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THE RECOMMENDED PLAN

BACKGROUND

A major component in LRTP development is the Recommended Plan. The Recommended Plan cites the major, regionally significant projects and investment programs that have been selected for funding for the life of the LRTP. This chapter explains what transportation infrastructure the MPO expects to fund during the next 25 years. It particularly focuses on those projects and programs that will be funded with MPO discretionary funds. The chapter begins with an overview of key elements that form the backdrop for these decisions and goes on to explain the project and program selection process. It then describes the projects and programs that comprise the Recommended Plan. Finally, this chapter describes the travel demand model results and offers an interpretation of the Recommended Plan's projects and programs.

The MPO's Challenge

The ultimate purpose of transportation is to serve human activity; therefore, the MPO defines its challenge for this LRTP as:

How can we maintain the transportation network to meet existing needs, adapt and modernize it for future demand, while simultaneously working within the reality of constrained fiscal resources?

Balancing Diverse Needs

The MPO recognizes the diversity of transportation needs throughout the Boston region. Matters of system preservation, safety, capacity management and mobility, the environment, economic vitality, and transportation equity all need to be addressed to balance diverse needs and reach the region's goals. The Recommended Plan demonstrates the MPO's method for reaching this balance—to provide adequate funding for regionally significant major infrastructure and capacity-adding projects as well as investment programs. A major infrastructure project is one that costs more than \$20 million. An expansion project is one that adds capacity to the existing system through adding a travel lane, constructing an interchange, building an extension of a commuter rail or rapid transit line, or procuring additional (not replacing) public transportation vehicles. Other investment programs allow for smaller-

scale projects that would be funded through the Transportation Improvement Program. This Recommended Plan is the MPO's response to the challenge above, including the issue of diversity.

Issues

The Recommended Plan addresses the following issues:

- The region's infrastructure is aging; clearly, the demands placed on highway and transit facilities have been taxing to the point that routine maintenance is insufficient to keep up with maintenance needs. As a result, there is a significant backlog of maintenance and state-of-good-repair work to be done on the highway and transit system, including on bridges, roadway pavement, transit rolling stock, and traffic and transit control equipment. Under these circumstances, the MPO recognizes that the concept of preservation has become even more important. Maintenance needs must be prioritized in a way that will address the most serious problems with the most effective investments in order to provide maximum current and future benefits. The Recommended Plan provides mechanisms for this.
- The Recommended Plan also needs to support a transportation system that expands travel choices within the region. While advocating for a system that adequately supports all modes of travel, the MPO recognizes that many people in the region are, and will continue to be, reliant on the automobile. MPO members expect both roadway congestion to worsen and transit demand to increase in the future. They recognize that many travel options need to be advanced in order to reduce our dependence on the single-occupant vehicle.
- Climate change likely will affect the Boston region significantly if climate trends continue as projected. In order to minimize the negative impacts, the MPO is taking steps to decrease our carbon footprint while simultaneously adapting our transportation system to minimize damage from natural hazards. The MPO strongly considers projects and strategies that protect and enhance the environment, promote energy conservation, and improve quality of life in the region.
- The Recommended Plan's transportation investments support livability by providing residents with convenient access to opportunities and resources. Affordable housing, access to services, employment opportunities, and shopping in close proximity all contribute to the livability of a community, as do safe, affordable, and healthy options for getting around.
- The MPO seeks, in the Recommended Plan, to provide access to transportation services on an equitable basis across the region. This includes, but is not limited to, providing transportation options to low-income and minority communities for travel to jobs, services, and other important destinations.

- Finally, the MPO recognizes that the transportation system plays a critical role in the continued economic health of the region. Many sectors of the economy depend heavily on safe and efficient movement of goods and services by truck, rail, air, and water.

PROJECT SELECTION

Chapter 2, Process for Developing Charting Progress to 2040, describes the MPO's process for selecting the recommended projects and programs included in this LRTP in more detail. The steps are summarized below:

1. Development of MPO's vision, goals, and objectives (Chapter 1)
2. Assessment of region's transportation needs (Chapter 3)
3. Analysis of future transportation scenarios (Appendix A)
4. Development of a Universe of Projects and Programs list (Appendix B)
5. Evaluation of major infrastructure projects (Appendix C)
6. Review of transportation revenues available for programming projects and programs through 2040 (Chapter 4)
7. Account of public participation that spanned the entire development process (Chapter 2 and Appendix D)

To develop the Recommended Plan, MPO staff needed to identify the region's top-priority highway and transit projects as candidates for funding. To arrive there, staff first had to comprise a draft list of major infrastructure projects and other investment programs for modeling. MPO staff used the information listed above, including results of the initial scenario planning, to create a balanced list that fits within the fiscal constraints of the LRTP.

Development of Alternative LRTP Scenarios

Developing the draft list of major infrastructure projects and other investment programs involved balancing two conflicting MPO policies:

- The policy and practice of maintaining its previous LRTP and TIP programming commitments
- The operations and management (O&M) approach to programming—a new policy of giving priority to low-cost, non-major infrastructure projects (adopted as part of this LRTP)

The MPO intends to ensure that the projects and programs funded in *Charting Progress to 2040* advance its goals. To address this, the MPO considered two alternatives: 1) program the projects included in *Paths to a Sustainable Region*, the previous LRTP, and 2) use the O&M approach for programming lower-cost projects as analyzed as part of the *Charting Progress to 2040* development process.

FIRST ALTERNATIVE—PROGRAM PROJECTS IN PATHS TO A SUSTAINABLE REGION

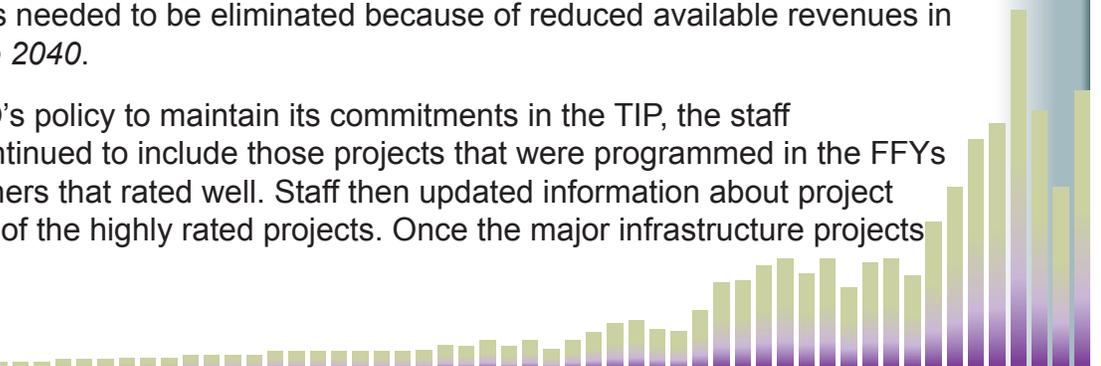
This alternative programmed all of the unfunded major infrastructure projects from *Paths to a Sustainable Region* in the five-year time bands established for *Charting Progress to 2040* (2016–2020, 2021–2025, 2026–2030, 2031–2035, and 2036–2040). Funding was available for all of the projects, although not in the same time bands because of reductions in available revenue. These major infrastructure projects, however, accounted for 68 percent of the total funding available for the 25-year period. This would not allow many smaller projects that do not add capacity or cost less than \$20 million (the projects that do not need to be listed in the LRTP) to be funded over the next 25 years.

SECOND ALTERNATIVE—O&M FUNDING

The O&M alternative targeted funding to lower-cost improvements such as intersection and complete street projects and a limited amount of major infrastructure projects. As shown in the scenario planning process (see Appendix A), this alternative was more effective in addressing the MPO’s goals and would provide greater opportunities to ensure geographic equity (money can be distributed throughout the region, as opposed to being concentrated in a few specific projects).

To develop the staff recommendation for major infrastructure projects under the O&M alternative, staff applied the MPO’s goals and objectives as criteria in a qualitative evaluation of the major infrastructure and capacity-adding highway projects. This was done for projects included in the Universe of Projects and Programs list that were sufficiently well defined to allow for analysis. Many of the major infrastructure projects in *Paths to a Sustainable Region* had been determined previously to address MPO priorities similar to the goals in *Charting Progress to 2040*; the projects that had rated highly in *Paths to a Sustainable Region* continue to rate highly in the *Charting Progress to 2040* project-evaluation process. In addition, many projects were identified in the *Charting Progress to 2040* Needs Assessment. For these reasons, staff included some of the *Paths to a Sustainable Region* major infrastructure projects in their recommendation for this LRTP. Some projects needed to be eliminated because of reduced available revenues in *Charting Progress to 2040*.

Respecting the MPO’s policy to maintain its commitments in the TIP, the staff recommendation continued to include those projects that were programmed in the FFYs 2015–18 TIP and others that rated well. Staff then updated information about project readiness and costs of the highly rated projects. Once the major infrastructure projects



were selected for *Charting Progress to 2040* (considering their updated readiness and costs), the remaining funding was used to implement the MPO's new policy of giving priority to the O&M program projects. Staff recommended implementing programming for O&M programs beginning in the FFYs 2021–26 time band and proposed funding in each program through the remaining time bands.

Staff developed the O&M alternative using the following assumptions for the various investment programs:

- No more than 50 percent of available funding in each five-year time band would be allocated to major infrastructure projects.
- If one major infrastructure project required more than 50 percent of funding in a particular time band, it would not be programmed.
- Four investment programs were established for the smaller projects that cost less than \$20 million and/or did not add capacity. This would give municipalities the confidence to begin designing projects knowing that there would be funding in the later years of the LRTP. Funding for the O&M investment programs used the funds that were left after the major infrastructure program was determined. Detailed information on each program is found under the Recommended List of Projects and Programs section of this chapter. The O&M investment programs and funding assumptions are as follows:
 1. Complete Streets Program – 58 percent
 2. Intersection Improvements Program – 28 percent
 3. Bicycle and Pedestrian Program – 10 percent
 4. Community Transportation, Parking, and Clean Air and Mobility Program – 4 percent

The first three programs include the types of projects that typically are funded in the TIP. The fourth, the Community Transportation, Parking, and Clean Air and Mobility Program, is a revival and expansion of the MPO's Clean Air and Mobility program (which had been in hiatus for several years because of lack of funding); it was established based on input from public outreach and information from the Needs Assessment.

Selection of the Recommended Projects and Programs

The MPO reviewed and discussed the two alternatives and ultimately adopted the O&M scenario as the basis for recommending projects and programs in the draft LRTP. After

further discussion, the MPO voted to adjust the last two time bands of the LRTP (2031–2035 and 2036–2040) continuing to fund the four O&M programs but leaving the major infrastructure program unallocated at this time. This was because of a number of factors:

- The Project Selection Advisory Council (PSA Council) was established by the state legislature to establish uniform project selection criteria for developing a comprehensive state transportation plan consistent with state and federal legislation and policies. The PSA Council was charged with delivering its recommendations for a project priority formula or other data-driven process to the legislature by June 30, 2015. The MPO decided to wait for these recommendations before programming new projects in the later time bands.
- MassDOT’s Capital Investment Plan for both highway and transit projects outlining the Commonwealth’s priorities for major highway and transit projects had not been released yet. The MPO felt that this information was important before determining projects that could be funded by the MPO in later years.
- MassDOT is beginning to develop the Program for Mass Transportation and determining its long-range priorities for transit in the region. The MPO felt that this information was also important to know before determining projects that could be funded by the MPO in later years.

Ultimately, the final selection of projects was based on the informed judgment of MPO members after they reviewed information obtained through the LRTP development process, including:

- Conclusions from the regional Needs Assessment (Volume II of the LRTP)
- Results from the scenario-planning process
- Information about projects available through feasibility studies, project-specific modeling work, and environmental impact reports
- Examination of individual highway and transit projects for conformity with the MPO’s goals and objectives
- Feedback from the Regional Transportation Advisory Council, the MPO’s advisory group, and the public via the MPO’s LRTP outreach process
- MPO members’ knowledge of proposed projects

A list of the major infrastructure projects and O&M programs is shown in Table 5.1; they are described in the next section.

TABLE 5.1
Major Infrastructure Projects in the Recommended Plan

Project Name	Current Cost
Middlesex Turnpike Improvements, From Crosby Drive North to Manning Road, Phase III (Bedford and Billerica)	\$26,935,000
Reconstruction of Rutherford Avenue, from City Square to Sullivan Square (Boston)	\$109,967,000
Intersection Improvements at Route 126 and Route 135/MBTA and CSX Railroad (Framingham)	\$115,000,000
Route 4/225 (Bedford Street) and Hartwell Avenue (Lexington)	\$23,221,000
Bridge Replacement, Route 27 (North Main St.) over Route 9 (Worcester St.) and Interchange Improvements (Natick)	\$25,793,000
Reconstruction of Highland Avenue, Needham Street and Charles River Bridge, from Webster Street to Route 9 (Newton and Needham)	\$14,298,000
McGrath Boulevard Project (Somerville)	\$56,600,000
Green Line Extension Project (Phase 2), College Avenue to Mystic Valley Parkway/Route 16 (Somerville and Medford)	\$190,000,000
Reconstruction and Widening on Route 18 (Main Street) From Highland Place to Route 139 (Weymouth and Abington)	\$58,822,000
Reconstruction of Montvale Avenue, from I-93 Interchange to Central Street (Woburn)	\$4,225,000
Bridge Replacement, New Boston Street over MBTA (Woburn)	\$9,707,000

RECOMMENDED LIST OF PROJECTS AND PROGRAMS

This LRTP includes funding to meet the needs and address the issues discussed in the Background section above, including maintenance and expansion of the transportation system. Funding for much of the roadway maintenance in the Boston Region MPO area is provided through statewide resurfacing, maintenance, and infrastructure programs. Maintenance of the bridges is provided through the statewide bridge program and the Accelerated Bridge Program.

In the Boston region, the highway network's major infrastructure and capacity expansion projects, and other maintenance and rehabilitation projects not included in the statewide programs are funded through the Boston Region MPO's share of the discretionary capital

program. The selection of projects and programs using these funds was described in the Project Selection section above.

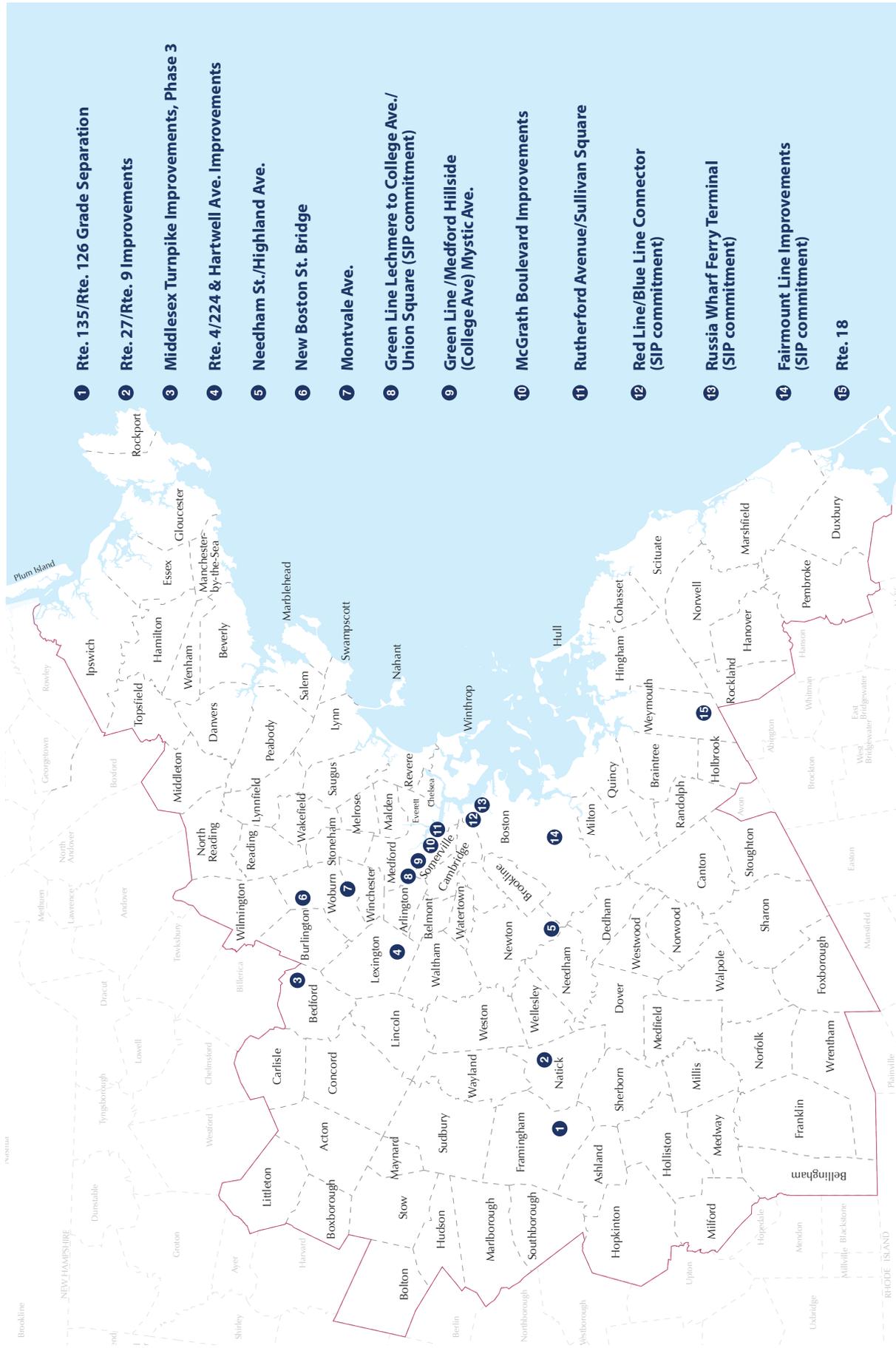
In this LRTP, for the transit network, the MPO has allocated all of the MBTA's future transit capital funding to system infrastructure maintenance, accessibility improvements, and system enhancements. It also demonstrates the MPO's commitment to State Implementation Plan projects by programming and funding them.

The following ongoing no-build major infrastructure and expansion projects are funded in this LRTP:

- Route 128 Additional Lanes (Randolph to Wellesley): The total budget for this project is approximately \$381.4 million; the remaining costs funded are \$57.8 million. The completion date is projected to be 2019.
- Fairmount Line Improvements: This is a State Implementation Plan project. The Commonwealth committed \$135 million to this project. The remaining cost, funded under this LRTP, is \$26.5 million. The completion date is projected to be the end of calendar year 2018.
- Green Line Extension to College Avenue and Union Square in Somerville: The Commonwealth committed \$996.122 million to this project. The Federal Transit Administration committed \$996.121 million to this project. The completion date is projected to be 2020.

After accounting for the costs of these ongoing projects, the remaining funds are available for major infrastructure and capacity expansion or set aside for low-cost, non-capacity-adding projects that advance the MPO's visions and policies. Table 5.1 listed the projects funded under the major infrastructure program and their current costs. Figure 5.1 shows the locations of these projects. As shown in Table 5.1, the Recommended Plan allocates the majority of highway funding for highway projects. However, it also provides for flexing \$190 million in highway funding to one transit project.

FIGURE 5.1
Major Infrastructure Projects in the Recommended Plan



1 Rte. 135/Rte. 126 Grade Separation

2 Rte. 27/Rte. 9 Improvements

3 Middlesex Turnpike Improvements, Phase 3

4 Rte. 4/224 & Hartwell Ave. Improvements

5 Needham St./Highland Ave.

6 New Boston St. Bridge

7 Montvale Ave.

8 Green Line Lechmere to College Ave./ Union Square (SIP commitment)

9 Green Line /Medford Hillside (College Ave) Mystic Ave.

10 McGrath Boulevard Improvements

11 Rutherford Avenue/Sullivan Square

12 Red Line/Blue Line Connector (SIP commitment)

13 Russia Wharf Ferry Terminal (SIP commitment)

14 Fairmount Line Improvements (SIP commitment)

15 Rte. 18

All public transportation funds are used for improvements to the regional public transportation system. Based on this distinction, the major infrastructure projects total approximately \$805 million, 28 percent, of the MPO’s discretionary funds. The MPO also included funding for approximately \$1.5 billion, 54 percent, in roadway modernization projects and programs, and \$63 million, 2 percent, for a community transportation, parking, and clean air and mobility program. Table 5.2 shows the total amount of funding dedicated to major infrastructure projects and O&M programs in this LRTP. In the last two time bands of the LRTP, \$446.7 million, 16 percent, has been left unallocated.

TABLE 5.2
Funding Dedicated to Programs in the LRTP

Program	Dedicated Funding
MPO Discretionary Capital Program: Major Infrastructure Projects	\$615,363,800
MPO Discretionary Capital Program: Highway Funds Flexed to Transit	\$190,000,000
MPO Discretionary Capital Program: Complete Street Program	\$936,262,700
MPO Discretionary Capital Program: Intersection Improvement Program	\$443,639,500
MPO Discretionary Capital Program: Bicycle/Pedestrian Program	\$158,442,700
MPO Discretionary Capital Program: Community Transportation/ Parking/ Clean Air and Mobility Program	\$63,377,100
MPO Discretionary Capital Program: Unassigned Funds	\$446,707,600
Total Highway Funding	\$2,853,793,400
Transit Expansion Projects Funded in the Boston Region MPO by the Commonwealth	\$1,555,250,000
Transit Funding	\$1,555,250,000

Highway Projects in the Recommended Plan

Table 5.3 lists the highway projects funded under the major infrastructure program, as well as other investment programs established for O&M projects, their costs, and the period in which they are projected to be programmed. The list also includes the Green Line Extension from College Avenue to Mystic Valley Parkway/Route 16 transit project, which is using highway funds flexed to transit.

Pursuant to federal guidance for allowing for inflation, costs associated with each highway project are based on the current estimated cost plus four percent per year through the year of construction. (Figure 5.1 shows the location of each project.) Table 5.4 lists bridges that cost more than \$20 million and currently are scheduled to be advertised. The next section of this chapter first provides a detailed description, current cost, and map for each major infrastructure highway project in the Recommended Plan; it also provides a detailed description of the other investment programs.

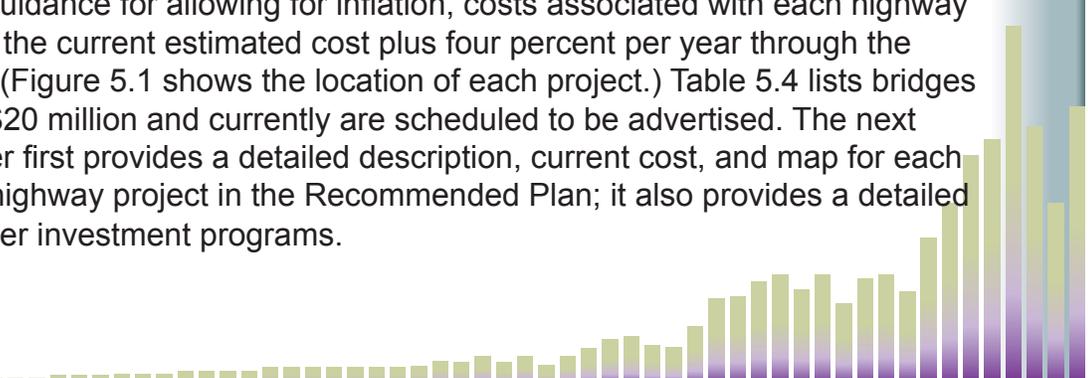


TABLE 5.3

Major Infrastructure Projects Programmed with Highway Funding in the Recommended Plan with Costs

Project Name	Current Cost	Investment Category	FFY 2016-2020	FFY 2021-2025	FFY 2026-2030	FFY 2031-2035	FFY 2036-2040	MPO Funding	Non-MPO Funding
Route 128 Additional Lanes (Needham & Wellestey)	\$57,768,183	MI	\$57,768,183					\$57,768,183	
Middlesex Turnpike Improvements from Crosby Dr North to Manning Rd, Phase III (Bedford & Billerica)	\$26,935,171	MI	\$28,296,348					\$28,296,348	\$1,000,000
Reconstruction of Rutherford Ave, from City Sq to Sullivan Sq (Boston)	\$109,967,000	MI	\$7,000,000	\$106,268,126				\$113,268,126	\$15,377,710
Intersection Improvements at Rte 126 & Rte 135/MBTA & CSX Railroad (Framingham)	\$115,000,000	MI			\$184,118,700			\$184,118,700	
Route 4/225 (Bedford St) and Hartwell Ave (Lexington)	\$23,221,000	MI		\$30,557,000				\$30,557,000	
Bridge Replacement, Rte 27 (North Main St) over Rte 9 (Worcester St) and Interchange Improvements (Natick)	\$25,793,370	MI		\$33,942,300				\$33,942,300	
Reconstruction of Highland Ave, Needham St & Charles River Bridge, from Webster St to Rte 9 (Newton & Needham)	\$14,297,606	MI	\$15,464,292					\$15,464,292	
McGrath Boulevard Project (Somerville)	\$56,563,000	MI			\$90,559,000			\$90,559,000	
Green Line Extension Project (Phase 2), College Ave to Mystic Valley Parkway/Rte 16 (Somerville to Medford)	\$190,000,000	MI	\$158,000,000	\$32,000,000				\$190,000,000	
Reconstruction & Widening on Rte 18 (Main St) from Highland Pl to Rte 139* (Weymouth & Abington)	\$58,822,115	MI	\$45,281,758					\$45,281,758	\$14,771,760

TABLE 5.3 (Cont.) Major Infrastructure Projects Programmed with Highway Funding in the Recommended Plan with Costs

Project Name	Current Cost	Investment Category	FFY 2016-2020	FFY 2021-2025	FFY 2026-2030	FFY 2031-2035	FFY 2036-2040	MPO Funding	Non-MPO Funding
Reconstruction of Montvale Ave, from I-93 Interchange to Central St (Woburn)	\$4,225,256	MI	\$4,752,838					\$4,752,838	
Bridge Replacement, New Boston St over MBTA (Woburn)	\$9,706,549	MI	\$11,355,289					\$11,355,289	
Complete Street Program (Regionwide)		CS		\$152,018,630	\$177,609,859	\$321,301,910	\$268,037,266	\$918,967,664	
Bicycle/Pedestrian Program (Regionwide)		B/P		\$26,210,109	\$30,622,389	\$55,396,881	\$46,213,322	\$158,442,701	
Intersection Improvement Program (Regionwide)		INT		\$73,388,304	\$85,742,690	\$155,111,267	\$129,397,301	\$443,639,562	
Community Transportation/Parking/Clean Air Mobility Program (Regionwide)		CT/PK/CA		\$10,484,043	\$12,248,956	\$22,158,752	\$18,485,329	\$63,377,080	
Total Available Regional Highway Target Funds			\$441,648,080	\$464,868,512	\$580,901,594	\$657,770,110	\$708,605,218	\$2,853,793,514	\$31,149,470
Total Programmed Regional Highway Target Funds			\$345,213,746*	\$464,868,512	\$580,901,594	\$553,968,810	\$462,133,218	\$2,407,085,880*	
Regional Highway Target Funds Available			\$96,434,334	\$0	\$0	\$103,801,300	\$246,472,000	\$446,707,634	
Percentage of Funding Allocated			78%	100%	100%	84%	65%	84%	

* Includes funding from projects not listed in LRTP but included in the 2016-2019 TIP

MI - Major Infrastructure Program

CS - Complete Streets Program

B/P - Bicycle/Pedestrian Program - Assabet River Rail Trail will be funded under this program

INT - Intersection Improvement Program

CT/PK/CA - Community Transportation/Parking/Clean Air and Mobility Program

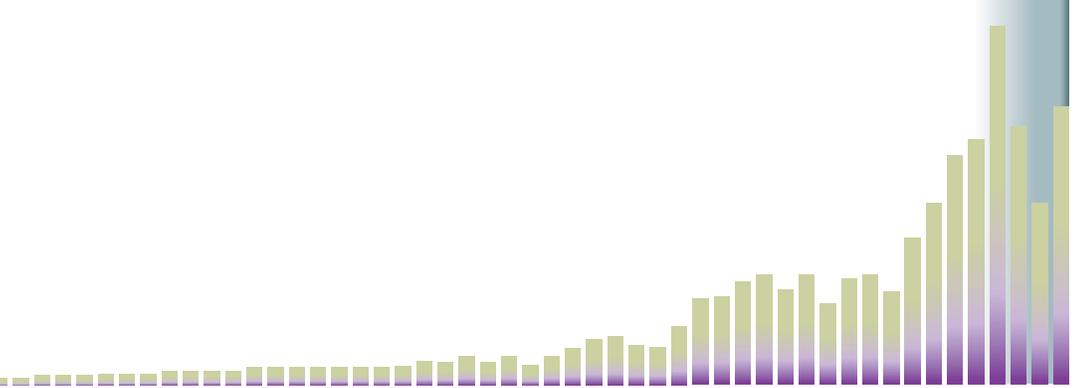


TABLE 5.3 (Cont.)
Major Infrastructure Projects Programmed with Highway Funding in the Recommended Plan with Costs

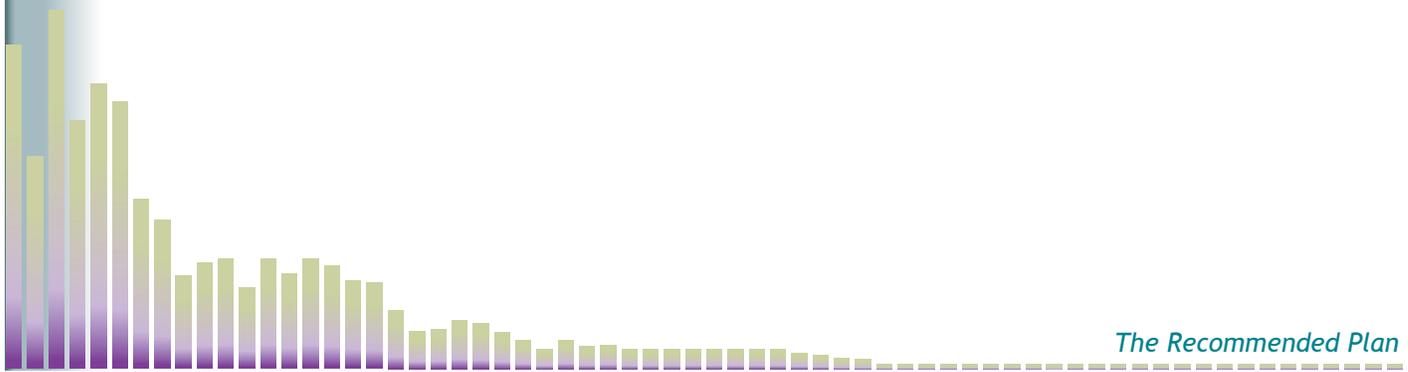
Project Name	Current Investment Cost Category	FFY 2016–2020	FFY 2021–2025	FFY 2026–2030	FFY 2031–2035	FFY 2036–2040	MPO Funding
Major Infrastructure		\$327,918,708	\$202,767,426	\$274,677,700	\$0	\$0	\$805,363,835
Complete Street		\$17,295,037	\$152,018,630	\$177,609,859	\$321,301,910	\$268,037,266	\$936,262,701
Bicycle and Pedestrian		\$0	\$26,210,109	\$30,622,389	\$55,396,881	\$46,213,322	\$158,442,701
Intersection Improvement Program		\$0	\$73,388,304	\$85,742,690	\$155,111,267	\$129,397,301	\$443,639,562
Community Transportation		\$0	\$10,484,043	\$12,248,956	\$22,158,752	\$18,485,329	\$63,377,080
Unallocated Funds		\$96,434,334	\$0	\$0	\$103,801,300	\$246,472,000	\$446,707,634
Total		\$441,648,079	\$464,868,512	\$580,901,594	\$657,770,110	\$708,605,218	\$2,853,793,514
% Major Infrastructure		74%	44%	47%	0%	0%	28%
% Complete Street		4%	33%	31%	49%	38%	33%
% Bicycle and Pedestrian		0%	5%	5%	8%	6%	6%
% Intersection Improvement Program		0%	16%	15%	24%	18%	16%
% Community Transportation		0%	2%	2%	3%	3%	2%
% Unallocated Funds		22%	0%	0%	16%	35%	15%
% Total		100%	100%	100%	100%	100%	100%

TABLE 5.4
Highway Bridges with Estimated Costs of More than \$20 Million

Municipality	Project	FFY 2016– 2020	FFY 2021– 2025	FFY 2026– 2030	FFY 2031– 2035	FFY 2036– 2040
Hanover and Norwell	Superstructure Replacement Route 3 over Route 123 (Webster Street) and Route 3 over Route 123 (High Street)	\$41,955,600				
Boston	North Washington Street over the Charles River	\$117,208,000				
Lynn and Saugus	Route 107 over the Saugus River	\$45,000,000				
Total Statewide Bridge Program		\$204,163,600				



PROJECT DESCRIPTIONS



BEDFORD AND BILLERICA: MIDDLESEX TURNPIKE, PHASE 3 (\$26,935,000)

Project Description

The proposed improvements will widen Middlesex Turnpike from 800 feet north of Plank Street to 900 feet north of Manning Road. This will provide two lanes in each direction, making it a four-lane highway with a median. There will be left-turn lanes at key intersections. The improvements span approximately 1.5 miles and include reconstructing the bridge over the Shawsheen River. The roadway's cross-section width will increase to 70 feet, and the total right-of-way will be 85 feet wide. Each direction will consist of a 14-foot outside travel lane, a 13-foot inside travel lane, and a 16-foot median. The median will be reconfigured at key intersections and driveways as a 4-foot median with a 12-foot protected left-turn lane. On the east side of the 70-foot travel way is a 7-foot grass strip, and on the west side are a 3-foot grass strip and a 4-foot concrete sidewalk.

Project Context and Possible Impacts by MPO Goal

CAPACITY MANAGEMENT/MOBILITY

Roadways:

A draft environmental impact report (DEIR) for earlier phases of this project, completed in 1995, contained a roadway segment capacity analysis. This analysis showed that the Middlesex Turnpike operated at level of service (LOS) E in the AM and PM peak hours; and, at six out of seven intersections along this roadway, the critical movement in the AM and PM peak hours operated at LOS F. In terms of delay, Congestion Management Process (CMP) monitoring conducted in 2002 found that the average travel speed is less than 70 percent of the posted speed along four segments in both the northbound and southbound directions, in both the AM and PM peak periods. MassDOT traffic counts as recent as 2007 show average weekday traffic ranging between 15,000 and 25,000 vehicles between Billerica and Burlington.

Transit:

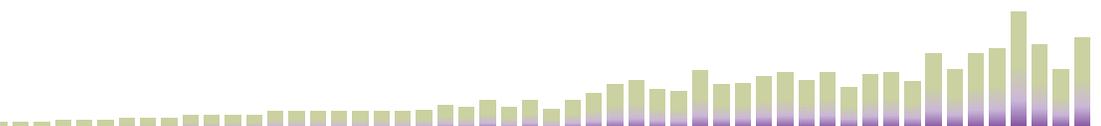
The MBTA and the Lowell Regional Transit Authority (LRTA) provide bus service in this corridor that connects with the downtown areas of Boston and Lowell.

Pedestrians/bicycles:

This project will add three miles of new bicycle lanes and rebuilt sidewalks.

SAFETY

There are no high-crash locations within the study area for the years 2010 to 2012, according to MassDOT's list of the top-200 high-crash intersections.



SYSTEM PRESERVATION

Three lane-miles of substandard pavement and one substandard bridge will be replaced as part of this project.

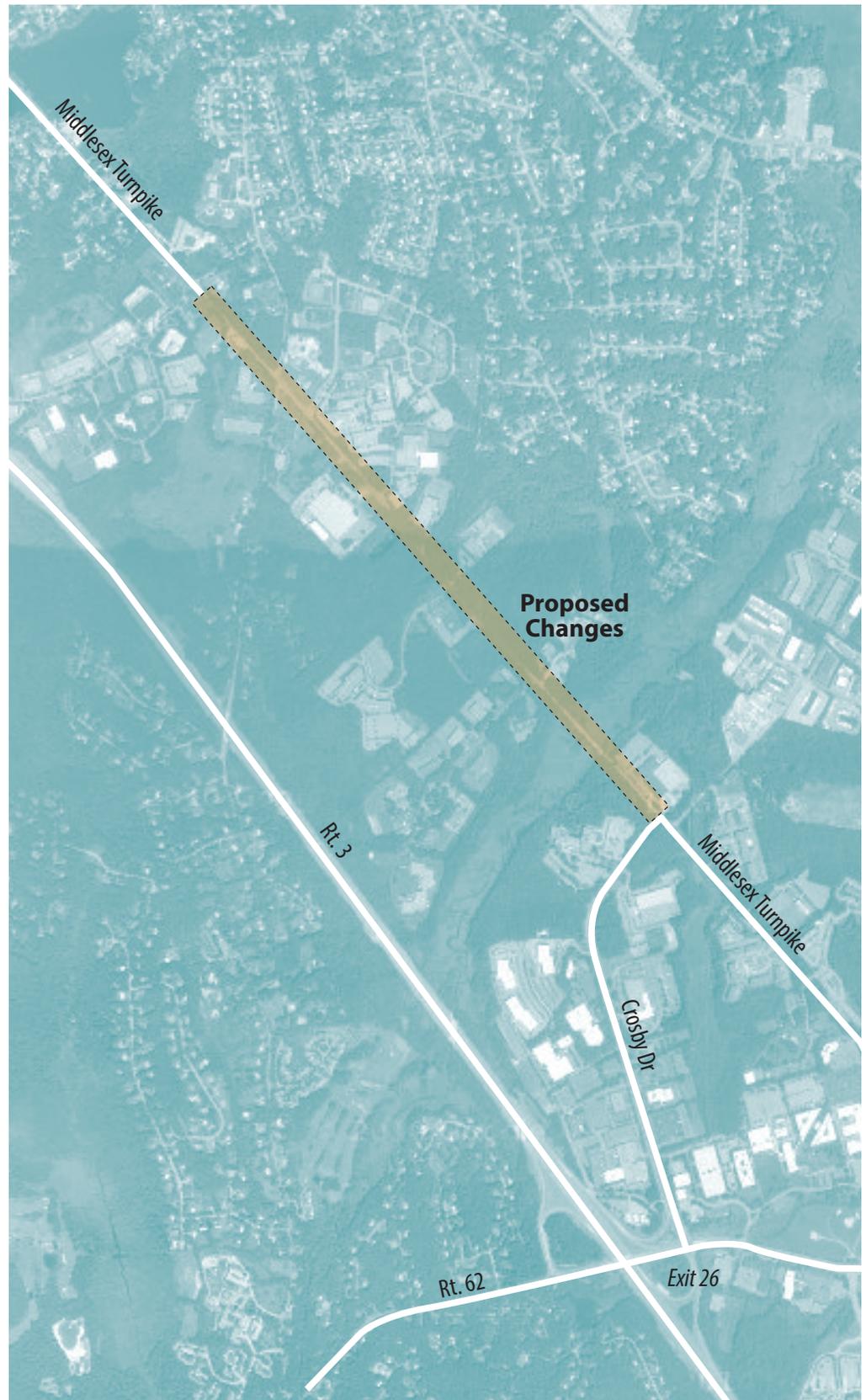
ECONOMIC VITALITY

The project consists of a corridor that spans two communities, Bedford and Billerica. The area in Bedford is zoned for industrial park, industrial, general business, and residential uses. The area in Billerica is zoned for industrial uses.

This phase of the reconstruction of the Middlesex Turnpike is in Bedford and Billerica, immediately north of an MPO-designated priority development area in Burlington. This project will improve access to the priority development area from US Route 3.

TRANSPORTATION EQUITY

This project is not within an environmental justice (EJ) area.



BOSTON: RUTHERFORD AVENUE/SULLIVAN SQUARE (\$109,967,000)

Project Description

The Rutherford Avenue project seeks to transform the corridor’s highway-like design into a multimodal urban boulevard. The Rutherford Avenue corridor in the Charlestown neighborhood of Boston extends about 1.5 miles from the North Washington Street Bridge to the Sullivan Square MBTA Orange Line station. The existing corridor consists of 8 to 10 lanes that facilitate high-speed automobile travel. Although this roadway layout served high volumes of traffic during construction of the Central Artery/Tunnel project, it now acts as a barrier to the neighborhood. The existing roadway creates significant challenges and safety issues for pedestrians and bicyclists seeking to reach various destinations, including Bunker Hill Community College, Paul Revere Park, the Hood Business Park employment area, and MBTA rapid transit stations.

Project Context and Possible Impacts by MPO Goal

CAPACITY MANAGEMENT/MOBILITY

Roadways:

The proposed roadway design includes mobility improvements for all modes through widened sidewalks, shortened crossings, on-street parking lanes, bicycle lanes, and exclusive bus lanes to improve bus operations at the Sullivan Square Station. The project provides improvements around Sullivan Square by reconfiguring the roadways into an urban grid system of streets to regularize traffic movements. The at-grade urban boulevard will eliminate the underpasses at Sullivan Square and Austin Street, add a 12 to 16-foot-wide landscaped median, and reduce the roadway to two lanes in each direction, with turn lanes at intersections.

Transit:

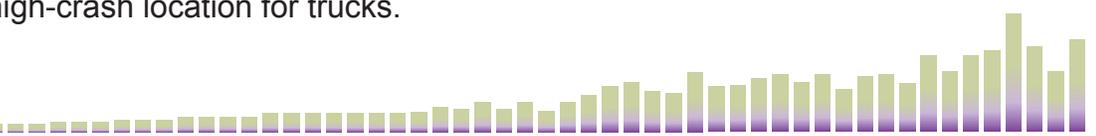
The designation of exclusive bus lanes at Sullivan Square Station also will improve operations for 12 MBTA bus routes served by almost 900 trips each day. The safety and convenience of street crossings for pedestrians accessing MBTA services will be improved.

Pedestrians/bicycles:

By transforming the highway-like roadway into a multimodal urban boulevard, the project will improve pedestrian and bicycle safety, and access to the Community College and Sullivan Square MBTA stations on the Orange Line. The livability elements consist of adding 10-foot sidewalks, creating a 20 to 40-foot linear park or buffer, installing ten traffic signals and crosswalks, shortening crossings, planting 900 trees, and possibly adding a 5-foot wide bike lane in the southbound direction.

SAFETY

There is one Highway Safety Improvement Program crash cluster in the project area. The project area is also identified as a high-crash location for trucks.





SYSTEM PRESERVATION

Nine lane-miles of substandard pavement will be replaced and three substandard bridges eliminated as part of this project.

ECONOMIC VITALITY

The plans for reconfiguring the Sullivan Square roadway network also provide an opportunity to create land parcels for transit-oriented-development that will be well suited and well located for commercial and residential redevelopment by the private sector. Many of the parcels in the Sullivan Square area are publicly owned, by either the MBTA or the City of Boston, which creates the potential for public-private partnerships.

TRANSPORTATION EQUITY

This project is not in an EJ area, but it is within a half-mile of an EJ area in the neighboring city of Somerville.

FRAMINGHAM: ROUTE 126/ROUTE 135 GRADE SEPARATION (\$115,000,000)

Project Description

This alternative would provide a grade separated crossing at the intersection of Route 135 and Route 126. Route 135 would be depressed under Route 126, with Route 126 approximately maintaining its existing alignment. The depressed section of Route 135 would extend from approximately 500 feet west of Route 126 to approximately 480 feet east of Route 126. The westerly limit of the depressed section would begin immediately east of a potential Hollis Court Extension. The easterly limit of the depressed section would be approximately 125 feet west of the existing at-grade crossing of the Framingham secondary track.

Within the proposed Route 135 cross-section would be an underpass that would include two 11-foot travel lanes with 4-foot shoulders. Retaining walls would be constructed on both sides of the underpass. The remaining space within the project cross-section would be used for at-grade features including ramps connecting Route 135 with Route 126, and sidewalks.

The available cross-section would be constrained by existing buildings on both sides of the road west of the Route 126 intersection, including two buildings on the south side and the historic train station on the north side. The proposed cross-section, west of the intersection, would include a 30-foot pavement section with two three-foot thick retaining walls and two 10-foot wide at-grade sidewalks on Route 135.

East of the intersection, three buildings on the south side of Route 135 directly abut the sidewalk. On the north side, two small buildings sit between Route 135 and the Boston mainline tracks. The existing distance between the buildings is approximately 66 feet. In order to make a partial connection between Route 135 and Route 126, ramps will be provided on Route 135 east of the intersection. These would consist of a one-way, one-lane ramp eastbound from Route 126 to Route 135 and a one-way one-lane ramp westbound from Route 135 to Route 126.

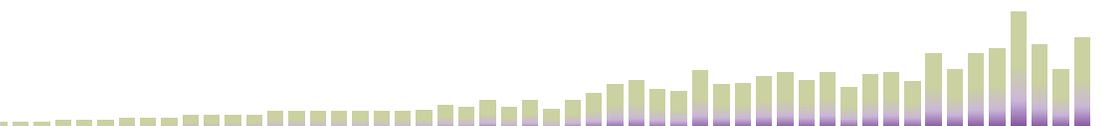
Side streets beyond the immediate vicinity of the intersection would be used to provide connections from eastbound Route 135 to Route 126 and from Route 126 to westbound Route 135. This would include the extension of Hollis Court, probably requiring new signals at the Route 126/Hollis Court and Route 135/Hollis Court Extension intersections.

Project Context and Possible Impacts by MPO Goal

CAPACITY MANAGEMENT/MOBILITY

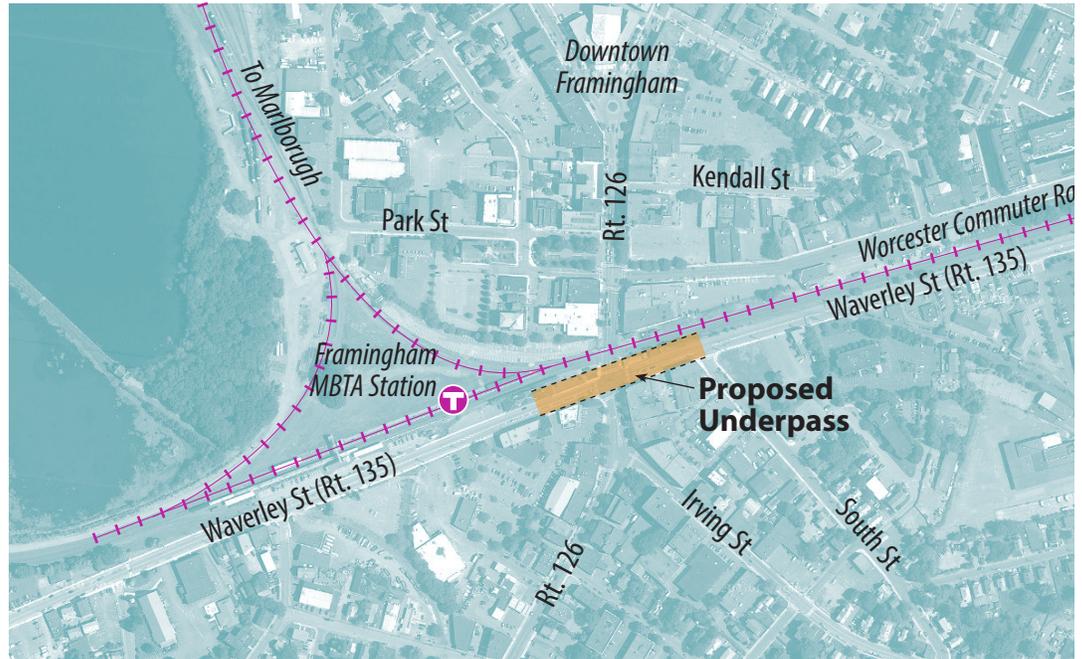
Roadways:

This project will allow traffic on Route 135 to bypass the intersection with Route 126. According to MassDOT 2005 traffic volume data, average daily traffic (ADT) at this location is 19,700 vehicles on Route 126 and 15,700 vehicles on Route 135. The Route 126/Route 135 intersection functions at LOS F in the AM and PM peak periods.



Transit:

The Framingham commuter rail station is located near the project site; and key Metrowest bus Routes 2, 3, and 7 now terminate at the station. Pedestrian and bicycle access to the station via Route 126 from the south will be improved since most of Route 135 traffic would now be below-grade.



Pedestrians/bicycles:

Project area sidewalks will be reconstructed and north-south travel by non-motorized modes will be facilitated.

SAFETY

This project area includes one of the top-200 Massachusetts crash locations, a situation that has existed for a number of years.

SYSTEM PRESERVATION

This project will rebuild one-half mile of roadway in its existing configuration.

ECONOMIC VITALITY

This project is entirely within an MPO-designated priority development area and is expected to be a catalyst for redevelopment of the downtown Framingham central business district.

This project is located in Framingham's central business district, which, according to the Executive Office of Environmental Affairs and the Metropolitan Area Planning Council's build-out analysis, is subject to absolute development constraints, but also is a designated redevelopment district. According to the *Route 126 Corridor Study*, the construction of this project would help facilitate redevelopment by making the downtown area more attractive and providing redevelopment sites through the partial taking of business sites as necessary for the roadway work.

As currently envisioned, the project includes many streetscape amenities and will facilitate downtown redevelopment, including possible facade improvements near the town common. The project also eliminates a significant congestion point in downtown Framingham.

TRANSPORTATION EQUITY

This project is entirely within an EJ area.



LEXINGTON: ROUTE 4/225 (BEDFORD STREET) AND HARTWELL AVENUE (\$23,221,000)

Project Description

The proposed project would greatly enhance mobility and safety for vehicular, bicycle, and pedestrian traffic in the project area. The preferred alternative includes reconstruction of Hartwell Avenue and Bedford Street to provide:

- Four through-travel lanes throughout most of the project area
- Three travel lanes at the southern end of Hartwell Avenue
- A sidewalk or multi-use path on both sides of the roadway
- A paved shoulder with bike lane on both sides of the roadway
- A raised center median to restrict mid-block left-turn movements
- Reconstruction of major intersections as multi-lane roundabouts

Project Context and Possible Impacts by MPO Goal

CAPACITY MANAGEMENT/MOBILITY

Roadways:

MassDOT traffic counts in 2005 found average weekday traffic of:

- 38,800 vehicles on Route 4/225 south of Hartwell Avenue
- 25,600 vehicles on Route 4/225 north of Hartwell Avenue
- 18,000 vehicles on Hartwell Avenue

The CMP has found that the average travel speed is less than 70 percent of the posted speed during the AM peak period and less than 60 percent in the PM peak. The section of Route 4/225 south of Hartwell Avenue already has four lanes. One or two additional lanes will be added to the other roadway sections.

Transit:

The MBTA provides bus service in this corridor connecting with the Red Line at Alewife station.

Pedestrians/bicycles:

This project will add four miles of new bicycle lanes and sidewalks.

SAFETY

There are two Highway Safety Improvement Program crash clusters in the project area.





SYSTEM PRESERVATION

Five lane-miles of substandard pavement will be replaced as part of this project.

ECONOMIC VITALITY

This project serves an existing area of concentrated development. There is potential for further development in this area, which would be facilitated by this project.

TRANSPORTATION EQUITY

This project is not within an EJ area.

NATICK: ROUTE 27 OVER ROUTE 9, BRIDGE AND INTERCHANGE REPLACEMENT (\$25,793,000)

Project Description

This project will reconstruct the Route 27 overpass that spans Route 9 and the associated cloverleaf-style ramps. While the basic configuration of the interchange will not change, reconstruction of all elements to current roadway design standards will address serious safety deficiencies and reduce traffic delay by providing new turning lanes.

Project Context and Possible Impacts by MPO Goal

CAPACITY MANAGEMENT/MOBILITY

Roadways:

MassDOT traffic counts in 2008 found average weekday traffic on Route 27 to be about 27,000 vehicles near the Route 9 overpass. Historic traffic growth at this location has been about 0.3 percent per year. Congestion is apparent in the existing conditions because of lengthy peak-period queues; one PM queue in a turning lane exceeds 1000 feet.

Transit:

Four bus routes of Metrowest Regional Transit Authority (MWRTA) operate in the study area.

Pedestrians/bicycles:

This project will add one mile of new bicycle lanes and one mile of new or rebuilt sidewalks.

SAFETY

This project is located at one of the top-200 Massachusetts crash locations between 2010 and 2012.

SYSTEM PRESERVATION

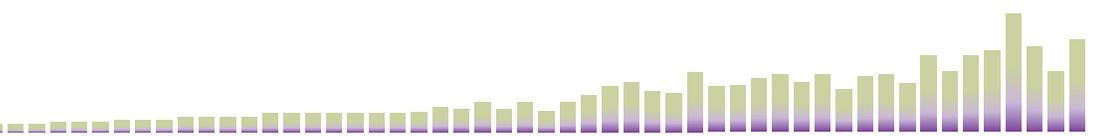
One lane-mile of substandard pavement and one substandard bridge will be replaced as part of this project.

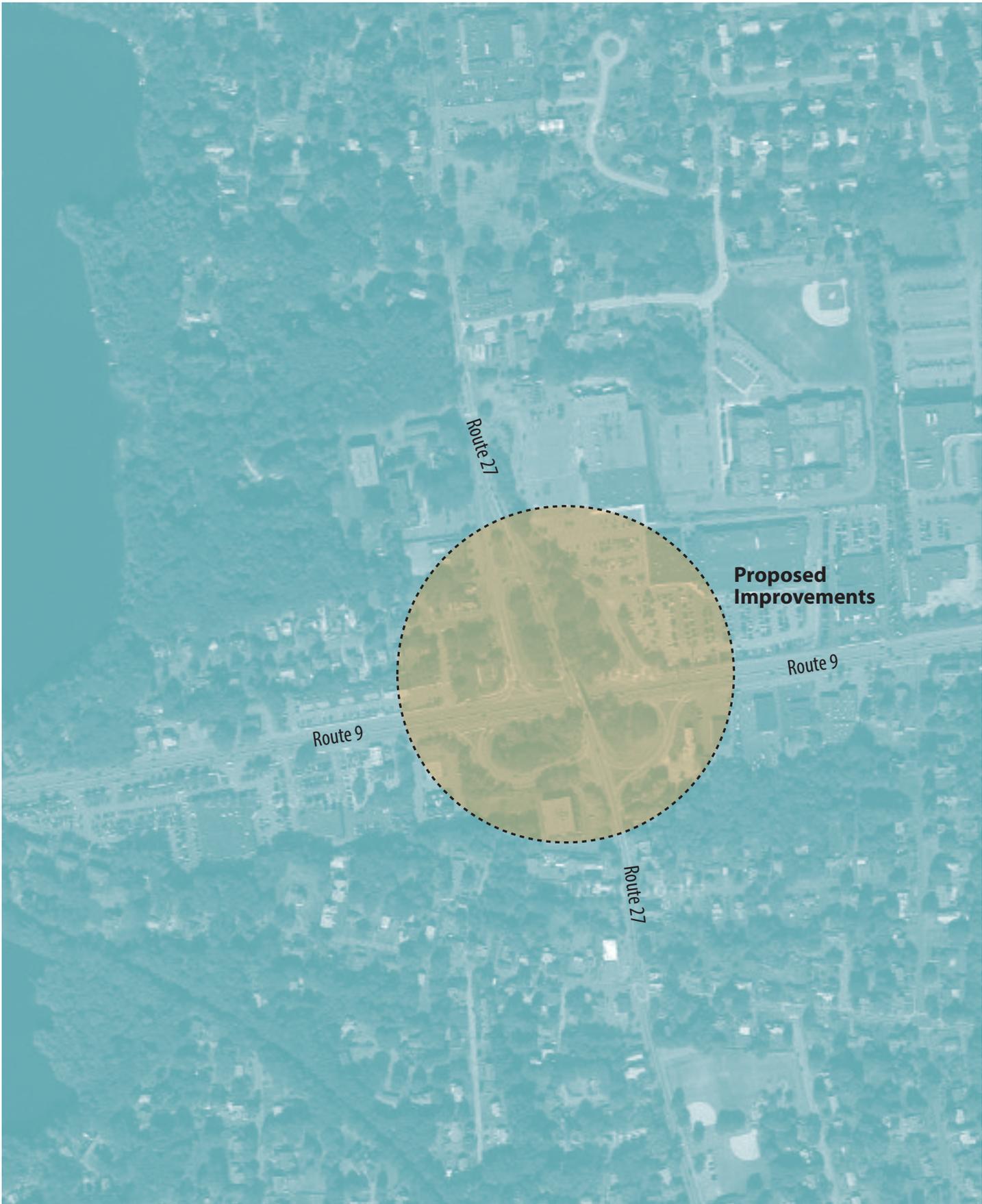
ECONOMIC VITALITY

The project serves an existing area of concentrated development. Few land-use-related benefits are projected.

TRANSPORTATION EQUITY

This project is not within an EJ area.





NEEDHAM AND NEWTON: NEEDHAM STREET/HIGHLAND AVENUE (\$14,298,000)

Project Description

This project will maintain Needham Street with a three-lane cross-section from the Needham Street/Winchester Street/Dedham Street intersection in Newton to the bridge over the Charles River at the Needham town line. The roadway will be rehabilitated and widened to include bicycle lanes, new sidewalks, reconfigured intersections, and updated traffic signals. The Highland Avenue portion of the project will improve the roadway's geometry from the Highland Avenue/Webster Street intersection in Needham to the Newton town line. Work will include upgrades and installation of traffic signals at five intersections. The project also will include reconstructing and widening the bridge over the Charles River to accommodate four travel lanes.

Project Context and Possible Impacts by MPO Goal

CAPACITY MANAGEMENT/MOBILITY

Roadways:

CMP monitoring in 2001–02 indicated that the average travel speed on both Needham Street and Highland Avenue was 15 miles per hour (mph) or less (LOS E/F) along multiple segments of this corridor northbound and southbound during the AM and PM peak periods. Counts performed as part of MassDOT's Highland Avenue Corridor Improvements Functional Design Report (FDR) in 2002, showed that average daily traffic (ADT) on Highland Avenue east of First Street (just east of I-95 and between the two other count locations) was 36,700 vehicles; counts as recent as 2008 have found similar traffic volumes.

Transit:

Two MBTA bus routes with 86 weekday trips travel through the project area.

Pedestrians/bicycles:

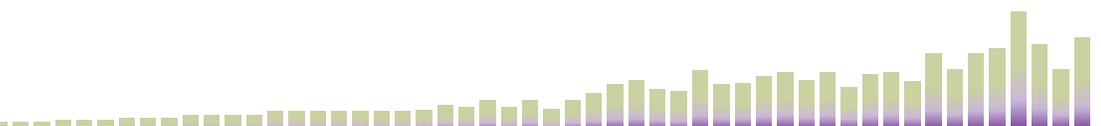
Roadway rehabilitation will include bicycle accommodation, six miles of new sidewalks, reconfigured intersections, and updated traffic signals to facilitate non-motorized travel options.

SAFETY

There are three Highway Safety Improvement Program crash clusters in the project area, which also is identified as a high crash location for trucks.

SYSTEM PRESERVATION

Nine lane-miles of substandard pavement will be replaced and one substandard bridge rehabilitated as part of this project.





ECONOMIC VITALITY

The project area in Newton along Needham Street is zoned as residential from Route 9 north, and as mixed-use and multi-unit residential from Route 9 south to the Needham town line. The project area in Needham is zoned as industrial from east of I-95 to the Newton town line and as residential west of I-95.

According to both the Highland Avenue Corridor Improvements FDR and the proposed Stop & Shop supermarket draft environmental impact report, this project would help facilitate redevelopment along this corridor.

TRANSPORTATION EQUITY

This project is not within an EJ area.

SOMERVILLE: MCGRATH BOULEVARD (\$56,600,000)

Project Description

The proposed improvements will remove the existing McCarthy Viaduct and replace it with an at-grade boulevard approximately 0.7 miles long, from the Gilman Street Bridge in the north to Squires Bridge in the south. The project will provide pedestrian and bicycle accommodation along the length of the reconstructed corridor, and result in more conventional intersection configurations at Washington Street and Somerville Avenue, which currently travel under or next to the viaduct. Removing the viaduct will physically reconnect the neighborhoods of Somerville with more direct vehicle, pedestrian, bicycle, and transit networks.

Project Context and Possible Impacts by MPO Goal

CAPACITY MANAGEMENT/MOBILITY

Roadways:

The elevated viaduct currently serves vehicles driving through Somerville to points north and south, but physically divides the Somerville neighborhoods directly to the east and west. The existing surface roadway network below the viaduct includes a series of unconventional intersections that cause confusion and present some safety concerns. The proposed McGrath Boulevard will create conventional intersections that provide clear direction and safer operation for all modes of transportation along the corridor.

Transit:

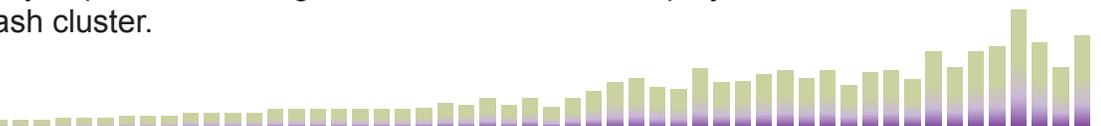
MBTA Routes 80 (Arlington Center to Lechmere) and 88 (Clarendon Hill to Lechmere) provide bus service in this corridor, with connections to the MBTA Green Line at Lechmere Station, and will have direct access to the Green Line Extension in the future, connecting the corridor to Boston, Cambridge, and Medford. Removing the viaduct will provide additional connectivity for existing bus routes along and across the proposed McGrath Boulevard.

Pedestrians/Bicycles:

New sidewalks and bicycle facilities will be provided for the length of the proposed McGrath Boulevard, creating safe and comfortable accommodation for users. Removing the viaduct will dramatically improve connections across McGrath Boulevard in the east/west direction, encouraging travel at a neighborhood scale. Mobility between communities on either side of the existing viaduct—including Union Square, Inner Belt, Gilman Square, and East Somerville—will improve vastly. The proposed bicycle and pedestrian facilities along McGrath Boulevard will connect with the extended Community Path, creating access to a more regional bicycle transportation network. The proposed facilities also will provide direct intermodal connections to existing bus routes and the new Green Line Station.

SAFETY

There are two Highway Safety Improvement Program crash clusters in the project area, as well as a bicycle and a pedestrian crash cluster.





SYSTEM PRESERVATION

Three lane-miles of substandard pavement, 1.5 miles of substandard sidewalk, and a substandard bridge will be improved as part of this project. Eliminating the McCarthy viaduct also will serve to reduce long-term maintenance costs.

ECONOMIC VITALITY

The project provides access to the Inner Belt/Brickbottom, Union Square, and Boynton Yards Priority Development Areas in Somerville, which are designated for mixed-use commercial and residential development. Redeveloping these three areas in Somerville should add 3,000 new housing units and an additional 6.5-million square feet of commercial development.

TRANSPORTATION EQUITY

This project is in an EJ area; and will improve transit, pedestrian, and bicycle access within the project corridor.

WEYMOUTH: ROUTE 18 CAPACITY IMPROVEMENTS PROJECT (\$58,822,000)

Project Description

This project will widen Route 18 to two continuous lanes in each direction (with four-foot shoulders) between Highland Place/Charmada Road (south of Middle/West Street) in Weymouth and Route 139 in Abington. Sidewalks will be constructed and the Route 18 bridge over the MBTA Plymouth commuter rail line will be reconstructed and widened.

Intersection improvements—including additional left- and right-turn lanes and some roadway widening between intersections on Route 18 from Route 3 to Route 139, and the Middle/West Street intersection. Park Avenue, Columbian Road, and Pond and Pleasant Streets—will be constructed as separate projects.

Project Context and Possible Impacts by MPO Goal

CAPACITY MANAGEMENT/MOBILITY

Roadways:

According to Highway Division traffic counts, the average daily traffic volumes on Route 18 along this stretch of roadway are as follows:

Weymouth:

- North of West Street (2009 counts) – 33,900 vehicles
- North of Park Avenue (2000 counts) – 31,200 vehicles
- North of Pond Street (2009 counts) – 25,900 vehicles

Abington:

- North of Route 139 (2000 counts) – 19,500 vehicles

Intersection analyses were performed as part of the South Weymouth Access Study in August 2000. Existing LOS during the PM peak period were as follows:

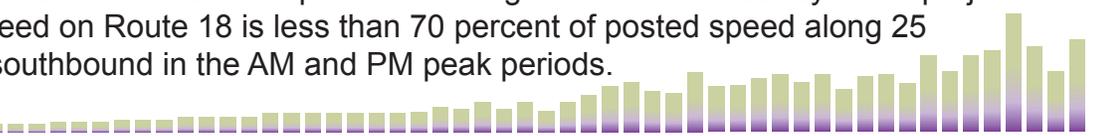
Weymouth:

- Route 18/West Street – LOS E
- Route 18/Pleasant Street – LOS D
- Route 18/Park Avenue – LOS C
- Route 18/Trotter Road – LOS D
- Route 18/Columbian Street – LOS E

Abington:

- Route 18/Route 139 – LOS D

According to 2002 CMP monitoring performed by CTPS, the average AM and PM speed on Route 18 northbound and southbound is less than 15 mph for three segments of the roadway in the project area. The average travel speed on Route 18 is less than 70 percent of posted speed along 25 segments northbound and southbound in the AM and PM peak periods.



Six signalized intersections in the project area are among the top-25 most delayed intersections (monitored as part of the CMP roadway network) for the South Shore Coalition MAPC subregion in the PM peak period.

Transit:

Route 18 provides access to the South Weymouth commuter rail station on the Plymouth Line. The South Shore Tri-Town Development Corporation, responsible for redeveloping the South Weymouth Naval Air Station, is proposing an expanded, multimodal station in conjunction with the existing South Weymouth commuter rail station. Route 18 is currently served by one MBTA bus route.

Pedestrians/bicycles:

The project will provide eight miles of new sidewalks and on-road bicycle accommodation to enhance pedestrian and bicyclist access along the corridor.

SAFETY

This project area includes six of the top-200 Massachusetts crash locations between 2010 and 2012. Four high-crash locations for trucks also are located in the project area.

SYSTEM PRESERVATION

Eight lane-miles of substandard pavement and one substandard bridge will be replaced as part of this project.

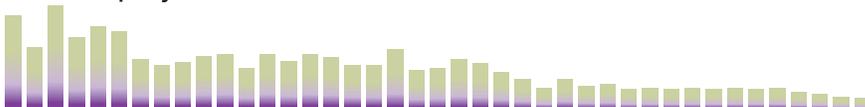
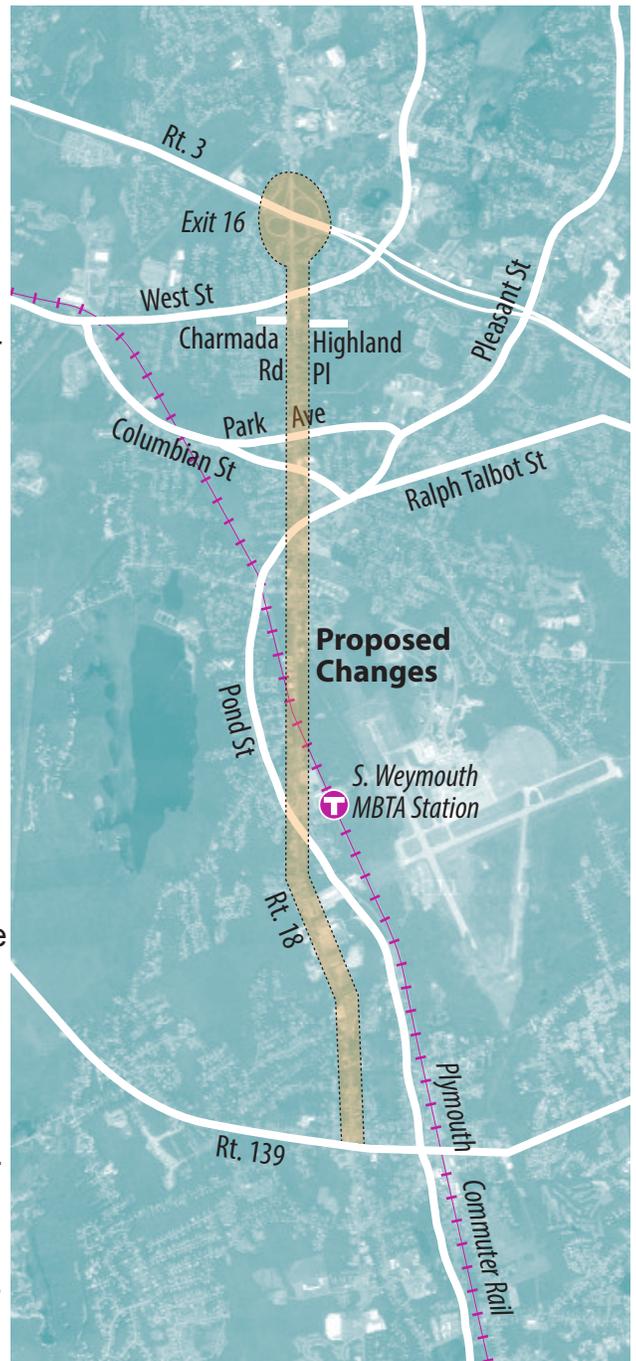
ECONOMIC VITALITY

Zoning along the Route 18 corridor in Weymouth includes residential, highway transition, medical services (South Shore Hospital and other related medical facilities), limited business, and general business. Zoning along Route 18 in Abington is industrial or highway commercial.

This project is a component of the development plan for the former South Weymouth Naval Air Station, which involves redeveloping the 1,450-acre site, consistent with the re-use plan formula. The South Shore Tri-Town Development Corporation foresees corporate office park, entertainment, and recreation use for the site, with more than 60 percent open space (recreational and conservation).

TRANSPORTATION EQUITY

This project is not within an EJ area.



WOBURN: MONTVALE AVENUE (\$4,225,000)

Project Description

This is an arterial and intersection improvement project along Montvale Avenue from Central Street to east of Washington Street in the City of Woburn. It includes the following improvements:

- Widening Montvale Avenue to four lanes and providing turning lanes at Washington Street
- Reconstructing roadways and sidewalks
- Installing a new traffic signal system at Central Street and modifying phasing and timing at Washington Street

Project Context and Possible Impacts by MPO Goal

CAPACITY MANAGEMENT/MOBILITY

Roadways:

The proposed project area serves as a critical connection between I-93, I-95, and the surrounding Woburn area. According to counts collected by MassDOT in 2008, ADT along Montvale Avenue east of Washington Street was 29,100 vehicles. Under 2007 traffic conditions, the intersection at Montvale Avenue and Washington Street operated at LOS C in the AM and PM peak periods, while the Montvale Avenue and Central Street intersection operated at LOS A in the AM and LOS B in the PM peak period. Although the LOS is acceptable, the proposed improvements will better utilize lanes and increase coordination between intersections to accommodate increasing traffic volumes.

Transit:

The project will enhance the operations of MBTA bus Routes 354 and 355 served by 38 weekday trips.

Pedestrians/bicycles:

The project will reconstruct one-half mile of sidewalk, which will improve pedestrian and bicycle access to nearby schools and activities.

SAFETY

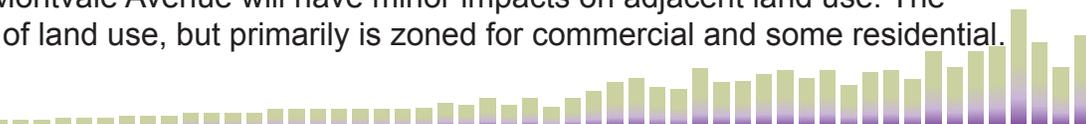
This project is located at one of the top-200 Massachusetts crash locations between 2010 and 2012.

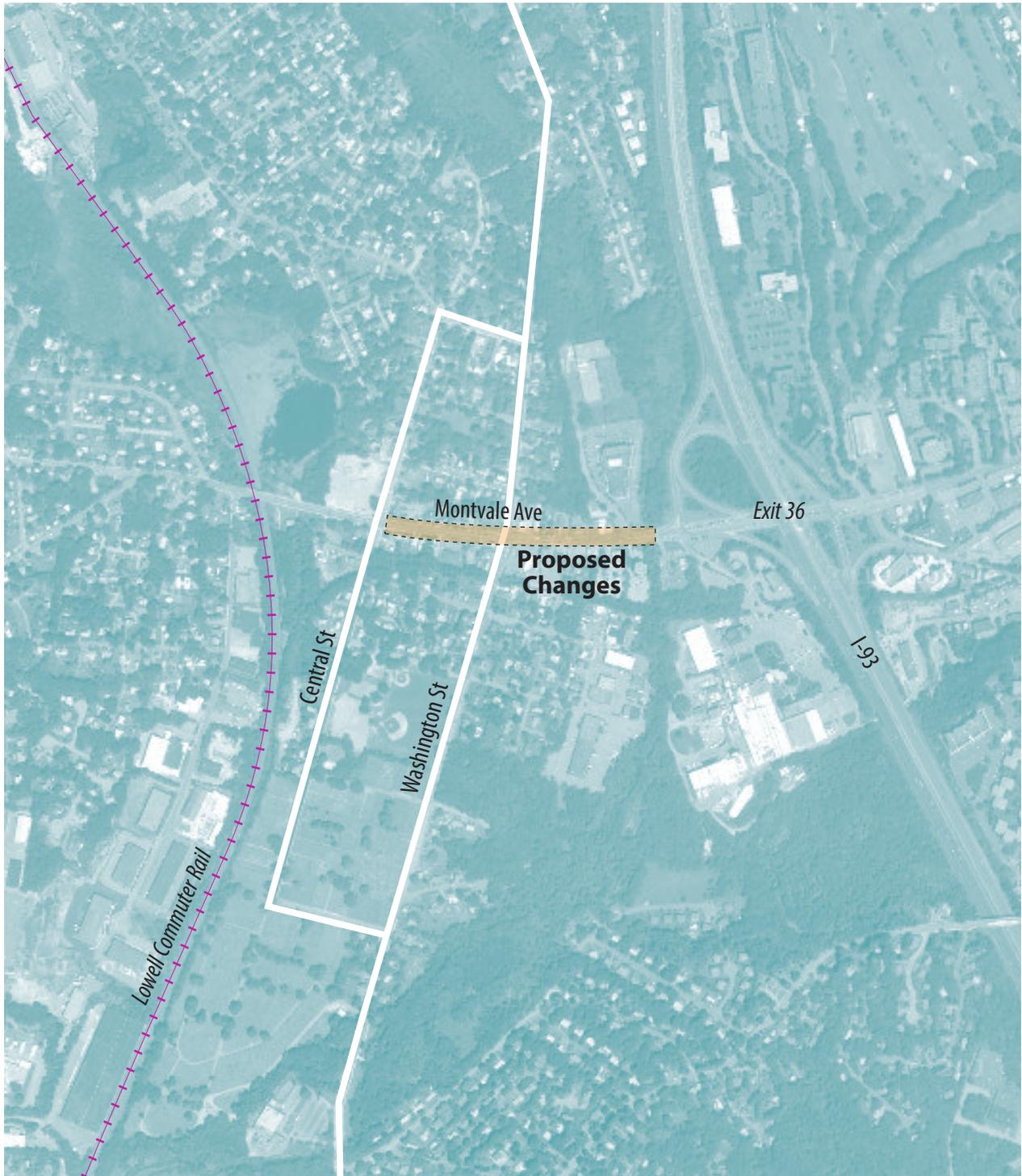
SYSTEM PRESERVATION

One lane-mile of substandard pavement will be replaced as part of this project.

ECONOMIC VITALITY

The proposed widening of Montvale Avenue will have minor impacts on adjacent land use. The project area contains a mix of land use, but primarily is zoned for commercial and some residential.





Maximum parking requirements and transportation demand management (TDM) requirements for all new developments are imposed. The project will improve pedestrian and disability access by widening the existing four-foot-wide sidewalks to five or six feet, and adding wheelchair ramps.

TRANSPORTATION EQUITY

This project is not in an EJ area.

WOBURN: NEW BOSTON STREET BRIDGE (\$9,707,000)

Project Description

A bridge on New Boston Street at the northern end of Woburn Industrial Park will be constructed. New Boston Street then will cross the MBTA's Lowell Line and connect with Woburn Street in Wilmington. This connection existed until approximately 30 years ago when the bridge was destroyed by fire and not reconstructed. Also included is the reconstruction of approximately 1,850 feet of New Boston Street.

Project Context and Possible Impacts by MPO Goal

CAPACITY MANAGEMENT/MOBILITY

Roadways:

No traffic studies have been performed to date; however, re-opening this bridge would provide a second means of access to the growing Industri-Plex area for residents of Wilmington and communities to the north, as well as for emergency vehicles from the North Woburn fire station.

Transit:

The Anderson Regional Transportation Center (RTC) is located just south of the proposed New Boston Street Bridge. The new bridge would provide an additional automobile access point for park-and-ride and transit services offered at the RTC.

Pedestrians/bicycles:

Non-motorized modes will be major beneficiaries of this project. The new network link will eliminate the need to use very circuitous alternate routes for many local and regional trips.

SAFETY

There is no recent crash history at the project location. Safety benefits may be realized at other locations that will have less traffic.

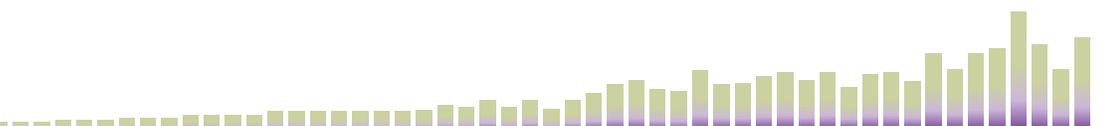
SYSTEM PRESERVATION

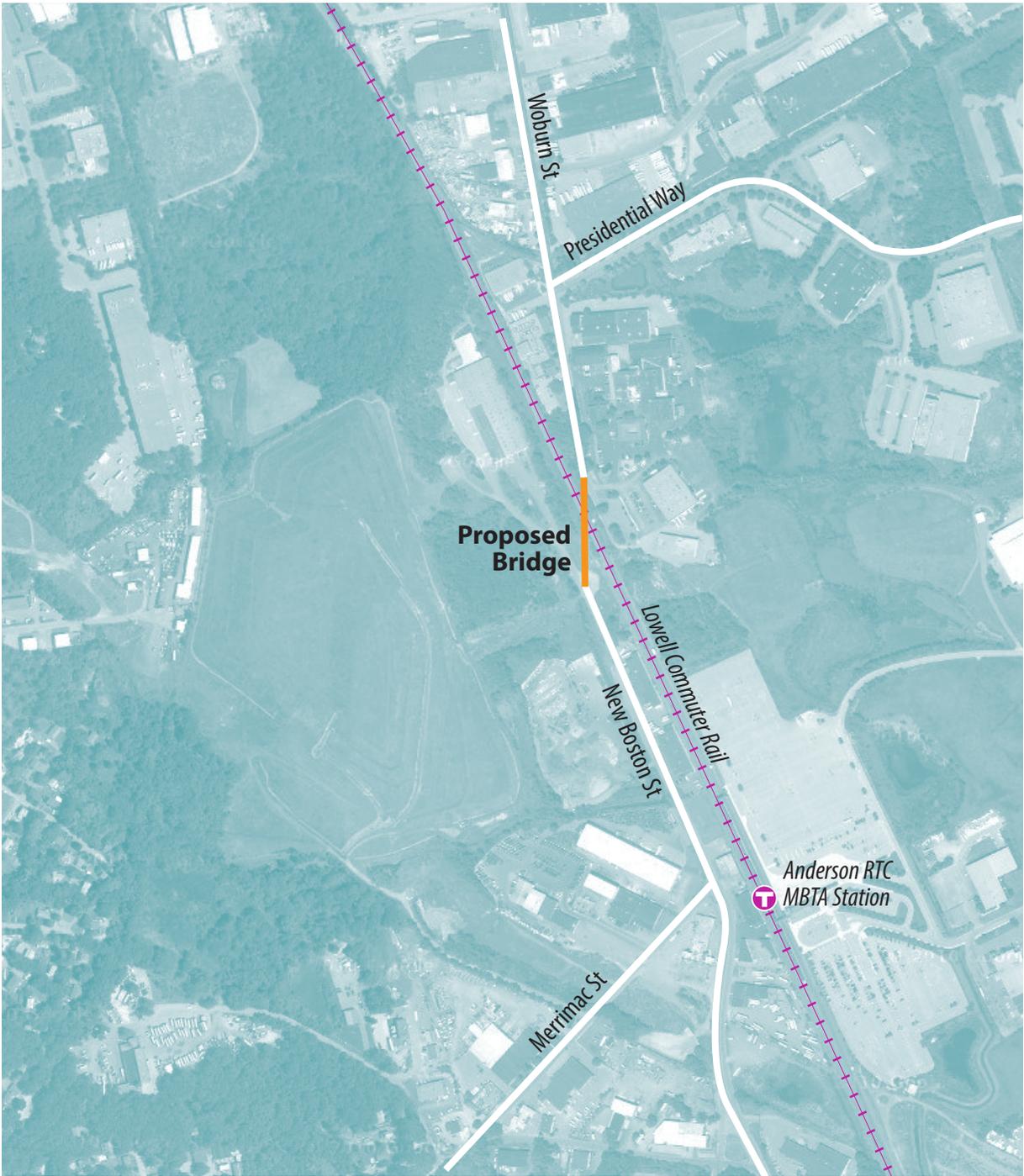
An existing stretch of New Boston Street will be rebuilt as part of this project.

ECONOMIC VITALITY

This project is entirely within an MPO-designated priority development area.

The majority of the land in the New Boston Street area in Woburn is zoned for industrial use; existing development in the area is primarily commercial/industrial. With the opening of the Anderson RTC and I-93 Interchange 37C serving the Industri-Plex developments, the city of Woburn anticipates more office and retail development in the project area over the next few years. Just north of the





proposed project in Wilmington, the land is zoned industrial and includes Southeast Wilmington Industrial Park. Further north on Woburn Street in Wilmington, the land is zoned residential up to Route 129.

TRANSPORTATION EQUITY

This project is not within an EJ area.

SOMERVILLE AND MEDFORD: GREEN LINE EXTENSION PROJECT (PHASE I: LECHMERE STATION TO COLLEGE AVENUE/UNION SQUARE AND PHASE II: COLLEGE AVENUE TO MYSTIC VALLEY PARKWAY/ROUTE 16 - \$190,000,000)

Project Description

This project—whose purpose is to improve corridor mobility, boost transit ridership, improve regional air quality, ensure equitable distribution of transit services, and support opportunities for sustainable development—will extend the MBTA Green Line in two separate phases. Phase I will extend the Green Line from a relocated Lechmere Station in East Cambridge to College Avenue in Medford, with a branch to Union Square in Somerville. Phase II will further extend the Green Line from College Avenue to Mystic Valley Parkway (Route 16) at the Somerville/Medford municipal boundary.

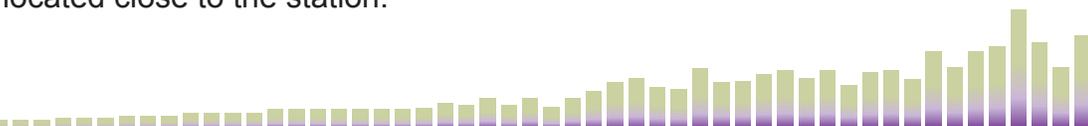
PHASE I

Lechmere Station to College Avenue with a branch to Union Square (State Implementation Plan commitment). This phase of the project is part of the no-build network but is included here to provide a full description of the project. It is funded with a combination of Commonwealth funds and federal transit funds.

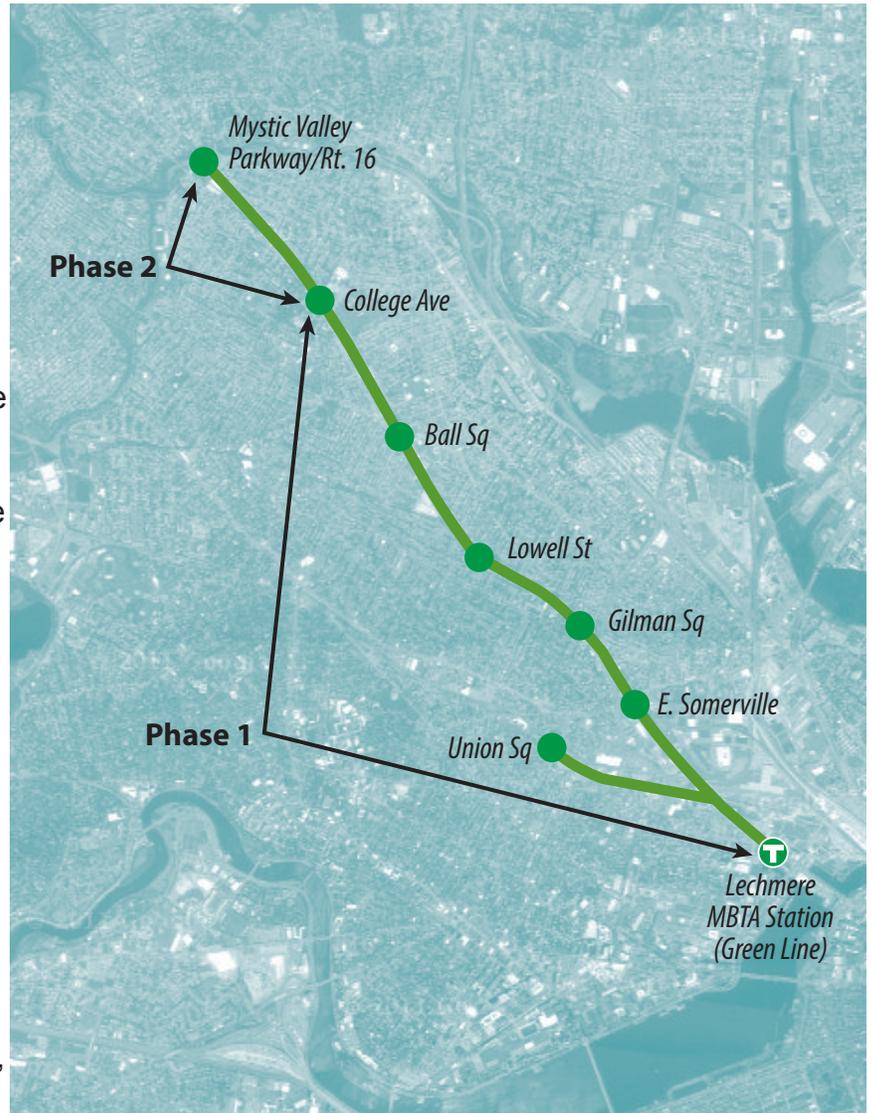
Proposed Stations

New Green Line stations are currently proposed for:

- College Avenue, Medford – Located at the intersection of College Avenue and Boston Avenue in Medford, adjacent to Tufts University. The station platform will be located on the north side of the College Avenue Bridge, which spans the MBTA Lowell Line. Access to the station will be provided from both Boston Avenue and College Avenue, as well as from the Burget Avenue neighborhood, which lies northeast of the station site.
- Broadway/Ball Square, Medford/Somerville – Located at the intersection of Broadway and Boston Avenue on the north side of Ball Square. The station platform will be located on the north side of the Broadway Bridge, which spans the MBTA Lowell Line. Access to the station will be provided from both Boston Avenue and Broadway. An electrical substation, needed to support the Green Line Extension, likely would be installed at this location.
- Lowell Street, Somerville – Located at the Lowell Street Bridge, which spans the MBTA Lowell Line adjacent to the proposed extension of the Somerville Community Path. The station platform will be located on the north side of the Lowell Street Bridge. Access to the station will be provided from Lowell Street.
- Gilman Square, Somerville – Located near the Medford Street crossing of the MBTA Lowell Line, behind Somerville’s city hall, public library, and high school. The station platform will be located on the north side of the Medford Street Bridge, which spans the MBTA Lowell Line. Access to the station will be provided from Medford Street. The proposed extension of the Somerville Community Path will be located close to the station.



- Washington Street, Somerville – Located within the footprint of the Washington Street Bridge, proximate to Somerville’s Brickbottom, Inner Belt, and Cobble Hill areas. The station platform will be located south of the Washington Street under-grade crossing of the MBTA Lowell Line. Access to the station will be provided via entrances under or adjacent to the south abutment of the bridge, in conjunction with improved sidewalk and street crossings. The proposed extension of the Somerville Community Path will be located near the station.
- Union Square, Somerville – Located east of Prospect Street near Union Square in Somerville. The station platform will be located within the MBTA Fitchburg Line right-of-way east of Prospect Street. Access to this station will be provided from both the street and bridge levels of Prospect Street.



Details of the station designs—including the relationship of stations to pedestrian, bicycle, and bus networks around them—are being developed more fully.

The MBTA is engaging the public in creating the look and feel of the stations and their surroundings.

Vehicle Storage and Maintenance Facilities

The Green Line Extension will also require construction of a new light rail vehicle storage and maintenance facility. MassDOT has identified a location known as “Option L” in the Inner Belt area of Somerville as its preferred location for the vehicle support facility. The MBTA is currently working on the program and design of the maintenance facility and its associated vehicle storage areas. The MBTA must acquire certain parcels of private property in order to construct the vehicle facility at the Option L location.

PHASE II

College Avenue to Mystic Valley Parkway (Route 16)

This project is not part of the State Implementation Plan commitment. Boston Region MPO members think that this is an important project and voted to include this phase in the recommended LRTP by flexing highway funding to this transit project. Design has not yet begun for this project. The terminus would be a station at Mystic Valley Parkway (Route 16).

OTHER INVESTMENT PROGRAMS

In addition to the major investment program discussed in the previous section, the MPO programmed four other types of investment programs in the recommended LRTP:

1. Intersection Improvement
2. Complete Streets
3. Bicycle Network and Pedestrian Connection
4. Community Transportation/Parking/Clean Air and Mobility

Projects included as part of these programs can be programmed in the TIP directly without first being listed in the LRTP because they do not add capacity to the transportation network. They would need to be listed in the LRTP only if they cost more than \$20 million.

The first three programs include types of projects that are regularly programmed in the TIP. The fourth program—Community Transportation/Parking/Clean Air and Mobility—is a revival and expansion of the MPO’s Clean Air and Mobility program (which had been in hiatus for several years because of lack of funding). This new iteration of the program is part of this LRTP in response to public input received during the LRTP development stage.

Each of these programs is discussed below, along with how they will address the MPO’s goals and objectives.

INTERSECTION IMPROVEMENT PROGRAM

Program Description

This program will fund intersection projects that modernize existing signals or add signals to improve safety and mobility. Improvements also could consist of the addition of turning lanes, shortened crossing distances for pedestrians, and striping and lighting for bicyclists. Improvements to sidewalks and curb cuts also will enhance accessibility for pedestrians. Updated signal operations will reduce delay and improve bus transit reliability.

Examples of intersection projects that are programmed in the MPO's 2016–20 TIP include:

- Improvements at Derby Street, Whiting Street, and Gardner Street in Hingham
- Traffic signal improvements at ten locations in Boston

Average Cost per Project

An average cost of \$2.8 million per intersection project was established based on similar projects the MPO has funded in the past, as well as those that are included in the Universe of Projects developed for this LRTP (see Appendix B) and awaiting potential funding in future TIPs.

Project Context and Possible Impacts by MPO Goal

CAPACITY MANAGEMENT/MOBILITY

Intersection projects can reduce congestion, which would improve mobility and reduce emissions. Improvements can include bicycle and pedestrian elements to improve mobility for bicyclists, and mobility and accessibility for pedestrians.

SAFETY

Intersection projects can improve safety at high crash locations for motorists, trucks, pedestrian, and bicyclists. Improvements can consist of upgraded geometry, shortened crossing distances, and enhanced signage and lighting.

SYSTEM PRESERVATION



Intersection projects can improve pavement condition and modernize signal equipment.

ECONOMIC VITALITY

Intersection projects can reduce congestion by improving signal timings, which will improve mobility and access to centers of economic activity. Improvements can include pedestrian and bicycle elements that will improve mobility for bicyclists, and mobility and accessibility for pedestrians in centers of economic activity.

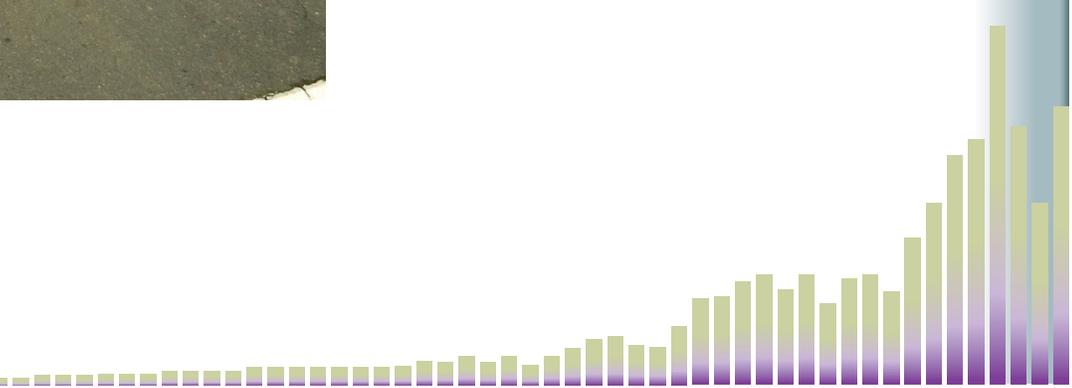
TRANSPORTATION EQUITY



Improvements to intersections can enhance transit services and provide better and more bicycle and pedestrian connections.

CLEAN AIR/CLEAN COMMUNITIES

Intersection projects can reduce emissions because of enhanced operations for all vehicles, and through mode shift, accompanied by improvements in transit reliability, and bicycle and pedestrian infrastructure.



COMPLETE STREETS PROGRAM

Program Description

The Complete Streets program modernizes roadways to improve safety and mobility for all users. Improvements can consist of continuous sidewalks and bicycle lanes, cycle tracks, and other bicycle facilities, as well as updated signals at intersections along a corridor. Improvements could also address other roadway infrastructure in the corridor, such as bridges, drainage, pavement, and roadway geometry. They will reduce delay and improve bus transit reliability. Expanded transportation options and better access to transit will improve mobility for all and encourage mode shift.

Examples of Complete Streets projects that are programmed in the MPO's 2016–20 TIP include:

- Intersection and Signal Improvements at Route 9 and Village Square (Gateway East) in Brookline
- Reconstruction of Route 85 (Maple Street) in Marlborough
- Reconstruction and related work on Derby Street from Pond Park Road to Cushing Street in Hingham
- Reconstruction on Route 129 (Lynnfield Street), from Great Woods Road to Wyoma Square in Lynn

Average Cost per Project

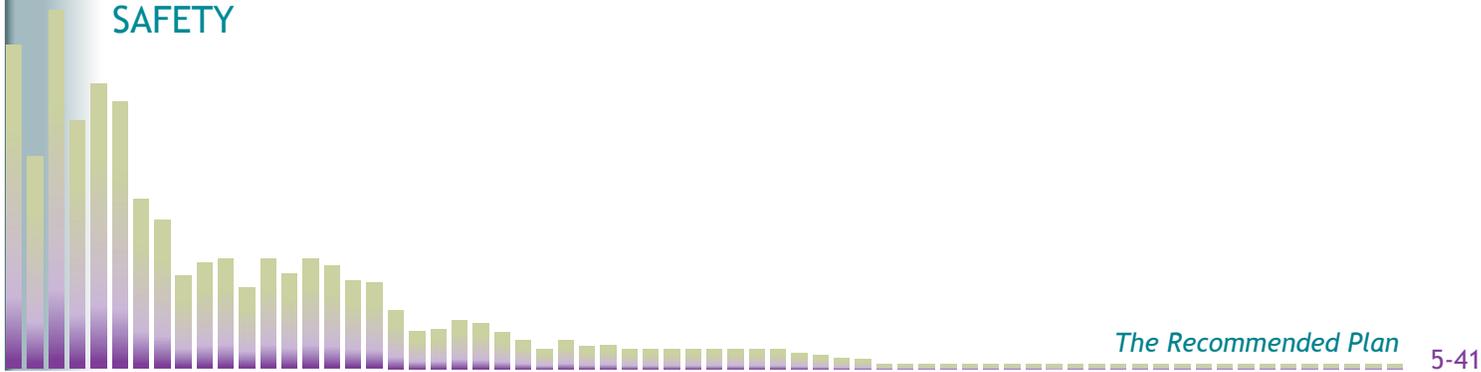
An average cost of six million dollars per mile of Complete Streets improvements was established based on similar projects that the MPO has funded in the past as well as projects that are included in the Universe of Projects in this LRTP (see Appendix B) and awaiting potential funding in future TIPs.

Project Context and Possible Impacts by MPO Goal

CAPACITY MANAGEMENT/MOBILITY

Complete Streets projects can increase transportation options by adding new sidewalks and bicycle facilities. They also can improve mobility for transit services.

SAFETY



Complete Streets projects can modernize the roadway network to provide safe conditions for all modes of travel along the corridor. Improvements could consist of lane reconfiguration, traffic signal and access improvements for motorists, new sidewalks, curb ramps, improved roadway crossings for pedestrians, and continuous bicycle facilities to reduce conflicts between bicyclists and motor vehicles.

SYSTEM PRESERVATION

Complete Streets projects can address pavement condition, upgrade sidewalk and bicycle accommodations, and improve bridges and culverts (including adaptations to transportation infrastructure that is vulnerable to climate change and other hazards).

ECONOMIC VITALITY



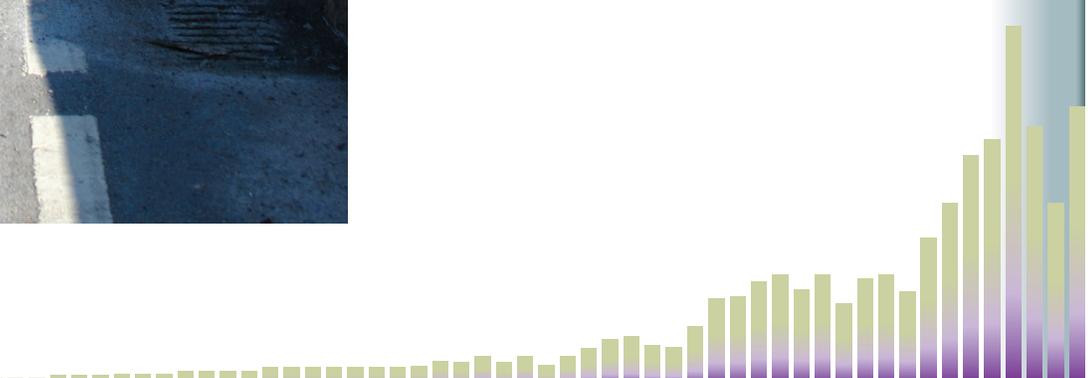
Complete Streets projects can increase transportation options and access to places of employment and centers of economic activity by adding new sidewalks and bicycle facilities and generally improving operations.

TRANSPORTATION EQUITY

Complete Streets projects in EJ areas can provide better access to transit, generally improved operations, and improved pedestrian and bicycle infrastructure.

CLEAN AIR/CLEAN COMMUNITIES

Complete Streets projects with bicycle and pedestrian infrastructure improvements can help to reduce VMT through improved operations and mode shift.



BICYCLE NETWORK AND PEDESTRIAN CONNECTION PROGRAM

Program Description

This program will expand bicycle and pedestrian networks to improve safe access to transit, school, employment centers, and shopping destinations. Bicycle and pedestrian connection projects could include constructing new, off-road bicycle or multi-use paths, improving bicycle and pedestrian crossings, or building new sidewalks. Improvements can also consist of traffic calming, sidewalk network expansion, and upgrades similar to those in a Complete Streets Program, or enhanced signage and lighting.

An example of a bicycle project that is programmed in the MPO's LRTP is the Assabet River Rail Trail in Stow and Hudson to be funded through this program.

Average Cost per Project

Project costs for sample bicycle and pedestrian projects were examined using evaluated TIP projects, the MPO's Bicycle Network Evaluation, and bicycle travel information from the 2011 Massachusetts Household Survey to develop an average cost of \$2 million per mile.

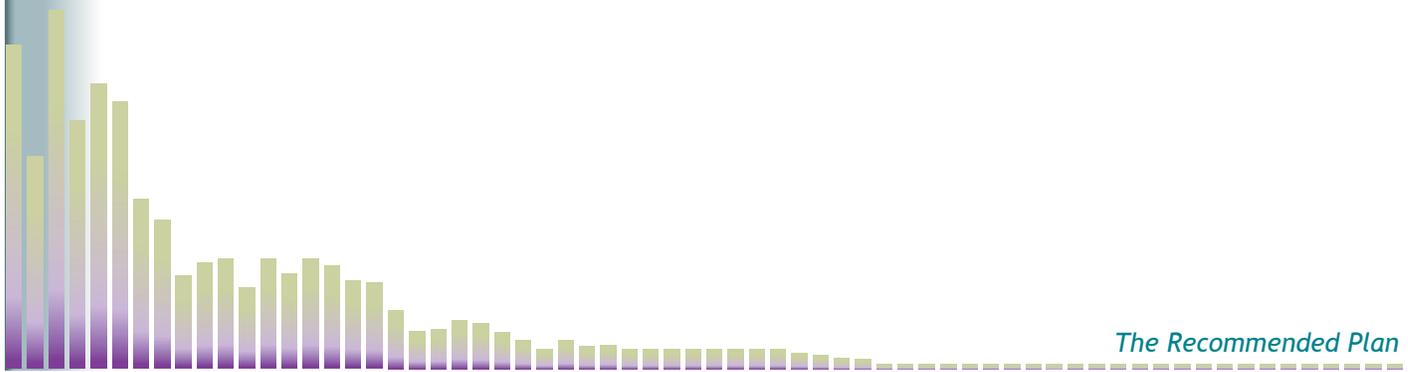
Project Context and Possible Impacts by MPO Goal

CAPACITY MANAGEMENT/MOBILITY

Projects in the Bicycle Network and Pedestrian Connection Program can increase transportation options, provide access to transit or other activity centers, and support last-mile connections.

SAFETY

Projects in this program can create a safe pedestrian and bicycle corridor that connects activity centers while avoiding high crash locations on the roadway system. They can include safety improvements to facilitate pedestrian access to transit or other activity centers.



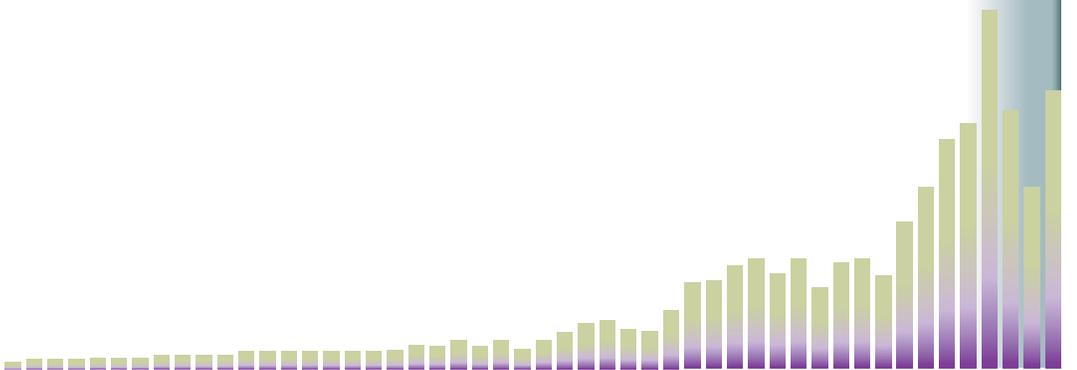


TRANSPORTATION EQUITY

Projects in EJ areas in this program can provide better access to transit and improved pedestrian and bicycle infrastructure.

CLEAN AIR/CLEAN COMMUNITIES

Bicycle and pedestrian infrastructure improvements can help to reduce VMT through mode shift.



COMMUNITY TRANSPORTATION/PARKING/CLEAN AIR AND MOBILITY PROGRAM

Program Description

This program includes a combination of the following types of projects:

- Community Transportation: Provides funding to launch locally developed transit services that support first-mile/last-mile connections to existing transit services and other destinations by purchasing shuttle buses and/or funding operating costs.
- Park-and-Ride: Targets funding to construct additional parking at transit stations that are at capacity, or at other viable locations.
- Clean Air and Mobility Program: Funds projects that improve mobility and air quality and promote mode shift. Examples include bike-share projects or shuttle-bus services.

Average Cost per Project

- Community Transportation: Staff estimates that an average cost for this type of service would be approximately \$1.5 million per year.
- Park-and-Ride: Average cost per parking space is \$35,000.
- Clean Air and Mobility Program: Based on review of projects funded through this program in the past, the costs vary widely depending on the project. Examples include:
 - Bike share projects – an average cost of \$200,000 per project
 - Transportation Demand Management projects – an average cost of \$140,000 per project
 - Shuttle Bus Services – an average cost of \$100,000 per project

Project Context and Possible Impacts by MPO Goal

CAPACITY MANAGEMENT/MOBILITY

Projects in this program can increase transit ridership by expanding automobile and bicycle parking at commuter rail and rapid transit stations. The program will also provide

funding for starting up new, locally developed transit services and supporting last-mile connections.



ECONOMIC VITALITY

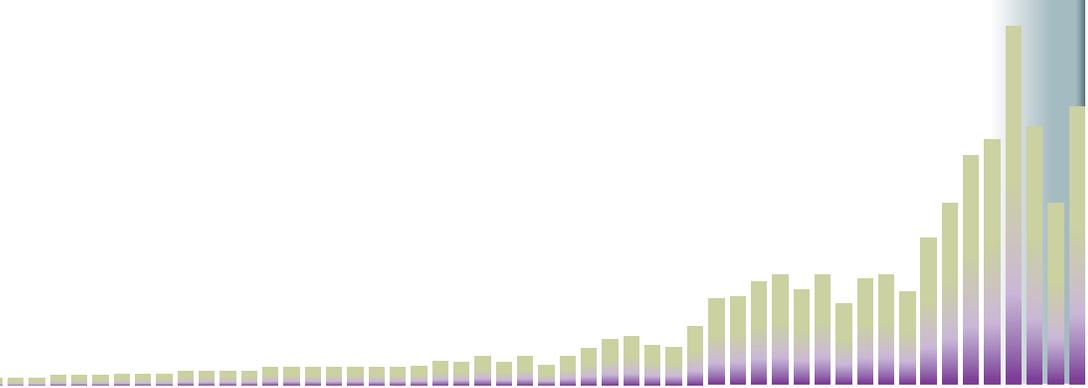
The program can provide funding for starting up new, locally developed transit services and support last-mile connections to places of employment and areas of economic activity.

TRANSPORTATION EQUITY

The program can provide funding for starting up new, locally developed transit services that include transit vehicles and coordination of service to transportation equity populations in suburban areas.

CLEAN AIR/CLEAN COMMUNITIES

Bicycle and pedestrian infrastructure improvements, locally developed transit services and first mile/last mile connections can help to reduce VMT through mode shift.



Transit Projects in the Recommended Plan

Table 5.5 and 5.6 lists transit projects funded under the capacity expansion program, their costs for the period of construction, and their projected completion dates. (Figure 5.1 shows the locations of projects.) The projects in Table 5.5 are projects that are included as part of the no-build and are being funded by the Commonwealth.

TABLE 5.5
Transit Expansion Projects in the Recommended Plan with Costs

Project	FFY 2016– 2020	FFY 2021– 2025	FFY 2026– 2030	FFY 2031– 2035	FFY 2036– 2040	Non-MPO Transit Funds	MPO Highway Funds
Green Line Extension from Lechmere Station to College Avenue/Union Square (Cambridge and Somerville)	\$1,399,987,000	\$128,763,000				\$1,528,750,000	
Fairmount Line Improvements Project (Boston)	\$26,500,000					\$26,500,000	

TABLE 5.6
Transit Expansion Projects in the Recommended Plan with Costs

Project	FFY 2016– 2020	FFY 2021– 2025	FFY 2026– 2030	FFY 2031– 2035	FFY 2036– 2040	Non- MPO Transit Funds	MPO Highway Funds
Green Line Extension from College Avenue to Mystic Valley Parkway (Somerville and Medford) (highway funding flexed to transit)	\$158,000,000	\$32,000,000					\$190,000,000



MBTA CAPITAL INVESTMENT PROGRAMS

The MBTA's Capital Investment Program (CIP) is a guide to the MBTA's planned capital spending in future fiscal years (FYs). The document describes the MBTA's infrastructure and the capital needs for maintaining the system, outlines ongoing and programmed capital projects, and details planned projects to expand the transportation network.

The MBTA recently released a one-year CIP for FY 2016. Unlike the prior CIP, this is not a five-year plan. The MBTA will develop and release a five-year CIP for FYs 2017–2021 that complies with the requirements of Chapter 161A of the General Laws of the Commonwealth by January 2016. The 2016 one-year plan, the first to be issued as part of the Baker-Polito Administration, reflects a commitment to sustainable mobility and the strategic and prudent expenditure of available capital resources. It provides a transition as the MBTA continues to categorize and define its needs over the next five years, and also updates the criteria used in evaluating and prioritizing investments in the regional transit system.

Projects in the CIP are selected through a prioritization process that strives to balance capital needs across the entire range of MBTA transit services. Given the MBTA's vast array of infrastructure and the need for prudent expansion, the number of capital needs identified each year usually exceeds the MBTA's capacity to provide capital funds. Therefore, the MBTA engages in an annual prioritization and selection process to select the needs with the highest priority for funding and inclusion in the CIP.

One of the highest priorities for the MBTA is the pursuit of a "State of Good Repair" (SGR). To measure the need for capital expenditures devoted to maintaining and replacing existing infrastructure, transit systems often use the SGR standard, wherein all capital assets are functioning at their ideal capacity within their design life. While few transit systems are likely to achieve this ideal, the standard does identify a level of ongoing capital needs that must be addressed over the long-term in order for the existing infrastructure to continue to provide reliable service.

To assist in this, the MBTA employs an SGR database to help guide its capital decisions. Based on an inventory of all existing MBTA capital assets, the model allows the MBTA to track the capital investment needs for its existing infrastructure and to develop scenarios for capital investment to maintain the system in a state of good repair.

Prioritization of projects to be included in the CIP is based on the following criteria, as defined in the MBTA's enabling legislation: the impact of the project on the effectiveness of the Commonwealth's transportation system, service quality, the environment, health, and safety; the state of repair of the MBTA infrastructure; and the MBTA's operating costs and debt service. Projects that receive the highest priority are those with the greatest benefit and the least cost, as prioritized by the following criteria:

1. Impact on the environment
2. System preservation

3. Financial considerations
4. Operations impact
5. Legal commitments

Transportation equity is also considered.

Below is a description of the programs funded by the MBTA to maintain the transit system.

Revenue Vehicles Program

DESCRIPTION

The revenue vehicle fleet is one of the most visible components of the MBTA service network. These are the trains, buses, and other vehicles that passengers board every day (i.e., all vehicles that carry passengers in revenue service). Scheduled major overhauls, maintenance, and planned retirements allow the fleet to reach its useful life and prevent the unwarranted consumption of resources to maintain its reliability.

COSTS

The revenue vehicle program is 30 percent of the MBTA's 2016 CIP, the largest share of any program area. In the 2009–2015 CIP, the MBTA allocated about 31 percent of its capital funds to this program. The MBTA will employ its SGR database to help guide its capital decisions for this program in the future. However, it is expected that funding for this program will continue to require a large share of the capital resources in the future.

Non-Revenue Vehicles Program

DESCRIPTION

Non-revenue vehicles and equipment support the entire range of MBTA operations and include over 1,000 systemwide vehicles and pieces of equipment. This program also includes funding for equipment for weather resiliency efforts as well as snow-fighting equipment.

COSTS

The non-revenue vehicle program is 11 percent of the MBTA's 2016 CIP. In the 2009–2015 CIP, the MBTA allocated less than 1 percent of its capital funds to this program. The MBTA will employ its SGR database to help guide its capital decisions for this program in the future. Funding will always be allocated for this program; however, as shown in

the varying allocations in the different CIPs, the funding will vary depending on the needs identified by the SGR database.

Tracks/Right-Of-Way/Signals Program

DESCRIPTION

Tracks/Right-of-Way: Several types of track can be found throughout the MBTA system, depending on the service (i.e., commuter rail, rapid transit). The right-of-way for heavy rail rapid transit track often includes an electrified third rail through which subway cars receive the traction power needed for movement.

Signals: The primary responsibility of the MBTA signal system is to control trains for efficient spacing and run times, making it an integral part of the transit system. The signal system's goal is to maintain train separation while attempting to minimize headways and run times.

COSTS

Systemwide track maintenance is 8 percent of the MBTA's 2016 CIP. In the 2009–2015 CIP, the MBTA allocated 17 percent of its capital funds to this program. The signal systems are crucial for supporting the safe and efficient operations of trains systemwide and account for 8 percent of the MBTA's 2016 CIP. In the 2009–2015 CIP, the MBTA allocated 6 percent of its capital funds to this program.

The MBTA will employ its SGR database to help guide its capital decisions for this program in the future. Funding will always be allocated for this program; however, as shown in the varying allocations in the different CIPs, the funding will vary depending on the needs identified by the SGR database.

Bridge Program

DESCRIPTION

Continued maintenance and rehabilitation of the MBTA's bridges will be required. This will include replacing bridge decks and reconstructing bridges. The MBTA bridge inspection program is tailored to ensure that bridge repairs are prioritized and that all bridges receive adequate attention.

COSTS

The Bridge Program is 9 percent of the MBTA's 2016 CIP. In the 2009–2015 CIP, the MBTA allocated 5 percent of its capital funds to this program. The MBTA prioritizes its bridges through its bridge inspection program. Funding will always be allocated for this

program; however, as shown in the varying allocations in the different CIPs, the funding will vary depending on the needs identified by the SGR database.

Stations Program

DESCRIPTION

MBTA stations are one of the most visible components of the transit system; they provide access to rapid transit, light rail, commuter rail, and Silver Line services in the MBTA transit system. Many of the bus stops also have bus shelters of various kinds. The majority of funding for stations is devoted to renovation of subway stations, including accessibility upgrades and the systemwide replacement of escalators and elevators.

COSTS

The Stations Program, including elevators and escalators, is 12 percent of the MBTA's 2016 CIP. In the 2009–2015 CIP, the MBTA allocated 25 percent of its capital funds to this program. The MBTA will employ its SGR database to help guide its capital decisions for this program in the future. Funding will always be allocated for this program; however, as shown in the varying allocations in the different CIPs, the funding will vary depending on the needs identified by the SGR database.

Supporting Infrastructure Program

DESCRIPTION

The Supporting Infrastructure Program includes both facilities and power.

Facilities: Facilities include administrative buildings, vent buildings, storage buildings, noise walls, retaining walls, culverts, parking garages and parking lots, layover facilities, and fencing (which prevent trespassers from gaining access to tracks and fast-moving trains).

Power: While power for the MBTA's network is supplied by an outside utility, the MBTA transforms and distributes electricity over its own system to power the entire network of subway, trackless trolley, and light rail lines. The capital equipment in this power program is essential to operations. It supplies electricity to subway trains and trolleys for the traction power needed for movement; to the signal systems for the power needed to control the trains; and to the stations to operate their lights, elevators, escalators, and other equipment. The MBTA's power program, arguably one of the least visible elements to passengers, is one of the most complex, important, far-reaching, and expensive systems for the MBTA to maintain.

COSTS

The supporting infrastructure program is 15 percent of the MBTA's 2016 CIP. In the 2009–2015 CIP, the MBTA allocated 12 percent of its capital funds to this program. The MBTA will employ its SGR database to help guide its capital decisions for this program in the future. Funding will always be allocated for this program; however, as shown in the varying allocations in the different CIPs, the funding will vary depending on the needs identified by the SGR database.

Communications and Technology Program

DESCRIPTION

The MBTA Communications Department's responsibilities include maintaining an inventory of equipment and overseeing contract services for the Wide Area Network, two-way radio systems, microwave links, emergency intercoms, public address systems, light-emitting-diode (LED) message signs, fire alarm systems, security systems, and the supervisory control and data acquisition system. The department manages the MBTA's Operations Control Center, which consists of technology that allows for real-time monitoring and supervisory control of the signal and communications systems for the rapid transit and bus systems. Current investments include a Green Line Real-Time Tracking System, systemwide communications enhancements, and a Maintenance Management System.

COSTS

The communications and technology program is 3 percent of the MBTA's 2016 CIP. In the 2009–2015 CIP, the MBTA allocated 3 percent of its capital funds to this program. The MBTA will employ its SGR database to help guide its capital decisions for this program in the future. Funding will vary depending on the needs identified by the SGR database.

Enhancement Program

DESCRIPTION

The Enhancement Program includes capital projects that improve existing service and foster increased ridership. Current investments include the Green Line Collision Avoidance Program, Commuter Rail Positive Train Control, and a climate change adaptation strategy.

COSTS

The enhancement program is 5 percent of the MBTA's 2016 CIP. The MBTA will employ its SGR database to help guide its capital decisions for this program in the future. Funding will vary depending on the needs identified by the SGR database.

MODEL RESULTS AND INTERPRETATION OF THE RECOMMENDED PLAN

In *Charting Progress to 2040*, the MPO has provided a 25-year vision of the Boston Region's transportation needs. Land-use patterns, growth in employment and population, and trends in travel patterns differ in how they affect demands on the region's transportation system. In order to estimate future demands on the system for this LRTP, the MPO utilized a regional travel demand forecast model. The model is a planning tool used to evaluate the impacts of transportation alternatives given varying assumptions about population, employment, land use, and traveler behavior. The model is used to assess potential projects in terms of air-quality benefits, travel-time savings, and congestion reduction.

Description of the MPO Model Set

RECENT TRAVEL MODEL CHANGES

Before describing the general capabilities of, and inputs to, the current travel demand model, a list of recent major changes to the model set follows:

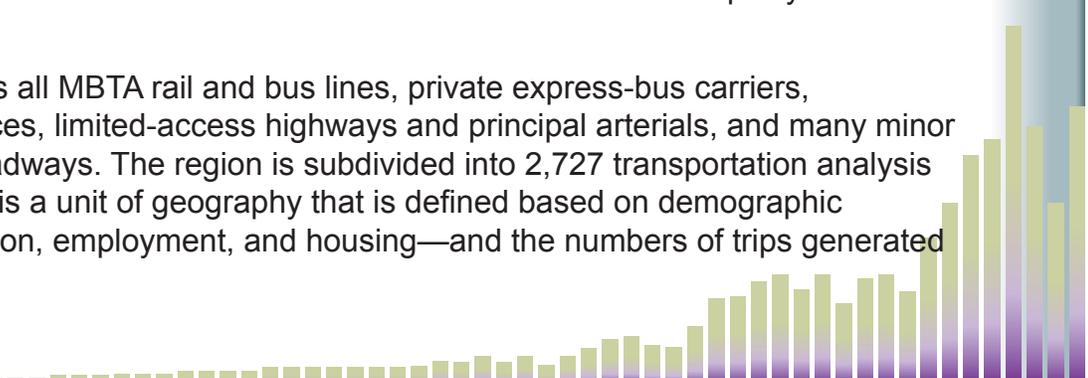
- Prior to 2010, the MPO model was run in a software package named EMME. The recently re-estimated model set is executed in a software package named TransCAD.
- In 2011, staff completed a new statewide household travel survey, conducted during an 18-month period. That survey, the 2011 Massachusetts Travel Survey (2011-MTS), was used to update the entire regional model.
- In addition to re-estimation, certain components of the model set have been completely revamped or enhanced, including:
 - Redesigned:
 - ◆ School trip purpose
 - ◆ Estimation of external trips
 - ◆ Internal-internal (I-I) distribution
 - ◆ Mode choice model

- Enhancements:
 - ◆ Developed a transportation analysis zone (TAZ)-specific pedestrian environmental variable (PEV)
 - ◆ Developed a turn-restrictions file, which is now incorporated in highway assignment procedures
 - ◆ Developed specific parameters for volume-delay functions to suit facility type
- Updates:
 - ◆ Because of the sensitivity of highway tolls, the actual toll rates are included in order to depict reality
 - ◆ Average fare by transit sub-mode is now incorporated into the model
- Staff updated and enhanced highway network characteristics using the Massachusetts Roadway Inventory File (RIF). This provided better representation of number of lanes, directionality, and capacity, as well as improvement of overall intersection detail throughout the network.
- Air quality calculations are now based on the latest technology, the EPA-approved motor vehicle emission simulator (MOVES 2014) model.
- In 2013, staff purchased a land-use allocation model (Cube Land), and incorporated it into the modeling process.
- TransCAD offers easy reporting at every step of the modeling process, which has been fully utilized to our advantage.

TRAVEL DEMAND MODEL CHARACTERISTICS

As discussed earlier in this section, the Boston Region MPO utilizes a robust quantitative travel model framework that employs a traditional four-step planning process—trip generation, trip distribution, mode choice, and trip assignment. This travel demand model set simulates existing travel conditions and forecasts future-year travel on eastern Massachusetts transit and highway systems. For a more accurate picture of travel demands in the Boston region, all communities within the commuting shed (the area from which people commute) for eastern Massachusetts are represented in the modeled area, including an additional 63 communities that are outside of the 101-municipality MPO region.

The model represents all MBTA rail and bus lines, private express-bus carriers, commuter boat services, limited-access highways and principal arterials, and many minor arterials and local roadways. The region is subdivided into 2,727 transportation analysis zones (TAZs). A TAZ is a unit of geography that is defined based on demographic information—population, employment, and housing—and the numbers of trips generated



in, and attracted to, it. The model set is made up of several models, each of which represents a step in the travel decision-making process (the four-step process). The model set simulates transportation supply characteristics and transportation demand for travel from every TAZ to every other TAZ.

This simulation is the result of several inputs (different categories of data). Two broad sets of these inputs are land-use patterns, to identify amount and types of trips produced and how they are distributed (trip generation and trip distribution); and a transportation network with associated trip-making behavioral parameters, to allocate each trip onto different travel modes and onto a system of transportation network links (mode choice and trip assignments).

Land Use

MAPC is responsible for developing the land-use inputs for the travel demand model. With guidance from an advisory panel (local jurisdiction staff, academic experts, and state agencies), MAPC and the MPO, in a joint effort, implemented an iterative land-use transportation model to quantify land-use patterns, by answering this basic set of questions:

- What will the Boston MPO region look like in 2040?
 - How many people will live here (population forecasts)?
 - What will they be doing (economic forecasts)?
 - Where will the activities take place (land-use patterns)?
 - How many trips will be made (trip-generation model)?
 - How will these trip ends be connected to form round trips (trip-distribution model)?

For each TAZ, this process generated number of households, household characteristics, employment-related activities, auto ownership, and other variables that produce travel demand on transportation systems (see Appendix E and the section below for more details).

Transportation Network

This set of inputs was derived from various resources such as the Massachusetts Roadway Inventory File (RIF) and the MBTA routes and schedules.

The model is used to answer questions such as:

- What will the travel patterns in 2040 look like?
 - How will travelers select a particular mode, or a combination of modes for each trip (mode-choice model)

- How will these trips choose network path links representing available alternative modes (trip-assignment model)

All these inputs are updated on a regular basis to ensure reliability of forecasts.

Travel-Demand under 2012 Base Year, 2040 No-Build, and 2040 Build Conditions

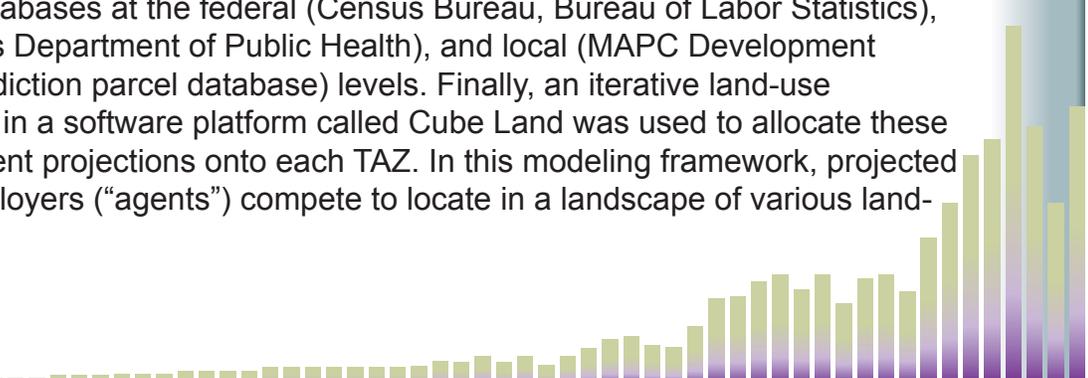
The travel model analysis for the LRTP consisted of several steps. First, staff tested an existing conditions network with existing land-use patterns, to simulate recent 2012 travel conditions. This constituted the model's Base Year. Projects included for analysis in the Base Year model were deemed "regionally significant," as defined by the federal government, because of being regional in nature, adding capacity, and having air-quality impacts for the region as measured by the model. Existing land-use information was derived from comprehensive land development and demographic databases maintained by MAPC and the Boston Region MPO.

Next, a 2040 No-Build alternative was incorporated into the model. This 2040 No-Build alternative was structured around the 2012 Base Year, and projects that were constructed between 2012 and 2015, as well as those that are currently under construction and those that are programmed in the first year of the 2015–2018 TIP. The process for developing 2040 land-use forecasts is described below.

Land-use forecasts, in the context of travel demand analyses, involve two basic factors or "agents" of growth—households and employments. To better deal with uncertainties in future projections of these variables, MAPC employed a scenario exercise between two alternatives, "Status Quo" and "Stronger Region." The latter option aligned better with the adopted land-use growth vision of the region called "MetroFuture," which entails the following assumptions:

- The region will attract and retain more young adults.
- Younger households (millennials) will be more inclined toward urban living.
- An increasing share of senior-headed households (baby boomers) will choose to downsize from single-family homes to apartments or condominiums.

With these assumptions, household and employment control totals were developed for the region and individual municipalities. The process utilized current and historic growth trends from a number of databases at the federal (Census Bureau, Bureau of Labor Statistics), state (Massachusetts Department of Public Health), and local (MAPC Development Database, local jurisdiction parcel database) levels. Finally, an iterative land-use transportation model in a software platform called Cube Land was used to allocate these household/employment projections onto each TAZ. In this modeling framework, projected households and employers ("agents") compete to locate in a landscape of various land-



use supplies, which are determined by economic factors (“bid-rents”) and zonal attraction characteristics (land-rent affordability, transportation connectivity). More detail is provided in Appendix E – Methodology for Land Use Projections in the Boston Region.

The 2012 Base Year and 2040 No-Build scenarios thus provided a baseline against which the predicted effects of potential investments in the transportation system were measured.

Finally, staff developed an alternative set of projects called the 2040 Build Scenario through an investment scenario process discussed earlier in the Project Selection section. This set of projects was analyzed with same 2040 No-Build land-use assumptions in the travel demand model set. Several important travel statistics were reported and compared from all these conditions, including:

- Total vehicle-miles traveled (VMT) and vehicle-hours traveled (VHT) on a typical weekday
- Average speed of highway traffic
- Amount of air pollution produced by automobiles and transit vehicles
- Number of daily trips made by auto and transit
- Average daily fixed-route transit ridership by mode (rapid transit, bus, commuter rail, commuter boat, express bus)
- Percentage of people traveling by each travel mode

Selected travel-modeling results for the 2012 Base Year, 2040 No-Build, and 2040 Build scenarios—are shown in Table 5.7 below.

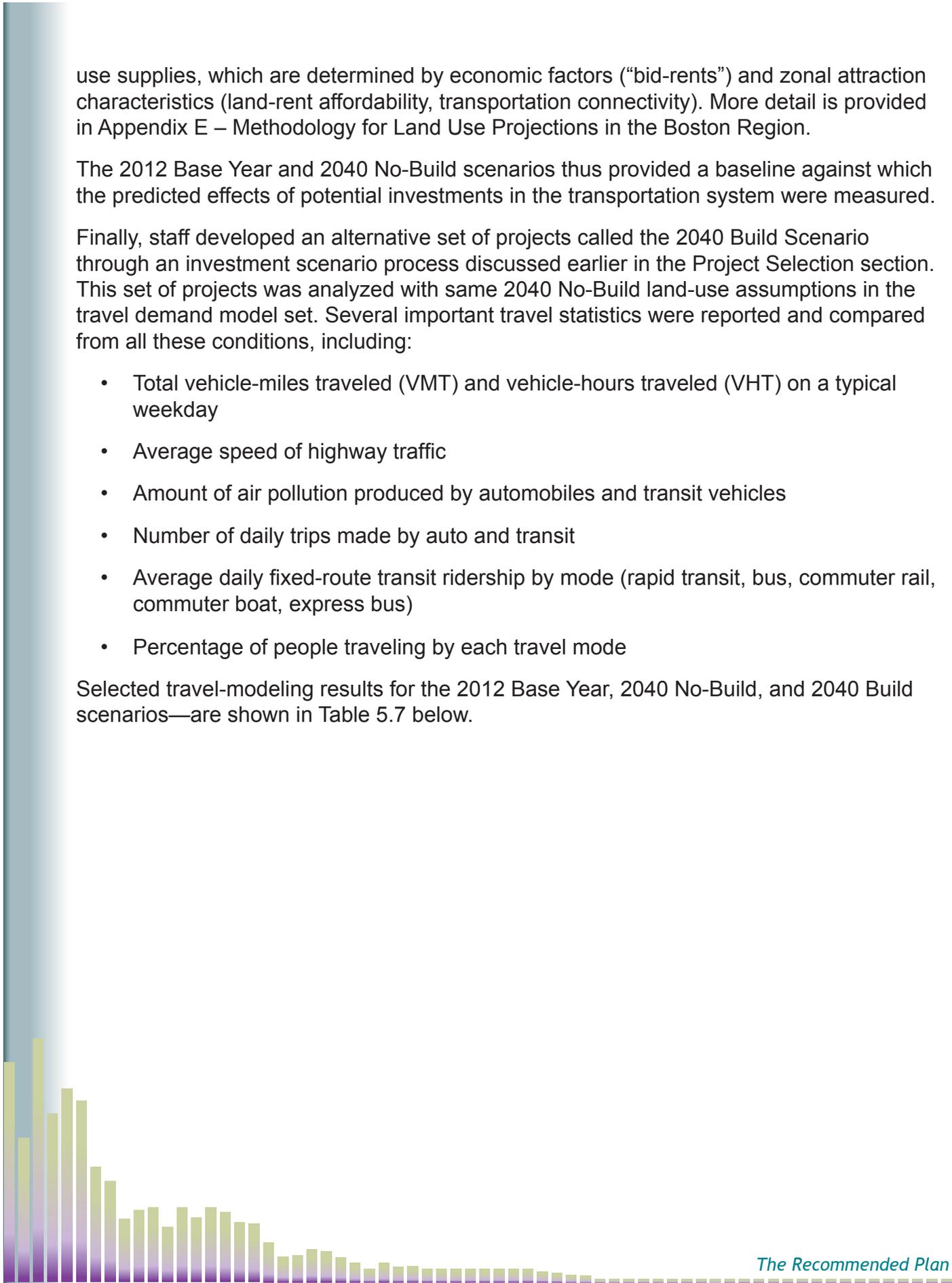


TABLE 5.7
2012 Base Year, 2040 No-Build, and 2040 Build Scenarios

Measure	2012 Base	2040 No-Build	2040 Build	Percentage Change From 2012 to 2040 No-Build	Percentage Change From 2040 No-Build to 2040 Build
Socioeconomic Variables (BRMPO)					
Population	3,163,900	3,601,600	3,601,600	13.8%	0.0%
Households	1,243,900	1,522,300	1,522,300	22.4%	0.0%
Household Size	2.5	2.4	2.4	-7.0%	0.0%
Total Employment	1,850,000	2,027,800	2,027,800	9.6%	0.0%
Basic	371,800	316,300	316,300	-14.9%	0.0%
Retail	316,800	334,600	334,600	5.6%	0.0%
Service	1,161,400	1,376,900	1,376,900	18.6%	0.0%
Households with Vehicles (BRMPO)					
0 vehicles	16%	20%	20%	25.0%	0.0%
1 vehicle	37%	39%	39%	6.4%	0.0%
2 vehicles	35%	25%	25%	-29.3%	0.0%
3+ vehicles	13%	16%	16%	30.9%	0.0%
Trip Activity					
Person Trips in Eastern MA	16,451,300	19,024,000	19,024,000	15.6%	0.0%
Auto person trips	13,425,500	15,077,100	15,076,600	12.3%	0.0%
Transit person trips	905,000	1,152,100	1,152,400	27.3%	0.0%
Non-motorized	2,120,800	2,794,800	2,795,000	31.8%	0.0%
Person Trips in BRMPO	12,801,500	14,802,600	14,802,600	15.6%	0.0%
Auto person trips	10,122,800	11,270,500	11,270,000	11.3%	0.0%
Transit person trips	898,100	1,144,700	1,145,000	27.5%	0.0%
Non-motorized	1,780,600	2,387,400	2,387,600	34.1%	0.0%
Mode Choice					
Mode Share in Eastern MA	100%	100%	100%	0.0%	0.0%
Auto share	82%	79%	79%	-2.9%	0.0%
Transit share	6%	6%	6%	10.1%	0.0%
Non-motorized share	13%	15%	15%	14.0%	0.0%
Mode Share in BRMPO	100%	100%	100%	0.0%	0.0%
Auto share	79%	76%	76%	-3.7%	0.0%
Transit share	7%	8%	8%	10.2%	0.0%
Non-motorized share	14%	16%	16%	16.0%	0.0%
Highway Results (Interzonal)					
Vehicles Assigned in Eastern MA	12,733,200	14,291,400	14,291,000	12.2%	0.0%
Auto	10,540,700	11,793,300	11,792,900	11.9%	0.0%
Trucks	2,192,500	2,498,100	2,498,100	13.9%	0.0%
Vehicles Assigned in BRMPO	10,169,600	10,637,900	10,637,500	4.6%	0.0%
Auto	7,977,100	8,847,600	8,847,200	10.9%	0.0%
Trucks	2,192,500	1,790,300	1,790,300	-18.3%	0.0%
VMT in Eastern MA	106,030,300	116,912,800	116,957,500	10.3%	0.0%

(Cont.)

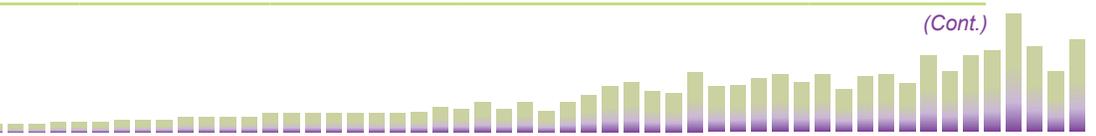


TABLE 5.7 (Cont.)

Measure	2012 Base	2040 No-Build	2040 Build	Percentage Change From 2012 to 2040 No-Build	Percentage Change From 2040 No-Build to 2040 Build
Highway Results (Interzonal) (cont.)					
Auto	86,846,500	93,362,500	93,413,300	7.5%	0.1%
Trucks	19,183,800	23,550,255	23,544,235	22.8%	0.0%
VMT in BRMPO	69,448,500	74,968,400	74,970,100	7.9%	0.0%
Auto	57,594,000	61,058,400	61,073,800	6.0%	0.0%
Trucks	11,854,500	13,910,000	13,896,300	17.3%	-0.1%
VHT in Eastern MA	3,277,800	3,765,200	3,763,600	14.9%	0.0%
Auto	2,712,500	3,049,500	3,048,500	12.4%	0.0%
Trucks	565,300	715,700	715,100	26.6%	-0.1%
VHT in BRMPO	2,301,000	2,556,500	2,553,600	11.1%	-0.1%
Auto	1,924,300	2,109,200	2,107,200	9.6%	-0.1%
Trucks	376,700	447,300	446,400	18.7%	-0.2%
Average Speed in Eastern MA	32.3	31.1	31.1	-4.0%	0.1%
Auto	32.0	30.6	30.6	-4.4%	0.1%
Trucks	33.9	32.9	32.9	-3.0%	0.1%
Average Speed in BRMPO	30.2	29.3	29.4	-2.8%	0.1%
Auto	29.9	28.9	29.0	-3.3%	0.1%
Trucks	31.5	31.1	31.1	-1.2%	0.1%
Congested VMT (0.75 V/C <)					
in Eastern MA	65,875,292	78,083,600	79,281,500	18.5%	1.5%
BRMPO	45,748,927	52,608,500	53,130,700	15.0%	1.0%
Transit Results					
Transit Trips (Linked)	905,000	1,152,100	1,152,400	27.3%	0.0%
Local Bus	360,000	435,600	435,300	21.0%	-0.1%
Express Buses	25,600	26,900	27,100	5.1%	0.7%
Bus Rapid Transit	27,400	63,000	63,200	129.9%	0.3%
Rapid Transit Lines	700,000	896,000	896,600	28.0%	0.1%
Commuter Rail	104,000	122,700	122,000	18.0%	-0.6%
Ferry	4,500	11,700	11,700	160.0%	0.0%
Transit Trips (Unlinked)	1,221,500	1,555,900	1,555,900	27.4%	0.0%
Walk Access Transit	1,050,500	1,338,100	1,338,900	27.4%	0.1%
Drive Access Transit	171,000	217,800	217,000	27.4%	-0.4%
Average Transfer Rate	1.35	1.35	1.35	0.1%	0.0%
Air Quality (BRMPO)					
Volatile Organic Compounds (kg)	8,546	3,908	3,905	-54.3%	-0.08%
Nitrogen Oxides(kg)	54,672	27,927	27,914	-48.9%	-0.05%
Carbon Monoxide - Winter (kg)	222,485	66,731	66,693	-70.0%	-0.06%

BRMPO - Boston Region MPO (101 Municipalities)

Eastern MA (164 Municipalities)

Linked Transit Trips - A transit trip made between an origin and a destination that does not account for transfers between vehicles or modes.

Unlinked Transit Trips - A transit trip made between an origin and a destination that accounts for transfers between vehicles or modes.

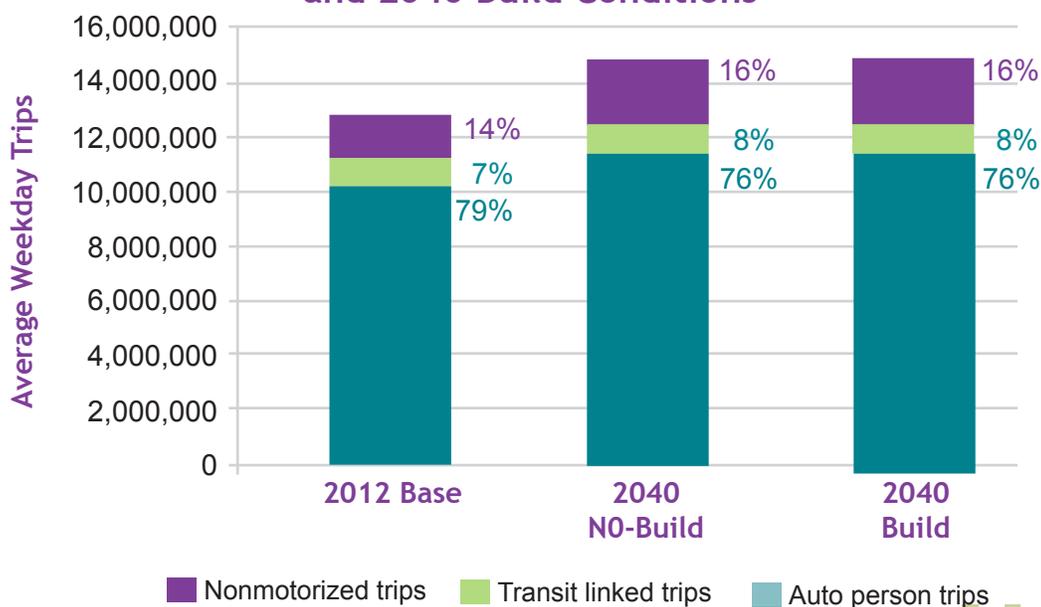
Interpretation of the L RTP

Analyzing current patterns of demographic shifts and the Boston region's vibrant economy, the 2040 demographic forecasts projected an increase in population (13.8 percent), households (22.4 percent), and employment (9.6 percent). This assumed level of demographic growth is estimated to produce approximately 19 million trips on an average weekday, regardless of modes—a 16 percent increase from the 2012 Base-Year conditions for the model area.

Within this overall growth, there is a larger growth shift estimated in the millennial (birth years from early 1980s to early 2000s) and the baby boomer (births between the years 1946 and 1964) age cohorts, which likely resulted in a greater number of 0 and 3+ vehicles households in the region. Consequently, there is a shift in mode choice between 2012 Base Year and 2040 No-Build/Build conditions.

Transit and nonmotorized trips are expected to grow faster than auto trips. Nonmotorized trips are forecasted to have the greatest percentage increase of slightly more than 34 percent, from 1,780,600 trips in 2012 to 2,387,400 trips in the 2040 No-Build condition. Transit trips will grow from 898,100 trips to 1,144,700 trips (28 percent), with a modest increase in auto trips, from 10,122,800 in 2012 to 11,270,500 in 2040 (about 11 percent). These higher growth shares in nonmotorized and transit trips are a result of underlying land-use allocation assumptions, as more households are located near transit services and other activity centers in a compact fashion. Figure 5.2 below shows the change in share of auto, transit, and nonmotorized trips in the Base Year, 2040 No-Build, and 2040 Build conditions. As transit and nonmotorized trips are growing at faster rates than auto trips, these modes have a slightly greater percentage of total trips made in the future year.

FIGURE 5.2
Mode Share Split - Person-Trips Under 2012 Base Year, 2040 No-Build, and 2040 Build Conditions

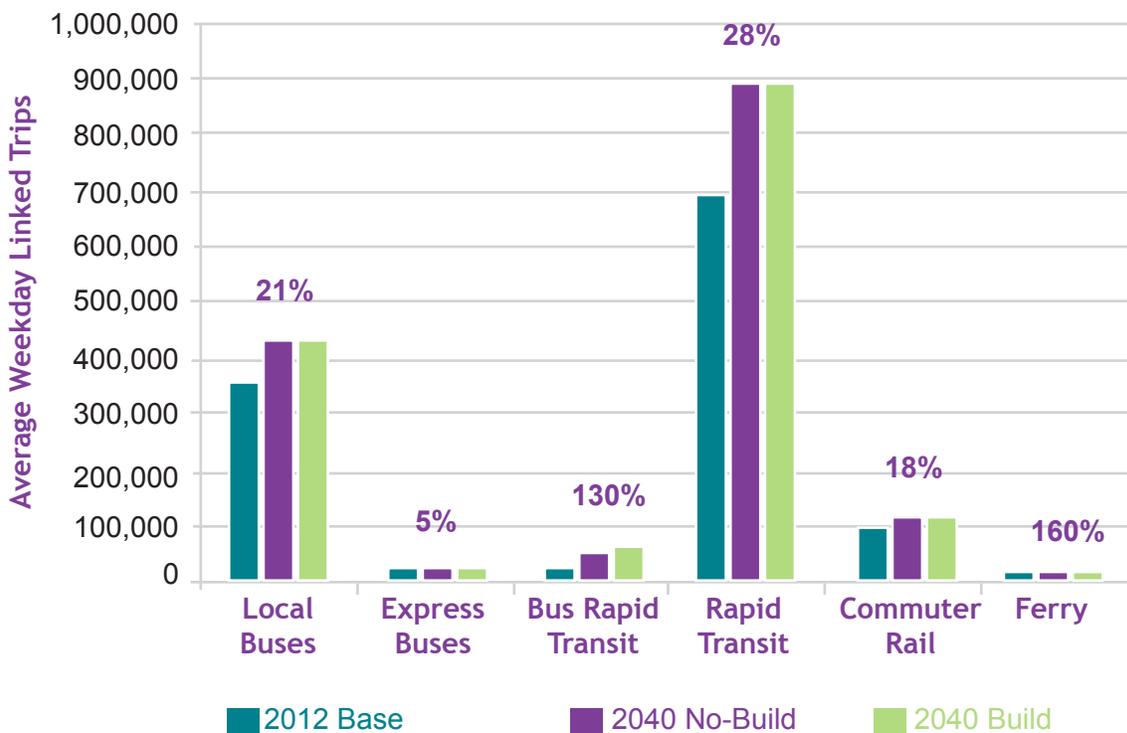


Source: CTPS Travel Demand Model

TRANSIT

As in the highway assignment portion of the model framework, transit ridership forecasts were not constrained by existing and proposed transit service capacity. This produced a true level of demands on highway and transit facilities. In the Base Year, the model set estimated 905,000 linked transit trips on a typical weekday. With an observed average transfer rate of 1.35, this translates to 1,221,500 unlinked trips. In the 2040 No-Build condition, growth of more than 27 percent was estimated for these transit trips. Two factors contributed to this growth: assumed growth in overall population and associated demographic shift (more 0-vehicle households), and changes in transit service supply (Green Line extension to Union Square, Fairmount Line service improvements, etc.). Figure 5.3 shows how these additional transit trips are estimated to be allocated across various transit modes.

FIGURE 5.3
Increases in Transit Trips by Mode



Source: CTPS Travel Demand Model

In addition to overall growth in transit trips because of transit-conducive demographic growth, there is mode-specific growth that warrants further discussion. The number of

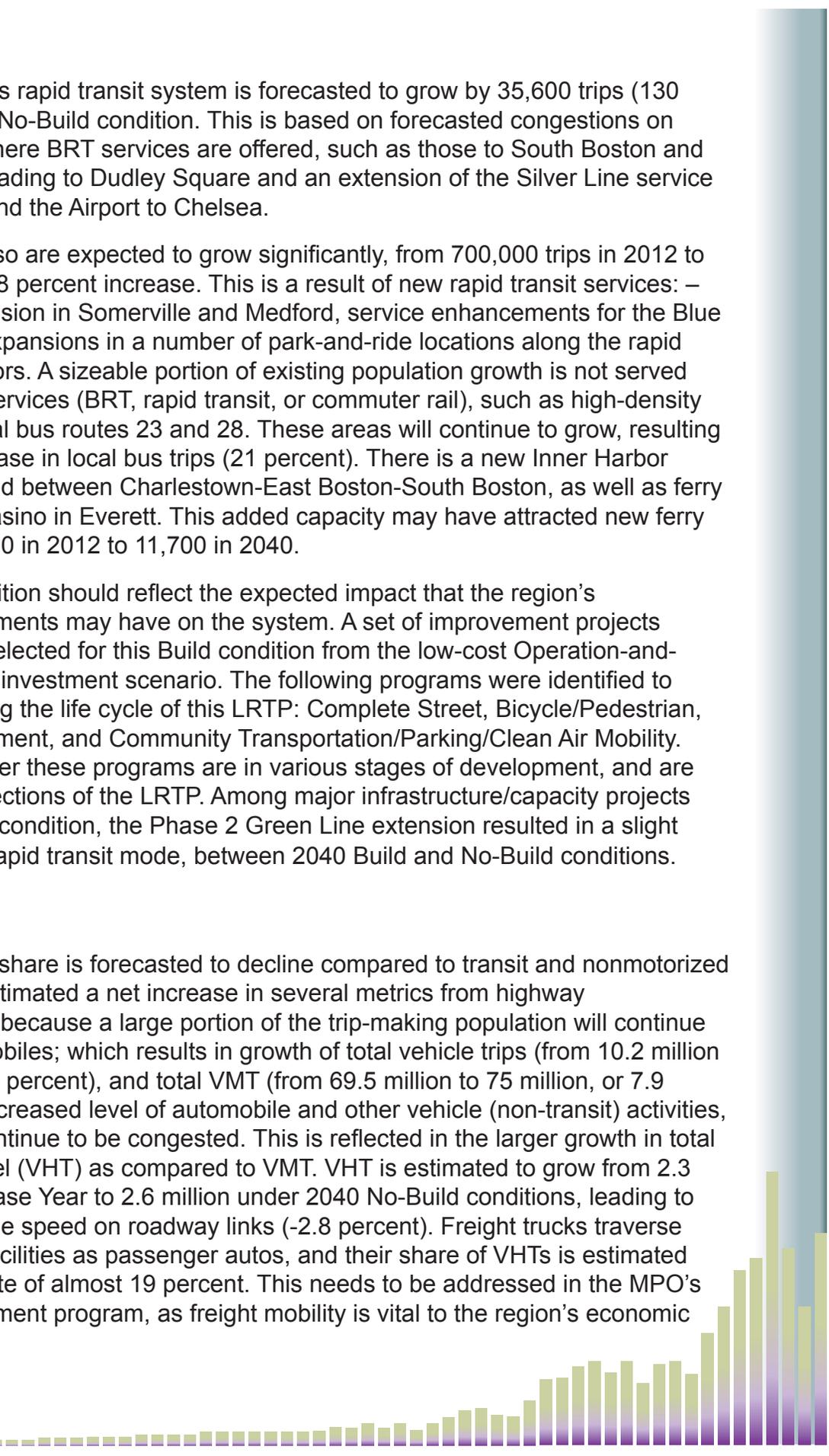
linked trips on the bus rapid transit system is forecasted to grow by 35,600 trips (130 percent) in the 2040 No-Build condition. This is based on forecasted congestions on roadway corridors where BRT services are offered, such as those to South Boston and the corridor south heading to Dudley Square and an extension of the Silver Line service from South Station and the Airport to Chelsea.

Rapid transit lines also are expected to grow significantly, from 700,000 trips in 2012 to 896,000 in 2040, a 28 percent increase. This is a result of new rapid transit services: – the Green Line extension in Somerville and Medford, service enhancements for the Blue Line, and capacity expansions in a number of park-and-ride locations along the rapid transit service corridors. A sizeable portion of existing population growth is not served by premium transit services (BRT, rapid transit, or commuter rail), such as high-density population along local bus routes 23 and 28. These areas will continue to grow, resulting in a substantial increase in local bus trips (21 percent). There is a new Inner Harbor ferry service proposed between Charlestown-East Boston-South Boston, as well as ferry service to the new casino in Everett. This added capacity may have attracted new ferry trips, rising from 4,500 in 2012 to 11,700 in 2040.

The 2040 Build condition should reflect the expected impact that the region’s transportation investments may have on the system. A set of improvement projects and programs was selected for this Build condition from the low-cost Operation-and-Management (O&M) investment scenario. The following programs were identified to receive funding during the life cycle of this LRTP: Complete Street, Bicycle/Pedestrian, Intersection Improvement, and Community Transportation/Parking/Clean Air Mobility. Specific projects under these programs are in various stages of development, and are discussed in other sections of the LRTP. Among major infrastructure/capacity projects included in the Build condition, the Phase 2 Green Line extension resulted in a slight increase in trips for rapid transit mode, between 2040 Build and No-Build conditions.

HIGHWAY

Although auto mode share is forecasted to decline compared to transit and nonmotorized modes, the model estimated a net increase in several metrics from highway assignments. This is because a large portion of the trip-making population will continue to depend on automobiles; which results in growth of total vehicle trips (from 10.2 million to 10.6 million, or 4.6 percent), and total VMT (from 69.5 million to 75 million, or 7.9 percent). With this increased level of automobile and other vehicle (non-transit) activities, roadway links will continue to be congested. This is reflected in the larger growth in total vehicle hours of travel (VHT) as compared to VMT. VHT is estimated to grow from 2.3 million in the 2012 Base Year to 2.6 million under 2040 No-Build conditions, leading to a decrease in average speed on roadway links (-2.8 percent). Freight trucks traverse the same roadway facilities as passenger autos, and their share of VHTs is estimated to grow at a faster rate of almost 19 percent. This needs to be addressed in the MPO’s transportation investment program, as freight mobility is vital to the region’s economic growth.



The cumulative effects of major highway capacity projects on vehicle travel, as analyzed in the 2040 Build condition, is minimal. With more roadway capacities introduced, there is an increase in VMTs, and a corresponding slight decrease in VHT, both less than one percentage point. A decrease in truck VHT is estimated, from 447,300 in No-Build to 430,900 in Build condition. This reduction in vehicle travel time between Build and No-Build conditions is expected, as the Build condition consisted of few large infrastructure projects from the adopted low-cost O&M Investment Programs.

NONMOTORIZED TRAVEL

Travel activities in this category consist of walking and bicycling trips occurring between, and within, traffic analysis zones (TAZs). These trips are a function of existing and assumed future land-use patterns; more compact and mixed-use land-use scenarios lead to a greater number of bicycle and pedestrian trips. With the MPO's adopted Stronger Region land-use scenario, nonmotorized trips are forecasted to grow by 34 percent between Base year and the 2040 No-Build conditions. The LRTP's Bicycle/Pedestrian and Complete Streets programs could add 3,400 pedestrian and bicycle trips per day in the Build condition.

