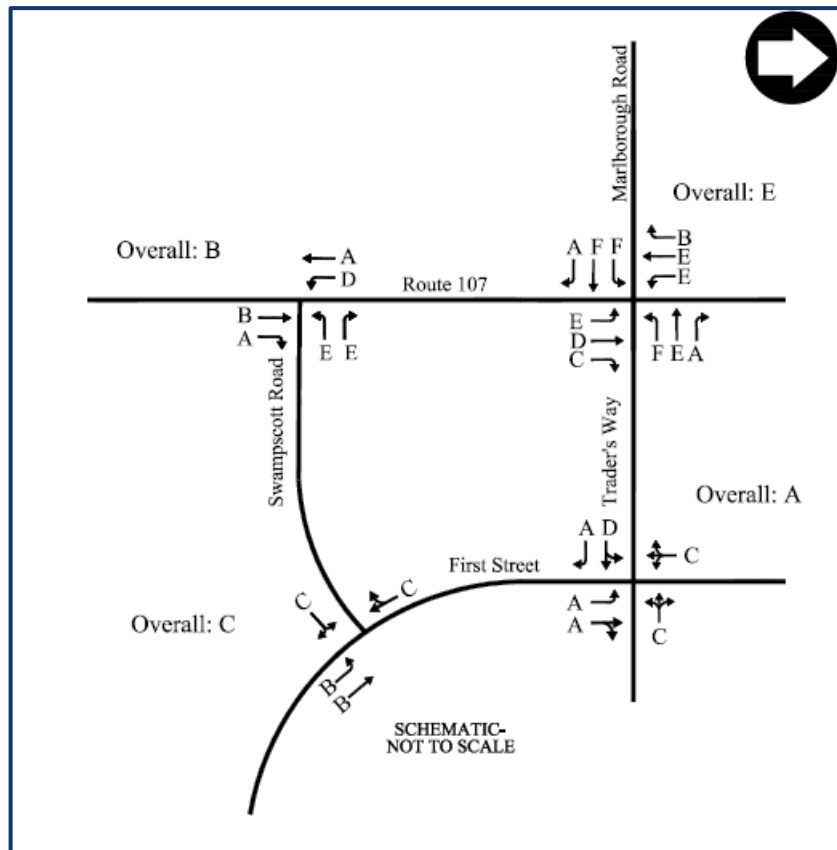


Figure V-47: Level of Service



#### 4. NORTHERN STUDY AREA ALTERNATIVES

The existing vehicular configuration of Route 107 within the northern study area segment varies from its four lane configuration near the schools to the wide single lanes provided near Salem Hospital. The right-of-way in the northern study area is 60 feet wide and the existing roadway cross-section provides two travel lanes, with four-foot grass strips and five-foot sidewalks on both sides.

In order to accommodate a proposed bicycle facility through the northern study area segment of Route 107 two-way separated bicycle lanes, protected buffered bicycle lanes and a shared use path were explored. Due to the constrained right-of-way through this segment of the study area, the implementation of bicycle facilities is often proposed with the minimum widths required to meet current standards. All of the alternatives discussed below are able to reduce the level of traffic stress currently experienced by bicyclists within the study area.

The majority of the northern study area segment provides narrow sidewalks on both sides of the roadway. Therefore, the primary focus of the pedestrian improvements within the area would be to provide additional sidewalk width where available or provide a shared use path through the entirety of the section to maximize the available pedestrian space. In addition to proposed sidewalks, the following would also be included in the potential pedestrian improvements:

- Maintaining an ADA compliant path for the entirety of the segment
- Providing accessible curb ramps at intersections and crossings
- Providing crosswalks at all signalized intersections for all approaches
- Improving unsignalized crossings
- Reevaluating signal timings to accommodate up-to-date pedestrian phase timings.

There are a number of opportunities to improve vehicular traffic operations and safety. Roadway modifications such as exclusive turn lanes, improved intersection geometry and a review of existing and potential traffic signals would be expected to enhance safety and operations within this segment of the Route 107 study area.

Exclusive turn lanes at certain study area intersections would remove vehicles waiting to turn left from the through movement on Route 107. The addition of the turn lanes would be expected to reduce the number of sideswipe collisions from vehicles attempting to pass on the narrow roadway and improve visibility of turning vehicles potentially reducing the number of angle collisions. Figure V-48 depicts



**Figure V-48: Potential Implementation of Exclusive Left-turn Lanes (Northern Study Area)**

the locations within the northern study area segment which were reviewed for the potential implementation of exclusive left-turn lanes.

A traffic signal warrant analysis at the Salem Hospital lower driveway indicated that a signal is warranted.

### Potential Roadway Cross-sections – Northern Segment

The first cross-section explored included one travel lane in each direction, a sidewalk with planting area on one side of the roadway and a separated shared use path on the other side of the roadway, as depicted in Figure V-49.

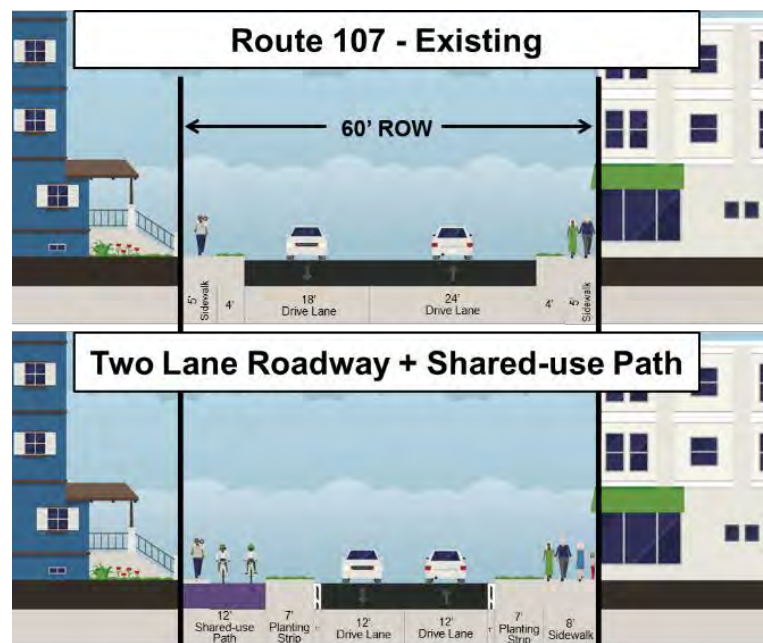


Figure V-49: Two Lane Roadway + Shared-use Path

#### Opportunities

- Reduction of travel lane width
- Landscaping separation between vehicles and pedestrians and bicyclists
- Landscaping to act as traffic calming for vehicle speeds.
- Improved definition of travel way with lane markings (and anything else)

#### Issues:

- Potential conflicts between cyclists and pedestrians
- No separation for left-turns at unsignalized intersections with Route 107
- Bicyclists directed to one side of the road



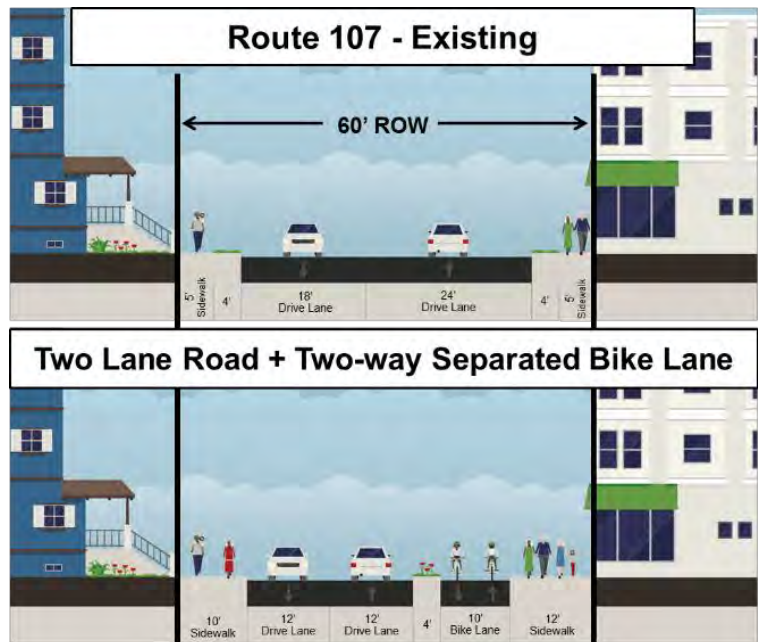
The next cross-section explored as part of the study included the implementation of a two-way separated bicycle lane, as depicted in Figure V-50.

**Opportunities:**

- Separation of all modes
- Wider sidewalks
- Reduction of travel lane width
- Improved definition of travel way with lane markings

**Issues:**

- Difficult to add turn lanes at intersections
- Bicyclists directed to one side of the road



**Figure V-50: Two Lane Road + Two-way Separated Bike Lane**

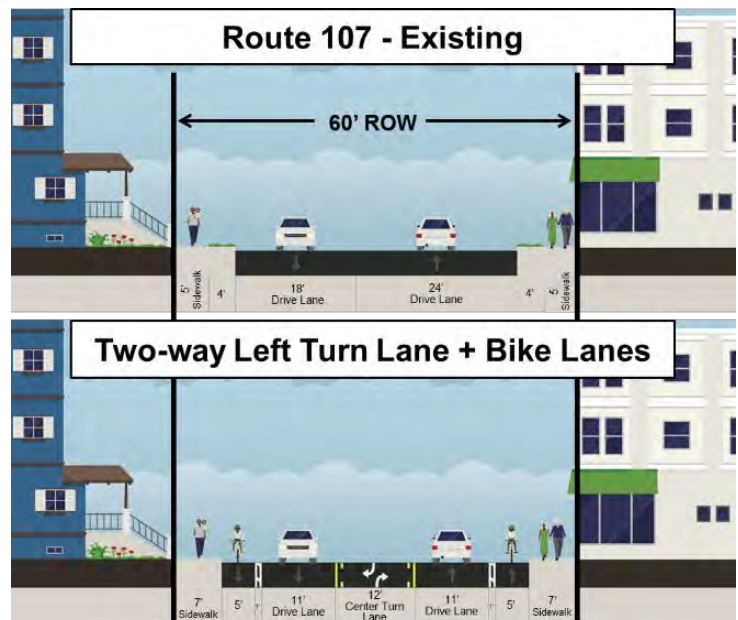
The next cross-section considered included one 11-foot travel lane in each direction and a 12-foot center two-way left-turn lane (TWLTL), as depicted in Figure V-51. It also includes five-foot bicycle lanes in each direction which are separated from the travel lane by one-foot buffers, along with seven-foot sidewalks on each side of the road.

**Opportunities**

- Reduce congestion and friction caused by left turning vehicles
- Reduction of travel lane width
- Improved definition of travel way with lane markings (and anything else)
- Separation of all modes
- Sidewalks on both sides of the roadway

**Issues:**

- Narrow bicycle facilities
- Minimal protected buffer between vehicles and bicycles



**Figure V-51: Two-way Left Turn Lane + Bike Lanes**

During discussions on the northern segment, the Working Group expressed concern about access at the fire station.

## VI. RECOMMENDATIONS

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### A. INTRODUCTION

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Improvements within the Route 107 study area were developed in accordance with the MassDOT Project Development and Design Guide of 2006.

In selecting the recommended cross-sections and intersection improvements, the primary considerations consisted of how the alternative met the study goals and objectives and input from the Working Group. The study goals and objectives are defined previously in Chapter 1. In addition, the following items were considered:

- Selecting proposed improvements that were practical and feasible
- Selecting alternatives that minimized right of way impacts and fit with the surrounding land use and vision of the communities
- Selecting alternatives which required fewer long-term maintenance obligations

### B. LONG-TERM RECOMMENDED ALTERNATIVE

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The recommended long-term improvements for the Route 107 study area are described in this chapter of the report. The recommendations are organized initially by study area-wide improvements by transportation mode. Next the improvements that apply to each of the three roadway segments; the Lynn study area, the retail study area and the northern study area, are described. This is followed by details of the intersection improvements. The cost estimates for the collective long-term recommendations are provided. Lastly, an evaluation matrix is presented for the long-term improvements, along with information on the next steps for the study in terms of MassDOT's project development and design process.

The recommendations support the following state and federal policies and regulations:

- The Massachusetts Healthy Transportation Policy, with focus on balancing the needs of all users, expanding mobility, improving public health, and supporting a clean environment.
- The Massachusetts Global Warming Solutions Act of 2008, which seeks a 25% reduction in greenhouse gas emissions from 1990 levels in 2020 across the state. This policy is served by MassDOT's mode shift goal of tripling the share of walking, bicycling, and transit usage.



## 1. STUDY AREA IMPROVEMENTS

### Bicycle

Bicycle lanes are recommended in both the northbound and southbound direction for the length of the study area. The recommended bicycle improvements are shown in Figure VI-1. Starting from the southern end of the study area, bicycle lanes, such as those shown in Image VI.1, are recommended to run from Chestnut Street to Linton Road in Lynn. North of Linton Road a protected buffered bicycle lane is proposed. Protected buffered bicycle lanes, depicted in Image VI.2, provide enhanced protection for cyclists from vehicular traffic as the retail portion of the study area becomes a faster, multi-lane thoroughfare. The protected buffered bicycle lane remains on both sides of the study area until Swampscott Road in Salem. From Swampscott Road to Marlborough Road, also known as the “zig zag”, there would be unprotected bicycle lanes due to roadside constraints. After Marlborough Road, for the remainder of the retail study area, the protected buffered bicycle lane picks back up until just short of Freeman Road in Salem, where it transitions back to an unprotected bicycle lane.



Image VI.1: Bicycle Lane



Image VI.2: Protected Buffered Bicycle Lane

Only one short section exists (approximately 200 feet) in the southbound direction only where the bicycle lane does not fit, and sharrows are necessary. This is located just south of the Willson Street intersection where an additional receiving lane is necessary for adequate operation of the intersection, and the right of way is extremely constrained.

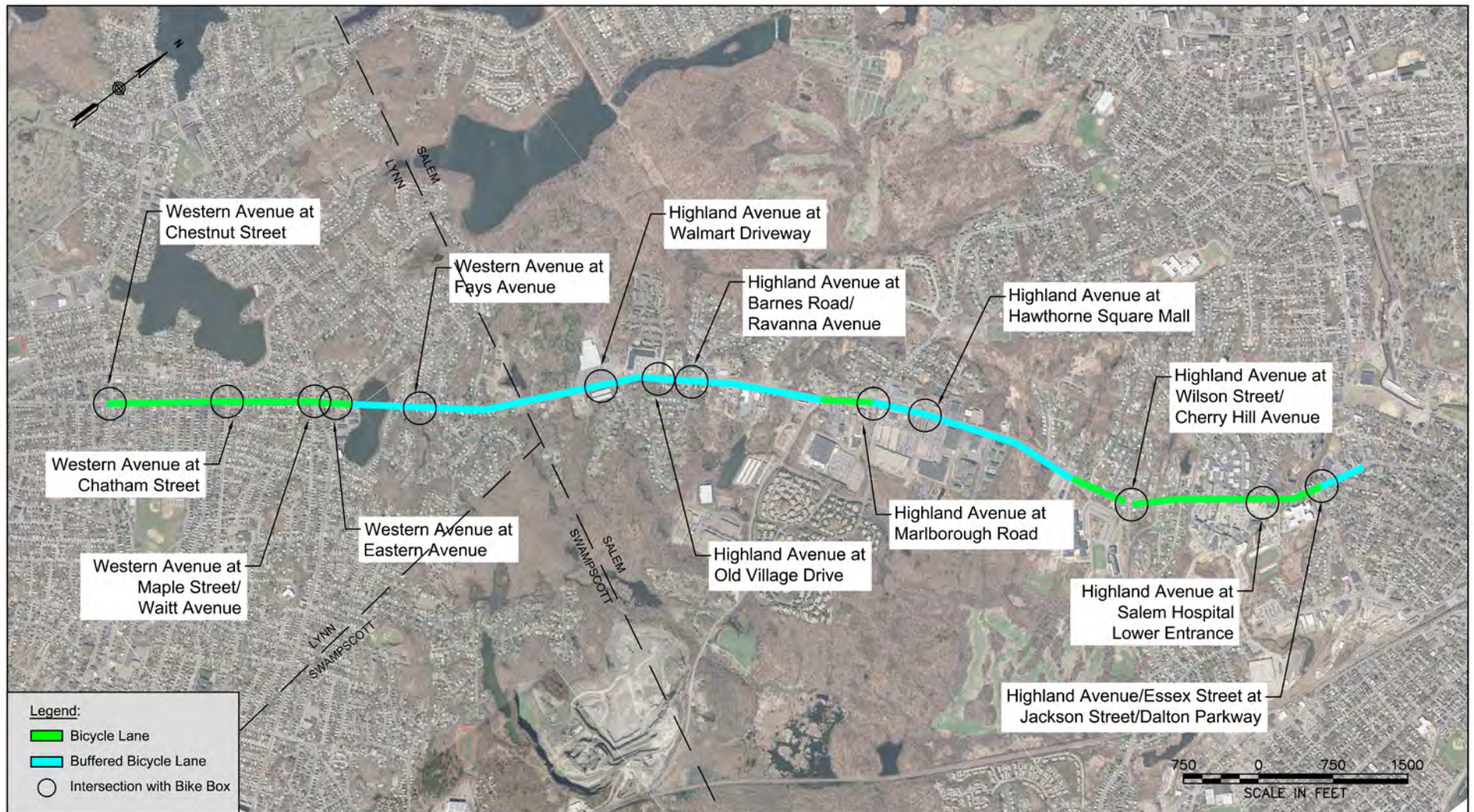
The bicycle lanes become buffered again just north of Dalton Parkway. The protected buffered bicycle lanes continue until the end of the study area at Boston Street and Essex Street where it joins the “shared street” (described further in Pedestrian section below).

Bicycle boxes are also proposed throughout the study area. Bicycle boxes, pictured in Image VI.3, help cyclists get out ahead of traffic during the red signal phase to navigate safely through an intersection. Both the location of bicycle boxes, bicycle lanes, and protected buffered bicycle lanes are depicted in the Conceptual Study Area Improvements, described in the subsequent sections of this report.



Image VI.3: Bicycle Box from Portland, OR





**Figure VI-1**  
**Proposed Bicycle Features**  
**Route 107 Corridor Study**  
**Lynn/Salem, MA**



## Pedestrian

Pedestrian improvements along the study area include the addition of sidewalks, crosswalks, curb extensions, and a shared street. Starting at the southern end of the study area in Lynn, a curb extension is proposed at (the southern end of the Buchanan Bridge before) Eastern Avenue. A curb extension is pictured in Image VI.4, and provides a safer, shorter crossing for pedestrians. It also increases the space available for benches, plantings, and street trees. A planted island in the center of the crossing across Eastern Avenue is also recommended. This creates a safer pedestrian crossing with a space for pedestrians to wait and also provides a traffic calming measure.



Image VI.4: Curb Extension

The Walmart Driveway in Salem is recommended for several improvements. The addition of sidewalks are recommended on the northern side to the south of the driveway and three crosswalks are proposed. This is also where the guardrail in the middle of Route 107 exists. It is recommended to remove the guardrail and convert it to a planted median, which would help improve the pedestrian environment.

New sidewalks and crosswalks are also recommended at the intersection of Olde Village Drive, Ravenna Avenue, and at the Salem Hospital Lower Driveway. At the intersection with Jackson Street and Dalton Parkway, crosswalks and an extension of the island between the two roads is recommended to facilitate safer pedestrian crossings. The intersection with Essex Street and Boston Street is recommended for the incorporation of raised shared street space. Shared street spaces are recommended for the corners of the intersection where useable right-of-way was created through the re-alignment of Route 107. A raised shared street in Montreal, shown in Image VI.5, provides an area for both pedestrians and vehicles at low speeds. They can also serve as spaces for recreation and socializing, providing added benefit to pedestrians, while still allowing for the unloading/loading necessities of vehicular traffic in a commercial area. A crosswalk is also recommended across Route 107 at the start of Boston Street. Reconfiguring this intersection would provide more structure and safety between different modes and serve as a gateway to the Route 107 study area in Salem.



Image VI.5: Raised Shared Street

## Transit

Study area-wide transit improvements were described in the previous chapter. This section describes some of the transit-specific or stop level recommendations that would be implemented in the long-term.

Recommendations outstanding from the proposed Bus Stop Optimization Plan in Figure V-1 and Figure V-2 (from Chapter V) and in the Bus Stop Consolidation Summary Table (in the Appendix) that cannot be rolled out in the short-term should be considered for implementation in the long-term. Some of these long-term recommendations would be incorporated into the intersection improvements, which are described later in this chapter. The remaining improvements are described below in the order of bus movement with inbound as north to south and outbound as south to north. Estimated impacts on parking required to implement improvements are noted but are approximate.

### Inbound stops:

1. Essex Street opposite Warren Street. Relocate the shelter to the recessed area along the existing sidewalk and shift the stop further north closer to the crosswalk and pedestrian path through the adjacent property (currently occupied by CVS).
2. Highland Avenue opposite Salem Hospital. Shift the stop slightly north, closer to the crosswalk to improve left turn movements for vehicles exiting the hospital driveway.
3. Highland Avenue opposite First Street. Investigate the potential to add a crosswalk and connecting sidewalk network to this stop, opposite Hawthorne Commons residential building. If a crosswalk is not feasible consideration should be given to removing the stop to discourage pedestrians and riders from crossing Route 107 across the median guardrail.
4. Western Avenue opposite Buchanan Circle. Add a curb ramp at the existing crosswalk adjacent to its new location far side of the crosswalk at Bellaire Avenue, assumed to have been relocated in the short-term.
5. Western Avenue at Cross Street. Lengthen the existing nearside bus stop by relocating the rear sign, to enable the bus to stop flush to the curb, which would require removal of about two parking spaces. Also, add a curb ramp at the crosswalk to the front of the bus stop.

### Outbound stops:

1. Western Avenue at West Colony Road. Shift the bus stop north to the far side of the driveway next to West Colony Road to enable both doors to open to a level sidewalk, which would require removal of about two parking spaces. Add a rear bus stop sign to clearly define the bus stop no parking area. Also, add a curb ramp at the crosswalk.
2. 331 Highland Avenue. Widen the sidewalk at this bus stop to provide a landing area and eliminate the pinch point at the existing utility pole. Also, coordinate with the abutting property owner(s) of the medical buildings to provide a safe and designated pedestrian path alongside the driveway to connect to the sidewalk on Route 107. Although this bus



stop is not currently paired with a stop across the street, it does not appear to be feasible or safe, due to the roadway alignment, grade and speed, to create a crosswalk across Route 107 at this location, and therefore a stop pair is not recommended to be added at this time.

3. Highland Avenue at First Street. As previously mentioned for this bus stop's pair – opposite First Street, investigate the potential to add a crosswalk at this stop, adjacent to the Hawthorne Commons residential building. If a crosswalk is not feasible consideration should be given to removing the stop to discourage pedestrians and riders from crossing Route 107 across the median guardrail.
4. Highland Avenue at Salem Hospital. Improve the adjacent sidewalk to provide a level and ADA compliant path of travel between the landing area and the shelter. Alternatively, consider relocating the stop to the far side of the intersection and crosswalk, in conjunction with the relocation or addition of a shelter and removal of the grass strip to create a landing area.
5. Essex Street at Warren Street. Relocate this stop to the far side of Warren Street, and far side of the crosswalk, for better sidewalk conditions, which would require removal of two or three parking spaces.

Bus stop amenities are recommended to be added to the following stops; the number of boardings at the stops, as of Fall 2014, is also noted, as ridership is one of the primary criteria for adding bus stop amenities:

- Highland Avenue opposite Salem Hospital (74)
- Highland Avenue at Walmart (37)
- Highland Avenue at Hawthorne Square (32)
- Western Avenue at Chestnut Street (42) – behind the sidewalk, in coordination with the property owner(s).

If, upon further investigation or through the design process, a shelter cannot be integrated into the proposed location, one or two benches should be considered instead. A trash receptacle should also be added to each of these locations also.

## 2. LYNN STUDY AREA RECOMMENDATIONS

The recommended cross-section for the Lynn study area segment of Route 107 includes eight to ten foot sidewalks, and seven foot on-street parking lanes on both sides, a narrow five foot bicycle lane and an 11 foot travel lane in each direction, as depicted in Figure VI-2. Pavement resurfacing improvements are recommended throughout this segment. At some of the key intersections within the Lynn study area, a left turn lane would be incorporated. At approaches to these intersections, parking would not be allowed, and the cross section would consist of three 11 foot lanes and two 6.5 foot bicycle lanes. For perspective on the consequential changes to on-street parking in the southern portion of the study area, refer to Figure VI-3.

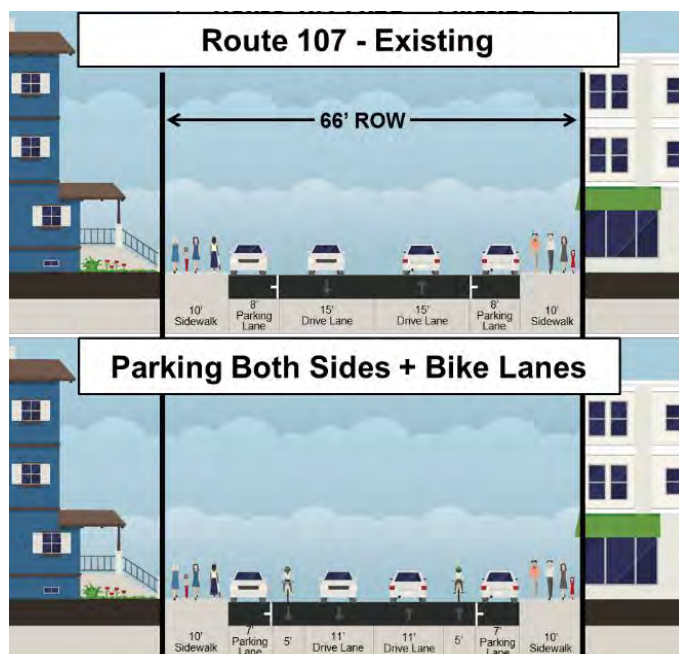


Figure VI-2: Cross-section – Parking Both Sides + Bike Lanes

The available 66 feet of right-of-way for potential improvements limits the space available for multimodal improvements. The recommended section allows for maintenance of parking on both sides of the street while incorporating a bicycle lane. The proposed bicycle facilities would need to be narrow in order to fit, and would not meet current standards for separated bicycle lanes. However, this would allow for a continuous bicycle facility for the entire study length. The narrow unbuffered bicycle lane would only be implemented between Chestnut Street and the Buchanan Bridge, and would temporarily widen to 6.5 feet at all intersections with left turn lanes. Details on implementation of the recommended cross section in the Lynn study area segment are noted below.

**Chestnut Street to Buchanan Bridge** – This section was developed to maintain the existing parking to the maximum extent possible, while incorporating left turn lanes at key intersections as well as providing dedicated bicycle lanes throughout. Given the existing curb to curb width of 46 feet, 11 foot travel lane widths can be utilized to achieve the minimum 5 foot bicycle lane and seven foot parking lane on each side of the road. While these dimensions are not ideal, the minimums can be achieved without altering the curb line. At intersections with left turn lanes, at each approach parking must be eliminated, leaving room for three 11 foot lanes and a 6.5 foot bicycle lane. The existing 8 - 10 foot sidewalks are wide enough to provide an adequate landing area at bus stops, and can be rebuilt in place to achieve ADA compliance. Intersections within this section include – Western Avenue (Route 107) with Chestnut Street, Chatham Street, Maple Street/Waitt Avenue, and Eastern Avenue/Stanwood Street. Specific improvements proposed at each intersection are noted in section 5.







**Buchanan Bridge** – The Bridge is fixed at 36 feet curb to curb and no physical improvements are proposed as part of this study. Since there is no parking allowed, a protected buffered bicycle lane can be provided within the existing cross section by restriping with 11 foot lanes, a 2 foot buffer and five foot bicycle lanes on each side. The existing eight foot sidewalks on the structure are adequate and in reasonable conformance with ADA guidelines. (Bridge section shown on Eastern Avenue/Stanwood Street intersection diagram Figure VI-9 in section 5, page 161)

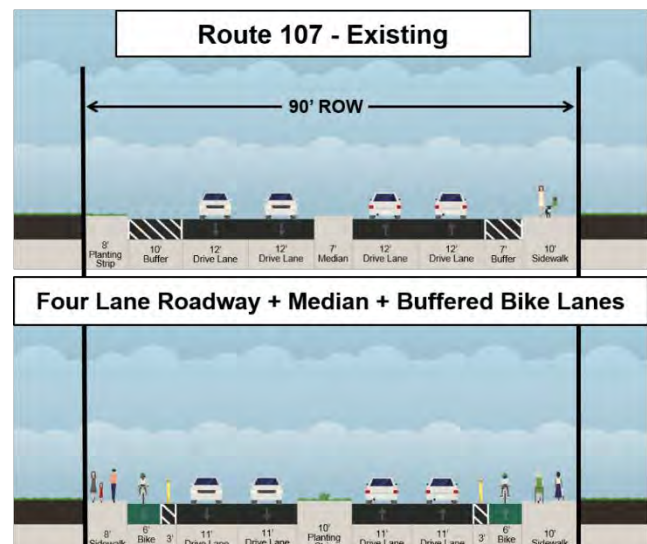
**Buchanan Bridge through Fays Avenue to Lynn/Salem City line** – Coming off the bridge, the two lane roadway transitions to a three lane cross section to provide a left turn lane at Fays Avenue. There is no on-street parking in this section, so the five foot protected buffered (two foot buffer) bicycle lanes which started on the bridge can be continued without altering the existing 46 foot curb to curb dimension. Existing sidewalks are roughly six feet wide, and can be widened as needed at bus stops to achieve the appropriate landing area width of eight feet. The three lane section at the intersection would consist of two 11 foot travel lanes and a 10 foot northbound left turning lane.

North of Fays Avenue, the roadway tapers back down to a two lane cross section. There is still no on-street parking, so for the approximate 1500 feet of road prior to the transition to four lanes at the city line both the travel and bicycle lanes can be widened. Widening the lanes is recommended in order to maintain the existing 46 foot curb to curb distance, and avoid potentially costly modifications to the existing drainage system. The recommended cross section consists of two 13 foot lanes, and two six foot bicycle lanes each with a four foot buffer.

Additional improvements at the intersection with Fays Avenue are noted in section 5.

### 3. RETAIL STUDY AREA RECOMMENDATIONS

The recommended cross-section for the retail study area segment (exclusive of the “zig zag” portion described separately below) includes accommodations for vehicles, pedestrians and bicyclists while maintaining vehicular operations. The proposed cross-section includes two 11 foot travel lanes in each direction, separated by a 10 foot planted median, a protected buffered six foot bicycle lane in each direction and six to eight foot sidewalks on both sides of the roadway, as depicted in Figure VI-4.



**Figure VI-4: Four Lane Roadway + Median + Protected Buffered Bike Lanes**



Although there is generally 90 feet of existing right of way, in several areas significant roadside features, including existing ledge may be impacted by developing a cross section equal to this dimension. One of the most critical areas is just north of Olde Village Way, where existing property improvements including elevated walls appear very close to the highway right of way. Based on this, it appears prudent to work within the existing roadway template of approximately 84 feet (back of sidewalk (east) to outer edge of shoulder (west)).

The proposed cross section would allow for incorporation of sidewalks on both sides of the roadway and protected buffered bicycle lanes throughout, as well as conversion of the existing paved median with guardrail to a planted median which could act as traffic calming. If, in the future, completion of a detailed survey reveals adequate space for additional improvements without major impacts, then perhaps 12 foot lanes could be considered for this section.

Resurfacing of the pavement structure is recommended throughout this segment. Details on implementation of the recommended cross section in the Retail study area segment are noted below.

**Lynn/Salem City line to “Zig zag”** - At the Lynn/Salem City line the roadway transitions to a four lane cross section, with a raised center median. The existing section promotes higher speeds with its freeway atmosphere and paved median. The east side of the road has an existing sidewalk, while the west side does not consistently have a sidewalk.

Working within the existing footprint of the roadway allows for a proposed cross section of four 11 foot lanes, a 10 foot median (eight feet planted), and a six foot bicycle lane and three foot buffer in each direction. Although the planted median would aid in calming traffic speeds, the additional foot of buffer is also recommended here to shield bicyclists. The existing six foot sidewalks along the east side can be reconstructed in place (and widened to eight feet as needed at proposed bus stop locations), and adequate room within the existing roadway template exists on the west side to provide new sidewalks where none exists today for the length of this section. At intersections which require left turn lanes, utilizing the width provided by the planted median would allow for installation of 10 foot turning lanes.

Intersections within this section include the Wal-Mart Entrance, Olde Village Drive, and Barnes Road/Ravenna Avenue. Additional specific improvements proposed at each intersection are noted in section 5.

**Highland Avenue at Swampscott Road/Dipietro Avenue and Highland Avenue at Marlborough Road/Traders Way (“Zig zag”)** – The proposed roadway improvements to the Highland Avenue at Swampscott Road/Dipietro Avenue intersection, and the Highland Avenue at Marlborough Road/Traders Way intersection (Zig zag) are limited due to several constraints including the proximity of Thomas Circle, ledge, walls, parking areas, elevation difference with abutting properties, and the existing alignment of Dipietro Avenue. These constraints made any widening of Highland Avenue between these two intersections extremely difficult and costly. Therefore, alternatives to reroute traffic and eliminate the need for expanding the number of vehicle lanes were explored. The alternative prohibits the “zig zag” movement on Route 107 between Swampscott Road and Marlborough Road and reroutes the movement through Traders Way and First Street. For this alternative, improvements would occur at the following intersections:

- Highland Avenue at Swampscott Road/Dipietro Avenue
- Highland Avenue at Marlborough Road/Traders Way
- Swampscott Road at First Street
- First Street at Traders Way

The existing curb to curb roadway width on Highland Avenue throughout the zig zag is approximately 70 feet with a 10-foot wide sidewalk on the east side of the road. Given this width, the study would provide bicycle accommodations through five foot bicycle lanes; however, they would not be buffered due to roadway constraints. Like the remainder of the retail study area, there would be no parking accommodations on Highland Avenue. A sidewalk would be added on the west side of Highland Avenue. Transit accommodations in the form of bus stop features such as shelters, signage, and pedestrian improvements would be provided on Highland Avenue. The alternative has four 11 foot lanes within the zig zag which results in increased safety due to potentially slower traffic speeds. Due to the minimal cross-section width, this section would have back-to-back ten foot left turn lanes separated by a two foot median. The two-foot wide median would likely be concrete due to the limited width available unlike the other parts of the retail study area where an aesthetically pleasing median is provided.

In order to restrict the zig zag movement, two foot wide lane barriers are proposed between the through travel lanes as shown in Section V for Highland Avenue at Swampscott Road/Dipietro Avenue and Highland Avenue at Marlborough Road/Traders Way. The lane barriers may consist solely of pavement markings. Vertical separation could also be applied in the form of concrete barrier or flexible delineator posts, as shown in the images below. In clockwise order beginning at the top left, these images are from Long Island, New York; Gijon, Spain; Seville, Spain; and San Diego, California. A local example of a lane barrier is the I-93 HOV image shown below. The type of lane barrier would require further consideration with attention to maintenance requirements, effectiveness of barrier type, and cost.





**Lane Barrier Examples**



**Local I-93 Lane Barrier Example**

Several concerns were raised in the public comment period regarding the efficacy of both lane barriers within the Route 107 roadway and the value of redirecting Marlborough-Swampscott movements off Route 107 and onto Traders Way and First Street. This report's analysis shows that traffic operations could not be substantially improved by adding capacity to the Marlborough Road and Swampscott Road intersections. The alternatives that involved the redirection of Marlborough-Swampscott movements via Traders Way and First Street resulted in significant improvements to the traffic operations. Level of service for this option improves from an F to an E at the Marlborough Road/Traders Way intersection, a D to a B at the Swampscott Road/Dipietro Road intersection, a B to an A at the Traders Way and First Street intersection, and an F to an E at the Swampscott Road and First Street intersection. These improvements are dependent upon traffic signal adjustments and re-orientation of the First Street and Swampscott Road intersection to encourage the redirected movements.

These improvements would be best achieved by the introduction of lane barriers within the Route 107 roadway, signalization and new channelization at the Swampscott Road and First Street intersection, and through coordinated signalization at the Route 107/Marlborough Road, Traders Way/First Street, and Swampscott Road/First Street intersections to favor these through movements. Modifications at the Swampscott Road and First Street intersection include signalization of the intersection, addition of a traffic signal, an additional left turn lane on First Street and an additional right turn lane on Swampscott Road.

Implementation of these two improvements without lane restrictions would likely result in a modest improvement in traffic operations. If the lane restrictions were to be established using only signage and pavement markings with no vertical separation enforcement of the turn restrictions would become a challenge and overall effectiveness of the new movement curtailed. If lane barriers are implemented, enforcement of the turn restrictions becomes less of a challenge. However, the presence of the vertical barriers increases maintenance obligations, particularly in regards to snow plowing, and could result in driver confusion. The details of lane separation require additional consideration and coordination during the design phase.

Further study is necessary to more comprehensively evaluate the traffic operations along Traders Way and First Street in peak periods, including to project the amount of traffic likely to be re-routed and identify improvements along Traders Way and First Street which may be necessary to handle the added traffic. Specific improvements proposed at each intersection are noted in section 5.

**Hawthorne Square Mall entrance to Freeman Road** – Proceeding north from the zig zag section, the roadway once again has a four lane section similar to the retail section north of Wal-Mart. The existing section promotes higher speeds with a paved median and no on-street parking. Between intersections, the curb to curb width is roughly 70 feet, widening to approximately 84 feet at the Hawthorne Square Mall intersection. This allows for a proposed cross section of four 11 foot lanes, a 10 foot median (eight feet planted), and a five foot bicycle lane and three foot buffer in each direction. Although the planted median would aid in calming traffic speeds, the additional foot of buffer is also recommended here to shield bicyclists. At the Hawthorne Square Mall intersection, 11 foot left turning lanes are recommended. Dropping the



exclusive southbound right turn lane would allow room to provide the bicycle lanes and buffer through the intersection without the need for roadway widening, without a deleterious effect on traffic operations. Other improvements proposed at the Highland Avenue intersection with Hawthorne Square Mall are detailed in section 5.

#### 4. NORTHERN STUDY AREA RECOMMENDATIONS

The recommended cross-section for the Northern study area segment of Route 107 includes six to eight foot sidewalks, a six foot (primarily unbuffered) bicycle lane and an 11 foot travel lane in each direction, as depicted in Figure VI-5. In addition, for the majority of the segment length, a 12 foot center two-way left turn lane (TWLTL) would be incorporated. Similar to the other segments, pavement resurfacing is recommended in the northern segment.

##### Freeman Road to Willson Street/Cherry Hill Avenue

– This area is a transition section from the four-lane retail study area to the three-lane section proposed for the northern leg of the study area. The proposed design is to carry two 11 foot lanes northbound to Willson Street. Approaching Willson Street, the right lane would become a right-turn only lane, with the northbound six foot bicycle lane crossing to be in-between the two travel lanes to prevent right turning traffic from crossing their path. Southbound, there would only be one 12 foot travel lane until after the roadway passes under the existing pedestrian bridge, which is the major design constraint in this section. The curb to curb width is approximately 50 feet here, with the bridge abutments directly behind the existing eight foot sidewalks. This condition extends north to Willson Street with existing property improvements and walls right at the back of sidewalk making any widening potentially extremely costly (approximately 48 feet curb to curb).

Based on these considerations, in order to maintain consistent bicycle lanes through this section, the recommended design is for only one southbound travel lane under the bridge, opening up to two 11 foot southbound lanes between Crowdis Street and Freeman Road. The exception to this would be at the Willson Street intersection, where two southbound through lanes would be necessary to accommodate southbound Route 107 traffic, and the double left turn lanes from Willson to southbound Route 107. For this short stretch (100 – 200 feet) the bicycle lane would be eliminated and sharrows would guide bicyclists until the 6 foot lane can be redeveloped as the roadway returns to one southbound travel lane.

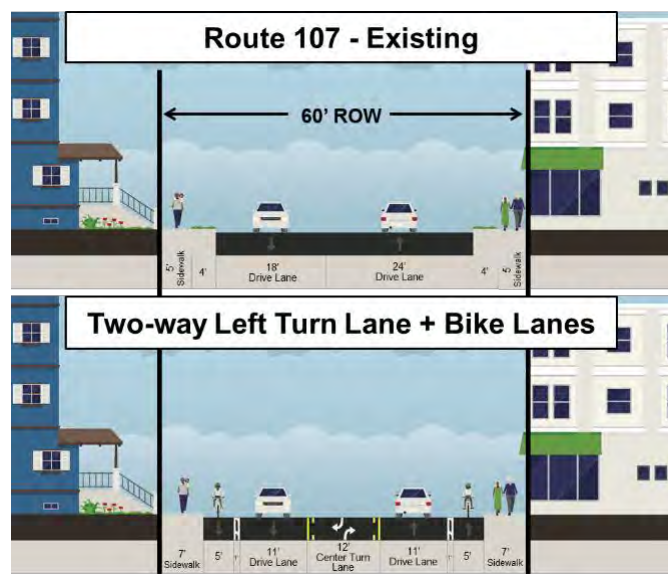


Figure VI-5: Cross-section – Two-way Left Turn Lane + Bike Lanes

The proposed cross-section between Willson Street and the pedestrian bridge is the critical section in attempting to provide a consistent bicycle lane throughout the study area. As design progresses, a detailed survey of this area would provide more information regarding dimensions available, and perhaps consideration of reduction in travel lanes or sidewalk widths and/or minor roadway widening could allow adequate room for a consistent southbound bicycle lane and/or an additional travel lane. There is also potential opportunity to explore shifting the northbound bicycle lane off of Route 107 and onto Salem High School property from just south of the pedestrian bridge to Willson Street (see Figure VI-22 in section 5, page 181). Shifting the bicycle lane off road could allow enough room to more fully develop other cross-section elements.

Other improvements proposed at the Highland Avenue intersection with Willson Street/Cherry Hill Avenue are noted in section 5.

**Willson Street/Cherry Hill Avenue through Jackson Street/Dalton Parkway intersection –** North of Willson Street, the proposed cross section transitions to a three lane section with no on street parking. Again, to minimize impacts such as right of way and cost, working within the existing 46 foot curb to curb dimension, this alternative consists of two 11 foot lanes and a 12 foot center two way left turning lane (TWLTL), with six foot unbuffered bicycle lanes in each direction. There are existing six to eight foot sidewalks on both sides of the road that can be reconstructed to be in accordance with ADA guidelines.

The above described section would extend through the Salem Hospital Lower Driveway where a new left turn lane would be installed in the northbound direction, after which the TWLTL section would resume for a short distance to the north. Approaching the Jackson Street/Dalton Parkway intersection, the center turning lane would be temporarily discontinued, in order to develop an exclusive right turn only lane northbound approaching Jackson Street. Similar to the Willson Street intersection, the bicycle lane would cross from the curb line to in-between the two travel lanes to prevent right turning traffic from crossing their path.

On the opposite (southbound) side of the Jackson/Dalton intersection a left turn lane would be developed, before the section transitions back to a TWLTL heading north toward Boston Street. North of Dalton Parkway, there appears to be additional width available to reestablish a 2 foot buffer between the bicycle lanes and travel lanes to Boston Street.

At the existing Jackson Street/Dalton Parkway intersection, Route 107 southbound widens by approximately six feet to add a short stretch to provide space for approximately three on-street parking spaces. The recommended alternative is to remove this parking and shift the roadway slightly utilizing this space to better align travel lanes on either side of the intersection. Throughout the entire intersection, vehicle, bicycle and pedestrian paths would be clearly marked to better assign space.

Additional specific improvements proposed at each intersection are noted in section 5.



**Essex Street/Boston Street intersection** – For this intersection, one of the study goals was to realign Route 107 to have it become the through movement, which is from Essex Street to Boston Street. The existing alignment has wide median areas separating directions of travel on Essex Street south of the intersection. In order to realign the intersection, it was necessary to shift the curb line away from existing residences and businesses, and eliminate this vast median. As Essex Street only requires a 3 lane section approaching Boston Street, this realignment created a large amount of useable space (up to 35 feet) between the proposed curb line and the existing back of the sidewalk on both sides of the roadway. Since access is still required for the existing residences and businesses that have frontage near the intersection, the recommended alternative includes converting the majority of this useable area to a “shared street” for vehicle access, bicycles and pedestrians (see Figure VI-25 in section 5, page 186). The shared street would be at the level of the sidewalk with the 6 foot bicycle lanes ramping onto it at either end, and driveway access points placed at strategic locations ramping onto the shared space as well. Pedestrians, bicycles and vehicles could move about freely over the entire area. Only vehicles requiring access to the abutting properties would need to access the space. An area within each shared street could be reserved for landscaping (or relocation of the existing monument at the northern end of intersection), preferably toward the curb to help buffer the shared street from the through roadway. The shared street area on the northwesterly side of the intersection (in front of Mande’s Pizza) would be for bicycles and pedestrians only.

The roadway cross section along Essex Street approaching the intersection northbound would transition from the TWLTL to a through and right turn lane northbound and a through southbound. Boston Street would be one through lane north (west) bound, and a through and a left turn lane south (east) bound. Essex Street southbound would tee into Route 107, with both a left and right turn lane, while northbound would be one through lane. All vehicle travel lanes are proposed to be 11 feet. All intersection approaches would have a 6 foot bicycle lane that ramps onto the shared street, and 8 foot sidewalks connecting to the shared street as well.

Other improvements proposed at the Essex Street intersection with Boston Street are noted in section 5.

## 5. INTERSECTIONS

This section describes the conceptual intersection improvements provided in Figure VI-6 through Figure VI-25.

For transit, Figure V-1 and Figure V-2 (in Chapter V), and the Bus Stop Consolidation Summary Table (in the Appendix) summarized the proposed improvements at each stop that are described below as part of the intersection improvements.

Summaries of the capacity analysis for the recommended improvements are provided in the report Appendix and include information on the levels of service, delay and queue lengths.

**Western Avenue at Chestnut Street** (see Figure VI-6).

Proposed improvements at this location include the following:

To improve safety, left turn lanes were added on Route 107 for both the northbound and southbound approaches. Left turn lanes were also added to both approaches on Chestnut Street. To improve traffic operations, traffic signal timings were optimized and signal coordination was improved. To facilitate installation of the left turn lanes, parking was removed in the immediate vicinity of the intersection. The installation of exclusive left turn lanes at each of the intersection approaches minimally increases the overall delay between No Build and Build conditions by approximately five seconds in each of the peak hour periods. All approaches to the intersection are expected to operate under capacity. Queue lengths are expected to increase along the Route 107 approaches (northbound and southbound) but are not shown to impact operations at the surrounding intersections.

The intersection is expected to operate at overall LOS D or better under the 2035 Build condition during the weekday morning, weekday afternoon, and Saturday midday peak hours.

Improvements to the crosswalks and pedestrian facilities are proposed in accordance with ADA, and bicycle lanes with bicycle boxes have been introduced at the intersection.

Access management is recommended to consolidate driveways and points of conflict where feasible.

Transit improvements include the retention of the inbound stop nearside of Chestnut Street with the addition of a bench, in coordination with the abutting property owner(s). At the outbound stop, rider safety and turn movements for buses turning left onto Chestnut Street are improved by relocating the stop away from the gas station driveways to the far side of Tucker Street, which requires the removal of two parking spaces. Bus stop pavement markings are recommended to deter parking.



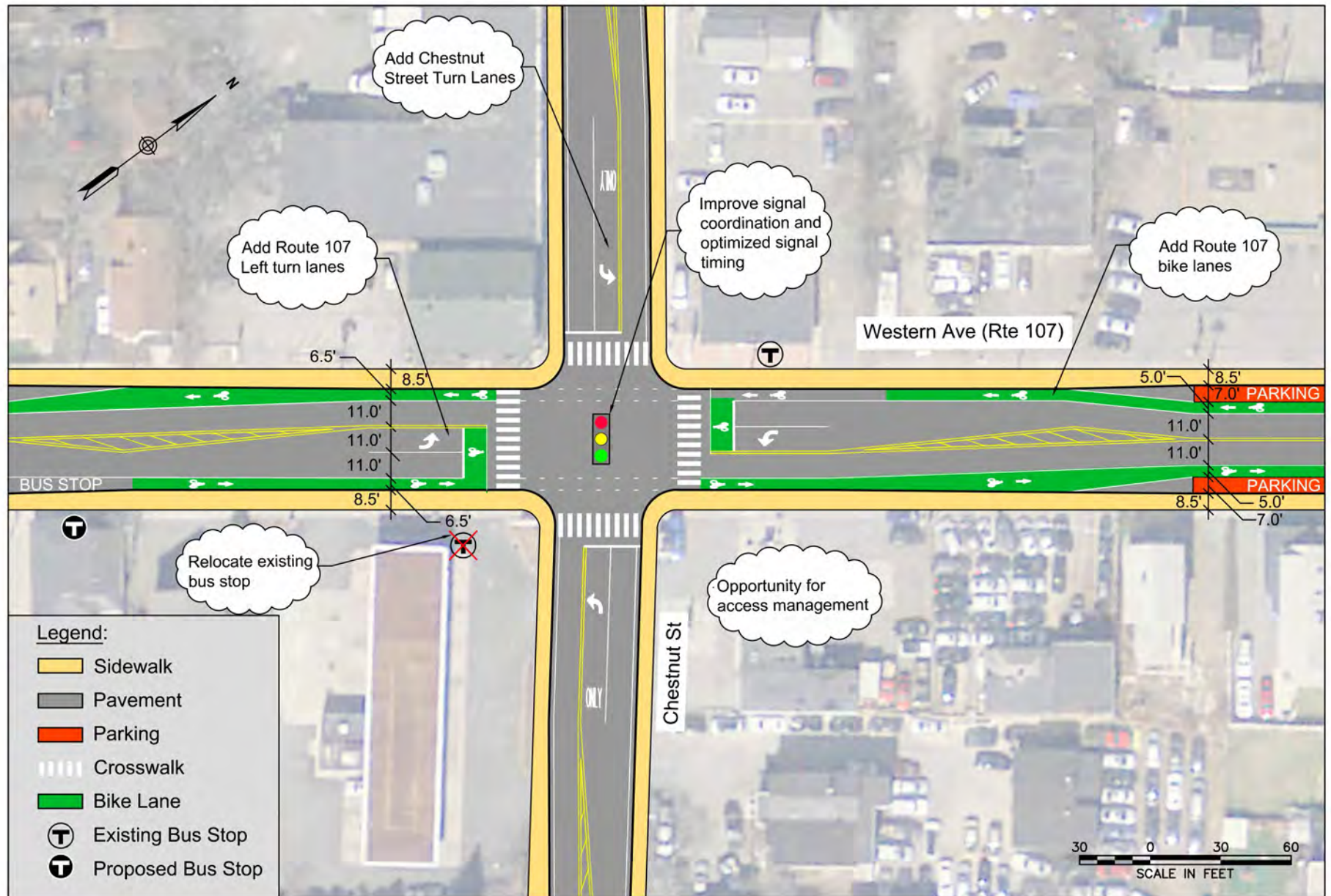


Figure VI-6  
Western Avenue (Route 107) at Chestnut Street  
Route 107 Corridor Study  
Lynn/Salem, MA

**Western Avenue at Chatham Street** (see Figure VI-7).

Proposed improvements at this location are similar to those at Chestnut Street and include the following:

For safety improvements, left turn lanes are proposed on both approaches of Route 107 and on both approaches of Chatham Street. The traffic signal timings optimization and signal coordination improvements are recommended. Consequentially, removal of parking in the immediate vicinity of the intersection to facilitate installation of the left turn lanes is recommended.

The proposed exclusive left turn lanes are expected to improve safety at the intersection. However, the safety improvements are shown to increase the overall intersection delay by approximately five seconds between the No Build and Build conditions. The intersection is expected to operate at overall LOS D or better under the 2035 Build condition during the weekday morning, weekday afternoon, and Saturday midday peak hours. Queueing is shown to extend slightly, but is expected to be contained within the available storage area of the intersections.

Recommendations for pedestrians include the improvement of crosswalks and pedestrian facilities in accordance with ADA. Bicycle lanes with bicycle boxes at the intersection are recommended.

Implementation of access management by consolidating driveways is recommended where feasible.

For transit, relocation of the existing inbound stop away from the existing driveway to the far side of Ryans Terrace is recommended, and requires the removal of three parking spaces. The outbound stop is recommended to shift slightly to the south, in front of a residential building, once the length between the two driveways is verified as 30 feet or longer to enable both doors to open to a level sidewalk. Formalizing the driveway aprons could help to maximize the curbside space. The loss of one or two parking spaces is anticipated.



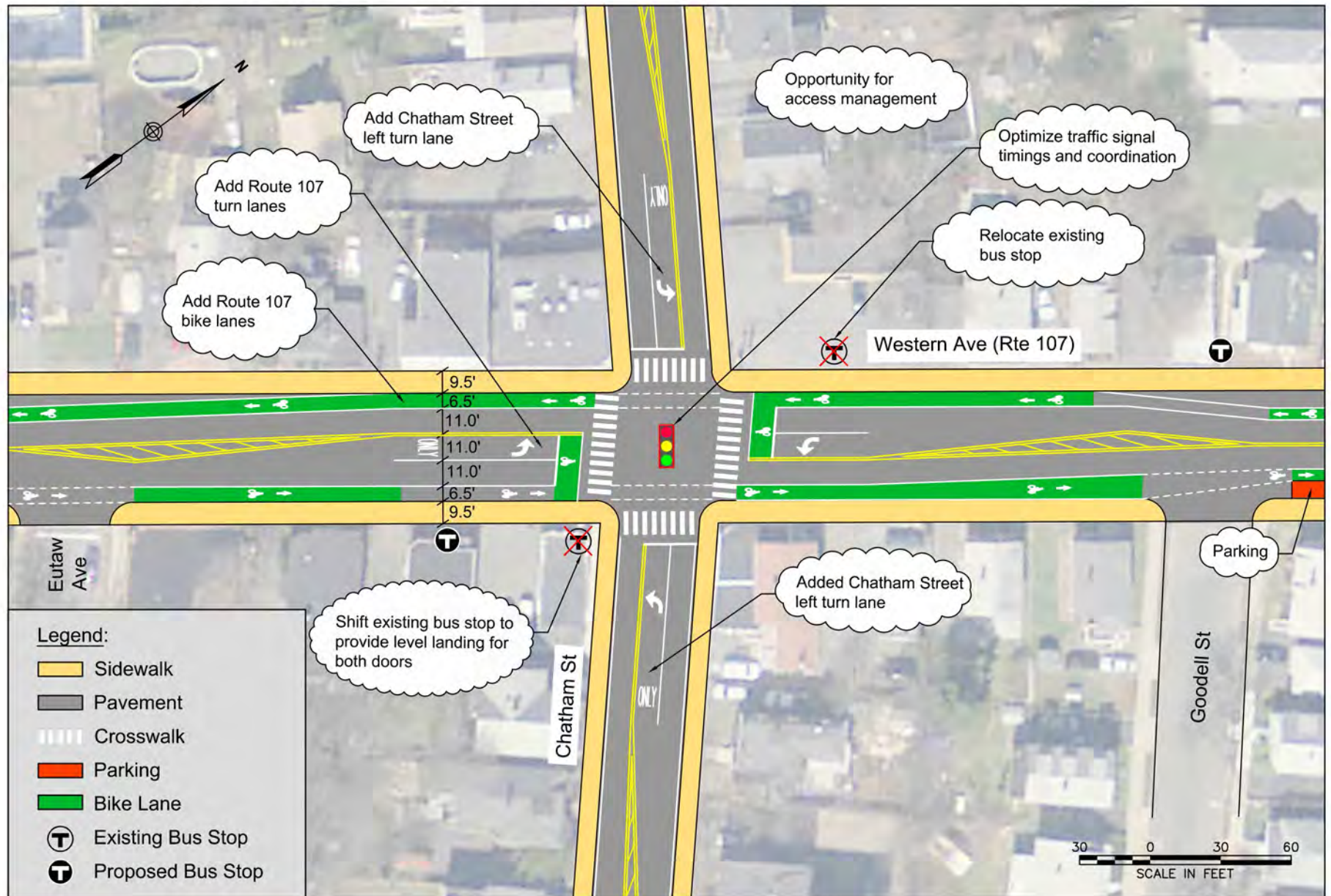


Figure VI-7  
Western Avenue (Route 107) at Chatham Street  
Route 107 Corridor Study  
Lynn/Salem, MA

**Western Avenue at Maple Street and Waitt Avenue** (see Figure VI-8).

Proposed improvements at this location include the following:

To improve traffic operations, recommendations include adding a left turn lane on Maple Street, adding a left turn lane on Waitt Avenue, and optimizing the traffic signal timings and improving signal coordination. The installation of the left turn lanes necessitates the removal of parking in the immediate vicinity of the intersection. The addition of left turn lanes and the improvements to the signal timings reduces the overall delay between the No Build and Build conditions at the intersection in the weekday morning, weekday afternoon, and Saturday midday peak hours. The changes also improve the capacity at the intersection, bringing the maximum volume to capacity ratio to under 1.00 in the weekday afternoon and Saturday midday peak hours and under 1.10 in the weekday morning peak hour. A volume to capacity (v/c) ratio compares the roadway demand with the roadway capacity and a v/c ratio under 1.0 indicates that the demand has not exceeded the capacity. The level-of-service for the eastbound Maple Street approach improves from LOS F to LOS E or better under all three peak hours studied. Queue lengths are expected to increase along the Route 107 approaches (northbound and southbound) but are not shown to impact operations at the surrounding intersections.

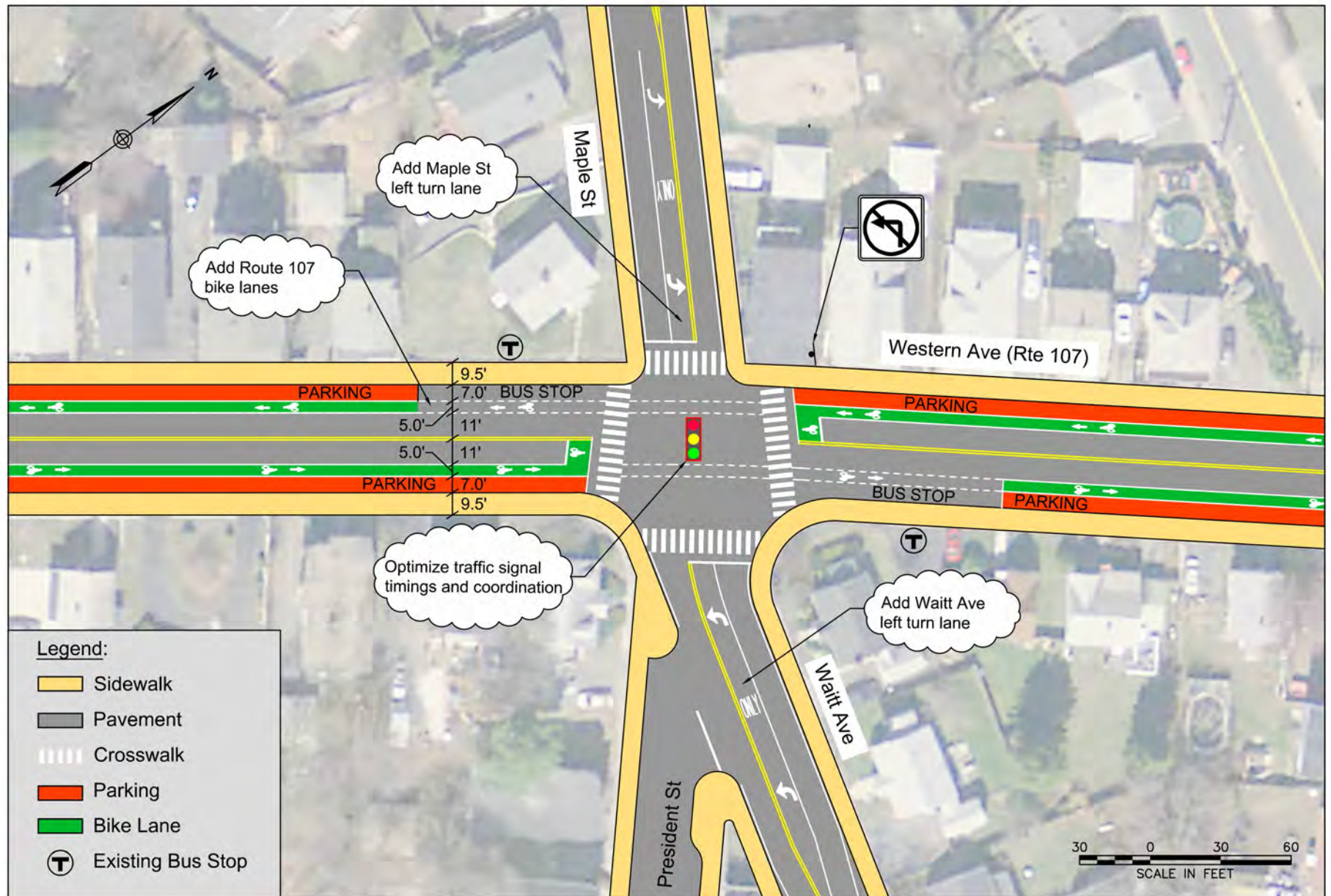
The intersection is expected to operate at overall LOS D under the 2035 Build condition during the weekday morning, weekday afternoon, and Saturday midday peak hours.

Improvements to crosswalks and pedestrian facilities in accordance with ADA are recommended and bicycle lanes with bicycle boxes are proposed at the intersection.

Improve the President Street alignment at its intersection with Waitt Avenue.

For transit, the inbound stop is recommended to remain in its current location although it should be lengthened, which would require the removal of one or two parking spaces, pending the outcome of intersection improvements at Eastern Avenue. At the outbound stop at Waitt Avenue, buses currently stop in the driveway or overhang the side street. Shifting the stop slightly north to the far side of the driveway to enable both doors to open to a level sidewalk is recommended.





**Western Avenue at Stanwood Street and Eastern Avenue** (see Figure VI-9).

Proposed improvements at this location include the following:

Installation of a new traffic signal to be coordinated with the adjacent signals along the study area is recommended. The addition of a left turn lane on Route 107 southbound is also recommended to improve operations and safety. The installation of the traffic signal at Stanwood Street and Eastern Ave significantly improves the level-of-service for the minor street approaches between the 2035 No Build and 2035 Build conditions. The v/c ratio for the eastbound Stanwood Street approach improves from well over 1.00 to under capacity. Restricting the westbound approach to right-only improves the level-of-service for the westbound approach from LOS F in the 2035 No Build condition to LOS B or better in the 2035 Build condition for all three studied peak hours. With the addition of the traffic signal and the southbound left turn lane, the intersection approaches on Route 107 operates at LOS C or better. Queues along the minor street approaches are greatly reduced under the 2035 Build condition and 50<sup>th</sup> percentile queues along Route 107 due to the installation of the signal are not expected to impact the intersection of Western Avenue at Maple Street and Waitt Avenue. If queue spillback is shown to occur with the new signal, coordination can be adjusted.

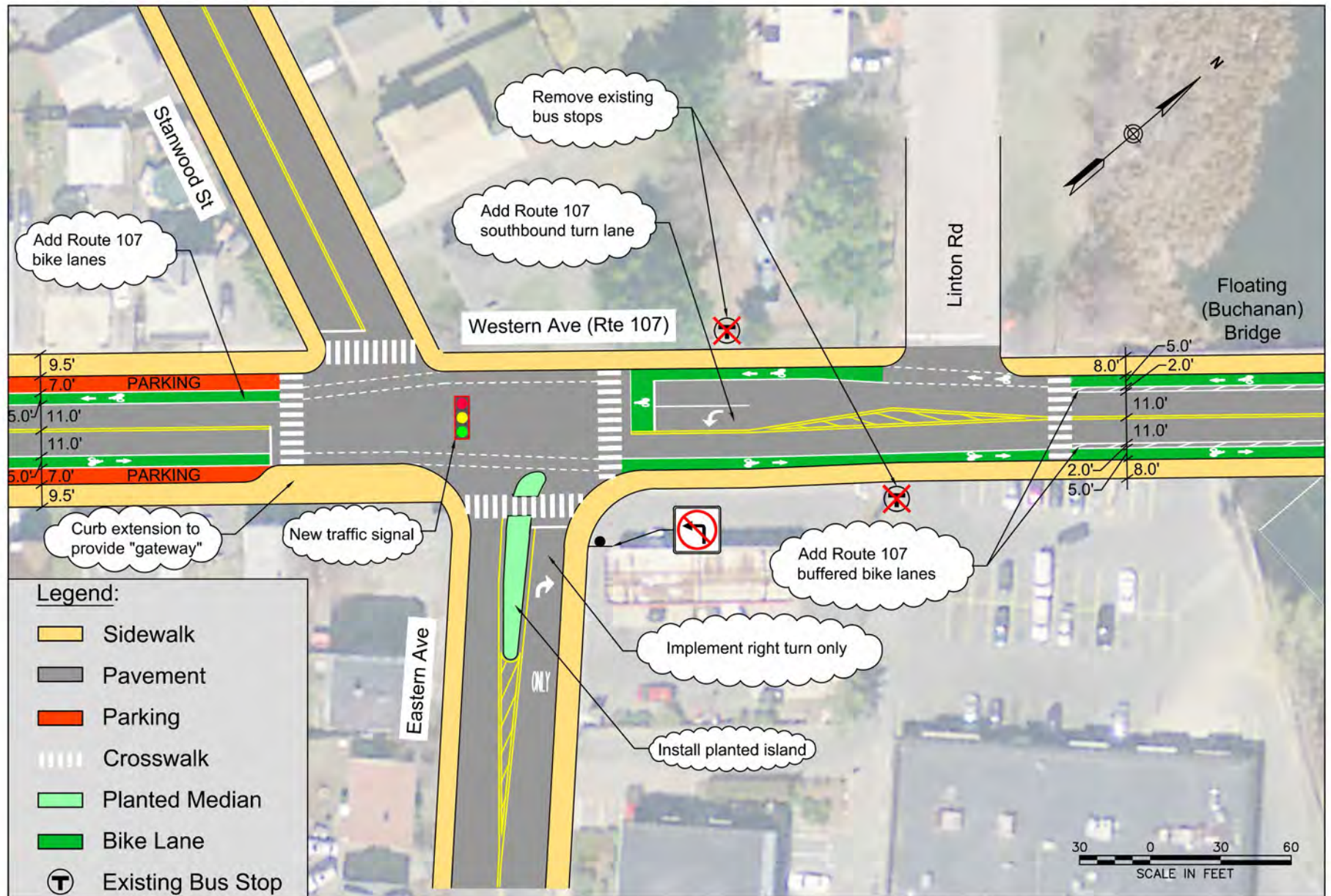
The intersection is expected to operate at overall LOS C or better under the 2035 Build condition during the weekday morning, weekday afternoon, and Saturday midday peak hours.

The provision of a curb extension at the end of the parking lane northbound approaching Eastern Avenue is recommended to create a “gateway” effect and to reduce the pedestrian crossing. A planted island has been proposed to facilitate a right turn only movement from Eastern Avenue to Route 107 northbound (left turns prohibited)

Pedestrian facilities in accordance with ADA and crosswalks are recommended. For bicyclists, bicycle lanes with bicycle boxes are proposed at the intersection. The protected buffered bicycle lane begins just north of Linton Road.

In terms of short-term transit improvements, the inbound and outbound stops at this intersection are proposed for removal.







With the proposed banned westbound left turn from Eastern Avenue onto Western Avenue, MBTA Bus Route 424 would no longer be able to continue its current inbound routing. Route 424 inbound trips currently travel westbound on Eastern Avenue, then turn left to head south on Western Avenue. Outbound trips currently operate from Western Avenue, right onto Waitt Avenue, and then right onto Eastern Avenue. To facilitate this new potential intersection control it is proposed that the inbound and outbound routing are flipped. This would maintain service on the same streets, just in the opposite direction, as shown in Figure VI-10. Four bus stops are affected by the change, and affect zero riders boarding, and four riders alighting (based on APC Fall 2014 data). Due to the proximity of existing bus stops, replacement bus stops are not proposed. The inbound bus stop on Western Avenue at Maple Street would also need to be lengthened to accommodate buses that would turn left from Waitt Avenue, and enable buses to pull flush to the curb. The removal of one or two parking spaces is anticipated.

Alternatively, the MBTA may wish to consider a more direct routing for inbound and outbound trips along Waitt Avenue.

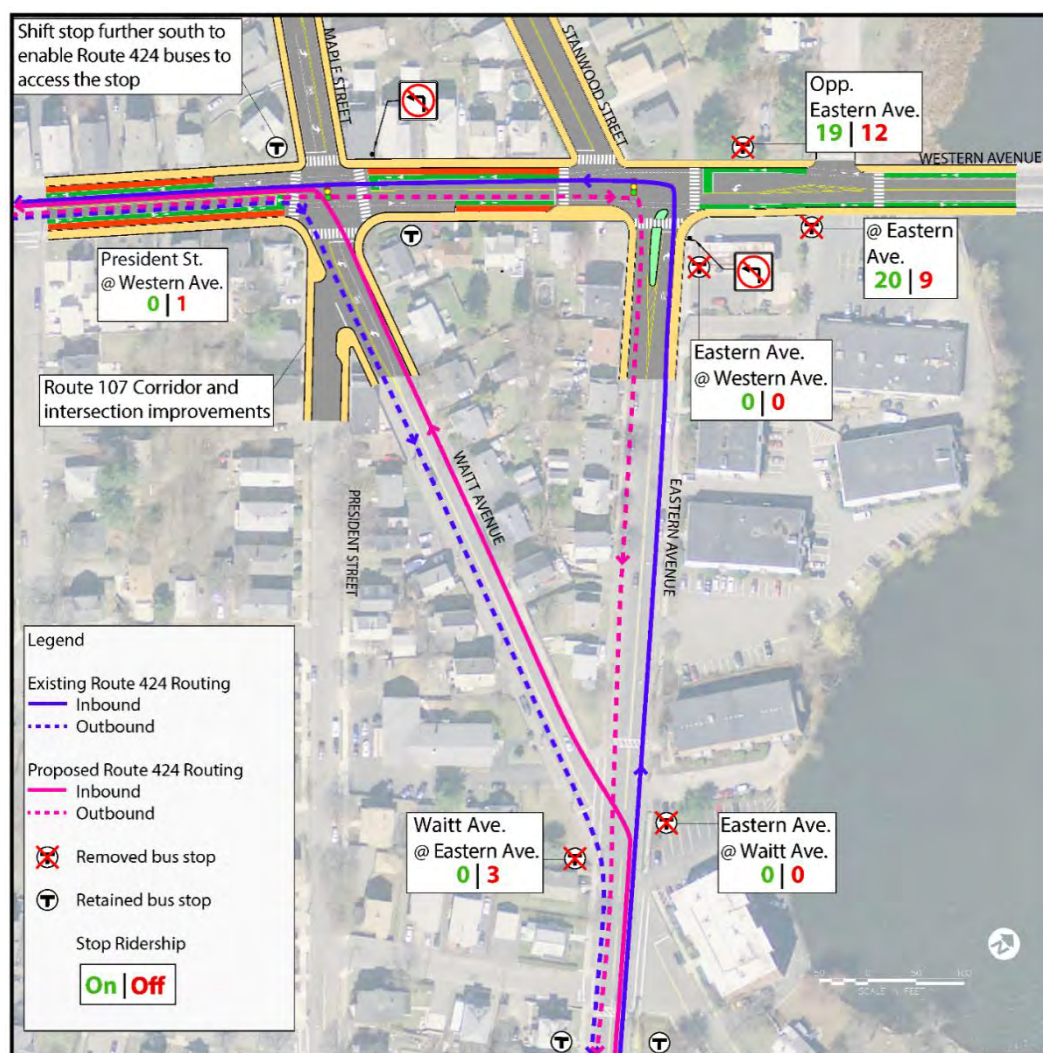


Figure VI-10: Bus Route 424 Existing and Proposed Routing



**Western Avenue at Fays Avenue** (see Figure VI-11).

Proposed improvements at this location include the following:

Optimize the traffic signal timings and improve signal coordination.

The intersection is expected to operate at overall LOS B under the 2035 Build condition during the weekday morning, weekday afternoon, and Saturday midday peak hours.

The existing six foot sidewalks should be reconstructed in place in accordance with ADA guidelines, and the introduction of protected buffered bicycle lanes with a northbound bicycle box are proposed at the intersection. Improvements to all crosswalks and pedestrian facilities in accordance with ADA are recommended.

For transit recommendations, relocate the inbound stop from the nearside to the far side of the intersection in conjunction with sidewalk widening at the landing area. At the outbound stop widen the sidewalk at the landing area.

**Western Avenue/Highland Avenue Study Area Transition** (see Figure VI-12)

Western Avenue/Highland Avenue transitions from a two-lane roadway to a four-lane roadway between Fays Avenue and the Walmart Driveway. Proposed improvements at this location include the following:

The existing six foot sidewalks shall be reconstructed in place in accordance with ADA guidelines, and protected buffered bicycle lanes are proposed throughout the transition. The existing pedestrian facilities should be improved to conform with ADA.

The removal of the guardrail is recommended and the existing paved median is recommended to be converted to a planted median.

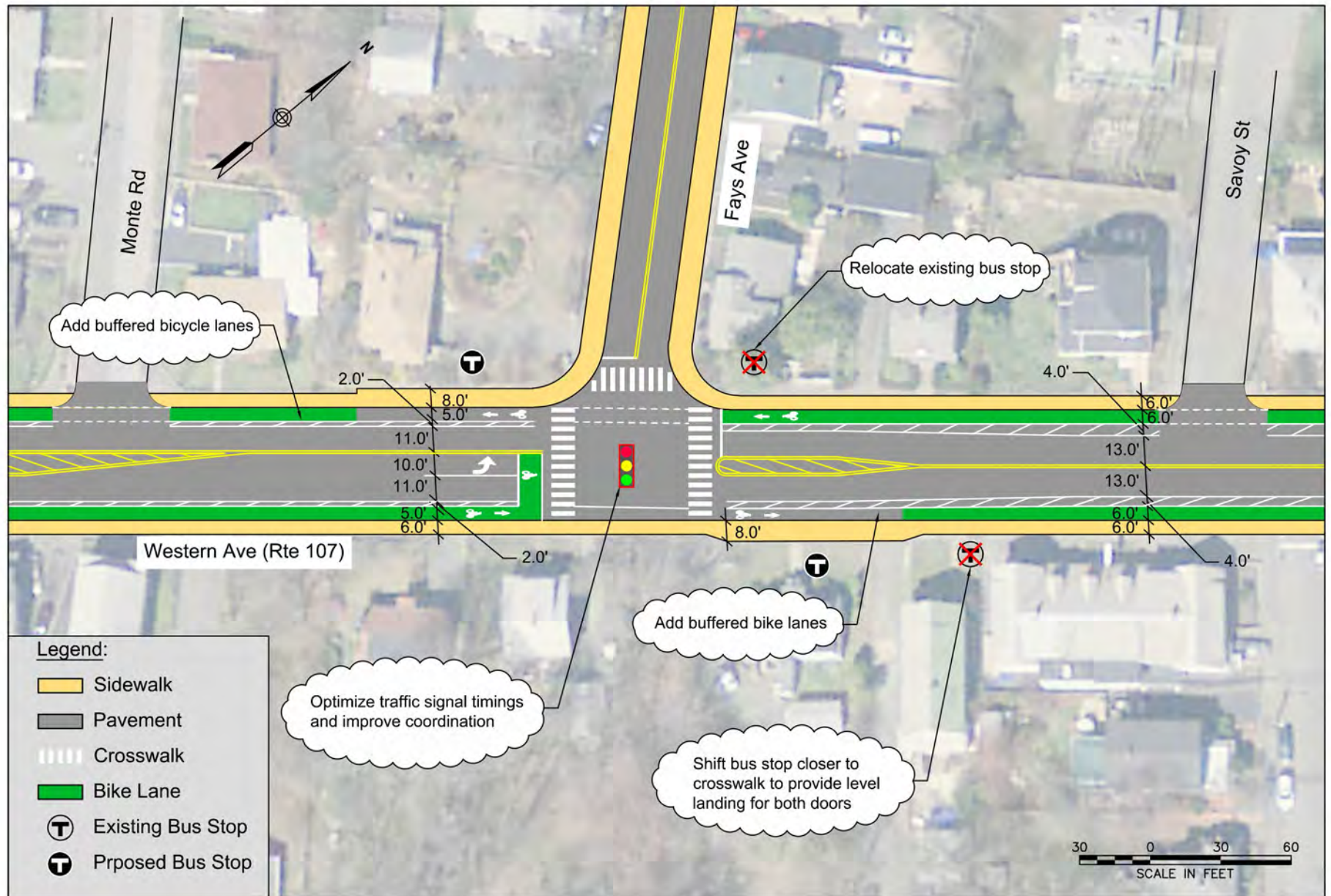
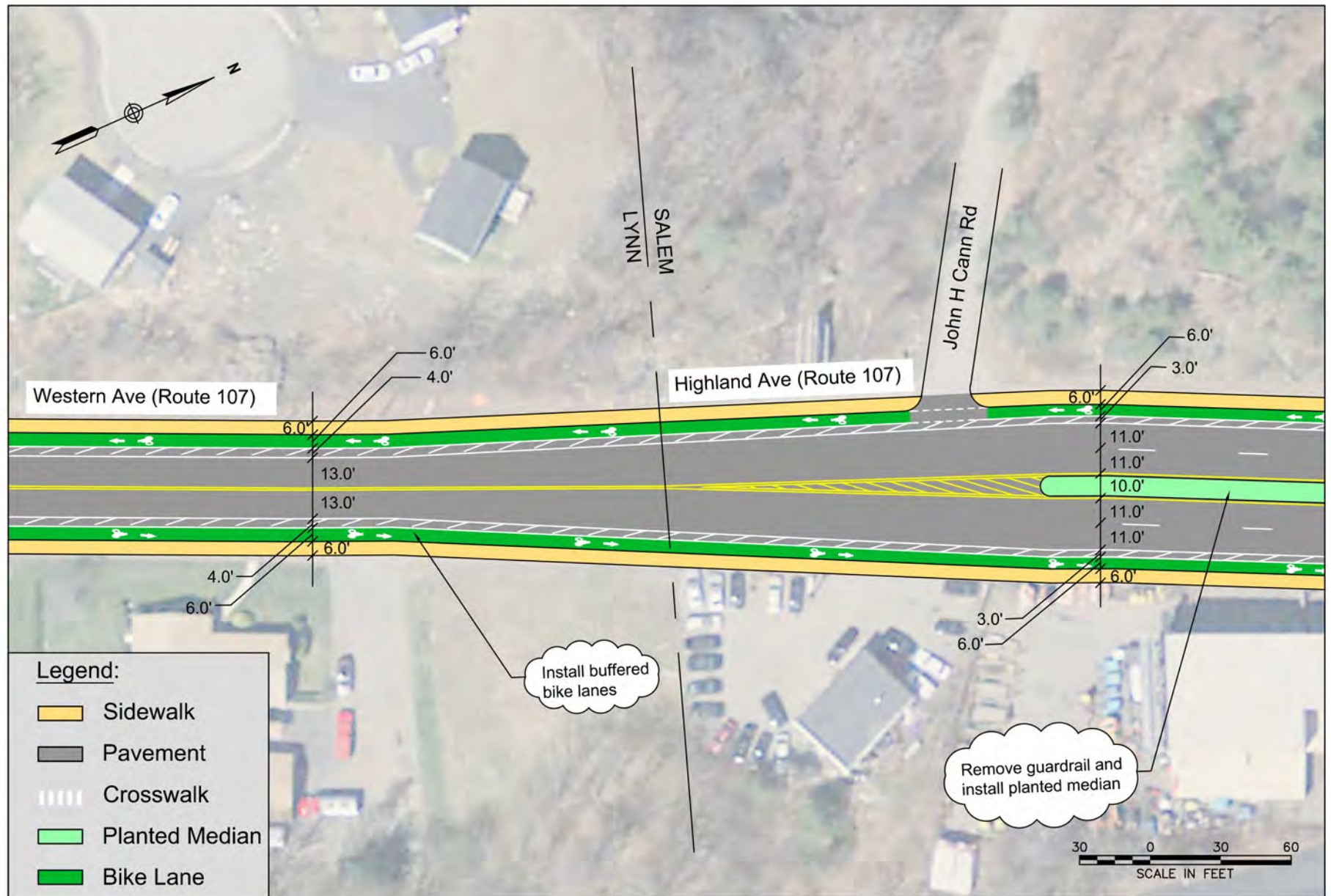


Figure VI-11  
Western Avenue (Route 107) at Fays Avenue  
Route 107 Corridor Study  
Lynn/Salem, MA





**Highland Avenue at Walmart Driveway (see Figure VI-13)**

Proposed improvements at this location include the following:

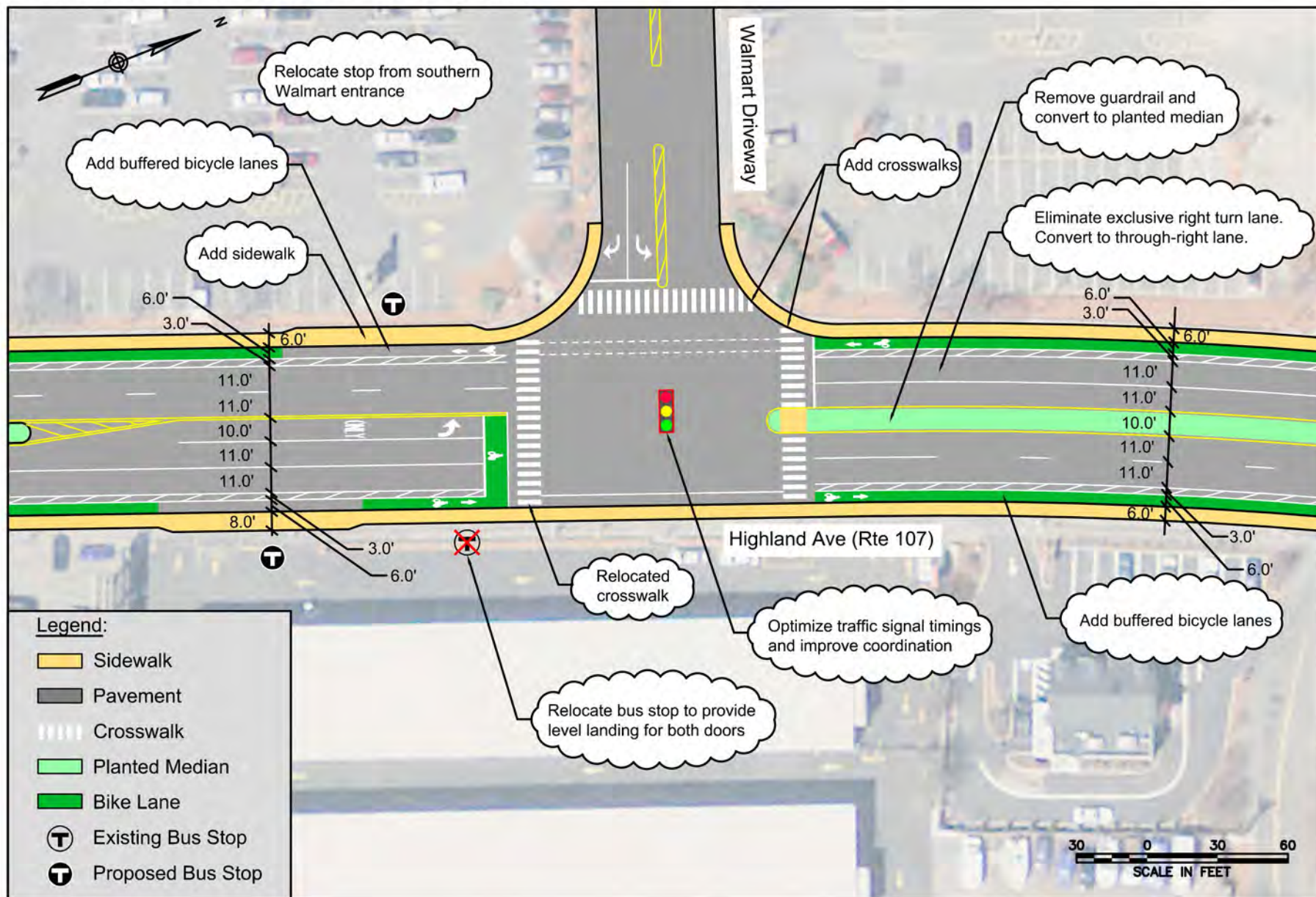
The elimination the exclusive right turn lane on the southbound Route 107 approach is recommended as this lane is not necessary based on traffic operations. Improvements to traffic signal timings and coordination are recommended.

With the signal timing adjustments and the conversion of the southbound approach, the intersection is expected to operate at overall LOS B or better under the 2035 Build condition during the weekday morning, weekday afternoon, and Saturday midday peak hours. Queueing is not expected to be significantly altered by the changes at the intersection.

Consistent with the proposed cross section in this segment, the existing paved median with guardrail is recommended to be replaced with a planted median. The improvement of existing crosswalks, the implementation of new crosswalks, and the extension of the planted median through the crosswalk would provide a refuge for pedestrians. New sidewalks are recommended to be installed on the west side of Route 107 and existing sidewalks on the east side are recommended to be reconstructed in accordance with ADA guidelines. Protected buffered bicycle lanes with a northbound bicycle box are proposed at the intersection.

Transit improvements are recommended to include the relocation of the existing stop from the southern Walmart entrance to the far side of the Walmart Driveway, in conjunction with construction of a sidewalk and landing area, and a sidewalk connection to Walmart. Also recommended is the relocation of the temporary stop far side of the crosswalk (assumed to have moved north of the crosswalk in the short-term) to the original stop location, south of the southern crosswalk, in conjunction with a widened sidewalk and landing area, and clearances that meet ADA requirements.





**Highland Avenue at Olde Village Drive** (see Figure VI-14).

Proposed improvements at this location include the following:

Traffic signal timings coordination improvements are recommended.

The intersection is expected to operate at overall LOS A under the 2035 Build condition during the weekday morning, weekday afternoon, and Saturday midday peak hours.

The median is recommended to be converted from the existing paved median with guardrail to a planted median. Existing crosswalks are recommended to be improved, missing crosswalks are recommended to be added, and the extension of the planted median through the crosswalk is recommended to provide a refuge for pedestrians. The installation of new sidewalks on the west side and the reconstruction of existing sidewalks on the east side in accordance with ADA guidelines are recommended. Protected buffered bicycle lanes with a northbound bicycle box are proposed at the intersection.

For transit, the retention of the existing inbound stop at Rich's Plaza is suggested but with the removal of a section of the existing grass strip to provide a landing area. The outbound stop should be retained nearside, but with a raised height of the bus stop sign, trimming of overgrowth at the back of sidewalk to improve the visibility of the stop, and the removal of a section of the existing grass strip to provide a landing area.

**Highland Avenue at Barnes Road and Ravenna Avenue** (see Figure VI-15).

Proposed improvements at this location include the following:

Traffic signal timings and signal coordination improvements are recommended and reflected in the projected Build condition capacity analysis results.

The intersection is expected to operate at overall LOS B or better under the 2035 Build condition during the weekday morning, weekday afternoon, and Saturday midday peak hours.

Median recommendations call for the removal of the guardrail and the conversion of the existing paved median to a planted median. New and improved crosswalks are recommended, as well as the installation of new sidewalks on the west side and reconstructed sidewalks on the east side in accordance with ADA guidelines. Protected buffered bicycle lanes with bicycle boxes are proposed at the intersection.

For transit recommendations, the relocation of the inbound stop from the temporary nearside stop to the original far side location is recommended. This is recommended to be done in conjunction with construction of a sidewalk and landing area that meet ADA requirements. Relocation the outbound stop to the far side of the intersection for improved transit operations, in conjunction with the addition of a crosswalk on the northern leg of the intersection, and associated sidewalk and intersection improvements is also recommended.



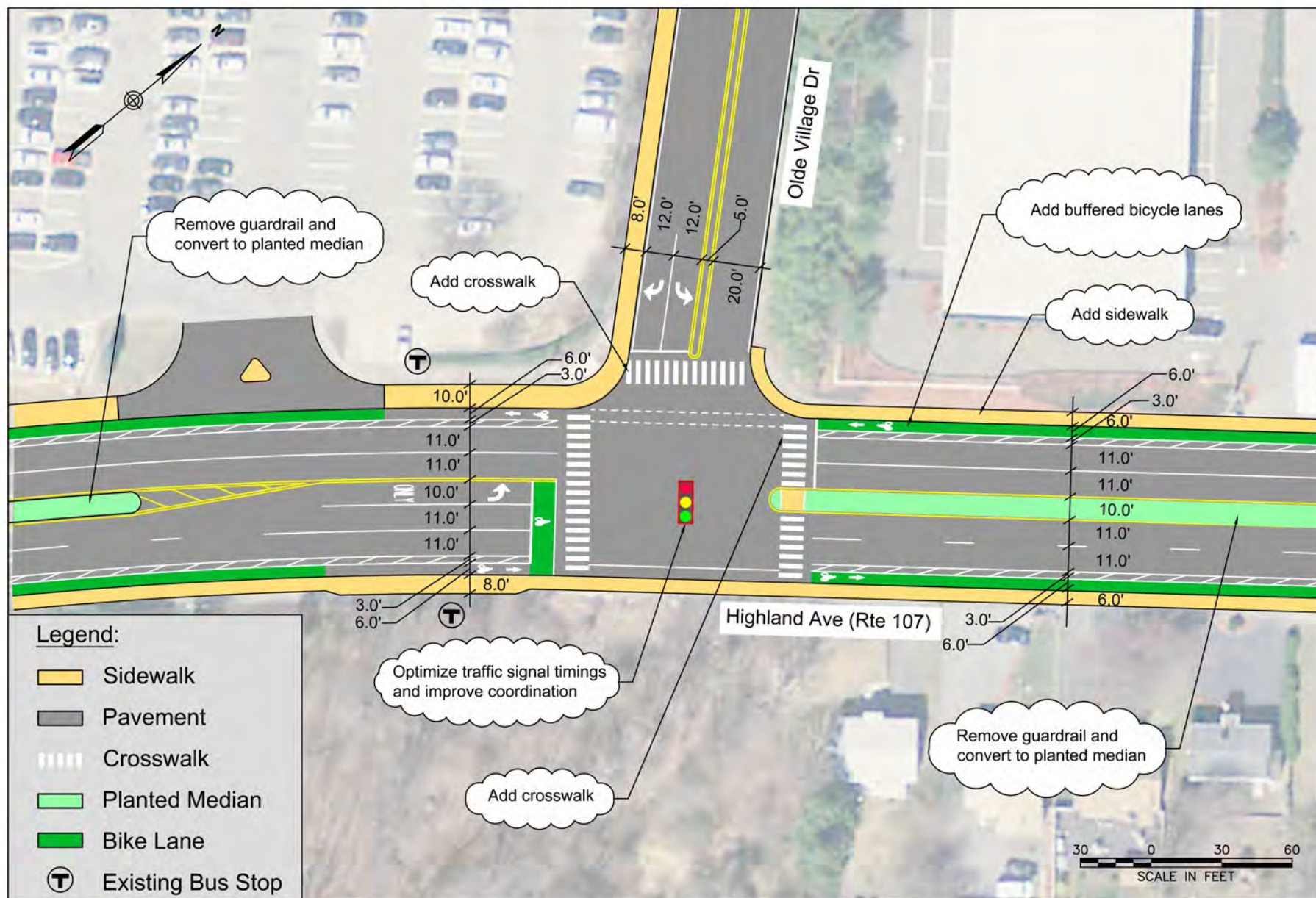
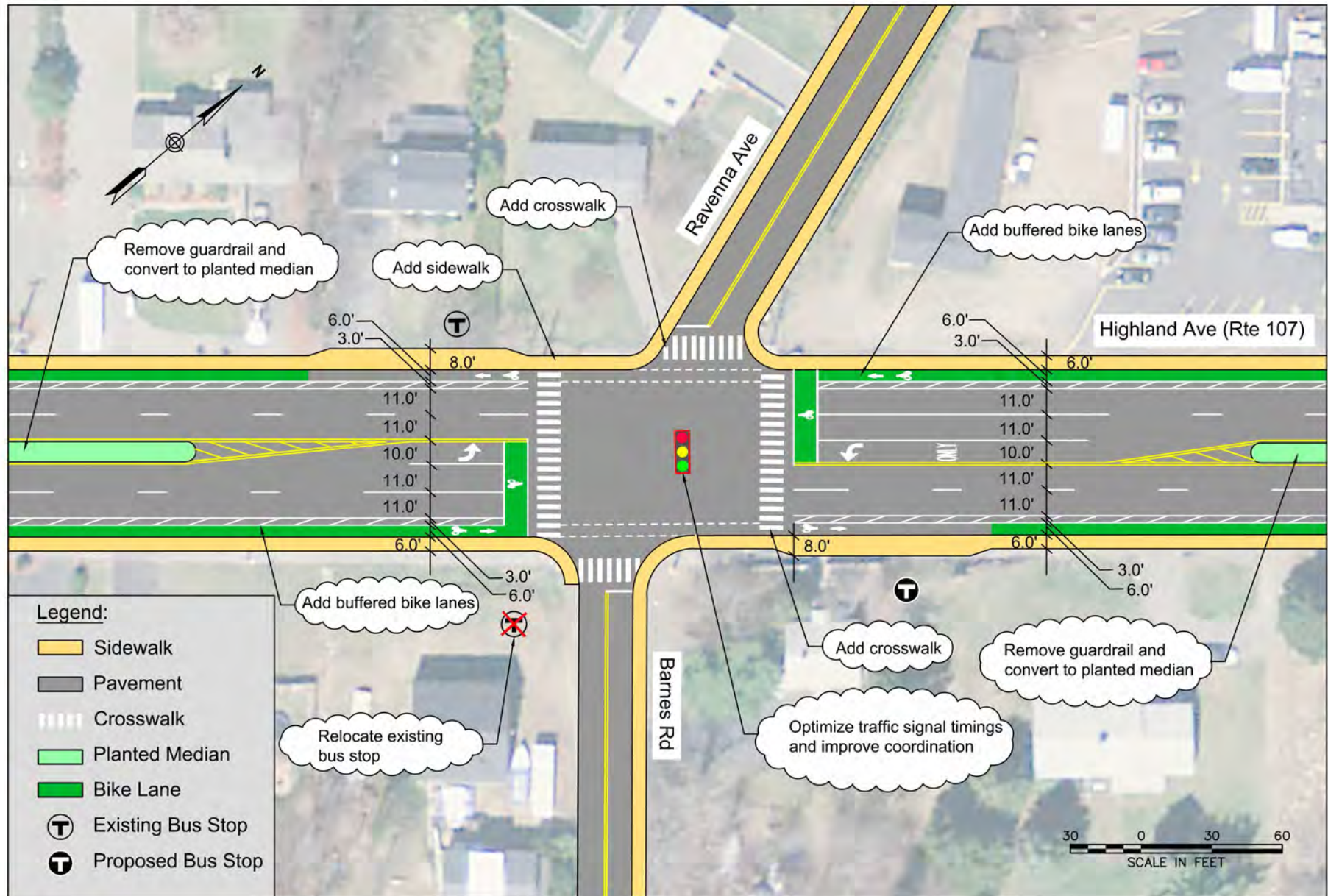


Figure VI-14  
Highland Avenue (Route 107) at Olde Village Drive  
Route 107 Corridor Study  
Lynn/Salem, MA







**Highland Avenue at Swampscott Road/Dipietro Avenue and Highland Avenue at Marlborough Road/Traders Way (Zig zag)** (see Figure VI-16 through Figure VI-17)

The proposed roadway improvements to the Highland Avenue at Swampscott Road/Dipietro Avenue intersection, and the Highland Avenue at Marlborough Road/Traders Way intersection (Zig zag) are limited due to several constraints including the proximity of Thomas Circle, ledge, walls, parking areas, elevation difference with abutting properties, and the existing alignment of Dipietro Avenue. The existing roadway width is approximately 70 feet. There is no sidewalk on the western side of the road and a 10-foot wide cement concrete sidewalk on the east side. Due to the extensive roadside constraints, the proposed cross-section width is essentially limited to the existing roadway width. Therefore, the proposed cross-section on Highland Avenue consists of four 11-foot travel lanes, one 11 foot left turn lane, five foot bicycle lanes in both directions, a two foot center median, and two sets of two foot wide lane barrier between the two through lanes. The proposed improvements incorporate a minimum six foot wide sidewalk on the western side of the road and retain the 10 foot wide sidewalk on the eastern side of the road. Other improvements include adding a crosswalk across Route 107, connecting the crosswalk on Swampscott Road to Route 107, optimizing traffic signal timings and improving signal coordination.

The intersection of Highland Avenue at Marlborough Road/Traders Way is expected to operate at overall LOS E under the 2035 Build condition during the weekday morning, weekday afternoon, and Saturday midday peak hours. Geometric and signalization changes to the intersection reduce the amount of queuing along Route 107 between the 2035 No Build and 2035 Build conditions. The intersection of Highland Avenue at Swampscott Road/Dipietro Avenue is shown to operate at overall LOS C or better under the 2035 Build condition during the weekday morning, weekday afternoon, and Saturday midday peak hours. All operations at the intersection operate at LOS E or better and well under capacity. Queuing is expected to be reduced from the 2035 No Build and 2035 Build conditions. The Route 107 southbound left turn queue is reduced significantly and eliminates the spillover that currently exists when the left turn lane storage is exceeded.

For Highland Avenue at Marlborough Road/Traders Way, the alignment of Marlborough Road/Traders Way would be slightly realigned toward the north. The realignment provides ample space for the four lanes on Marlborough Road, and provides a better alignment for the through movements between Marlborough Road and Traders Way. The realignment requires right-of-way acquisition, however the majority of the property is a landscaped area in front of the CVS Pharmacy. Lane barriers would be added on Highland Avenue to prevent the zig zag movement. At the intersection, Highland Avenue would consist of six 11-foot travel lanes (two through lanes in each direction, opposing left turn lanes, and northbound and southbound right turn lanes), a two-foot median, two two-foot lane barriers, five-foot bicycle lanes, a six-foot wide sidewalk on the west side, and an eight-foot sidewalk on the east side. On Traders Way, improvements include adding a second receiving lane eastbound, and removing the channelized right turn lane and raised island. On Marlborough Road, a left turn lane was added.

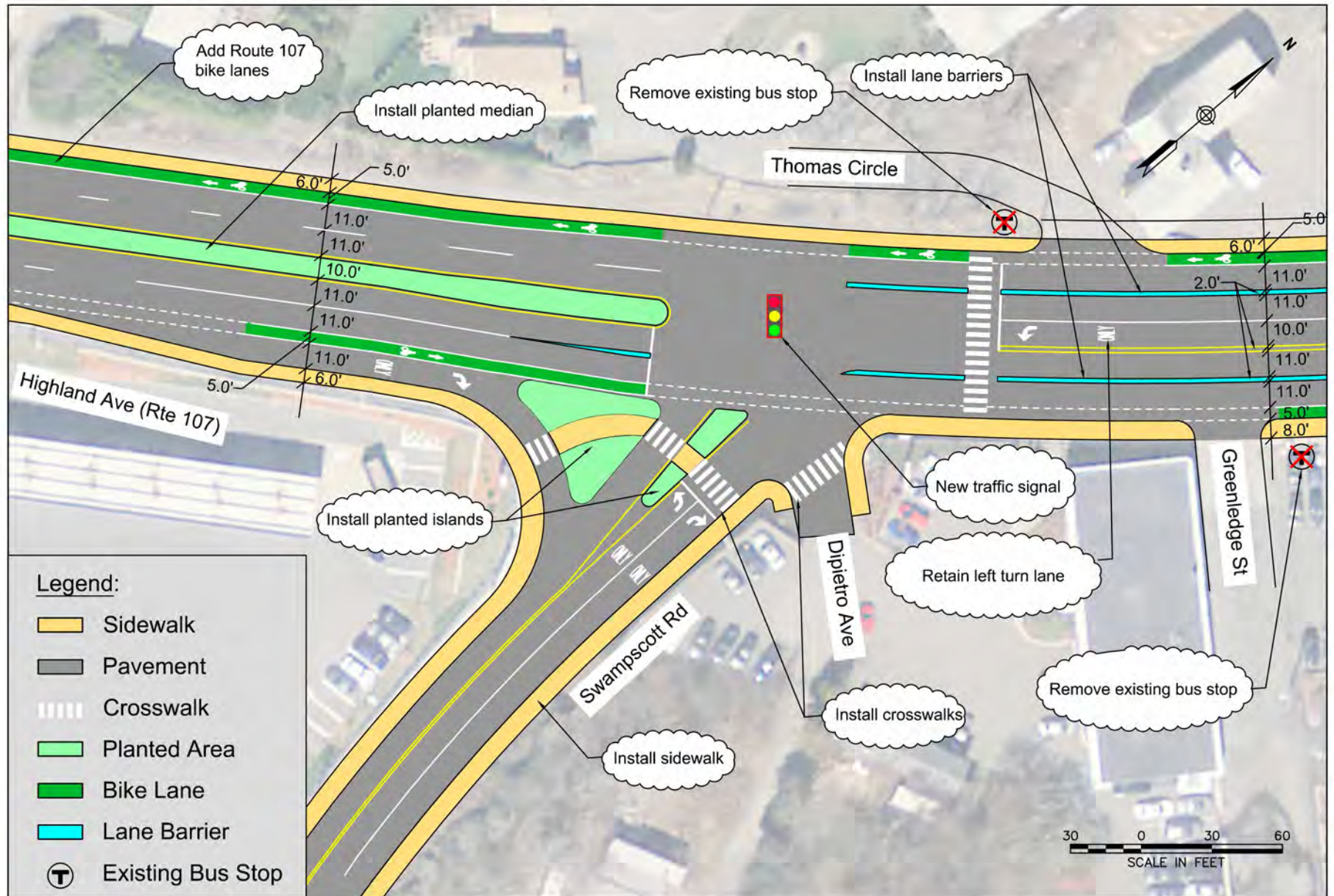


Figure VI-16  
Highland Ave (Route 107) at Swampscott Road  
Route 107 Corridor Study  
Lynn/Salem, MA



For the Swampscott Road and First Street intersection, minor strip acquisition and access management would be required for the proposed intersection improvements. On Swampscott Road, the existing width is approximately 42 feet including the sidewalk on the east side. There is not an existing sidewalk on the west side of the roadway. The proposed cross-section at the intersection includes two 11-foot lanes on the northern side (one through lane northbound and one through/left turn lane southbound) and four 11-foot lanes on the southern side (two through lanes southbound, one through and one right turn lane northbound) and an eight-foot wide sidewalk on the east side of the roadway. On First Street, the existing curb to curb width is approximately 40 feet. The proposed cross-section at the intersection consists of three 11-foot lanes (one lane eastbound, and one left turn and one left/right turn lane westbound) and two eight-foot sidewalks. A new traffic signal would be added at this intersection. Other improvements include advance destination signage for navigation through the area and crosswalks to be added on the First Street and Swampscott Road northbound leg.

At First Street and Traders Way, the improvements include optimization of traffic signal timings and providing curb ramps to meet current standards. In addition, consideration should be given to providing a free-right turn with a larger radius from Traders Way onto First Street to better accommodate the traffic.

If this alternative is studied further, re-alignment of the First Street and Swampscott Road intersection to establish Swampscott Road and First Street as the through movement as shown in Figure V-47 (in Chapter V) should be further evaluated. Traffic impacts to First Street under this condition should be modeled to examine potential impacts that may result.

Transit improvements include the relocation of the Marlborough Road inbound stop to the far side of the intersection, out of the right turn only lane, to remove the conflict with the proposed bicycle lane, and in conjunction with access management and construction of a sidewalk on the west side of Route 107. The proposed lane barrier on the far side of the intersection would not enable vehicles to overtake a bus stopped at the stop, however the delay to general traffic is anticipated to be minimal given the relatively low ridership and low frequency of service on routes serving this stop. Opportunities to relocate or add new amenities at this stop should be pursued. Given the proximity of this relocated stop to the next stop at Thomas Circle, and the low ridership and narrow sidewalk, this inbound stop is proposed for removal.

For the outbound bus stops, Greenledge Street is proposed for removal, in conjunction with the removal of its existing inbound stop pair at Thomas Circle, and because of the proposed establishment of a new outbound stop far side of Traders Way. The new stop is proposed to create a stop closer to rider origins/destinations at the adjacent Shaw's and other retail stores, and create a missing stop pair for the existing inbound Marlborough Street stop.

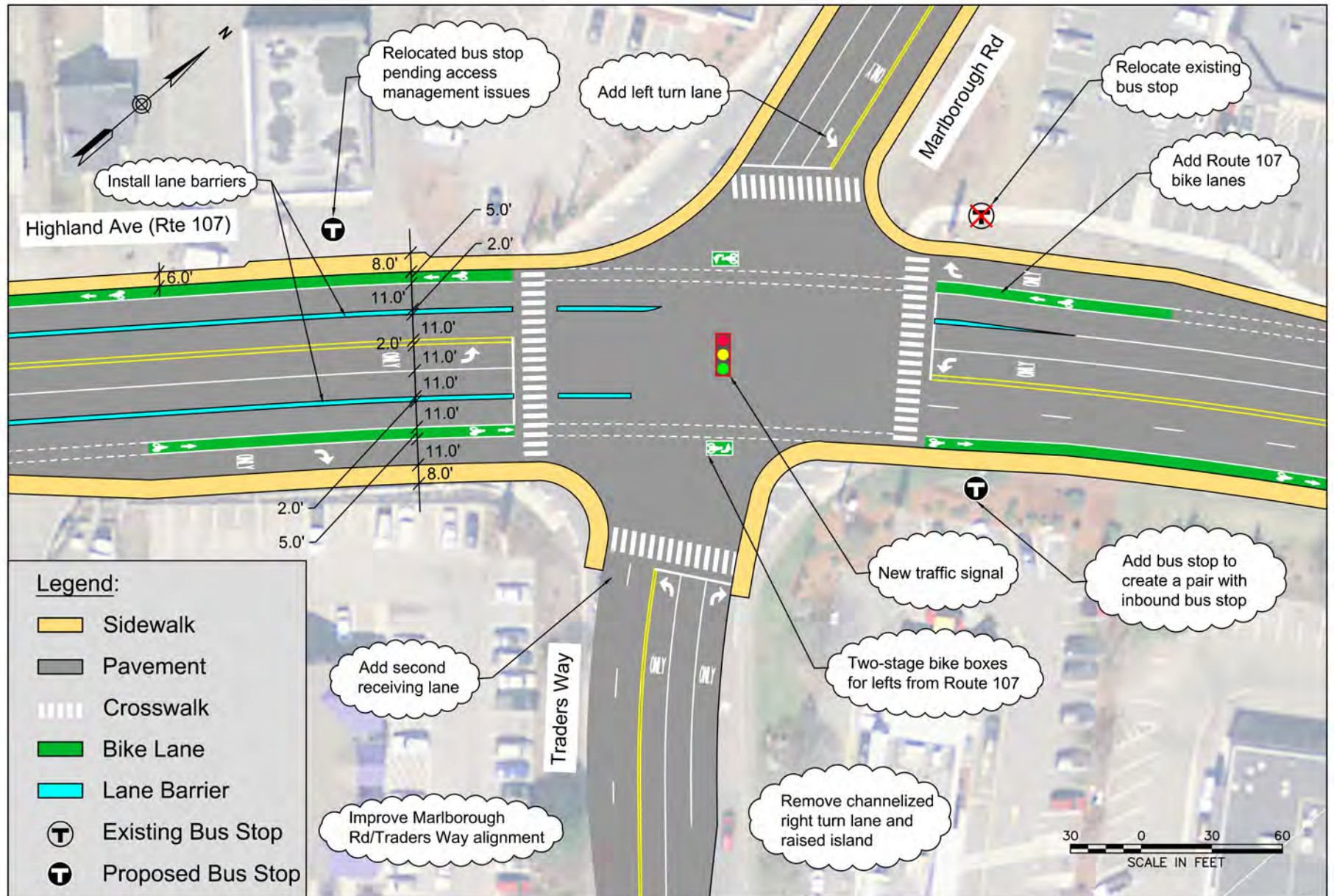
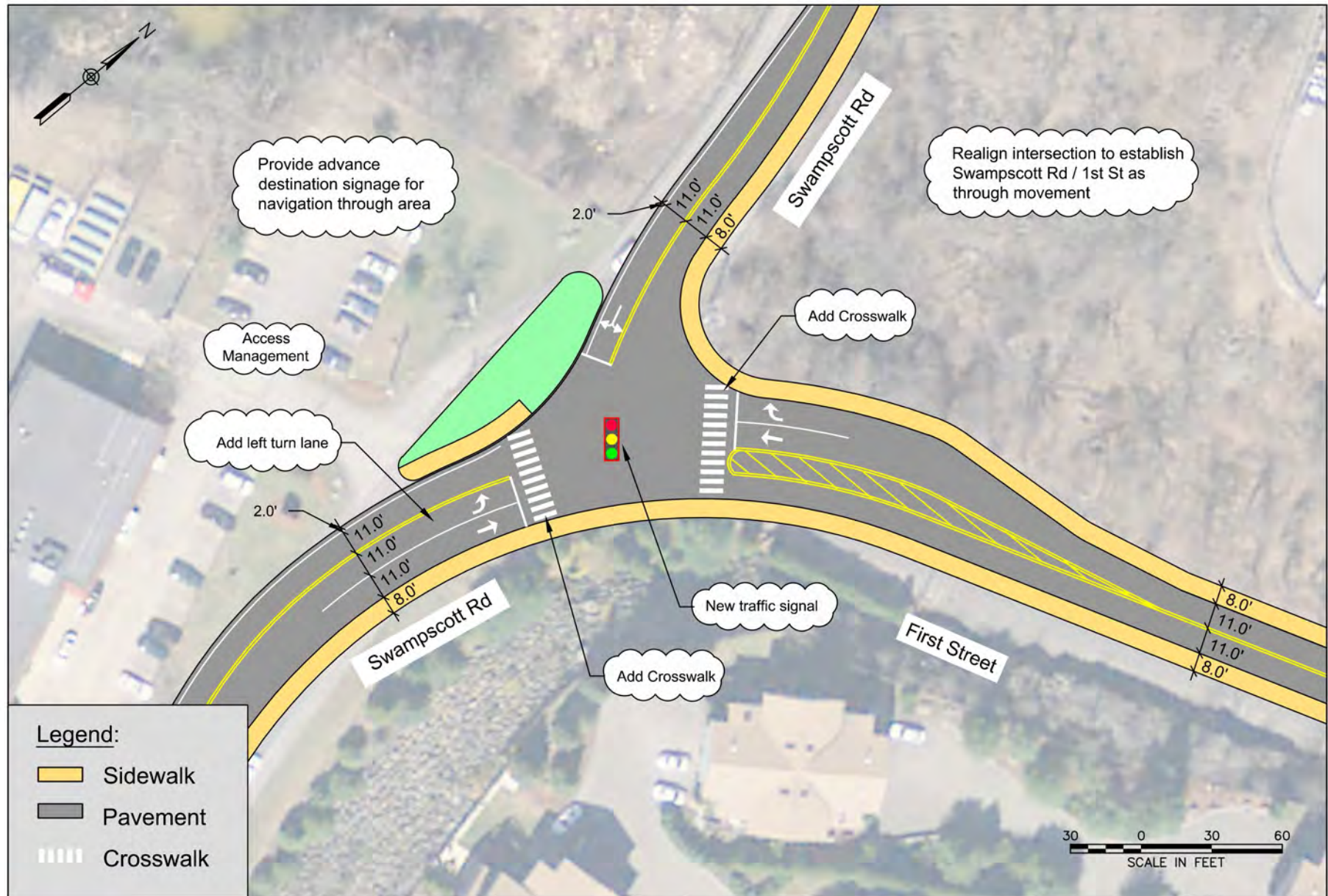


Figure VI-17  
Highland Avenue (Route 107) at Marlborough Road  
Route 107 Corridor Study  
Lynn/Salem, MA





**Figure VI-18**  
**Swampscott Road at First Street**  
 Route 107 Corridor Study  
 Lynn/Salem, MA

**Highland Avenue at Hawthorne Square Mall Shopping Center** (see Figure VI-19)

Proposed improvements at this location include the following:

Remove exclusive right turn lane on southbound Route 107 and establish through/right lane. Improve channelization at the Dunkin Donuts/Pep Boys approach to the intersection. Optimize the traffic signal timings and improve signal coordination.

The intersection is expected to operate at overall LOS D or better under the 2035 Build condition during the weekday morning, weekday afternoon, and Saturday midday peak hours. Improvements in the coordination between Hawthorne Square Mall and the zig zag intersections prevent the queues in the northbound direction from extending back to the Marlborough Road intersection.

Remove the guardrail and convert the existing paved median to a planted median. Improve/provide crosswalks and extend the planted median through the crosswalk so it provides a refuge for pedestrians. Improve crosswalks and pedestrian facilities in accordance with ADA, and introduce protected buffered bicycle lanes with bicycle boxes at the intersection.

For transit, retain the existing inbound stop nearside, and shift the outbound stop closer to the intersection to a wider section of the sidewalk for improved pedestrian connections to the retail area.

**Highland Avenue Study Area Lane Drop Transition** (see Figure VI-20).

Improvements at the study area transition from the four-lane roadway to the three-lane roadway include the following:

Remove the guardrail and convert the existing paved median to a planted median. Improve pedestrian facilities in accordance with ADA, and transition protected buffered bicycle lanes to unprotected bicycle lanes.

For transit, at the transition section near Freeman Road, the inbound and outbound stops at the Freeman Road intersection are proposed for removal in the short-term. The inbound stop east of Crowdis Street and the pedestrian bridge is to be retained. Consider adding a crosswalk behind this stop, and relocating the outbound stop opposite Valley Street to the far side of this crosswalk, to improve pedestrian connections to the bridge and stop spacing with the removal of the Freeman Road stops.



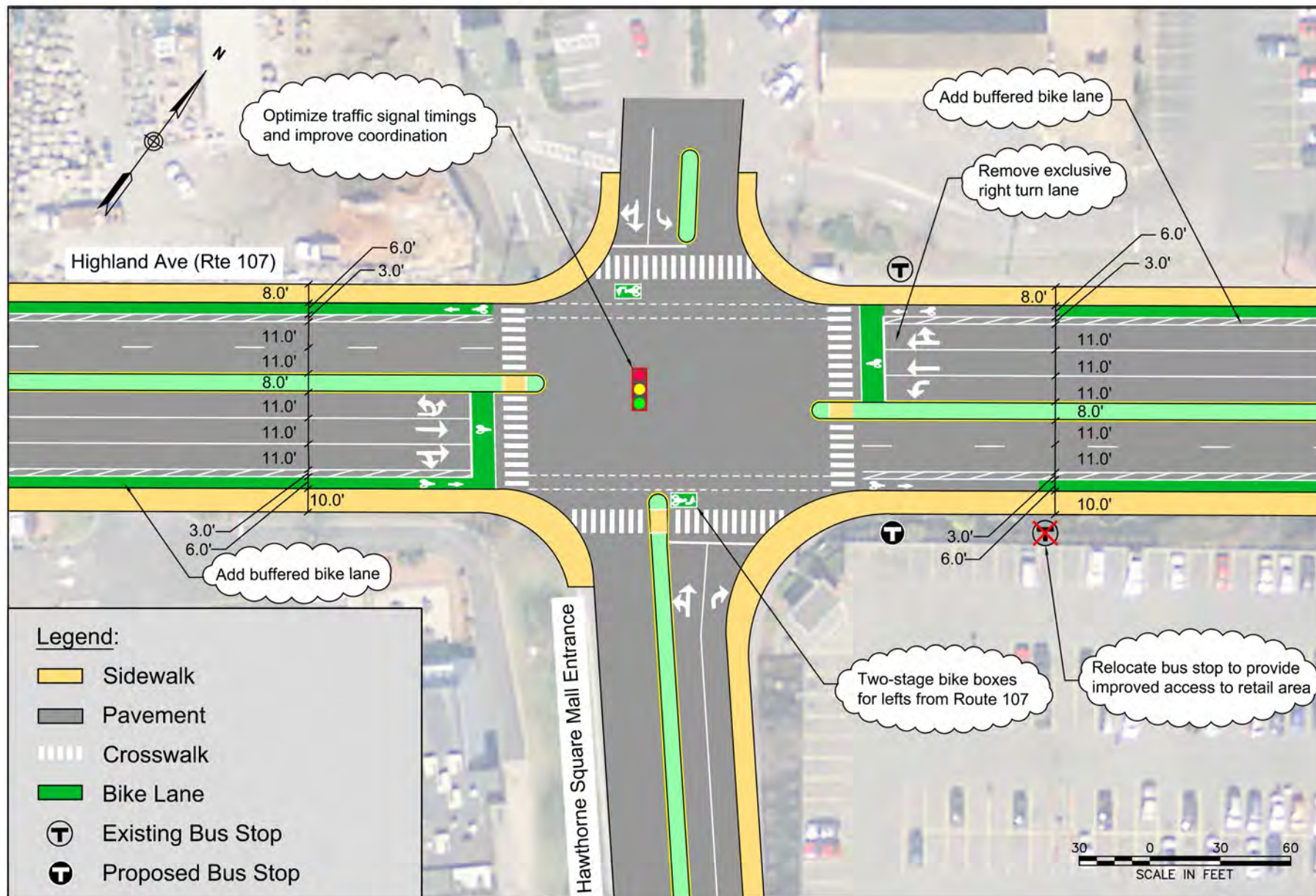


Figure VI-19  
Highland Avenue (Route 107) at Hawthorne Square Mall  
Route 107 Corridor Study  
Lynn/Salem, MA



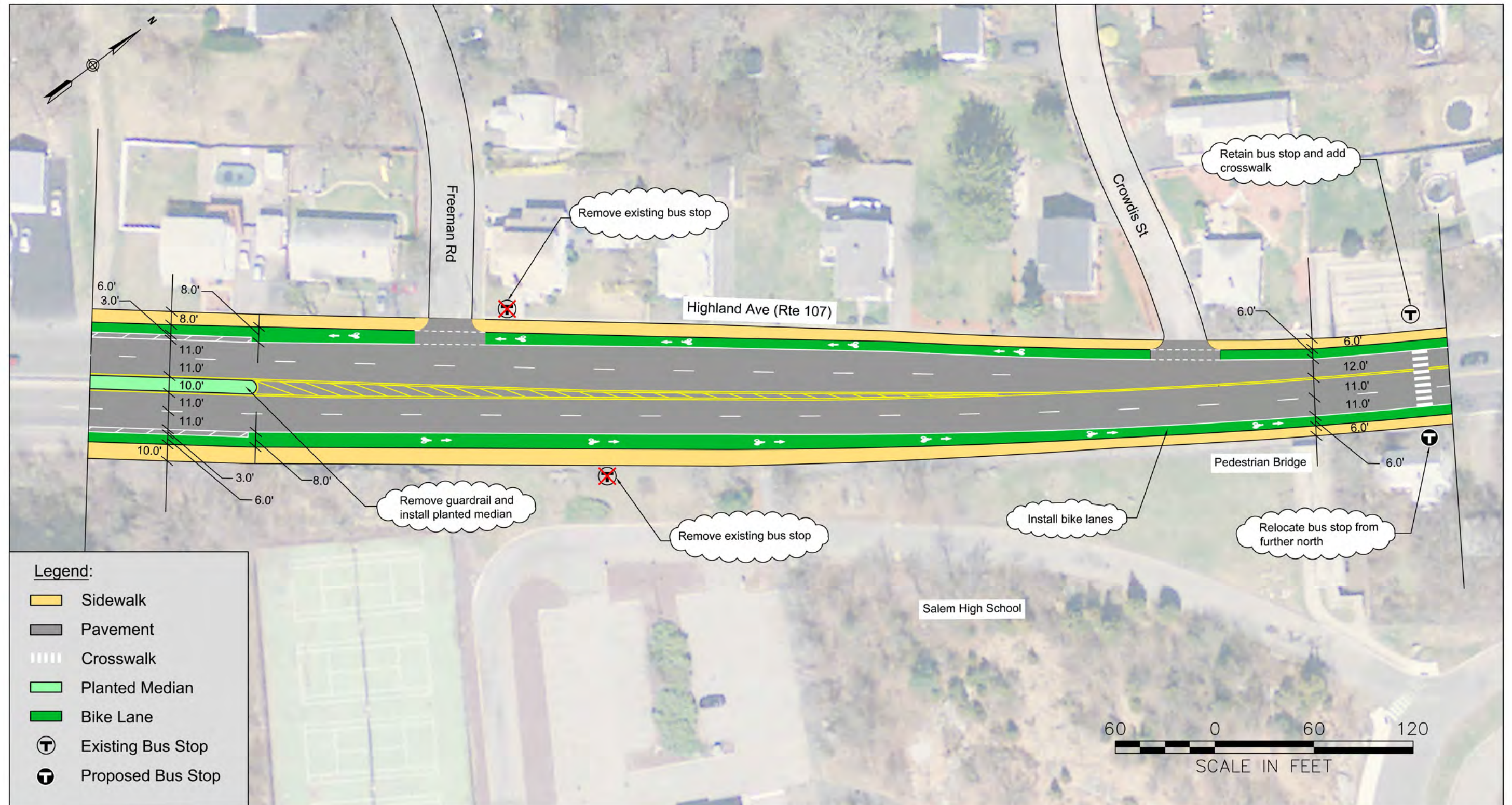


Figure VI-20  
Highland Avenue (Route 107) Corridor Transition 2  
Route 107 Corridor Study  
Lynn/Salem, MA



**Highland Avenue at Willson Street and Cherry Hill Avenue** (see Figure VI-21)

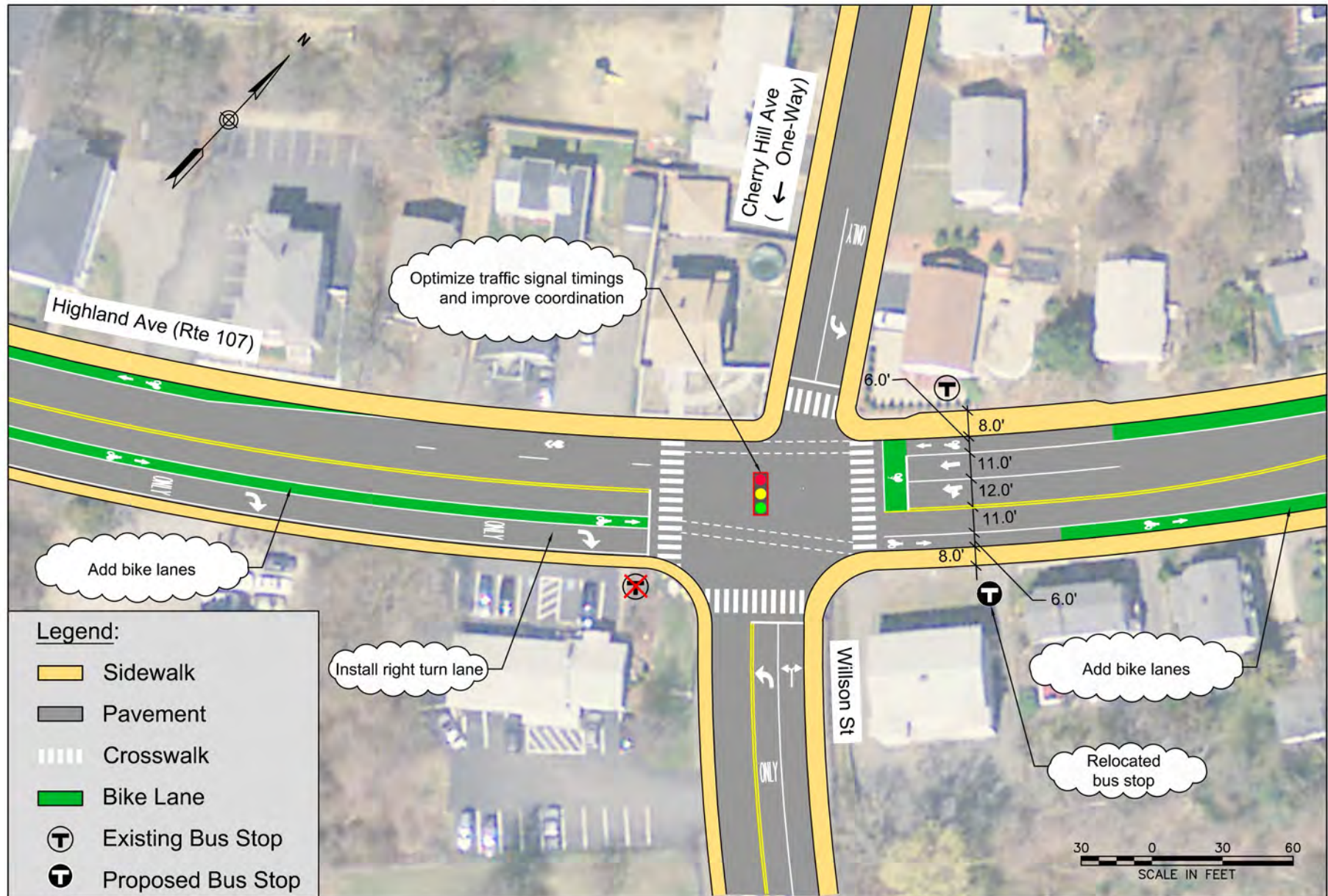
Proposed improvements at this location include the following:

Recommendations for the northbound approach are to provide a through lane and a right turn only lane. On the southbound approach, a through/left turn lane and a through lane are recommended. Two receiving lanes on Route 107 south of the intersection are necessary to handle the Route 107 south through traffic and the Willson Street left turning traffic. Improvements to the traffic signal timings and coordination are recommended.

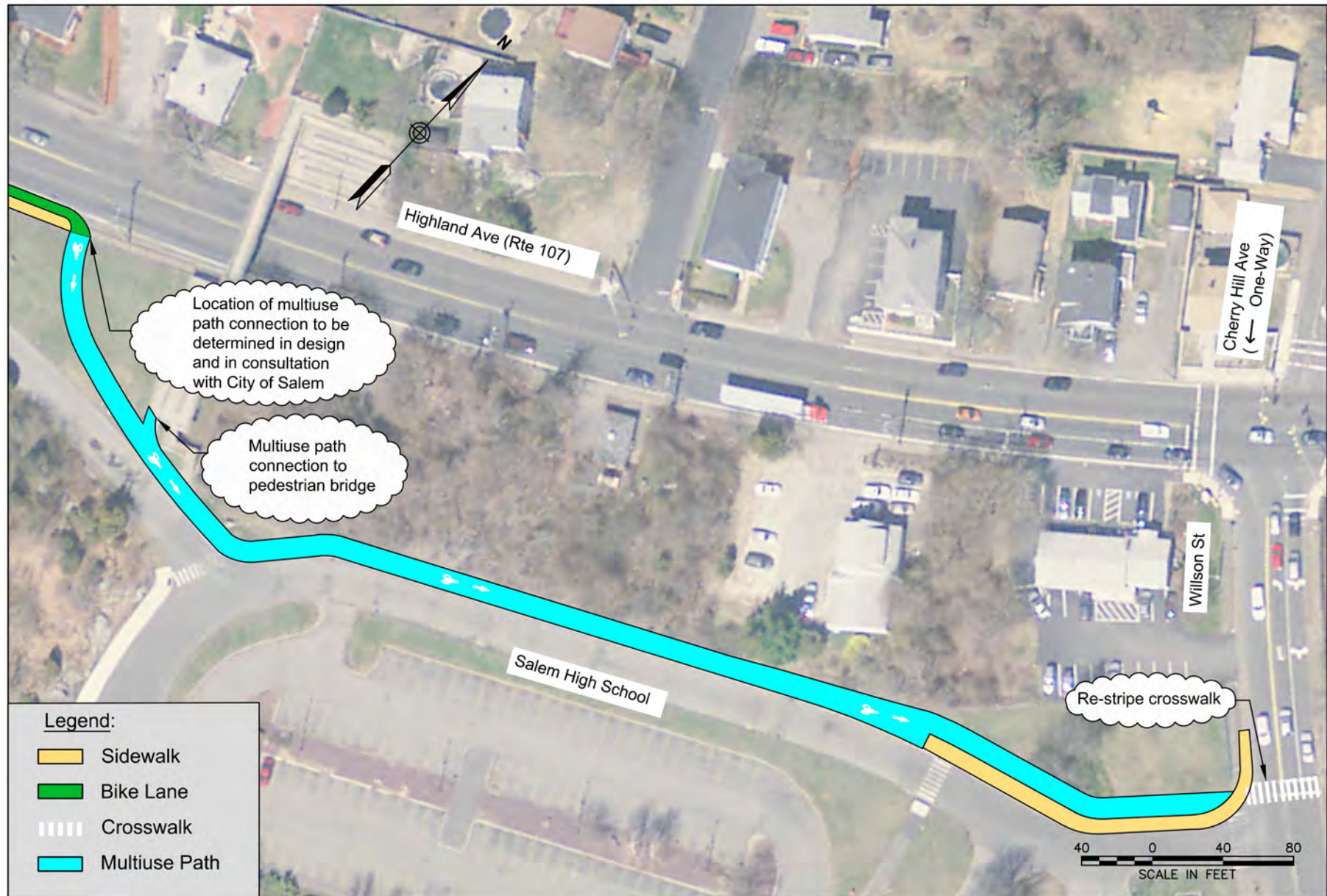
The intersection is expected to operate at overall LOS D during the weekday afternoon and Saturday midday peak hours and LOS E during the weekday morning peak hour under the 2035 Build condition. Queuing is expected to increase along Route 107 due to the changes at the intersection; however, it is not expected to impact the surrounding intersections.

The proposed plan includes improved crosswalks and pedestrian facilities in accordance with ADA and the introduction of bicycle lanes with a southbound bicycle box at the intersection. Sharrows are recommended on Route 107 for the short two lane section southbound just south of the intersection, since a full bicycle lane is not feasible at this location. The Working Group suggested that use of the adjacent high school property be considered for bicycle accommodations. One option is depicted in Figure VI-22, where the northbound bicycle lane is taken off road beginning just south of the pedestrian bridge and transformed into a multiuse path. The path maneuvers through the City owned property abutting the high school driveway and reconnects to Willson Street. This would allow the Route 107 southbound bicycle lane to continue through this intersection. This concept should be explored in more detail as the project progresses into the next phase.

Transit improvements include retaining the inbound stop nearside, due to the proximity of the schools, considering a shifting of the stop slightly to the north if sight distance is an issue for drivers, and widening the sidewalk to provide a landing area. The outbound stop should also be retained at its new far side location (assumed to have been relocated in the short-term) and improvements made to the existing sidewalk.







**Highland Avenue at Salem Hospital Lower Driveway** (see Figure VI-23)

Proposed improvements at this location include the following:

A new traffic signal is recommended at this intersection, with a new left turn lane on Route 107 southbound.

The installation of the traffic signal at the Salem Hospital Lower Driveway improves the level-of-service for the hospital entrance approach from LOS E and LOS F under the 2035 No Build condition to LOS D or better under the 2035 Build condition during the three identified peak hours. With the addition of the traffic signal and the southbound left turn lane, the intersection approaches on Route 107 still operate at LOS B or better. Queues along Route 107 due to the installation of the signal are not expected to impact the surrounding intersections.

The intersection is expected to operate at overall LOS B or better under the 2035 Build condition during the weekday morning, weekday afternoon, and Saturday midday peak hours.

Reconstruction of the existing sidewalks in accordance with ADA guidelines is recommended as well as the installation of bicycle lanes with a southbound bicycle box. Added crosswalks and improvements to the existing crosswalks are recommended to enhance pedestrian facilities.

For transit, retain the inbound stop nearside of Proctor Street and far side of the crosswalk, and widen the sidewalk to provide a landing area. At the outbound stop, opposite Procter Street, retain the far side stop, in conjunction with sidewalk and crosswalk improvements at the intersection.

**Highland Avenue/Essex Street at Jackson Street and Dalton Parkway** (see Figure VI-24)

Proposed improvements at this location include the following:

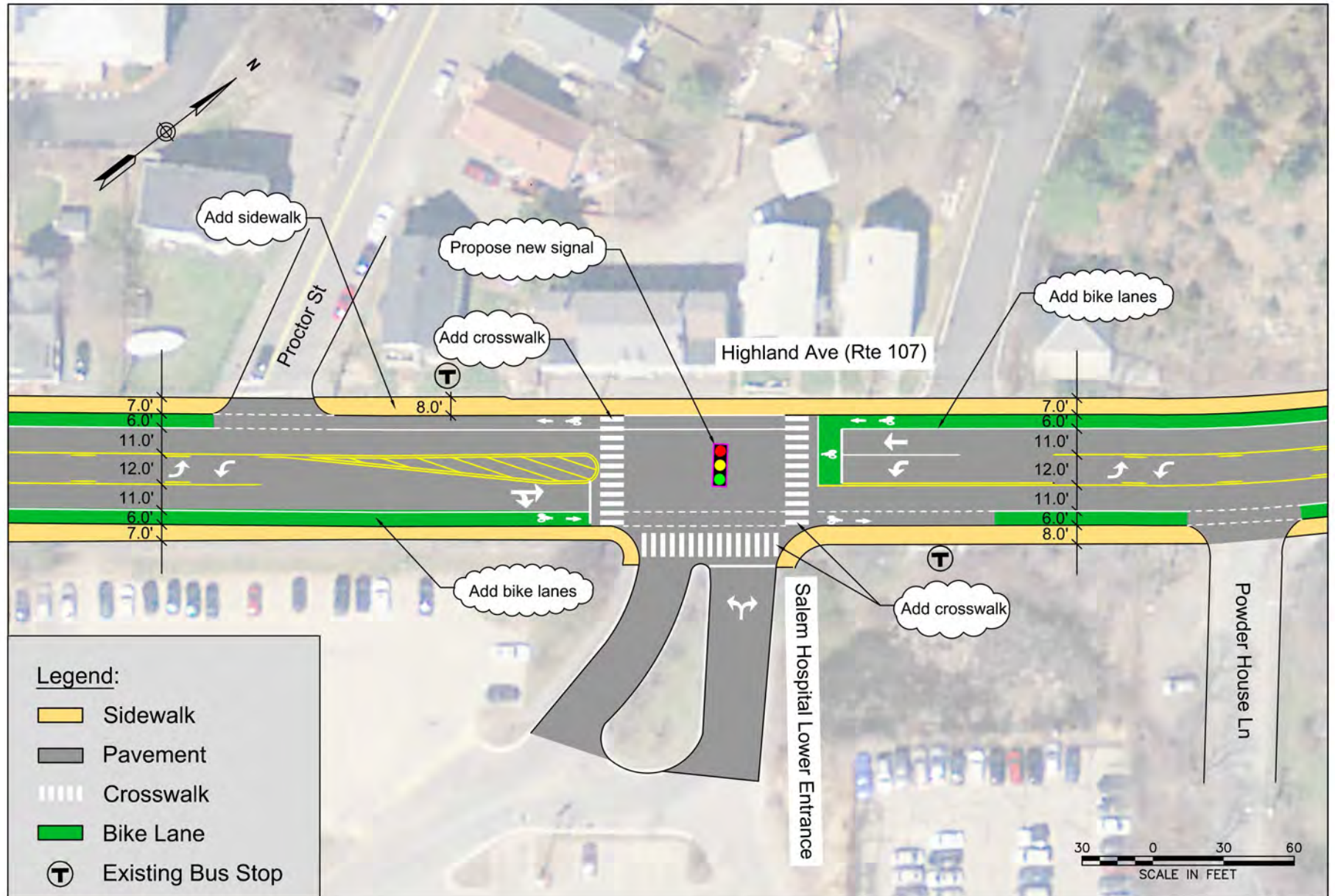
Traffic signal timings and coordination improvements are recommended.

The intersection is expected to operate at overall LOS C or better under the 2035 Build condition during the weekday morning, weekday afternoon, and Saturday midday peak hours.

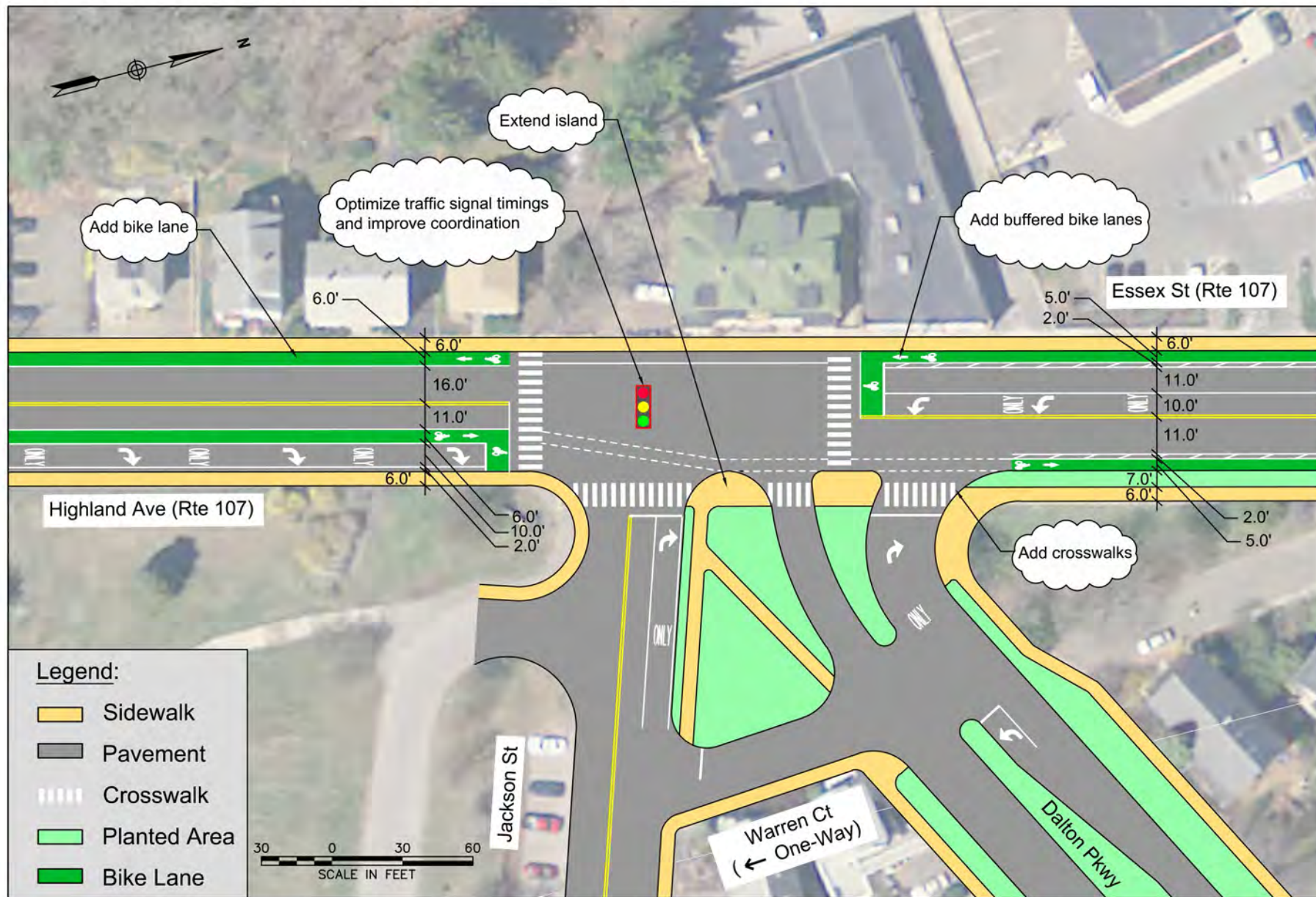
To better manage the turn restrictions and to better define the two adjacent minor street approaches, island modifications are recommended including the extension of the large island between Jackson Street and Dalton Parkway toward Route 107 and into the crosswalk to provide pedestrian refuge and reduce intersection size. Pavement striping and signage improvements are proposed to better define lane assignments. Improve crosswalks and pedestrian facilities in accordance with ADA, and introduce bicycle lanes with bicycle boxes at the intersection. North of the intersection, reintroduce protected buffered bicycle lanes.

No transit improvements in this section of the study area.











**Essex Street at Boston Street** (see Figure VI-25)

Proposed improvements at this location include the following:

Due to the predominant traffic stream flowing between Route 107 to the south and Route 107 to the west, realignment of the intersection to establish Essex to Boston (Route 107) as the through movement is recommended.

Within the newly created public areas resulting from the realigned intersection, a “shared street” for local vehicular property access, bicycles, and pedestrians is recommended. The shared space can serve the driveways at this intersection, offer space for pedestrian and bicyclists to converge, and provide an area for landscaping and/or the relocated monument. The shared street space is proposed to be constructed of a different material or texture, so that it is obvious that this space is different from a travel way. Shared street spaces can serve for recreation and socializing, providing added benefit to pedestrians, while still allowing for the unloading/loading necessities of vehicular traffic in a commercial area. The idea behind the concept is create new open space and a plaza-style environment created by realignment of the intersection. Due to the driveways at the intersection a “shared street” would allow for continued access to businesses at this intersection. Entry and egress through the driveways by motorists would need to be made obvious by markings in the pavement of the road or within the different material or texture of the new space itself, signage, and orientation of the space itself. A decision to implement the “shared street” space would be the choice of the City of Salem, and orientation of the space itself determined in the design phase.

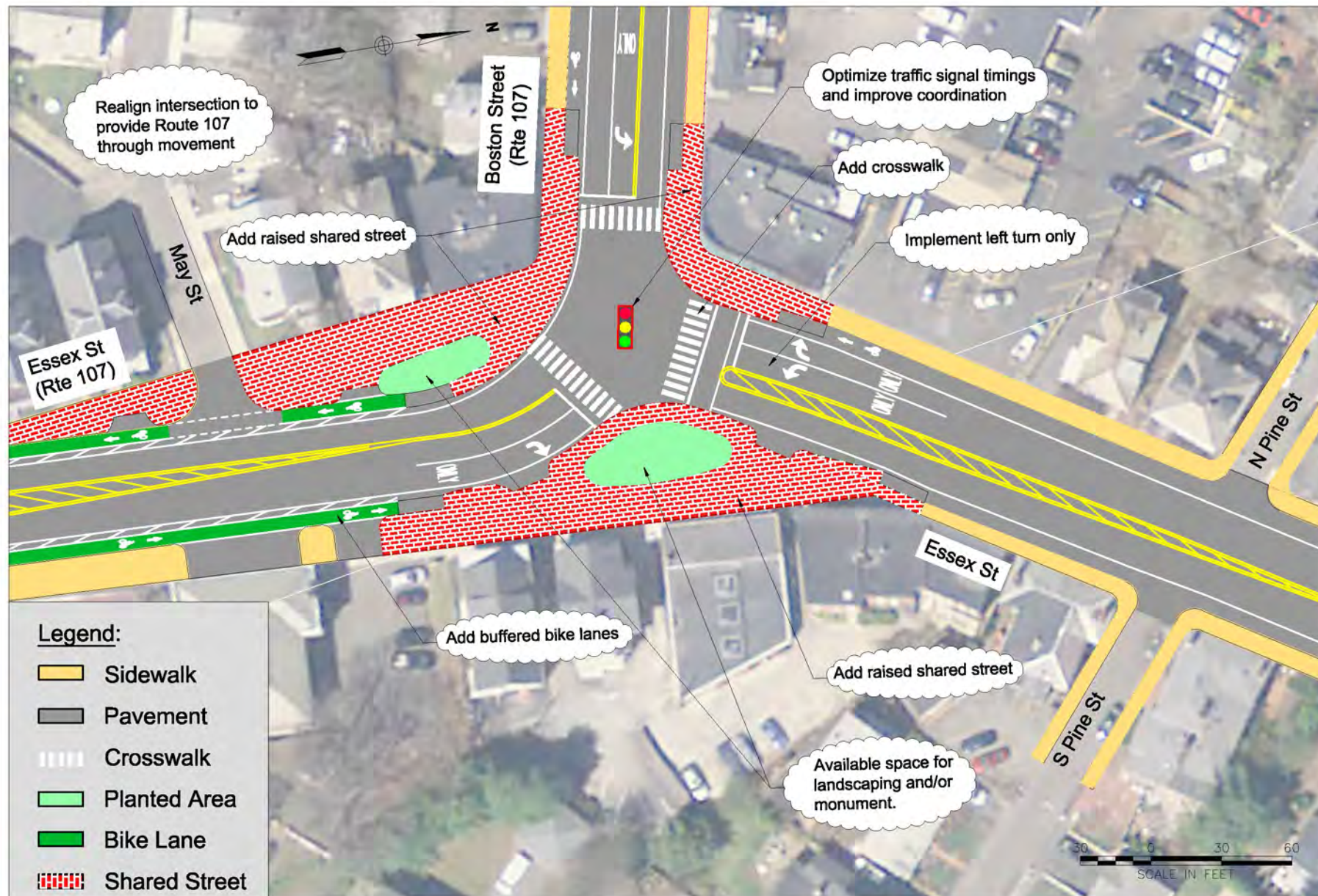
On the Essex Street southbound approach, a left turn only lane and a right turn only lane are proposed. A through lane and a right turn only lane are proposed on the Boston Street westbound approach. For the northbound approach, a through lane and a right turn only lane are proposed.

The traffic signal timings and phasing would be modified to better serve the proposed lane arrangements and signal coordination is to be improved. Special pavement markings would be provided at the fire station driveway to alert motorists that driveway access is to be maintained.

Pedestrian improvements proposed include the improvement and addition of crosswalks and pedestrian facilities in accordance with ADA. The protected buffered bicycle lanes along Route 107 terminate prior to the intersection and at the point where the shared street begins.

Given the proposed alignment and signal timing adjustments, the intersection is expected to operate at overall LOS C or better under the 2035 Build condition during the weekday morning, weekday afternoon, and Saturday midday peak hours. The realignment of Route 107 as the through movement reduces queueing along the mainline thus preventing spillback to the intersection of Highland Avenue and Jackson Street/Dalton Parkway.

No transit improvements are proposed at this location.





## Short Term Improvements

The study area offers limited opportunity to provide short-term improvements since a majority of the recommendations involve major infrastructure changes. A number of the improvements produce a positive effect when implemented in conjunction with study area wide improvements and improvements at adjacent intersections as well. However, some short term improvements can be made to improve safety and operations at the study area intersections along the Route 107 study area. The level-of-service for the Route 107 intersections with the short term improvements in place is included in the LOS summary provided in the Appendix.

Adjustments can be made to the current signal timings to reduce vehicular delay and queuing along the study area. It was discovered that by optimizing and shortening cycle lengths at a majority of the intersections, the movement delay and queuing would decrease. Updates to the minimum split times can also be made to make the signal operate more efficiently and provide more green time to the critical intersection movements. Updates to the existing coordination for adjacent intersections can improve operations along the Route 107 mainline, specifically at the zig zag intersections where large delay and queue spillback was identified to be a problem.

Focusing more specifically on the individual intersections, short term improvements were identified at multiple locations along the study area. In order to provide more effective exclusive left turn lanes, the southbound left turn at Highland Avenue and Marlborough Road/Traders Way and the northbound left at Highland Avenue and Hawthorne Square Mall Shopping Center can be updated from leading to lagging left turns. Another short term improvement to reduce queue spillback between the signalized intersections would be to coordinate Highland Avenue at Jackson Street/Dalton Parkway and Boston Street at Essex Street. To address high crash rates, implementation of the recommended turn lanes on Route 107 at the intersections of Chestnut Street and Chatham Street in Lynn should be considered in the near term.

Short-term improvements for pedestrians and bicyclists are somewhat limited. Cleaning the sidewalks and shoulder areas would help conditions. Implementing recommended crosswalks that do not require signalization could be completed in the short term. In the retail segment, the wide shoulder area could be restriped as a bicycle lane. However, the bicycle amenity would only exist for a short distance.

Transit provides the most opportunity for short term improvements. Route 456 presents an opportunity to improve bus service along the study area. The route has remained unchanged since 2002. The following aspects of the Route 456 service are recommended for review and further investigation as follows:

- Expand Route 456's use as a commuting option to/from Salem Hospital, especially with the closure of Union Hospital in Lynn, which would likely result in more people in the area traveling to Salem Hospital. The service also has the potential to better serve workers commuting to the Hawthorne Square Mall Shopping Center.

- Provide better connections between Downtown Lynn and Salem and retail centers along Route 107. Connecting these economic centers can help unite the study area and provide a better sense of place.
- Improve overall transit service. Comments received from the public survey support the need for increased bus service overall along the study area, including faster speeds, more frequent service, and longer hours of operation.

Further study of Route 456 by the MBTA could potentially be integrated into their quarterly schedule reviews, or their biennial Service Plan.

Select bus stop changes from the proposed Bus Stop Optimization Plan, could be implemented in the short-term, following consultation with the MBTA and identification of the local municipal approval process for bus stop changes. A determination would need to be made on whether the number and extent of the proposed changes are significant to warrant a separate public process, or if they could be implemented as soon as MBTA resources are available to remove bus stop signs and update internal tracking systems. The MBTA may also consider relocating some stops temporarily to better existing locations, while funding opportunities, for the design and construction at bus stops to meet MBTA and ADA requirements, is pursued. Temporary relocations for short-term improvements were noted in the optimization plan previously summarized in Table V.1 and depicted in Figure V-1 and Figure V-2 (in Chapter V), and are described below.

Bus stops within the study area are proposed for removal for one or more of the following reasons:

- low ridership
- absence of an existing crosswalk
- missing curb ramps at the adjacent intersection
- narrow sidewalk
- poor sidewalk conditions, including a grass strip within the landing area
- poor safety of riders isolated between very active driveways
- proximity of non-trip generating uses (e.g. water bodies, heavily wooded areas, etc.)
- close proximity to the previous and/or next bus stop

The early implementation of the following stop removals would help to speed up service in the short-term. Bus stops on either side of those proposed for removal are proposed to be retained, although their location may need to adjust slightly (for example a stop may move from one side of the intersection to the other side, or shift about 200 feet) in the short and or long-term.

On-street parking spaces may be added by the municipality in some locations once the bus stop has been removed. Refer to Figures 5.1 and 5.2 for the bus stop modification plan and the bus stop location plan, accordingly. Seven bus stop pairs (seven stops in each direction), and one single bus stop, for a total of 15 bus stops, are proposed for removal as follows:



**Inbound stops:**

1. Highland Avenue at Alameda Street
2. Highland Avenue at Freeman Road
3. Highland Avenue opposite Cedar Road
4. Western Avenue opposite Victory Road
5. Western Avenue opposite Eastern Avenue
6. Western Avenue at Brooklawn Terrace
7. Western Avenue opposite Tracy Avenue

**Outbound stops:**

1. Western Avenue at Tracy Avenue
2. Western Avenue at Lloyd Terrace
3. Western Avenue at Eastern Avenue
4. Western Avenue at Victory Road
5. Highland Avenue at Cedar Road
6. Highland Avenue opposite Freeman Road
7. Highland Avenue at Alameda Street
8. Highland Avenue opposite 30 Highland Avenue

The following stops should be considered for temporary relocation due to accessibility deficiencies, safety and/or visibility issues at the existing stop, many of which were specifically highlighted in the deficiencies chapter of the report. Some stops could be restored to their original location, following sidewalk and other improvements as part of the long-term recommendations. ADA accessibility at the proposed locations has not been determined as part of this study. No parking impacts were determined to be associated with these proposed changes. Other recommendations included in this list are improvements to the accuracy of the bus stop descriptions.

**Inbound stops:**

1. Highland Avenue opposite Salem Hospital. Rename the stop description to Highland Avenue opposite Salem Hospital (not "at" Salem Hospital) to reflect the location of the hospital relative to the stop. Consider adding "Upper Entrance" to the stop description to distinguish between the upper and lower entrances to the hospital, where the lower entrance is located at Proctor Street.
2. Highland Avenue at Thomas Circle. Temporarily retain this stop, pending future sidewalk construction, as part of future corridor and intersection improvements, and improve visibility of the stop by relocating the front sign.
3. Highland Avenue at Ravenna Avenue. The existing stop is located far side of the intersection but there is no sidewalk and there are a number of pinch points because of the mast arm post and pedestrian signal post. Temporarily relocate the stop to the nearside of the intersection where a sidewalk is currently provided and pending

- sidewalk construction at the existing location, as part of future intersection improvements.
4. Western Avenue opposite Buchanan Circle. Relocate the stop about 270 feet south to the far side of the crosswalk to improve pedestrian connections and safety. Rename the stop description to Western Avenue at Bellaire Avenue to reflect the side street adjacent to the stop.
  5. Western Avenue at Fays Avenue. Relocate the front sign from the pedestrian signal at back of sidewalk onto its own post at the face of the sidewalk, to improve visibility of the stop.
  6. Western Avenue at (North) Maple Street. Rename the stop description to Western Avenue at Maple Street (no "north") to reflect the side street adjacent to the stop.

### **Outbound stops:**

1. Western Avenue opposite Fays Avenue. The rear door of the bus currently opens to a driveway. Shift the stop further south towards the Fays Avenue intersection to enable both doors to open to a level sidewalk. Rename the stop description to Western Avenue opposite (not "at") Fays Avenue to reflect the absence of a side street at this stop.
2. Western Avenue at Buchanan Circle. The existing stop and front sign is located behind a guard rail. Relocate the front sign onto its own post, about 40 feet north of its current location.
3. Highland Avenue at Wyman Avenue. This stop was planned for deactivation by the MBTA in Fall 2015 due to safety concerns. Verify the bus stop signs were removed.
4. Highland Avenue opposite Walmart. The existing midblock stop is located at a narrow sidewalk, and a utility pole in the middle of the sidewalk creates a major barrier between the bus stop and the pedestrian crossing. Temporarily relocate the stop to the far side of the crosswalk pending sidewalk widening at the existing location, as part of future intersection improvements.
5. Highland Avenue at Greenledge Street (see Image VI.6). The existing far side stop is located on a sidewalk with no curb reveal and no barrier to divide the sidewalk and parked cars from the abutting auto dealership, which indicates the sidewalk may actually be a driveway. Temporarily relocate the stop to the nearside of Greenledge Street for a better existing sidewalk and a more pleasant and safe waiting area, and pending sidewalk construction on the west side of Route 107, as part of future intersection improvements. Rename the stop description to



**Image VI.6: Poor sidewalk conditions on Highland Avenue at Greenledge Street.**



- Highland Avenue at Greenledge Street (not Greenledge “Road”) to reflect the side street adjacent to the stop.
6. Highland Avenue at Wilson Street. The existing nearside stop is located in a wide driveway. Relocate the stop to the sidewalk on the far side of the intersection, after the crosswalk.
  7. Highland Avenue at Salem Hospital. Consider adding “Upper Entrance” to the stop description to distinguish between the upper and lower entrances to the hospital, where the lower entrance is located opposite Procter Street.

It is assumed that other improvements require sidewalk construction, intersection improvements, and/or involve parking impacts and therefore would be considered longer term improvements.

### Construction Costs

Preliminary construction costs were estimated for the proposed long-term improvements. The construction costs of the following items were estimated:

- Pavement
- Sidewalks
- Driveways
- Signals
- Curbing
- Temporary traffic control
- Drainage
- Contingencies

The construction costs include intersection improvements and roadway segment improvements. The costs are based upon MassDOT weighted average bid prices for 2015-2016. Design, right-of-way, and utility relocation costs are not included in these estimates.

The overall cost is estimated at approximately \$26 million. The breakdown of these costs by the project segments is shown below:

- Lynn Study Area= \$6,000,000
- Retail Study Area= \$9,300,000
- Northern Study Area= \$5,000,000
- Zig zag Portion= \$5,300,000

## 6. EVALUATION MATRIX

The evaluation matrix (see Table VI.1) below applies the evaluation criteria for each section of the Route 107 study area. The evaluation criteria, as detailed in Chapter I, were determined to be:

- Multimodal Mobility
- Safety
- Land Use and Economic Development
- Environmental Effects
- Community, Health, and Social Equity
- Constructability
- Cost

Within the evaluation matrix, each of the evaluation criteria is reviewed for the Lynn study area, the retail study area and the northern study area in order to show how the long-term recommendations meet the criteria. The short-term improvements achieve project goals similar to the long-term improvements, but to a lesser degree.

**Table VI.1: Evaluation Matrix**

Evaluation Category	Long-Term Recommendations		
	<i>Lynn Study Area</i>	<i>Retail Study Area</i>	<i>Northern Study Area</i>
	- Reduce lane width to 11'	- Reduce lane width to 11	- Reduce lane width to 11'
	- Add left turn lanes	- Add protected buffered bicycle lanes	- Add 12' center turn lane
	- Coordinate/optimize traffic signals	- Add sidewalk/crosswalks to west side of Route 107	- Install a signal at Salem Hospital entrance
	- Add signal to Route 107/Eastern Ave intersection	- Coordinate/optimize traffic signals	- Extend island & install crosswalks at Dalton Pkwy/Jackson St
	- Add bicycle lanes	- Remove exclusive WB right-turn lane at Walmart & Hawthorne Square Mall	- Realign Route 107 intersection at Boston Street to provide Route 107 through movement.
	- Consolidate bus stops	- Consolidate bus stops	- Add bicycle lanes/protected buffered bicycle lanes
	- Provide ADA compliant bus stops	- Provide ADA compliant bus stops	
	- Replace sidewalks		



	- Access management	- Replace guardrail with landscaped median  - Address zig zag movement on Route 107 connecting Swampscott Road to Marlborough Road through turn restrictions and re-routing movements onto First Street and Traders Way	- Consolidate bus stops  - Provide ADA compliant bus stops  - Replace sidewalks
Multimodal Mobility			
<i>Reduce Traffic Congestion (LOS)</i>	Signal timing adjustments and optimization at the southern study area intersections reduces the delay experienced by vehicles at the intersection. Introducing a signal at Eastern Avenue significantly reduces the delay experienced by vehicles accessing Route 107 from the minor streets.	Signal timing adjustments and optimization at the retail study area intersections reduces the delay experienced by vehicles. At the Marlborough-Swampscott zig zag, vehicle trips were redistributed through the First Street intersections so as to improve the operations along Route 107.	Signal timing adjustments and optimization reduces the delay experienced by vehicles at the northern study area intersections.
<i>Cross-study area mobility</i>	Exclusive left turn lanes at study intersections facilitate connections to crossing streets.	New intersection configurations and access controls improve the operations and reduce queuing at the Zig zag movement.	Realigning the Route 107 intersection at Boston Street to provide a Route 107 through movement improves the operations along Route 107 and prioritizes the Route 107 through movements.
<i>Improve transit, bicycle and pedestrian modes</i>	The consolidation of bus stops allows for more efficient transit travel within the study area. The amount of delay resulting from bus boarding/alighting and starting/stopping is reduced with fewer bus stops.	The consolidation of bus stops allows for more efficient transit travel within the study area. The amount of delay resulting from bus boarding/alighting and starting/stopping is	The consolidation of bus stops allows for more efficient transit travel within the study area. The amount of delay resulting from bus boarding/alighting and starting/stopping is reduced with fewer bus stops. Updating the existing bus stops to be

	<p>Updating the existing bus stops to be ADA compliant also increases the accessibility of transit to all users.</p> <p>The reduction of lane width and addition of bicycle lanes provides cyclists with their own lane and reduces their level of traffic stress. The number of conflicts between cyclists and vehicles is reduced, thus making bicycle travel more accommodating. The replacement of sidewalks enhances the pedestrian experience along Route 107.</p>	<p>reduced with fewer bus stops. Updating the existing bus stops to be ADA compliant also increases the accessibility of transit to all users.</p> <p>The reduction of lane width and addition of primarily protected buffered bicycle lanes provides cyclists with their own lane and reduces their level of traffic stress. The number of conflicts between cyclists and vehicles is reduced, thus making bicycle travel more accommodating.</p> <p>The replacement of sidewalks enhances the pedestrian experience along Route 107. The addition of sidewalks and crosswalks on the west side of Route 107 provides a facility for pedestrians that did not previously exist and expands the pedestrian network.</p>	<p>ADA compliant also increases the accessibility of transit to all users.</p> <p>The reduction of lane width and addition of non-buffered and protected buffered bicycle lanes provides cyclists with their own lane and reduces their level of traffic stress.</p> <p>The replacement of sidewalks enhances the pedestrian experience along Route 107.</p> <p>The extension of the island and installation of crosswalks improves pedestrian visibility and accessibility at the Dalton Pkwy/Jackson St intersection. The proposed shared street concept offers an opportunity to provide an area in which pedestrians, bicyclists, and motorists seeking access to abutting properties can coexist in a calm low speed area.</p>
Safety			
Vehicular safety	<p>The reduction in lane width serves as a traffic calming measure and discourages speeding along Route 107. Adding left turn lanes with protected phases at the Chestnut Street and</p>	<p>The reduction in lane width serves as a traffic calming measure and discourages speeding along Route 107. Vehicular clearance intervals were adjusted based on MassDOT</p>	<p>The reduction in lane width serves as a traffic calming measure and discourages speeding along Route 107. Vehicular clearance intervals were adjusted based on MassDOT standards to reduce</p>



	<p>Chatham Street intersections reduces the number of conflicts involving left-turning vehicles. Vehicular clearance intervals were also adjusted based on MassDOT standards to reduce the amount of crashes due to conflicts at the signalized intersections. Access management along the southern part of the study area limits the amount of conflict points both at the intersection and along the travel way which also increases safety.</p>	<p>standards to reduce the amount of crashes due to conflicts at the signalized intersections.</p>	<p>the amount of crashes due to conflicts at the signalized intersections.</p>
<i>Bicycle and pedestrian safety</i>	<p>Reducing the travel lane widths and vehicle speeds increases the safety of pedestrians and bicycles in the study area. Introducing and/or enhancing the separate facilities for both bicycles and pedestrians also increases safety because it minimizes the interaction with vehicles.</p>	<p>Reducing the travel lane widths and vehicle speeds increases the safety of pedestrians and bicycles in the study area. Introducing and/or enhancing the separate facilities for both bicycles and pedestrians also increases safety because it minimizes the interaction with vehicles.</p> <p>Removing the exclusive westbound right-turn lane at Walmart &amp; Hawthorne Square Mall allows for the reduction in crossing length for pedestrians, thus decreasing their amount of exposure.</p>	<p>Reducing the travel lane widths and vehicle speeds increases the safety of pedestrians and bicycles in the study area. Introducing and/or enhancing the separate facilities for both bicycles and pedestrians also increases safety because it minimizes the interaction with vehicles.</p>

		Extending the island at Jackson Street and Dalton Parkway provides a pedestrian refuge area.	
Land Use and Economic Development			
Supports development	<p>Reducing vehicular congestion and enhancing pedestrian, bicycle and bus access supports local businesses in the Lynn segment of the study area.</p> <p>On-street parking is reduced by 33 spaces overall in this segment. Most of the eliminated parking is a consequence of safety improvements at high crash locations. Overall, this segment would have approximately 97 on-street spaces under the Build scenario.</p>	The proposed improvements include consideration of traffic associated with the Cinema World development. Improved traffic operations, and pedestrian, bicycle and bus accommodations provide multimodal access to businesses in this segment of the study area. Replacing the median guardrail with a landscaped median improves the attractiveness of the study area for business development.	The proposed improvements are consistent with the redevelopment plans for Salem Hospital (NSMC) and the North River Canal area. Vehicle operations are improved by adding turn lanes, installing a signal at NSMC, and optimizing signal timing/coordination to accommodate growth in vehicular traffic. Reducing lane width and providing bicycle and pedestrian accommodations enhances safety and provides multimodal travel options to the NSMC and mixed use developments in the North River Canal area.
Improves access for all modes	The proposed improvements improve safety and reduce congestion, thereby improving vehicular access to parcels in the study area. Improved pedestrian, bicycle, and transit accommodations results in improved access by alternate modes.		
Environmental Effects			
Air quality	Improving traffic operations to reduce congestion also reduces emissions for all study area segments		
Environmental resources	All proposed work is within existing ROW which avoids impacts to Buchanan Bridge Pond. Permitting	Limited ROW acquisition is required in this segment. The improvements avoid impact to the Forest River	All proposed work is within existing ROW. No



	requirements to be determined during design.	crossing under Route 107 south of Swampscott Road and an unnamed stream and wetlands between First Street and Salem High School. Permitting requirements to be determined during design.	environmental resources abutting the ROW.
Community, Health, and Social Equity			
Enhance attractiveness for residents and businesses	New lane striping, addition of bicycle lanes and replacement of sidewalks enhances visual attractiveness.	Replacing the median guardrail and providing a landscaped median, continuous sidewalks, and a bicycle lane on both sides of Route 107 enhances visual attractiveness of the study area.	Revised striping, addition of bicycle lanes and replacement of sidewalks enhances visual attractiveness.  Realignment of Route 107 at Boston Street provides opportunities for landscaping.
Health	Improved pedestrian and bicycle facilities in the study area would increase opportunities for active transportation.		
Environmental Justice	The online survey and public information materials were provided in English and Spanish to allow for more inclusive participation by study area stakeholders. The proposed improvements are generally within the existing right-of-way. No significant impacts have been identified, and therefore there are none that would disproportionately affect the EJ communities in the study area. The proposed improvements provide a benefit by enhancing pedestrian, bicycle and bus transit facilities, and improving bus operations within the study area.		
Constructability			
Minimize impacts to private property, drainage, utilities and ledge.	Limiting improvements to the existing roadway right-of-way and maintaining the existing curb line minimizes impacts to the existing drainage system, underground and overhead utilities, adjacent ledge outcrops, and private property.	Generally limiting improvements to the existing roadway right-of-way and maintaining the existing curb line minimizes impacts to the existing drainage system, underground and overhead utilities, adjacent	Limiting improvements to the existing roadway right-of-way and maintaining the existing curb line minimizes impacts to the existing drainage system, underground and overhead utilities, adjacent ledge outcrops, and private property.

		<p>ledge outcrops, and private property.</p> <p>Rerouting zig zag traffic to First Street/Traders Way avoids widening Highland Avenue, and therefore avoids major impacts to adjacent private property, ledge outcrops, the existing drainage system, and underground and overhead utilities. It does require right-of-way at the Marlborough Road intersection.</p>	
Cost			
Capital Construction Cost in 2016 \$ <sup>1</sup>	\$6,000,000	\$14,600,000	\$4,900,000

1 – Capital construction cost based on 2016 construction costs. Costs do not include design, right-of-way, or utility relocation.



## VII. IMPLEMENTATION

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Implementation of the recommendations presented in this report is dependent upon the entity with jurisdiction of the roadway (see Figure 2.2). Western Avenue from Chestnut Street to the southern end of the Buchanan Bridge is under the City of Lynn's jurisdiction. Reconfiguration of the Chestnut Street and Chatham Street intersections, a new traffic signal at Eastern Avenue, reconfiguration of travel lanes to incorporate bicycle lanes, and any parking spot removals are examples of recommendations that would need to be borne by the City.

The City of Salem has jurisdiction of Highland Avenue and Essex Street from Greenway Road up to the end of the study area at Boston Street. Addition of a new signal at Salem Hospital's Upper Driveway, extension of the island at the Jackson Street/Dalton Parkway intersection, and reconstruction of the Essex Street/Boston Street intersection are examples of recommendations that would need to be borne by the City.

Between the southern end of the Buchanan Bridge in Lynn and Greenway Road in Salem the study area is under MassDOT jurisdiction. Given that pieces of the northern study area segment fall under both MassDOT and City of Salem jurisdiction attention should be given to ensure implementation of study area-wide elements (such as the center lane and bicycle lanes) are carried out in tandem.

### **MassDOT Project Development and Design Process**

Transportation decision-making is complex and can be influenced by legislative mandates, environmental regulations, financial limitations, agency programmatic commitments, and partnering opportunities. Project development is the process that takes a transportation improvement from conception through construction. Decision-makers and reviewing agencies, when consulted early and often throughout the project development process, can ensure that all participants understand the potential impact these factors may have on project implementation.

The MassDOT Highway Division has developed a comprehensive project development process which is contained in Chapter 2 of the MassDOT Highway Division's Project Development and Design Guide. The eight-step process covers a range of activities extending from identification of a project need, through completion of a set of finished contract plans, to construction of the project. The sequence of decisions made through the project development process progressively narrows the project focus, while developing greater design details, and ultimately leads to a project that addresses the identified needs in the most cost-effective and publicly acceptable way. The Route 107 Corridor Study has been structured to meet the first two steps of the project development process: I - Needs Identification and II - Planning. The more-detailed descriptions provided in the following sections are focused on the process for a roadway project, but the same basic process would need to be followed for non-roadway projects as well.

### **Step I: Needs Identification**

For each of the locations at which an improvement is to be implemented, MassDOT leads an effort to define the problem, establishes project goals and objectives, and defines the scope of the planning needed for implementation. To that end, it has to complete a Project Need Form (PNF), which states in general terms the deficiencies or needs related to the transportation facility or location. The PNF documents the problems and explains why corrective action is needed. For this study, the information defining the need for the project would be drawn primarily, perhaps exclusively, from the present report. Also, at this point in the process, MassDOT meets with potential participants, such as the Metropolitan Area Planning Council (MAPC) and community members, to allow for an informal review of the project.

The PNF is reviewed by the MassDOT Highway Division District 4 office whose jurisdiction includes the location of the proposed project. MassDOT also sends the PNF to the MPO, for informational purposes. The outcome of this step determines whether the project requires further planning, whether it is already well supported by prior planning studies, and, therefore, whether it is ready to move forward into the design phase, or whether it should be dismissed from further consideration.

### **Step II: Planning**

This phase would likely not be required for the implementation of the improvements proposed in this planning study, as this planning report should constitute the outcome of this step. However, in general, the purpose of this implementation step is for the project proponent to identify issues, impacts, and approvals that may need to be obtained, so that the subsequent design and permitting processes are understood.

The level of planning needed varies widely, based on the complexity of the project. Typical tasks include: define the existing context, confirm the project need, establish goals and objectives, initiate public outreach, define the project, collect data, develop and analyze alternatives, make recommendations, and provide report documentation. Likely outcomes include consensus on the project definition to enable it to move forward into environmental documentation (if needed) and design, or a recommendation to delay the project or dismiss it from further consideration.

### **Step III: Project Initiation**

At this point in the process the proponent, MassDOT Highway Division, completes a Project Initiation Form (PIF) for each improvement, which is reviewed by its Project Review Committee (PRC) and the MPO, in this case the MAPC. The PRC is composed of the Chief Engineer, each District Highway Director, and representatives of the Project Management, Environmental, Planning, Right-of-Way, Traffic, and Bridge departments, and the Federal Aid Program Office (FAPO). The PIF documents the project type and description, summarizes the project planning process, identifies likely funding and project management responsibility, and defines a plan for interagency and public participation. First the PRC reviews and evaluates the proposed project



based on the MassDOT's statewide priorities and criteria. If the result is positive, MassDOT Highway Division moves the project forward to the design phase and to programming review by the MPO. The PRC may provide a Project Management Plan to define roles and responsibilities for subsequent steps. The MPO review includes project evaluation based on the MPO's regional priorities and criteria. The MPO may assign project evaluation criteria score, a Transportation Improvement Program (TIP) year, a tentative project category, and a tentative funding category.

#### **Step IV: Environmental Permitting, Design, and Right-of-Way Process**

This step has four distinct but closely integrated elements: Public Outreach, Environmental Documentation and Permitting (varying levels, if required), Design, and Right-of-Way Acquisition (if required). The outcome of this step is a fully designed and permitted project ready for construction. The sections below provide more detailed information on the four elements of this step of the project development process.

##### *Public Outreach*

Continued public outreach in the design and environmental process is essential to maintain varying levels of public support for the project and to seek meaningful input on the design elements. The public outreach is often in the form of required public hearings (conducted at the 25% and 100% design milestones), but can also include less formal dialogues with those interested in and affected by a proposed project.

##### *Environmental Documentation and Permitting*

The project proponent, in coordination with the Environmental Services section of the MassDOT Highway Division, is responsible for identifying and complying with all applicable federal, state, and local environmental laws and requirements. This includes determining the appropriate project category for both the Massachusetts Environmental Protection Act (MEPA) and the National Environmental Protection Act (NEPA). Environmental documentation and permitting is often completed in conjunction with the Preliminary Design phase described below.

##### *Design*

There are three major phases of design. The first is Preliminary Design, which is also referred to as the 25-percent submission. The major components of this phase include a full survey of the project area, preparation of base plans, development of basic geometric layout, development of preliminary cost estimates, and submission of a functional design report. Preliminary Design, although not required to, is often completed in conjunction with the Environmental Documentation and Permitting.

The next phase is Final Design, which is also referred to as the 75% and 100% submission. The major components of this phase include preparation of a subsurface exploratory plan (if required), coordination of utility relocations, development of temporary traffic control plans

through construction zones, development of final cost estimates, and refinement and finalization of the construction plans. Once Final Design is complete, a full set of Plans, Specifications, and Estimates (PS&E) is developed for the project.

#### *Right-of-Way Acquisition*

A separate set of Right-of-Way plans is required for any project that requires land acquisition or easements. The plans must identify the existing and proposed layout lines, easements, property lines, names of property owners, and the dimensions and areas of estimated takings and easements.

### **Step V: Programming (Identification of Funding)**

Programming, which typically begins during the design phase, can actually occur at any time during the process, from planning to design. In this step, which is distinct from project initiation, the proponent requests that the MPO include the project in the region's Transportation Improvement Program (TIP) process. The proponent requesting the project's listing on the TIP can be the community or it can be one of the MPO member agencies (the Regional Planning Agency, MassDOT, and the Regional Transit Authority). The MPO then considers the project in terms of state and regional needs, funding availability, project readiness, evaluation criteria, and compliance with the Regional Transportation Plan and decides whether to place it in the Draft TIP for public review and then in the Final TIP. A project does not have to be fully designed in order for the MPO to program it in the TIP, but generally a project has reached 75-percent design to be programmed in the year-one element of the four-year TIP.

### **Step VI: Procurement**

Following project design and programming of a highway project, the MassDOT Highway Division publishes a request for proposals, which is also often referred to as being „advertised“ for construction. MassDOT then reviews the bids, and awards the contract to the qualified bidder with the lowest bid.

### **Step VII: Construction**

After a construction contract is awarded, MassDOT Highway Division and the contractor develop a public participation plan and a temporary traffic control plan for the construction process.

### **Step VII: Project Assessment**

The purpose of this step is to receive constituents' comments on the project development process and the project's design elements. MassDOT Highway Division can apply what is learned in this process to future projects



Table VII.1 contains the summary of these steps along with their effect on the project schedule and lists approximate duration ranges associated with each step.

**Table VII.1: Project Development Schematic Timetable**

Description	Schedule Influence	Typical Duration
<b>Step I: Problem/Need/Opportunity Identification</b> The proponent completes a Project Need Form (PNF). This form is then reviewed by the MassDOT District office, which provides guidance to the proponent on the subsequent steps of the process.	The PNF has been developed so that it can be prepared quickly by the proponent, including any supporting data that is readily available. The District office shall return comments to the proponent within one month of PNF submission.	1 to 3 months
<b>Step II: Planning</b>  Project planning can range from agreement that the problem should be addressed through a clear solution to a more-detailed analysis of alternatives and their impacts.	For some projects, no planning beyond preparation of the PNF is required. While other projects require a planning study centered on specific project issues associated with the proposed solution or a narrow family of alternatives. More complex projects would likely require a detailed alternatives analysis.	Project Planning Report: 3 to 24+ months
<b>Step III: Project Initiation</b>  The proponent prepares and submits a Project Initiation Form (PIF) and a Transportation Evaluation Criteria (TEC) form in this step. The PIF and TEC are informally reviewed by the Metropolitan Planning Organization (MPO) and MassDOT District office, and formally reviewed by the Project Review Committee (PRC).	The PIF includes refinement of the preliminary information contained in the PNF. Additional information summarizing the results of the planning process, such as the Project Planning Report, is included with the PIF and TEC. The schedule is determined by PRC staff review (dependent on project complexity) and meeting schedule.	1 to 4 months
<b>Step IV: Design, Environmental, and Right of Way</b>  The proponent completes the project design. Concurrently, the proponent completes necessary environmental permitting analyses and files applications for	The schedule for this step is dependent upon the size of the project and the complexity of the design, permitting, and right-of-way issues. Design review by the MassDOT District and appropriate sections is completed in this step.	3 to 48+ months

permits. Any right of way needed for the project is identified and the acquisition process begins.		
<b>Step V: Programming</b> The MPO considers the project in terms of its regional priorities and determines whether or not to include the project in its Draft Transportation Improvement Program (TIP) which is then made available for public comment. The TIP includes a project description and funding source.	The schedule for this step is subject to each MPO's programming cycle and meeting schedule. It is also possible that the MPO would not include a project in its Draft TIP based on its review and approval procedures.	3 to 12+ months
<b>Step VI: Procurement</b> The project is advertised for construction and a contract awarded.	Administration of competing projects can influence the advertising schedule.	1 to 12 months
<b>Step VII: Construction</b> The construction process is initiated including public notification and any anticipated public involvement. Construction continues to project completion.	The duration for this step is entirely dependent upon project complexity and phasing.	3 to 60+ months
<b>Step VIII: Project Assessment</b> The construction period is complete and project elements and processes are evaluated on a voluntary basis.	The duration for this step is dependent upon the proponent's approach to this step and any follow-up required.	1 month

Source: MassDOT Highway Division Project Development and Design Guide

The project development process described previously is based on a conventional project delivery method, commonly referred to as "Design-Bid-Build" (D-B-B). The essence of the D-B-B process is that project is designed to the PS&E level and then advertised for construction, i.e. the design and construction are carried out sequentially. Under this scenario the engineer of record (designer) and the construction contractor are two separate contracting entities. A schematic timeline illustrating this process is shown in Figure VII-1, and for the purpose of this discussion assumes aggressive durations and that construction funding would be available at the end of the design phase.



## Route 107 Corridor Project (Conventional Delivery Method)

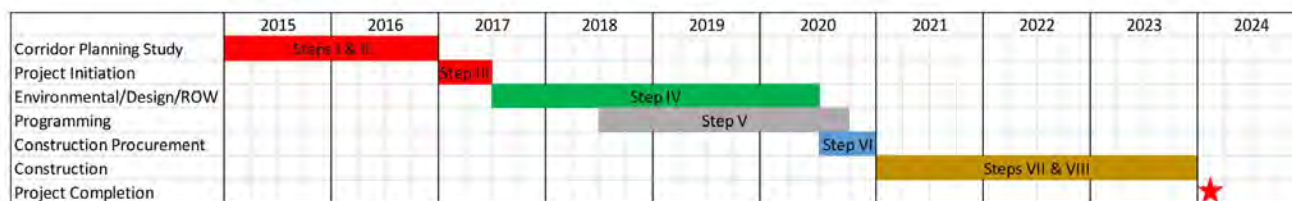


Figure VII-1: Schematic Implementation Timeline for a Design-Bid-Build Project

## 1. ENVIRONMENTAL CONSIDERATIONS

### Environmental Documentation and Permitting

The project proponent, in coordination with the Environmental Services section of the MassDOT Highway Division, is responsible for identifying and complying with all applicable federal, state, and local environmental laws and requirements. This includes determining the appropriate project review documentation category for both the Massachusetts Environmental Policy Act (MEPA) and the National Environmental Policy Act (NEPA). Environmental documentation and permitting is often completed in conjunction with the Preliminary Design phase described below.

Going forward, in the Environmental Permitting and Design phases, any proposed study area improvements must comply with both the Massachusetts (MEPA) and National (NEPA) Environmental Policy Acts. It is anticipated that the study area improvements would be supported in part by federal funds, and therefore would also require review under Section 106 of the National Historic Preservation Act of 1966, as amended. In addition, due to the presence of wetland resource areas in close proximity to the Route 107 right-of-way, such as Floating Bridge Pond and the Forest River, the proposed improvements also require compliance with the Massachusetts Wetlands Protections Act and its implementing regulations ( 310 CMR 10.00).

## 2. ENVIRONMENTAL POLICY ACTS

The project proponent, in coordination with the Environmental Services section of the MassDOT Highway Division, is responsible for identifying and complying with all applicable federal, state, and local environmental laws and requirements. This includes determining the appropriate project documentation category for both MEPA and NEPA. Environmental documentation and permitting is often completed in conjunction with the Preliminary Design phase.

NEPA does not establish any quantitative thresholds for the environmental classification of a transportation improvement project. Transportation projects vary in type, size and complexity, and potential effect to the environment. The effects of such projects can vary from very minor to significant impacts to the human environment. To account for the variability of project impacts,

three basic “classes of action” are allowed to determine how compliance with NEPA is carried out and documented.

- An Environmental Impact Statement (EIS) is prepared for projects where it is known that the action would have a significant impact on the environment
- An Environmental Assessment (EA) is prepared for actions in which the significance of the environmental impact is not clearly established. Should environmental analysis and interagency review during the EA process find a project to have no significant impacts on the quality of the environment, a Finding of No Significant Impact (FONSI) is issued
- Categorical Exclusions (CEs) are issued for actions that do not individually or cumulatively have a significant impact on the environment.

Since the proposed Route 107 improvements occur largely within the existing highway right-of-way, they are not anticipated to result in a significant impact on the environment and a Categorical Exclusion (CE) is likely to be the appropriate class of action. The CE would be prepared in accordance with the *Programmatic Agreement between the Federal Highway Administration, Massachusetts Division and the Massachusetts Department of Transportation for Determinations and Approvals of Categorical Exclusions under the National Environmental Policy Act* (May 2016).

The MEPA process includes eleven review thresholds that identify categories for projects that are likely to cause damage to the environment. These review thresholds determine whether MEPA review is required. MEPA review is required when one or more review thresholds are met or exceeded and the subject matter of a least one review threshold is within MEPA jurisdiction. A review threshold that is met or exceeded also specifies whether MEPA review shall consist of an Environmental Notification Form (ENF) and a mandatory Environmental Impact Report (EIR), or an ENF and other MEPA review if the Secretary of the Executive Office of Energy and Environmental Affairs so requires.

For the Route 107 study area improvements the following MEPA review thresholds that may require an ENF or an EIR were evaluated:

1. **Land** - The improvements are largely within the existing right-of-way and do not trigger any thresholds for alteration of land, creation of new impervious surface, or impact Article 97 land (public lands with natural resources).
2. **Wetlands** - The improvements are adjacent to wetlands, but none of the thresholds established for wetlands impacts would be exceeded if the improvements were implemented.



- 3. Transportation** – The study area improvements do not meet any thresholds requiring an EIR. In addition the improvements do not meet the following ENF thresholds:
- Construction of a new roadway one- quarter mile long or widening of an existing roadway by four or more feet
  - Cutting five or more living public shade trees whose diameter is 14” or greater.
  - Generation of 2,000 or more new ADT, or 1,000 or more ADT with 150 new parking spaces
  - Construction of 300 or more new parking spaces.
- 4. Historic and Archeological Resources** – The improvements do not require demolition of a historic structure or archeological site, and therefore does not meet the MEPA threshold for this category.

Several MEPA thresholds do not apply to this study: Water, Wastewater, Energy, Air, Solid and Hazardous Waste, State-listed Endangered Species, Areas of Critical Environmental Concern, and Regulations.

Given that the proposed improvements are primarily within the existing right-of-way, the proposed improvements do not meet any MEPA thresholds for an EIR or an ENF. This would need to be confirmed during the Preliminary Design phase.