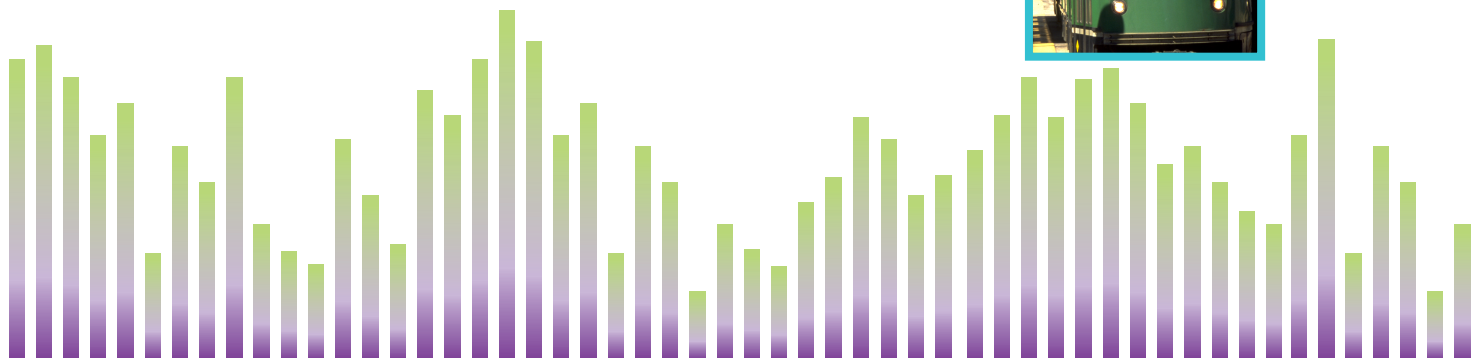
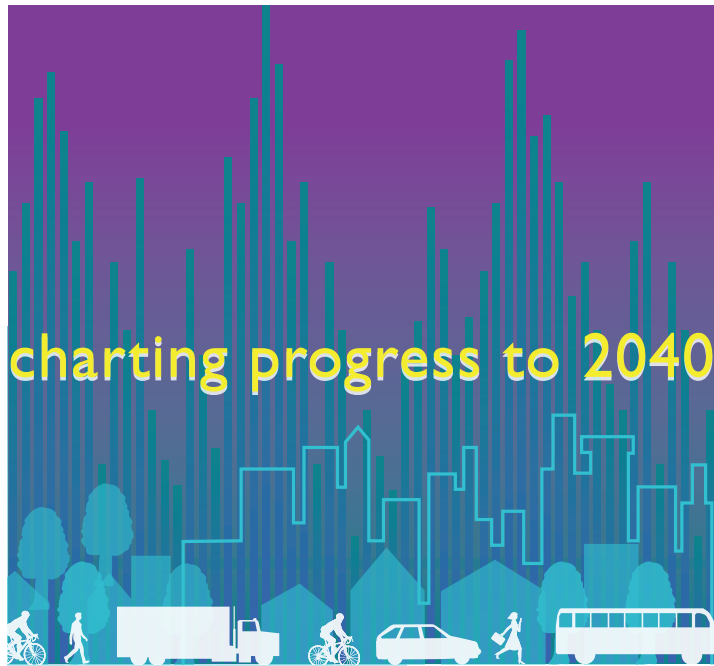


charting progress to 2040

Long-Range Transportation Plan of the Boston Region Metropolitan Planning Organization

July 2015





charting progress to 2040



LONG-RANGE TRANSPORTATION PLAN OF THE BOSTON REGION METROPOLITAN PLANNING ORGANIZATION

JULY 2015

The Boston Region Metropolitan Planning Organization (MPO) is composed of:

Massachusetts Department of Transportation

Metropolitan Area Planning Council

Massachusetts Bay Transportation Authority

Massachusetts Bay Transportation Authority Advisory Board

Massachusetts Port Authority

Regional Transportation Advisory Council

Federal Highway Administration (nonvoting)

Federal Transit Administration (nonvoting)

City of Beverly

City of Boston

Town of Braintree

City of Everett

City of Newton

City of Somerville

City of Woburn

Town of Arlington

Town of Bedford

Town of Framingham

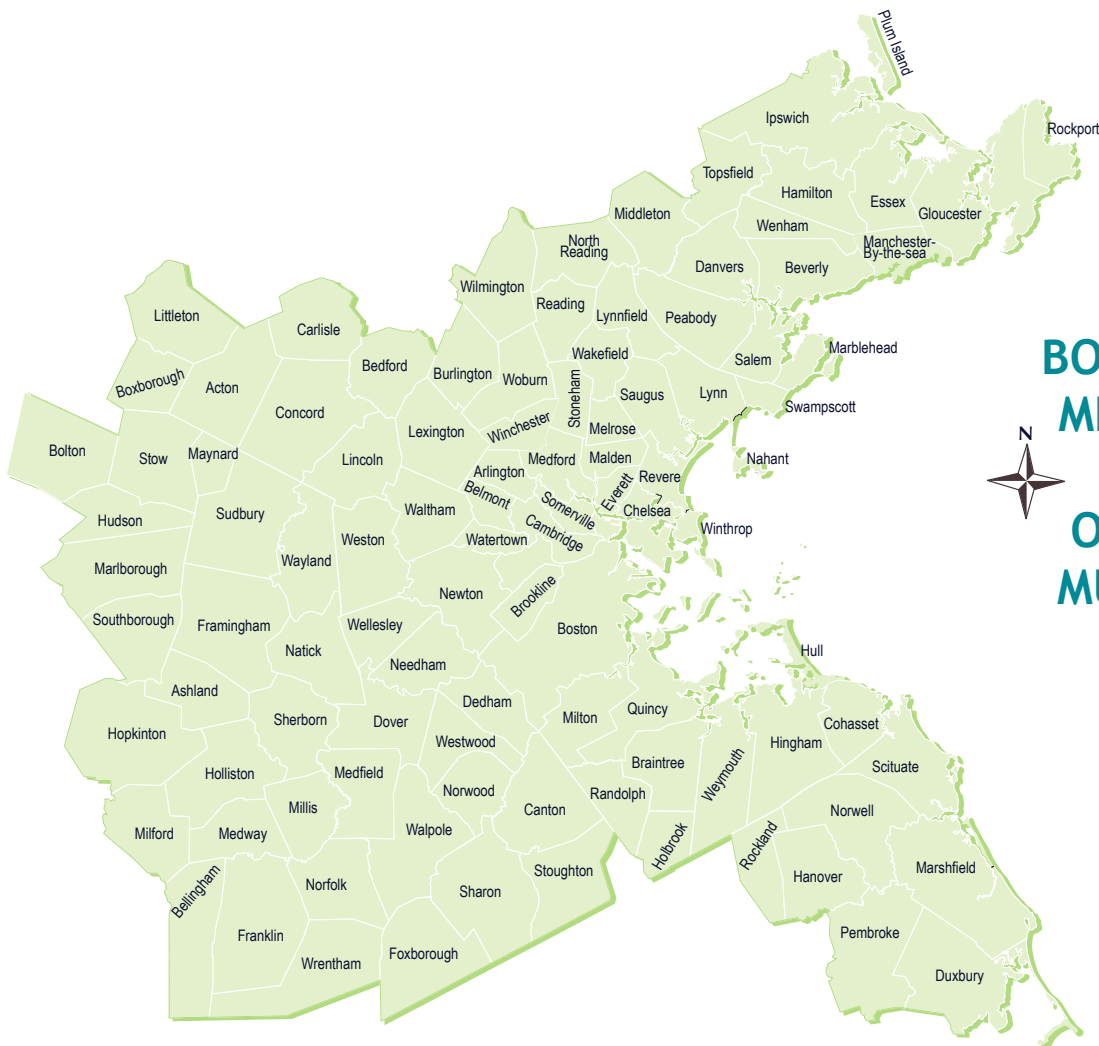
Town of Lexington

Town of Medway

Town of Norwood

Prepared by the MPO's Central Transportation Planning Staff

This document was funded in part through grants from the Federal Highway Administration and Federal Transit Administration of the U.S. Department of Transportation. Its contents do not necessarily reflect the official views or policies of the U.S. DOT.



BOSTON REGION METROPOLITAN PLANNING ORGANIZATION MUNICIPALITIES

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Certification of the Boston Region MPO Transportation Planning Process

The Boston Region Metropolitan Planning Organization certifies that its conduct of the metropolitan transportation planning process complies with all applicable requirements, which are listed below, and that this process includes activities to support the development and implementation of the Regional Long-Range Transportation Plan and Air Quality Conformity Determination, the Transportation Improvement Program and Air Quality Conformity Determination, and the Unified Planning Work Program.

1. 23 USC 134, 49 USC 5303, and this subpart.
2. Sections 174 and 176 (c) and (d) of the Clean Air Act, as amended (42 USC 7504, 7506 (c) and (d) and 40 CFR Part 93.
3. Title VI of the Civil Rights Act of 1964, as amended (42 USC 2000d-1) and 49 CFR Part 21.
4. 49 USC 5332, prohibiting discrimination on the basis of race, color, creed, national origin, sex, or age in employment or business opportunity.
5. Section 1101(b) of the SAFETEA-LU (Pub. L. 109-59) and 49 CFR Part 26 regarding the involvement of disadvantaged business enterprises in U.S. DOT-funded projects.
6. The provisions of the Americans with Disabilities Act of 1990 (42 USC 12101 et seq.) and 49 CFR Parts 27, 37, and 38.
7. The Older Americans Act, as amended (42 USC 6101), prohibiting discrimination on the basis of age in programs or activities receiving federal financial assistance.
8. Section 324 of Title 23 USC regarding the prohibition of discrimination based on gender.
9. Section 504 of the Rehabilitation Act of 1973 (29 USC 794) and 49 CFR Part 27 regarding discrimination against individuals with disabilities.
10. Anti-lobbying restrictions found in 49 USC Part 20. No appropriated funds may be expended by a recipient to influence or attempt to influence an officer or employee of any agency, or a member of Congress, in connection with the awarding of any federal contract.

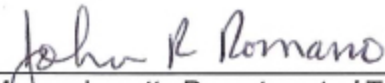
July 30, 2015

A handwritten signature in blue ink, appearing to read "Stephanie Pollack", is written over a horizontal line.

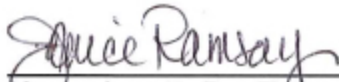
Stephanie Pollack, Secretary and Chief Executive Officer
Massachusetts Department of Transportation
Chair, Boston Region MPO

The signatures of the other MPO members may be found on page 2.


Certification of the Boston Region MPO Transportation Planning Process, p. 2


Massachusetts Department of Transportation
Highway Division


Metropolitan Area Planning Council



Massachusetts Bay Transportation Authority


Regional Transportation Advisory Council


City of Boston for Mayor Martin Walsh


At-Large - City of Newton



At-Large - Town of Lexington

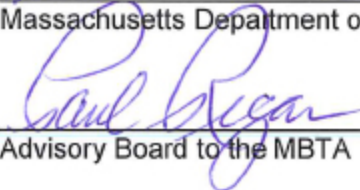

MetroWest Regional Collaborative -
Town of Framingham


North Shore Task Force - Town of Beverly
City

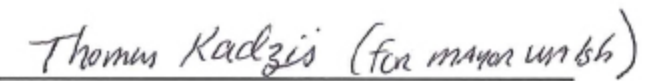
South Shore Coalition - Town of Braintree

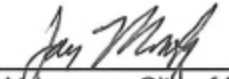

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Norwood

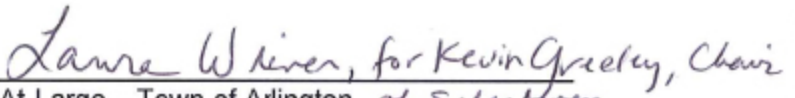

Massachusetts Department of Transportation

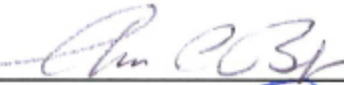

Advisory Board to the MBTA

Massachusetts Port Authority


City of Boston


At-Large - City of Everett
(For Mayor DeMaria)


At-Large - Town of Arlington of Selectmen
for Kevin Greeley, Chair


Inner Core - City of Somerville


Minuteman Advisory Group on Interlocal
Coordination - Town of Bedford


North Suburban Planning Council - City of
Woburn

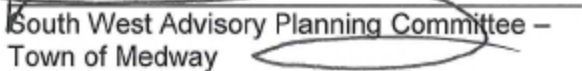

South West Advisory Planning Committee -
Town of Medway

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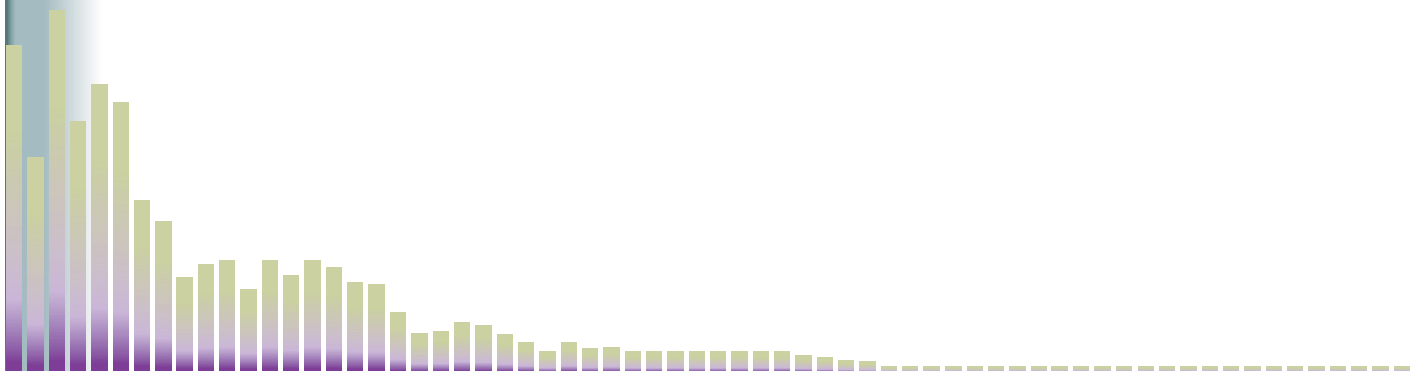
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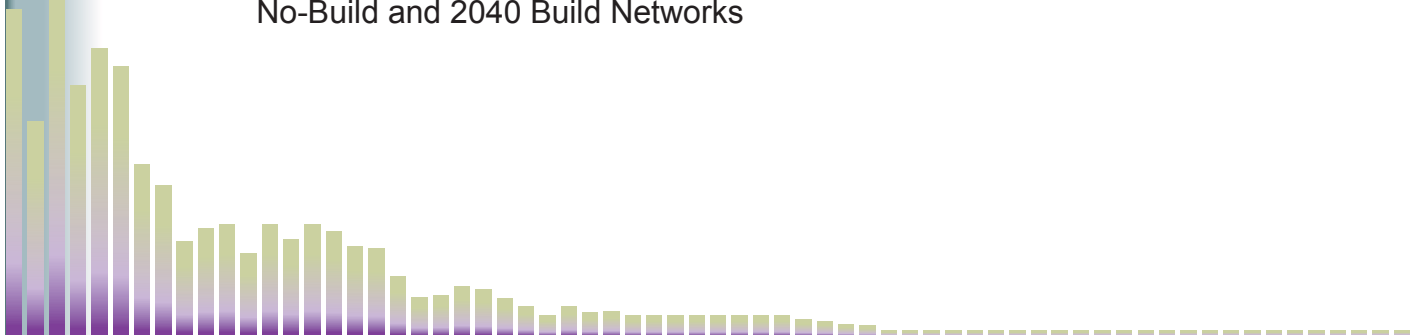
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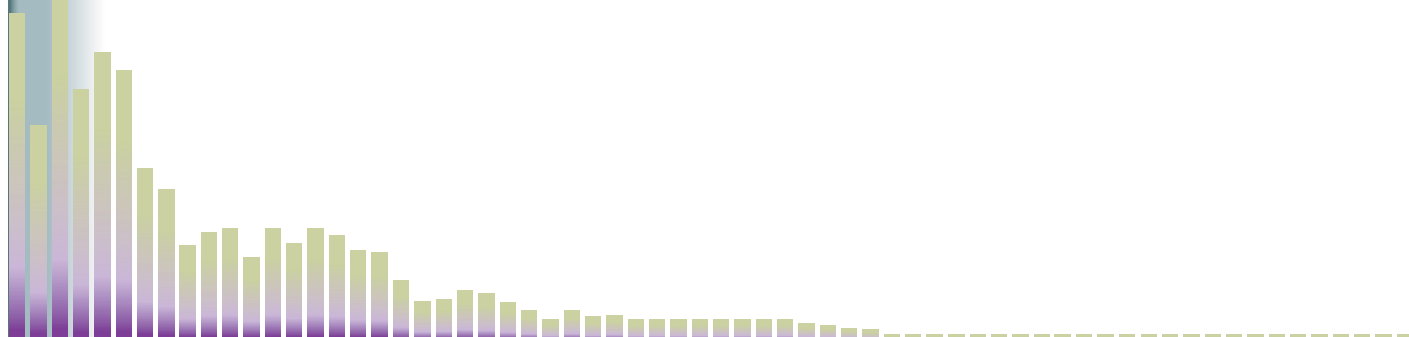
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EXECUTIVE SUMMARY

INTRODUCTION

This document, *Charting Progress to 2040*, is the Boston Region Metropolitan Planning Organization's (MPO) Long-Range Transportation Plan (LRTP) that will be used to move the region's transportation network from its present state towards the MPO's vision for the system's future:

The Boston Region Metropolitan Planning Organization envisions a modern transportation system that is safe, uses new technologies, provides equitable access, excellent mobility, and varied transportation options—in support of a sustainable, healthy, livable, and economically vibrant region.

To help achieve the MPO's vision, this LRTP identifies goals, evaluates needs, and sets priorities, which will be supported with federal funding that the MPO receives for planning and programming investments in capital projects. However, given the region's aging transportation infrastructure and limited resources, the MPO addresses the following challenge through this LRTP:

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

In answering this challenge, the MPO has re-evaluated its past practices and set a new course by moving away from programming expensive capital-expansion projects to ease congestion, and instead, setting aside more funding for small operations-and-management (O&M)-type projects that support bicycle, pedestrian, and transit, along with major roadway improvements.

The MPO developed *Charting Progress to 2040* in compliance with current federal highway legislation, Moving Ahead for Progress in the 21st Century (MAP-21), which governs MPO activities. In keeping with MAP-21, planning for this LRTP incorporated a number of new elements that brought more information to the decision-making process, for both the MPO and the public. One new element is an interactive web-based needs-assessment application that all interested parties may access. In addition, MPO staff enhanced its performance-based planning practice for this LRTP and expanded its use of contemporary planning tools, such as scenario planning, to inform policy and other types of decisions.

Public participation provided on-going critical input to the MPO's decision-making process. Throughout development of this LRTP, the MPO engaged in extensive outreach with an eye toward making public participation convenient, inviting, and engaging for everyone. In particular, the MPO sought to break down barriers to participation for people who traditionally have been only minimally involved in the continuous, comprehensive, cooperative (3C) planning process; for example, minority and low-income populations, and those with limited English proficiency or disabilities. These outreach efforts reflected the MPO's recently revitalized public participation program that includes using more electronic forms of communication and interactive engagement techniques.

VISION, GOALS, AND OBJECTIVES

Early in the process of developing *Charting Progress to 2040*, the MPO revised its vision statement to focus more sharply on the transportation issues of greatest concern to the MPO and the public for the envisioned future transportation system, including:

- Safety
- System Preservation
- Capacity Management/Mobility
- Clean Air/Clean Communities
- Transportation Equity
- Economic Vitality

For each of these issues, the MPO identified problems and their associated requirements for the transportation network. This allowed the MPO to set goals that, if accomplished, would result in concrete solutions for the identified problems, and help the region achieve its vision by 2040. The MPO established objectives for each goal. (See Figure ES.1.)

FIGURE ES.1 MPO Vision, Goals, and Objectives

| CENTRAL VISION STATEMENT | |
|--|--|
| <p>The Boston Region Metropolitan Planning Organization envisions a modern transportation system that is safe, uses new technologies, provides equitable access, excellent mobility, and varied transportation options—in support of a sustainable, healthy, livable, and economically vibrant region.</p> | |
| GOALS | OBJECTIVES |
| SAFETY | |
| <p>Transportation by all modes will be safe</p> | <ul style="list-style-type: none"> Reduce number and severity of crashes, all modes Reduce serious injuries and fatalities from transportation Protect transportation customers and employees from safety and security threats (Note: The MPO action will be to incorporate security investments into capital planning.) |
| SYSTEM PRESERVATION | |
| <p>Maintain the transportation system</p> | <ul style="list-style-type: none"> Improve condition of on- and off-system bridges Improve pavement conditions on MassDOT-monitored roadway system Maintain and modernize capital assets, including transit assets, throughout the system Prioritize projects that support planned response capability to existing or future extreme conditions (sea level rise, flooding, and other natural and security-related man-made hazards) Protect freight network elements, such as port facilities, that are vulnerable to climate-change impacts |
| CAPACITY MANAGEMENT/MOBILITY | |
| <p>Use existing facility capacity more efficiently and increase healthy transportation capacity</p> | <ul style="list-style-type: none"> Improve reliability of transit Implement roadway management and operations strategies, constructing improvements to the bicycle and pedestrian network, and supporting community-based transportation Create connected network of bicycle and accessible sidewalk facilities (at both regional and neighborhood scale) by expanding existing facilities and closing gaps Increase automobile and bicycle parking capacity and usage at transit stations Increase percentage of population and places of employment within one-quarter mile of transit stations and stops Increase percentage of population and places of employment with access to bicycle facilities Improve access to and accessibility of transit and active modes Support community-based and private-initiative services and programs to meet last mile, reverse commute and other non-traditional transit/transportation needs, including those of the elderly and persons with disabilities Eliminate bottlenecks on the freight network Enhance intermodal connections Emphasize capacity management through low-cost investments; give priority to projects that focus on lower-cost O&M-type improvements such as intersection improvements and Complete Streets solutions |
| CLEAN AIR/CLEAN COMMUNITIES | |
| <p>Create an environmentally friendly transportation system</p> | <ul style="list-style-type: none"> Reduce greenhouse gases generated in the Boston region by all transportation modes as outlined in the Global Warming Solutions Act Reduce other transportation-related pollutants Minimize negative environmental impacts of the transportation system Support land use policies consistent with smart and healthy growth |
| TRANSPORTATION EQUITY | |
| <p>Provide comparable transportation access and service quality among communities, regardless of income level or minority population</p> | <ul style="list-style-type: none"> Target investments to areas that benefit a high percentage of low-income and minority populations Minimize any burdens associated with MPO-funded projects in low-income and minority areas Break down barriers to participation in MPO-decision making |
| ECONOMIC VITALITY | |
| <p>Ensure our transportation network provides a strong foundation for economic vitality</p> | <ul style="list-style-type: none"> Minimize the burden of housing and transportation costs for residents in the region Prioritize transportation investments that serve targeted development sites Prioritize transportation investments consistent with the compact-growth strategies of MetroFuture |

Source: Central Transportation Planning Staff.

Together, the vision, goals, and objectives lay the groundwork for the MPO's performance-based planning practice, which in turn informs all of the work conducted by the MPO, including evaluating and selecting projects and programs for the LRTP, selecting projects for the Transportation Improvement Program (TIP), and selecting planning studies for the Unified Planning Work Program (UPWP).

TRANSPORTATION NEEDS

The MPO assessed the region's transportation needs to help decide which projects to fund in the LRTP. This Needs Assessment includes information about how the region's surface transportation system is used, both now and in future projections; how it interacts with land-use conditions and the environment; and how well it serves low-income, minority, and other historically underserved populations. The Needs Assessment also establishes the baseline for charting progress through performance-based planning.

The MPO has made the Needs Assessment data available via the internet to help educate the public and make the planning process more transparent. A Needs Assessment document, also found on the MPO's website, summarizes these data and identifies the region's most critical needs relative to each of the MPO's goals. The Needs Assessment makes clear that the region faces extensive maintenance and modernization needs, and must address safety and mobility for all modes.

Using the Needs Assessment, the MPO compiled a comprehensive universe of projects that could be programmed to solve the identified problems; the projects that became the recommended list selected for evaluation and inclusion in this LRTP, were taken directly from this universe.

FINANCE

During the 25 years of this plan, the Boston Region MPO has the discretion to program \$2.85 billion in federal funds for highway transportation projects. This amount is significantly less than was available four years ago when the MPO programmed approximately \$3.8 billion in its prior LRTP, *Paths to a Sustainable Region*.

Because, as of this writing, Congress had not yet passed new federal legislation that would solidify long-term revenue projections, the federal agencies advised the MPO to assume that revenues would increase by 1.5 percent each year for federal fiscal years (FFYs) 2021 through 2040. For the same period, the MPO was told to assume that project costs would inflate by 4 percent each year. If these assumptions hold true, project costs will outpace available revenues, resulting in diminished buying power in future years. A new authorization by Congress, following publication of this LRTP, could change the outlook for financing transportation projects in the Boston region.

TABLE ES.1
Comparison of Available Capital Highway Funds in *Charting Progress to 2040* to the Previous LRTP, *Paths to a Sustainable Region*

| | FFYs 2013-15 | FFYs 2016-20 | FFYs 2021-25 | FFYs 2026-30 | FFYs 2031-35 | FFYs 2036-40 | Total |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------|
| <i>Paths to a Sustainable Region Revenue*</i> | \$229.83 | \$557.47 | \$815.61 | \$1018.44 | \$1180.65 | -- | \$3802.00 |
| <i>Charting Progress to 2040 Revenue</i> | -- | 441.65 | 464.87 | 580.90 | 657.78 | \$708.60 | \$2853.80 |
| Difference | | (\$115.82) | (\$350.74) | (\$437.54) | (\$522.87) | | (\$948.20) |
| Percentage Change | | -21% | -43% | -43% | -44% | -- | -25% |

FFYs = Federal fiscal years.

Note: Dollars in millions.

* *Paths to a Sustainable Region* is a 23 year LRTP compared to *Charting Progress to 2040* which is a 25 year LRTP.

Source: Central Transportation Planning Staff.

The financial plan for *Charting Progress to 2040* reflects the way in which the MPO plans to balance the diversity of identified needs with the fiscal constraint of projected revenues. The financial plan includes estimated costs for the specific regionally significant transportation projects that the MPO will fund, as well as defined amounts of money set aside throughout the life of the plan for programs that will fund smaller projects. Because these smaller projects are not regionally significant, they are not accounted for individually in the LRTP, but will be selected through the TIP programming process.

In addition to reporting on the MPO's discretionary spending decisions, this financial plan also provides information on the nearly \$6 billion that the state plans to spend on highway projects. It also will cite the \$10.3 billion that the Massachusetts Bay Transportation Authority (MBTA) is expected to spend, and the capital resources available to the other two Regional Transit Authorities operating in the MPO region.

RECOMMENDED PLAN

MPO staff used a variety of analytic methods, including a number of new and/or enhanced planning tools and techniques, to shed light on the potential outcomes of various investment strategies (and inform the MPO's general discussions and decision making). Staff also increased its use of scenario planning to allow the MPO and other stakeholders to compare the relative effects of different possible transportation solutions.

Scenario planning helped illuminate the relative merits of two different approaches to one of the objectives related to the MPO's capacity management goal:

Should the MPO continue to use a *congestion-reduction* approach by investing in major arterials and express highways? Or, should the MPO adopt a *capacity-management* approach by investing in smaller-scale, but more diverse and geographically dispersed, O&M-type projects?

The results of this exercise led the MPO to adopt the O&M approach to programming in the LRTP, signaling a pivotal change in the MPO's funding philosophy, and committing a significant portion of MPO funds to the following investment programs:

- **Intersection Improvements:** Modernizes existing signals or adds new signals to improve safety and mobility. Improvements also could consist of turning lanes, shortened crossing distances for pedestrians, and striping and lighting for bicyclists. Improvements to sidewalks and curb cuts will enhance accessibility for pedestrians. Updated signal operations will reduce delay and improve transit reliability.
- **Complete Streets:** Modernizes roadways to improve safety and mobility for all users. Improvements could consist of continuous sidewalks and bicycle lanes, cycle tracks, and other bicycle facilities, as well as updated signals at intersections along a corridor. Improvements will reduce delay and improve transit reliability. Expanded transportation options and better access to transit will improve mobility for all and encourage mode shift.
- **Bicycle Network and Pedestrian Connections:** Expands the bicycle and pedestrian networks to improve safe access to transit, school, employment centers, and shopping destinations. Could include constructing new, off-road bicycle or multi-use paths, improving bicycle and pedestrian crossings, or building new sidewalks.
- **Community Transportation/Parking/Clean Air and Mobility:** Includes a combination of the following types of projects:
 - Funds transit services developed at a local level that support first-mile/last-mile connections to existing transit services and other destinations by purchasing shuttle buses and/or funding operating costs
 - Targets funding to construct additional parking at transit stations that now are at capacity, or at identified new parking locations
 - Provides funding to projects (such as bike share projects or shuttle bus services) to improve mobility and air quality and promote mode shift
- **Major Infrastructure:** Includes large-scale projects that modernize and/ or expand major highways and arterials to reduce congestion and improve safety. Projects could include major interchange improvements and major bottleneck reconstruction. This category also includes spending on major transit or bridge projects.

In addition to prioritizing the programs discussed above, the MPO also tried to honor its past policy and practice of maintaining its previous LRTP and TIP-programming commitments when selecting the recommended list of projects for inclusion in the plan. MPO staff used the recommended list to model two alternatives:

- The first alternative programmed all of the currently unfunded major infrastructure projects from the previous LRTP, *Paths to a Sustainable Region*.
- The second alternative targeted funding to lower-cost O&M-type programs, using the following assumptions:
 - 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.
 - Funding for the O&M investment programs used funds that were left after the major infrastructure program was determined, based on the following allocations:
 - Complete Streets Program – 58 percent
 - Intersection Improvements Program – 28 percent
 - Bicycle and Pedestrian Program – 10 percent
 - Community Transportation, parking, and Clean Air and Mobility Program – 4 percent

Ultimately, the MPO chose the O&M alternative for the final selection of projects and programs. The final selection was based on the informed judgment of the MPO and knowledge gained through the LRTP development process, including the needs assessment; scenario-planning; project information from feasibility studies, project-specific modeling work, and environmental impact reports; adherence to the MPO's goals and objectives; and feedback from the general public and other interested parties.

Table ES.2, below, presents the MPO's final list of the projects and programs included in *Charting Progress to 2040's 25-year horizon*.

TABLE ES.2
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 |

Table ES.3, below, presents a list of the amount of funding dedicated to programs included in *Charting Progress to 2040*.

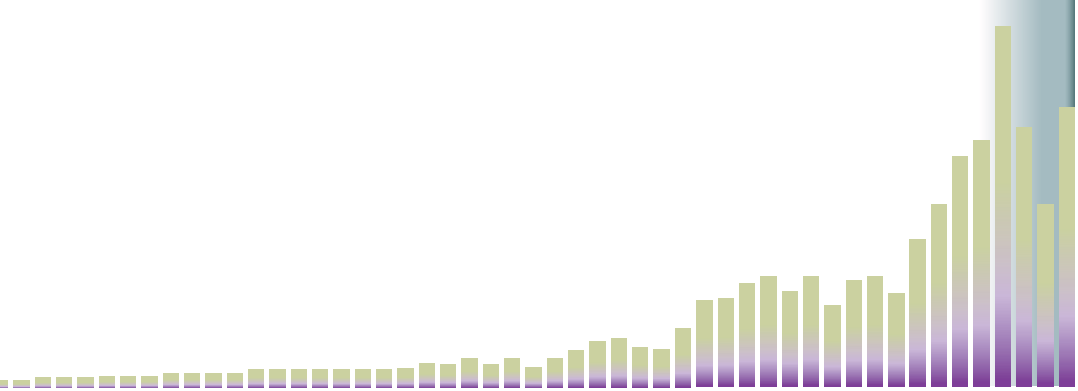


TABLE ES.3
Funding Dedicated to Programs in the LRTP

| 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 |

CHARTING PROGRESS

Increasingly, over the past two decades, transportation agencies have been utilizing “performance management”—a strategic approach that uses performance data to guide decisions and track progress over time to help achieve desired outcomes. Another term for this strategy is performance-based planning and programming (PBPP). The goal of PBPP is to ensure that transportation investment decisions—both long-term planning and short-term programming—are based on their ability to meet established goals.

Although the Boston Region MPO has been developing a PBPP practice for several years, it stepped up its efforts for this LRTP—both to improve the process and to meet MAP-21 requirements—through the following actions:

- Established goals and objectives that align with national goals
- Identified performance measures for established goals and objectives
- Analyzed trends over time for some performance measures to identify priorities
- Prioritized investments that advance its goals and objectives

The MPO used PBPP to evaluate the degree to which proposed investments—both major infrastructure projects and O&M-type investment programs—advance each of the MPOs goals over the life of the LRTP. For the regionally significant projects and

those that will be funded through O&M-type programs, MPO staff conducted project-level assessments using sketch-planning and travel-demand modeling techniques.

Performance-based planning is an ongoing process and will evolve as the MPO monitors and evaluates its progress using performance measures. The MPO will continue to use PBPP to monitor system-level trends annually and will propose performance targets for each performance measure. By continuously monitoring and evaluating its progress, the MPO will be able to weigh the trade-offs among competing goals and objectives in a more informed manner.

TRANSPORTATION EQUITY

The MPO supports a transportation equity (TE) program to ensure that populations protected under various federal and state civil rights statutes, executive orders, and regulations (TE populations) are provided equal opportunity to participate fully in the MPO's transportation-planning and decision-making process. Federal regulations require that TE populations share equitably in the benefits and burdens of past, present, and future transportation projects, programs, and service. The MPO's TE program comprises various activities, including a public-participation program designed specifically to communicate with low-income and minority residents, the elderly, persons with disabilities, and persons with limited English proficiency (LEP).

For this LRTP, MPO staff used the travel-demand model set to perform two types of equity analyses:

- **Accessibility analysis:** Based on both the ability to reach desired destinations (employment opportunities, health care facilities, and higher education facilities), and the ease of doing so. This analysis investigated the number of destinations that could be reached from low-income, non-low-income, minority and nonminority transportation analysis zones (TAZs) as well as the average transit and highway travel times to these destinations for each type of TAZ.
- **Mobility, congestion, and air-quality analysis:** Focused on the average door-to-door travel time and average vehicle-miles traveled (VMT) under congested conditions and carbon monoxide levels.

For the first part of each type of analysis, which looked at the change between the 2040 No-Build and Build alternatives for low-income, non-low-income, minority, and nonminority TAZs, respectively, all projected changes were within the margin of error of the model. The second part of the analysis, which measured the ratio of the change from the 2040 No-Build to the Build alternative for low-income versus non-low-income TAZs and minority versus nonminority TAZs, showed no disproportionate burdens or disparate impacts for all six of the accessibility factors and most of the seven mobility, congestion, and air-quality factors analyzed. However, for one mobility and congestion measure,

both a disproportionate burden and disparate impact was found; and for another, only a disparate impact was found. Because the underlying data for this analysis were within the model's margin of error, these findings likely would not be meaningful; however, the MPO will track them via future TIP equity evaluations to ensure that they are addressed.

AIR QUALITY

The MPO completed two types of air-quality analyses for *Charting Progress to 2040*. The first is the air-quality conformity determination for projects in the LRTP, as required by federal and state regulations, which specifically addresses carbon monoxide (CO). The requirement to perform a conformity determination ensures that federal approval and funding go to transportation activities that are consistent with air-quality goals. The air-quality conformity analysis shows that CO emissions from projects in *Charting Progress to 2040* are consistent with the emissions budget set forth in the State Implementation Plan.

The second air-quality analysis looked at greenhouse gas (GHG) emissions for projects in the LRTP and TIP as mandated by state legislation, which requires that GHG emissions be reduced below 1990 levels by 25 percent by 2020, and 80 percent by 2050. To do so, state policies require the transportation sector to promote healthy transportation modes and support smart growth development.

The Massachusetts Department of Transportation, using MPO and statewide travel-demand models, will provide the MPO with statewide estimates of carbon dioxide (CO₂) emissions (the most prominent GHG). These estimates will be based on the collective list of recommended projects in all the Massachusetts LRTPs combined (and supplemented by CO₂ emission-reduction results for smaller, "off-model" projects supplied by the MPO). The results of the GHG modeling will be available in a separate statewide air quality report at the end of August 2015. Although not federally required, an emissions analysis for ozone precursors will also be included in this separate air quality report for informational purposes only, based on comments received during the public comment period for the Draft LRTP.

CONCLUSION

Charting Progress to 2040 represents a turning point in the philosophy and practice of the MPO. The Boston region has long embraced transit and supported non-motorized modes of transportation. However, this is the MPO's first LRTP that does not prioritize the funding of regionally significant roadway projects over other types of investments. The MPO hopes that charting this new course will achieve its transportation vision for the future, to improve the quality of life of its residents and enhance the environment in the whole region.



1

TRANSPORTATION PLANNING FOR THE BOSTON REGION

INTRODUCTION

To get from one place to another, it is helpful to have a clear vision of where you want to go and a plan that outlines the steps needed for the journey. The plan should include a road map to guide the way and help you understand the terrain you will need to negotiate and the obstacles in your way. Also important to the plan would be knowledge of the resources you could draw on to stay on track and keep moving forward.

This document, *Charting Progress to 2040*, is such a plan. It is the Boston Region Metropolitan Planning Organization's (MPO) Long-Range Transportation Plan (LRTP) that will be used to move the region's transportation network from its present state towards the MPO's vision for the system's future:

The Boston Region Metropolitan Planning Organization envisions a modern transportation system that is safe, uses new technologies, provides equitable access, excellent mobility, and varied transportation options—in support of a sustainable, healthy, livable, and economically vibrant region.

To help achieve the MPO's vision, this LRTP defines goals and objectives that guide the planning process and establish performance metrics to evaluate progress. The plan also describes the problems the region would face as it moves toward its vision, and the needs that it must address. In addition, the LRTP evaluates various strategies' potential to meet those needs, and identifies financial resources and impediments to implementing solutions.

METROPOLITAN TRANSPORTATION PLANNING FRAMEWORK

History and Function of MPOs

Charting Progress to 2040 is a product of the Boston Region MPO, which is the designated metropolitan planning organization for the Boston metropolitan area. States create MPOs for urbanized areas of more than 50,000 people. The Federal-aid Highway Act of 1962 mandated the existence of MPOs to ensure that decisions about federal funding of transportation projects and programs would be based on a

“continuing, cooperative, and comprehensive” (3C) planning process. To implement the prescribed 3C planning process, MPOs are required to:

- Plan for the long-range future of their region by developing and maintaining an L RTP for the metropolitan area
- Develop a short-range capital spending plan to achieve the region’s goals—the Transportation Improvement Program (TIP)—which is the implementing arm of the L RTP
- Conduct planning studies to identify and evaluate alternative transportation-improvement options and other information needed for MPO decision making, as described in the Unified Planning Work Program (UPWP)
- Establish and manage a fair and impartial setting for effective regional decision making in the metropolitan area
- Involve the public in the area’s decision making

Current MPO Requirements

The current federal legislation governing MPOs is Moving Ahead for Progress in the 21st Century (MAP-21). This law establishes national goals for federal highway programs that relate to safety, system preservation, congestion reduction, system reliability, improved freight movement for economic vitality, environmental sustainability, and reduced project delay and delivery. MAP-21 continues many of the metropolitan planning requirements established through previous iterations of federal highway legislation, such as:

- Considering environmental effects
- Analyzing air quality
- Developing fiscally constrained financial plans, operational, and management strategies to improve performance of existing facilities
- Generating capital investments and strategies for preserving the system, and providing multi-modal capacity increases
- Initiating public-participation activities that include the full spectrum of the public

MAP-21 also introduced some new metropolitan planning responsibilities, such as requiring MPOs to implement performance-based planning practices that include performance measures and targets to track and report on progress toward well-defined goals and objectives.

In addition to MAP-21, a number of other federal and state laws, regulations, executive orders, policy directives, and planning frameworks influence and guide metropolitan transportation planning:

- United States Department of Transportation (USDOT) 23 CFR (Code of Federal Regulation) Parts 450 and 500, and 49 CFR Part 613
- 1990 Clean Air Act Amendments
- United States Environmental Protection Agency (EPA) Conformity Regulation (40 CFR Parts 51 and 93).
- Americans with Disabilities Act (ADA)
- Title VI of the 1964 Civil Rights Act and related Presidential Executive Orders
- Massachusetts Global Warming Solutions Act (GWSA)
- Massachusetts Strategic Highway Safety Plan (SHSP)
- Massachusetts Department of Transportation initiatives
 - GreenDOT Policy
 - Healthy Transportation Compact (HTC)
 - Mode Shift Goal
 - youMove Massachusetts (YMM) planning initiative

All of the above are discussed in Appendix A of the *Charting Progress to 2040* Needs Assessment document (available online at http://www.bostonmpo.org/Drupal/charting_2040_needs).

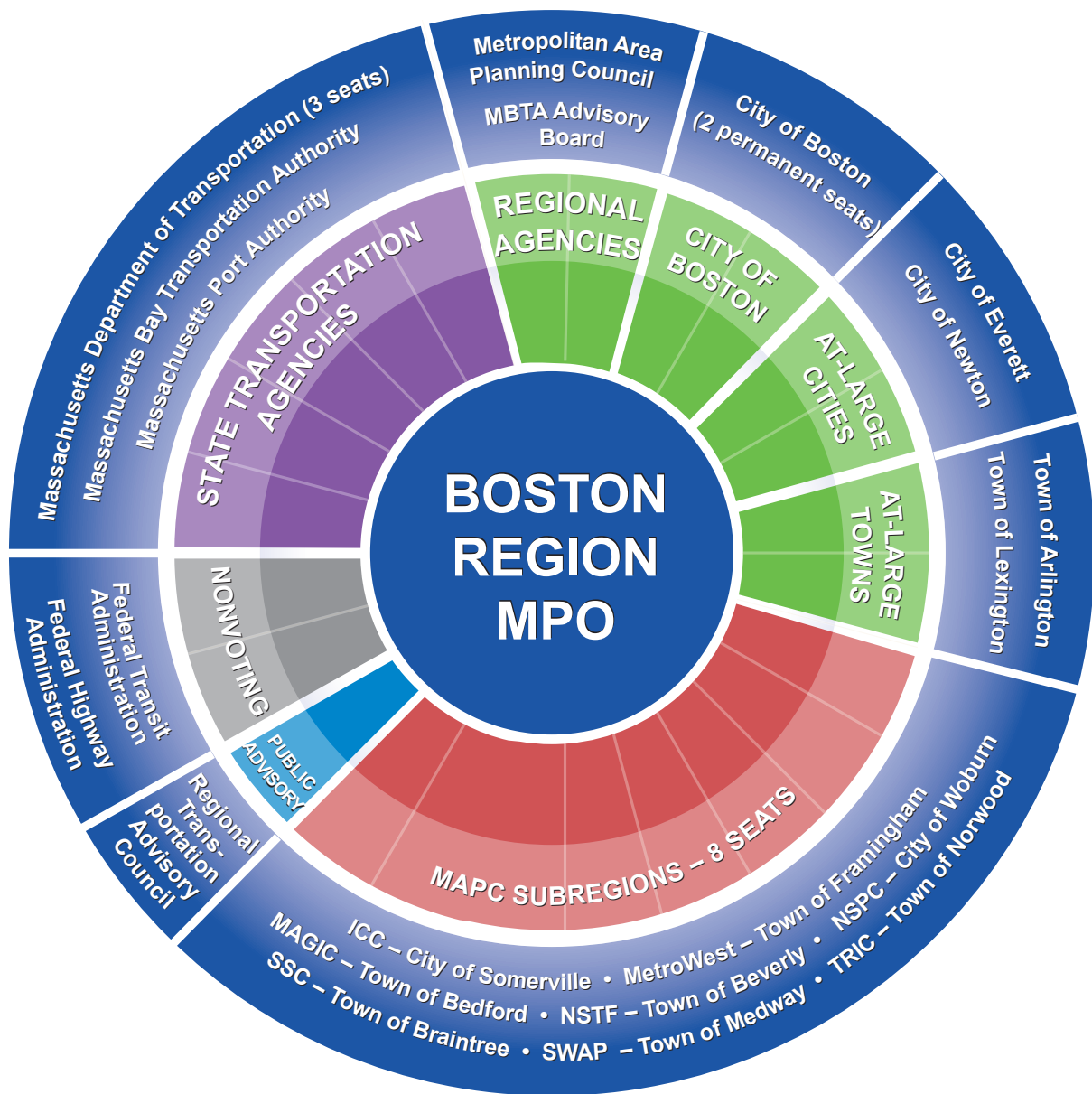
THE BOSTON REGION MPO

Composition of the MPO

The Boston Region MPO is responsible for transportation planning in the metropolitan area. Currently, the MPO has 22 voting members, which include representatives from state transportation agencies, regional entities involved in transportation, and municipalities. The Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) participate in the MPO in a nonvoting capacity. (For more information about Boston Region MPO membership see Figure 1.1.)



FIGURE 1.1
Boston Region Metropolitan Planning Organization Member Structure



The Central Transportation Planning Staff (CTPS) is the technical staff to the MPO. CTPS conducts planning studies and technical analyses, and develops and maintains a set of specialized analytical tools that help to inform the MPO's transportation planning and policy decisions.

(For more information about the MPO and its operation, visit the MPO website at www.bostonmpo.org.)

To understand a region's transportation problems and needs, it is important to appreciate the diversity of its land use, population, employment, geography, and travel options that help to shape the transportation system and regional travel patterns.

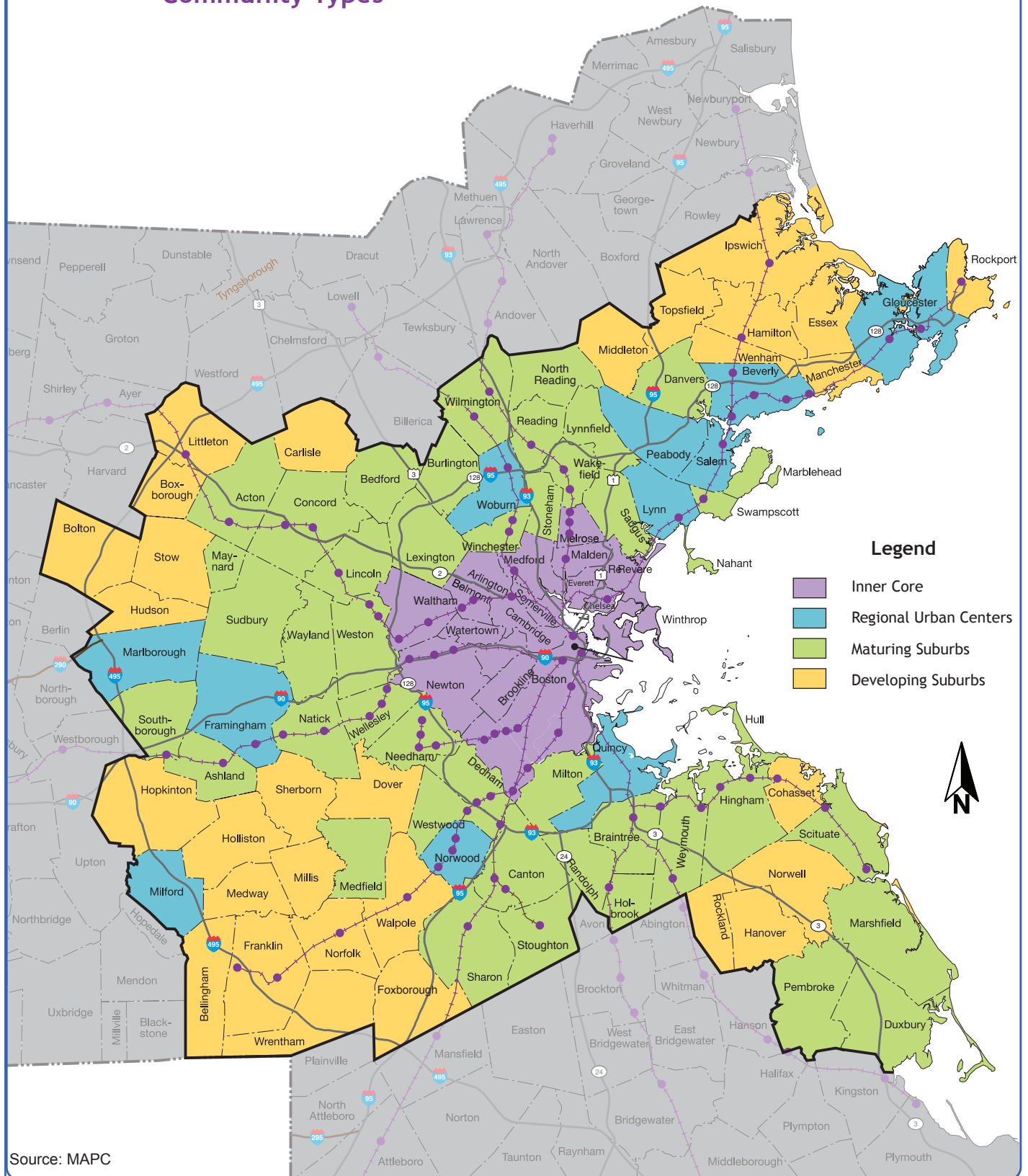
DIVERSE LAND TYPES

The Boston region is notable for its diverse municipalities, ranging from relatively rural towns, such as Essex, to the densely populated, urban city of Cambridge. At its heart is the city of Boston, which covers 48.4 square miles. Although the city comprises only 3 percent of the region's area, it is home to 20 percent of the region's jobs and 20 percent of its residents.

The region's municipalities can be divided into four different community types, based on existing development patterns and growth potential.

- **Inner Core:** High-density built-out communities in the center of the region with multi-family homes as a significant portion of housing stock, and employment concentrated in downtown Boston and portions of Cambridge. The Inner Core is essentially "built-out," with little vacant developable land.
- **Regional Urban Centers:** Communities outside the inner core with urban-scale downtown centers, moderately dense residential neighborhoods, a mixture of built-out areas and developable land on the periphery, as well as growing immigrant populations.
- **Maturing Suburbs:** Moderately dense communities with less than 20 percent of land vacant and developable. These communities are comprised mainly of owner-occupied single-family homes, and are mainly residential, although some are significant employment centers.
- **Developing Suburbs:** Communities with large expanses of vacant developable land, ranging from those with strong town centers and moderately dense neighborhoods to ones that are more rural.

FIGURE 1.3
Metropolitan Area Planning Council
Community Types

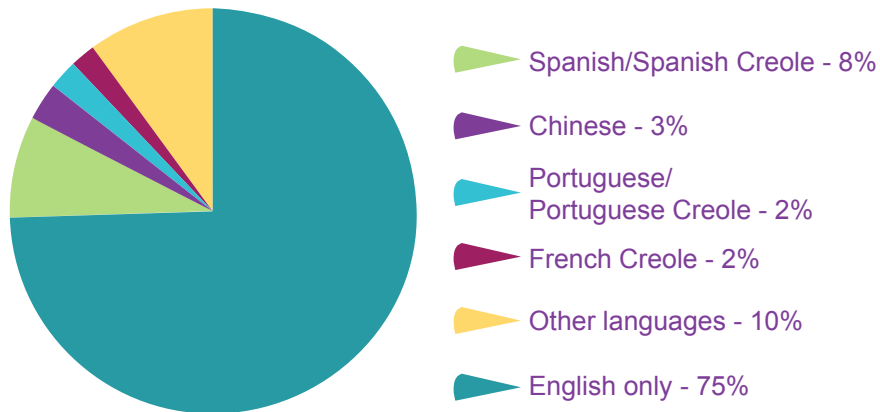


DIVERSE PEOPLE

The Boston region is home to a diverse population in terms of race, language, and age, as well as household size and income.

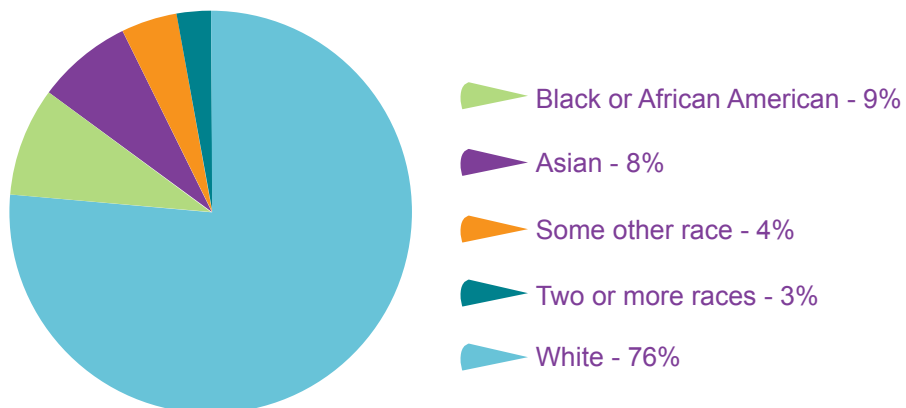
A quarter (25 percent), of the population speaks a language other than English at home (Figure 1.4) and a quarter of the population (24 percent) identifies as nonwhite (Figure 1.5).

FIGURE 1.4
Language Spoken at Home
for the Population 5 Years and Over



Source: 2013 American Community Survey 5-Year Summary File, Table B16001.

FIGURE 1.5
Population by Race

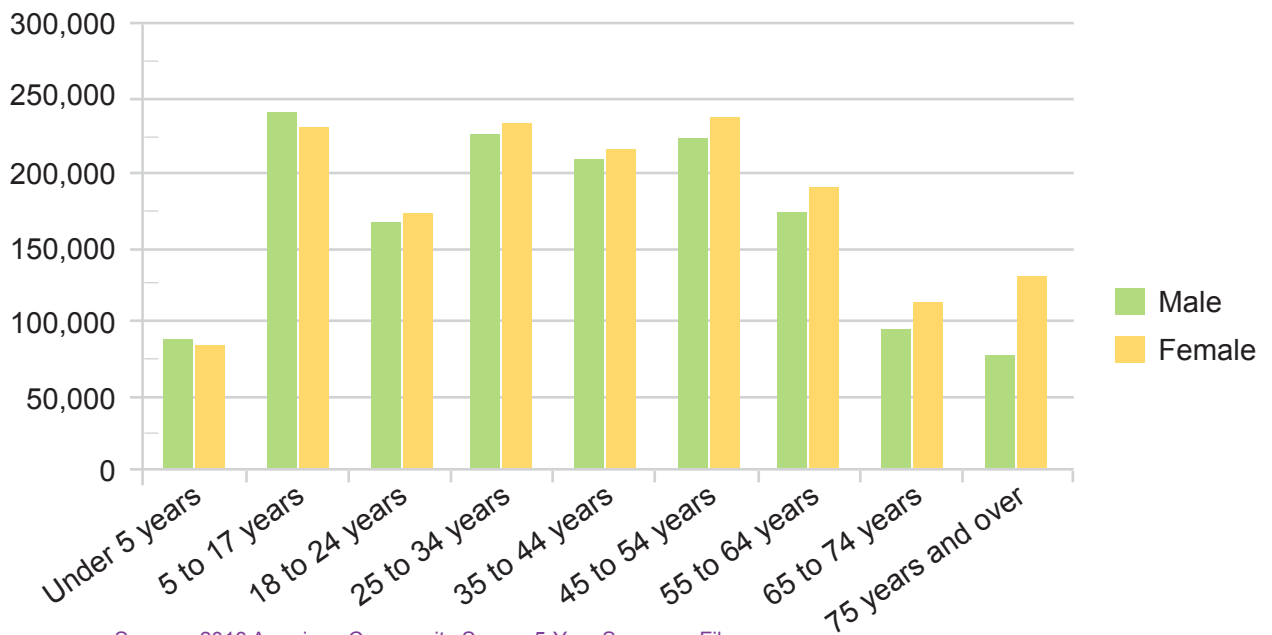


Source: 2013 American Community Survey 5-Year Summary File.

Although the population is representative of all ages, the largest age groups are 5 to 17, 45 to 54, and 25 to 34 years, with a median age of 37.9 years (Figure 1.6). This provides the Boston region with a robust workforce, and the large number of young residents fuels growth of the region’s education sector. Household size is shrinking, with one- and two-person households making up 62 percent of all households in the region (Figure 1.7).

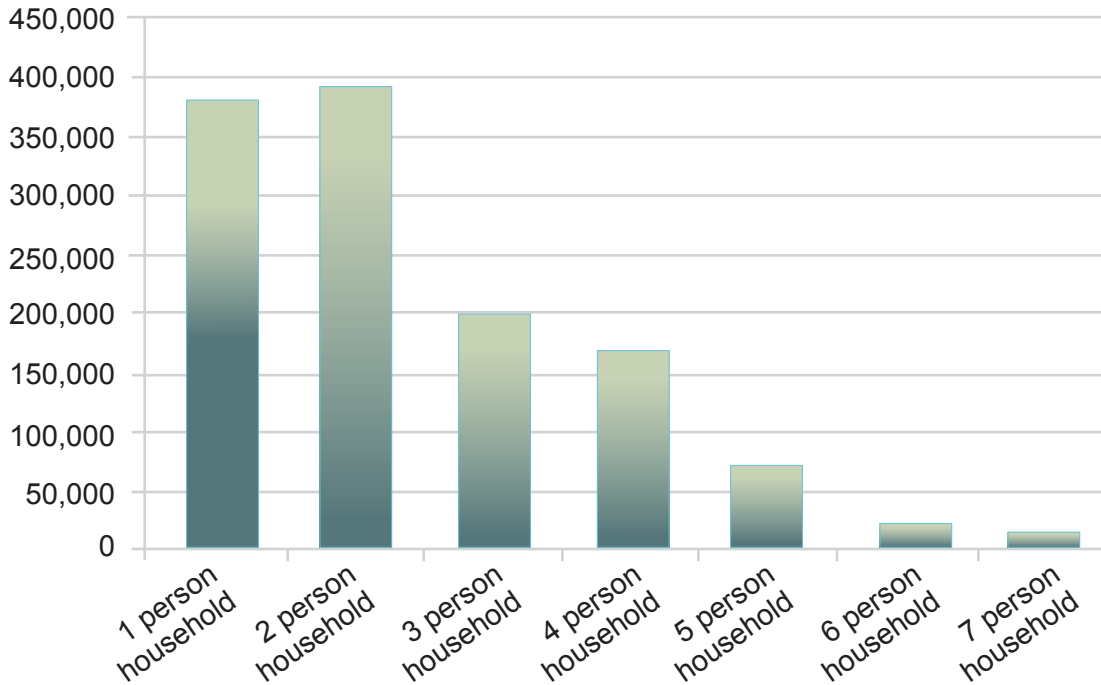
The region’s residents also fare well economically, with 50 percent of households earning more than \$75,000. Despite this, 22 percent of the region’s households earn less than \$29,000, highlighting the need to examine regional economic equity (Figure 1.8).

FIGURE 1.6
Population by Sex and Age



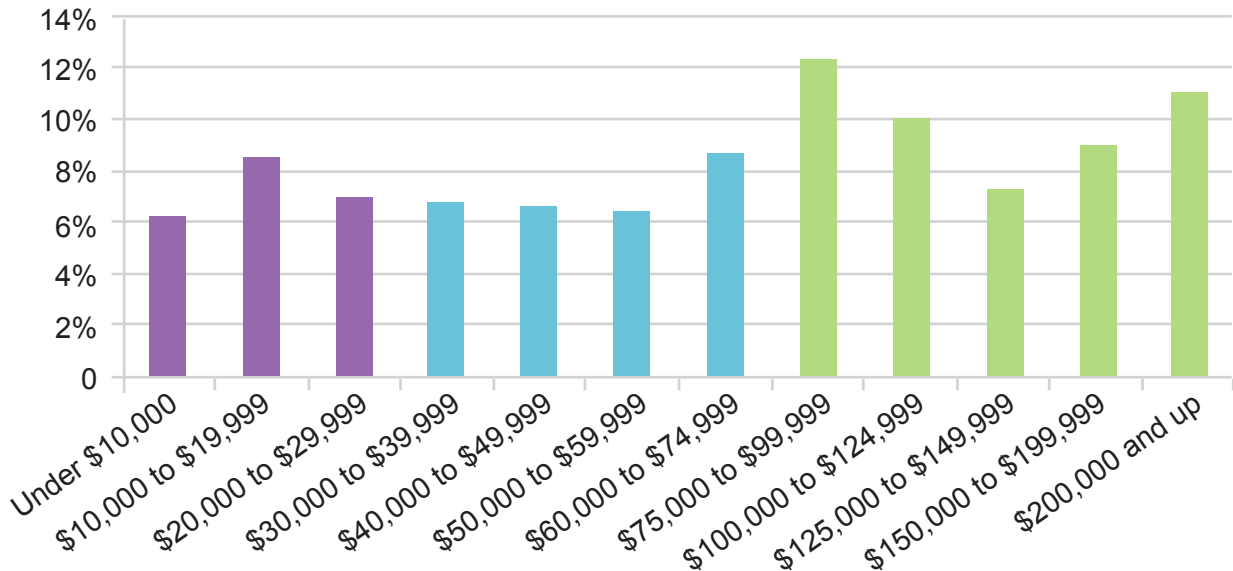
Source: 2013 American Community Survey 5-Year Summary File.

FIGURE 1.7
Households by Size



Source: 2013 American Community Survey 5-Year Summary File.

FIGURE 1.8
Household Income 2009-2013 (in 2013 dollars)



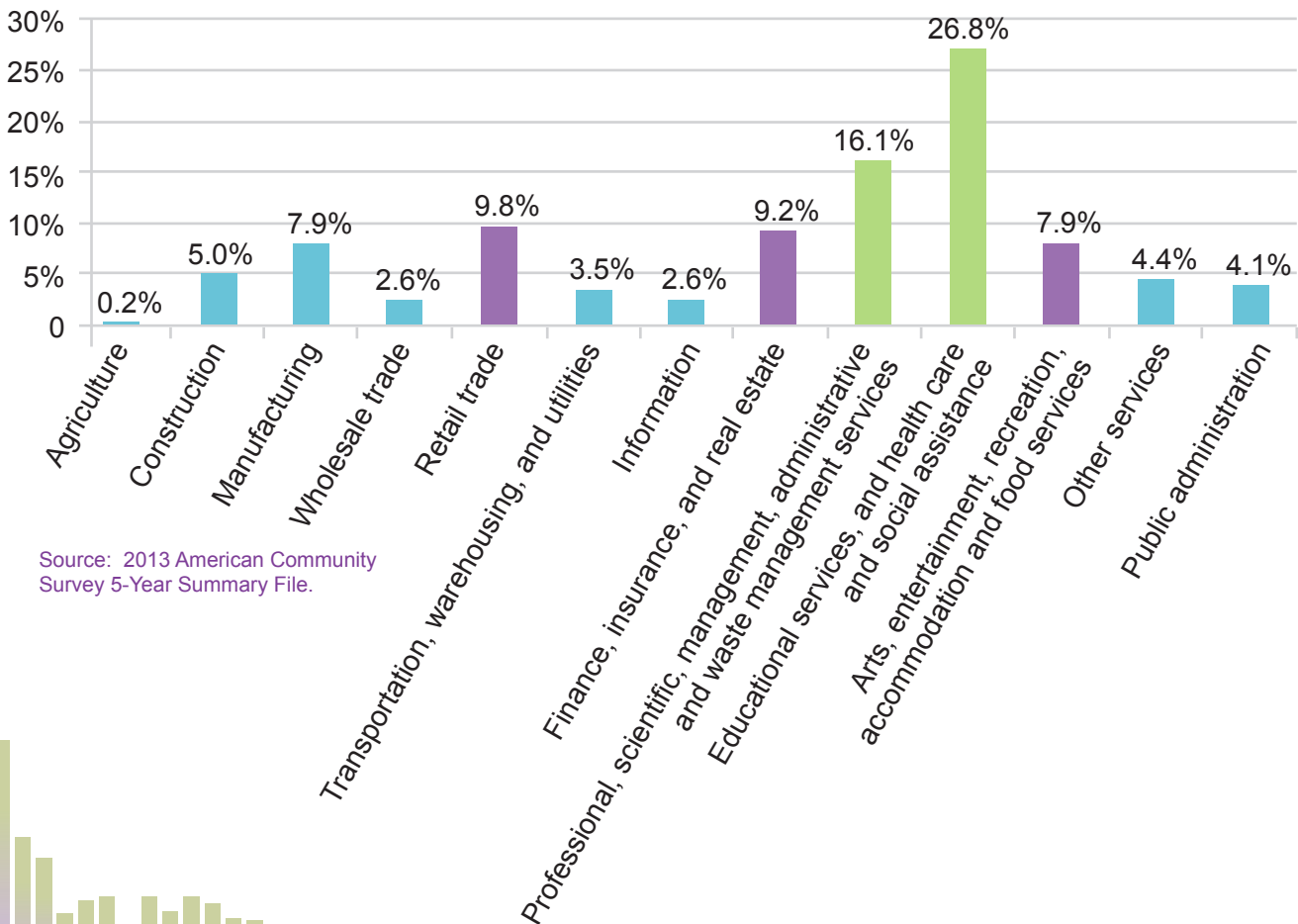
Source: 2013 American Community Survey 5-Year Summary File.

DIVERSE WORK

The Boston region is home to a broad spectrum of industries and professions. The largest employment sectors include educational services, health care, and social assistance, totaling 26.8 percent of all employment. The second-largest sectors include the professional, scientific, and management fields, as well as administrative and waste-management services, at 16.1 percent of total regional employment. Combined, these sectors comprise almost half of the region's employment, at 42.9 percent (Figure 1.9).

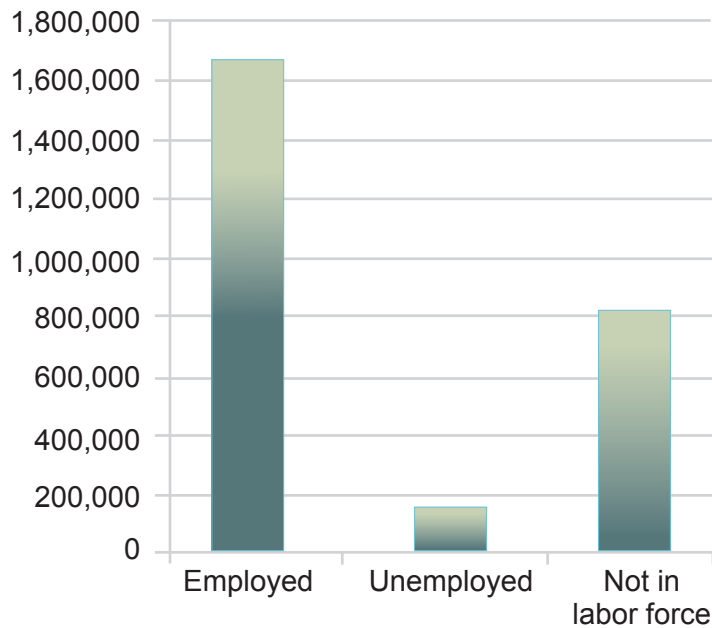
The Boston region is a national leader in education and health care, and the prominence of these industries enables a consistently strong economy, with only 6 percent of the population older than 16 years unemployed (Figure 1.10). The importance of the region's finance and housing markets also is reflected in strong employment in finance, insurance, and real estate. Finally, the region is notably shaped by the arts, entertainment, and recreation, as well as retail, all of which contribute to the region's strong tourism trade and cultural environment.

FIGURE 1.9
Employment by Industry as a Percentage of Total Employment



Source: 2013 American Community Survey 5-Year Summary File.

FIGURE 1.10
Employment Status



Source: 2013 American Community Survey 5-Year Summary File.

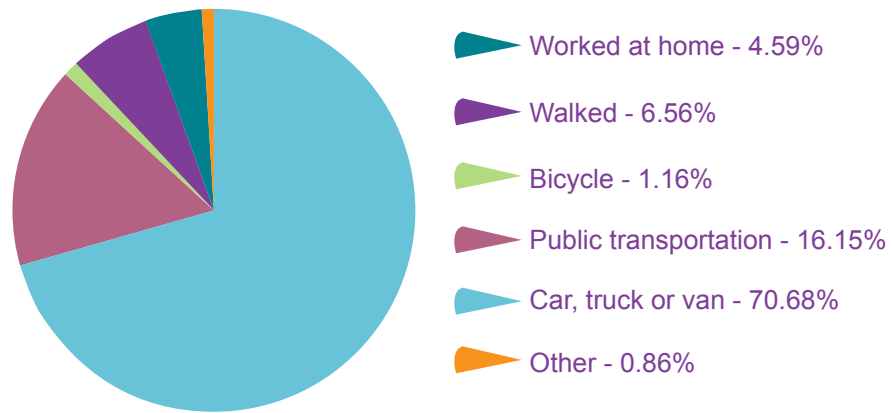
DIVERSE GEOGRAPHY

Although the City of Boston and the 13 surrounding cities form the heart of the region, it also includes a sizable amount of undeveloped land. The Boston region is home to more than 25 state forests and parks, and forests cover 39 percent of the land area. The region is rich in other types of natural landscapes as well, with water, wetlands, and open space comprising another 11 percent of total land area, and 550 miles of coastline.

DIVERSE TRAVEL

The Boston region's transportation system provides varied travel options. In addition to the roadway network, which allows residents to commute by car, bike, and foot, an extensive public transportation system provides bus, heavy and light rail, ferry, and commuter rail services. Although the majority of residents drive to work, 16.15 percent take some form of transit, making the Boston metropolitan area one of the highest users of public transportation for commuting compared to other metropolitan areas in the country (Figure 1.11).

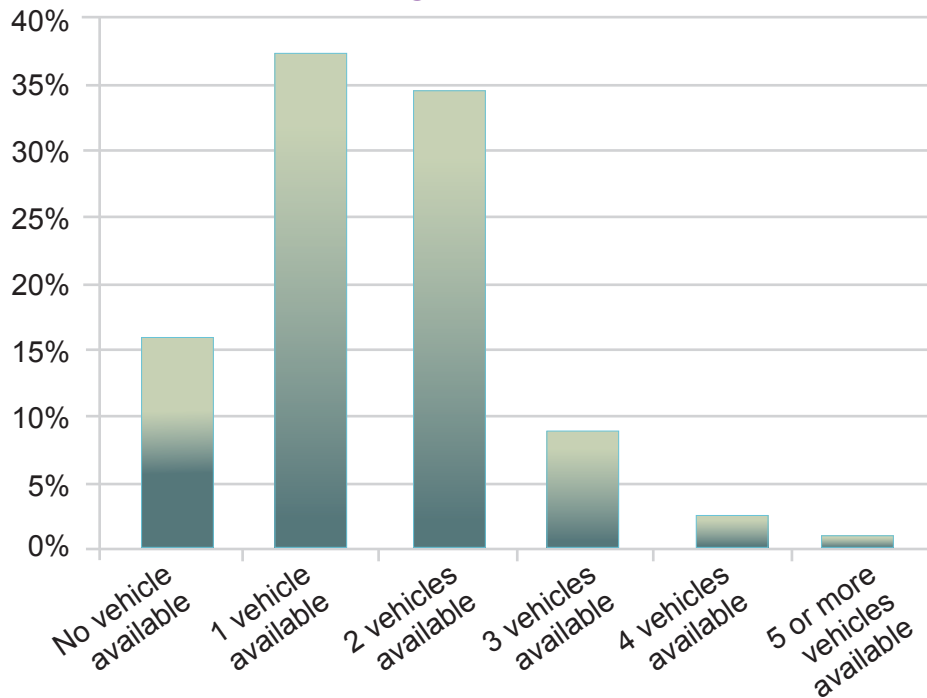
FIGURE 1.11
Means of Transportation to Work



Source: 2013 American Community Survey 5-Year Summary File, Table B16001.

The region also has a significant number of zero- and one-vehicle households, totaling more than half of all households at 53 percent (Figure 1.12).

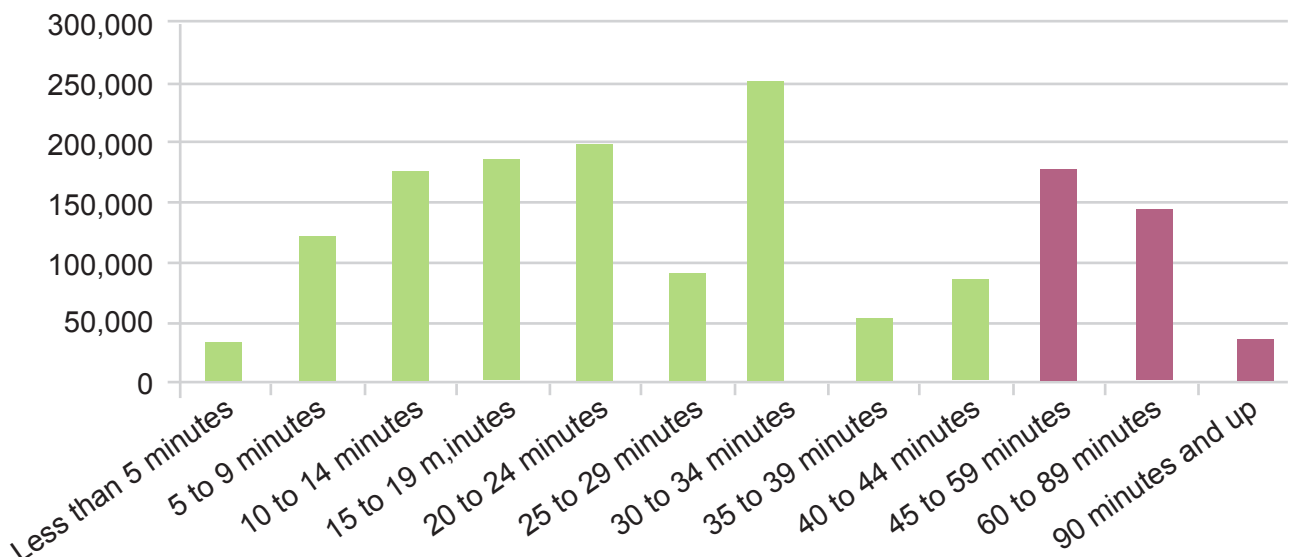
FIGURE 1.12
Vehicles Available by Household as
Percentage of Total Households



Source: 2013 American Community Survey 5-Year Summary File.

Most of the Boston region’s commuting trips take less than 35 minutes; however, almost a quarter (23 percent) are longer than 45 minutes (Figure 1.13). The average travel time to work in the region for all travel modes is 22.9 minutes. Walkers have the shortest average commute time, at 13.3 minutes, followed by those who drive alone or in carpools (20 minutes), taxicab, motorcycle, or bike (24 minutes), and public transportation (39.3 minutes). Although the region has a relatively large share of transit commuters, transit commutes remain significantly longer than other average commute times.

FIGURE 1.13
Commute Time



Source: 2013 American Community Survey 5-Year Summary File.

ASSESSING THE REGION’S TRANSPORTATION PROBLEMS

The MPO understands that transportation is not a simple end in itself. People use various transportation modes because they want to move themselves and/or their goods from one place to another in order to accomplish innumerable purposes. These may be for commuting between work and home, or home and school, or between home and other economic, health, administrative, or recreational activities or services. In brief, the function of transportation is to enable social interaction, commerce, and personal development and fulfillment.

However, there are obstacles to serving these functions. Foremost is the combined lack of adequate funding and aging transportation infrastructure. In addition, the socio-demographic and economic patterns of the region are in transition. Because of

the region's aging population over the next 25 years, and forecasted in- versus out-migration, the region's mobility and accessibility needs are evolving. The MPO is forging consensus about which projects are priorities for development and the density of their related economic and residential land uses.

Considering that the ultimate purpose of transportation is to serve human activity, 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?

Charting Progress to 2040 is the roadmap for responding to this conundrum. The subsequent chapters describe ways to work toward achieving the MPO's vision and goals for the region that are both visionary and tangibly realistic.

CHAPTERS

Chapter 2—Process for Developing *Charting Progress to 2040*—provides an overview of the process used to develop this plan, including updating the MPO's vision and establishing related goals and objectives; assessing the region's transportation needs; developing and analyzing future transportation scenarios; finalizing the plan; and citing the public participation that supported the planning process throughout.

Chapter 3—Transportation Needs in the Boston Region—includes a summary of the regional transportation needs identified in the Needs Assessment.

Chapter 4—Funding the Transportation Network—considers all transportation funding to be spent in the MPO region over the life of the LRTP; explains LRTP fiscal constraint requirements; and identifies the amount of total transportation funding over which the MPO has decision-making power, compared to the cost of selected projects and programs.

Chapter 5—The Recommended Plan—describes and maps the set of projects and programs selected for the LRTP.

Chapter 6—Charting Performance—discusses MAP-21 requirements for performance measurement and describes the MPO's development and implementation of a performance-based planning practice.

Chapter 7—Transportation Equity (TE)—includes a description of the MPO approach to identifying communities of concern and their role in Title VI analysis and in the MPO Transportation Equity Program; describes the Transportation Equity Program, its goals, activities, and some key results; presents Title VI analysis and reporting; explains the TE analysis for the LRTP, both the procedure and results; identifies projects and programs that benefit TE areas.

Chapter 8—Air Quality Conformity Determination and Greenhouse Gas Analysis— includes the air-quality conformity determination showing that the LRTP is consistent with the Commonwealth’s plans for attaining and maintaining air-quality standards; a report on the legislation and regulations requiring carbon dioxide (CO₂) emission reductions by the MPO and the process for documenting CO₂ emissions associated with projects and programs included in the LRTP as required for implementing the Massachusetts Global Warming Solutions Act.

CONTINUING WORK

Several components of the LRTP were designed to be dynamic and will be continuously updated and developed. These include the Needs Assessment, performance-based planning practice, and the public participation program.

All interested parties, including members of the public, are encouraged to follow the MPO’s work and to be engaged in the development and modifications that will be underway during the next four years.



2 PROCESS FOR DEVELOPING *CHARTING PROGRESS TO 2040*

OVERVIEW OF THE PROCESS

The process for developing *Charting Progress to 2040* incorporated a number of new elements that brought more information into the decision-making process, for both the MPO and the public. One new element is an interactive web-based needs-assessment application that can be accessed by all interested parties. In addition, MPO staff enhanced its performance-based planning practice for this LRTP and expanded use of contemporary planning tools, such as scenario planning, to inform policy and other types of decisions. Other new components are incorporating more electronic forms of communication into the MPO's approach to public participation, and heightened collaborative engagement with members of the public, both of which were integral to the LRTP development process and helped guide MPO decision making.

All of these new elements helped shape a fresh approach to programming—setting the MPO on a path that will make it more agile as it responds to performance measurement results, and more adept at charting a course for the transportation network of 2040.

Perhaps the most notable change, however, was moving away from the MPO's past practice of programming expensive capital-expansion projects to ease congestion, and adopting a new approach by funding a larger number of small operations-and-management (O&M)-type projects that support bicycle, pedestrian, and transit in addition to roadway improvements.

This chapter discusses the process and rationale for decision making throughout the LRTP's development. The outcomes of these decisions, in terms of identifying needs, analyzing scenarios, selecting projects and programs, and finalizing the LRTP, are discussed in subsequent chapters.

IMAGINING THE FUTURE: VISION, GOALS, AND OBJECTIVES

Early in the process of developing this LRTP, the MPO revisited its vision statement to focus more sharply on the transportation issues of greatest concern to the MPO and the public for the envisioned future transportation system:



- Safety
- System Preservation
- Capacity Management/Mobility
- Clean Air/Clean Communities
- Transportation Equity
- Economic Vitality

For each of these issues, the MPO identified problems and their associated needs for the transportation network. This allowed the MPO to set goals that, if accomplished, would result in concrete solutions for the identified problems, and help the region achieve its vision by 2040. The MPO established objectives for each goal (see Figure 2.1).

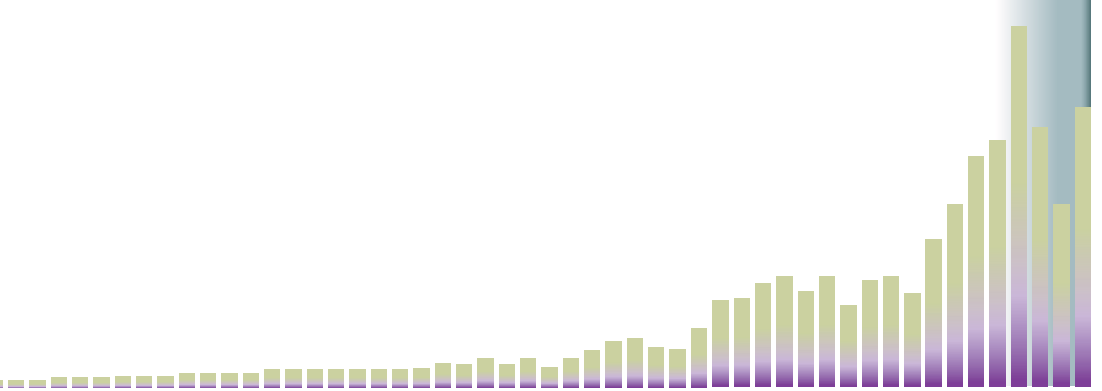
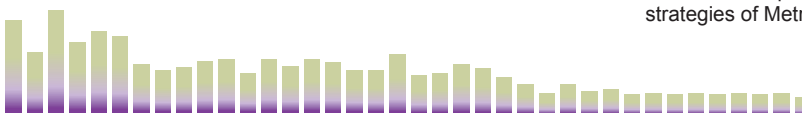


FIGURE 2.1 MPO Vision, Goals, and Objectives

| CENTRAL VISION STATEMENT | |
|---|--|
| The Boston Region Metropolitan Planning Organization envisions a modern transportation system that is safe, uses new technologies, provides equitable access, excellent mobility, and varied transportation options—in support of a sustainable, healthy, livable, and economically vibrant region. | |
| GOALS | OBJECTIVES |
| SAFETY | |
| Transportation by all modes will be safe | <ul style="list-style-type: none"> • Reduce number and severity of crashes, all modes • Reduce serious injuries and fatalities from transportation • Protect transportation customers and employees from safety and security threats (Note: The MPO action will be to incorporate security investments into capital planning.) |
| SYSTEM PRESERVATION | |
| Maintain the transportation system | <ul style="list-style-type: none"> • Improve condition of on- and off-system bridges • Improve pavement conditions on MassDOT-monitored roadway system • Maintain and modernize capital assets, including transit assets, throughout the system • Prioritize projects that support planned response capability to existing or future extreme conditions (sea level rise, flooding, and other natural and security-related man-made hazards) • Protect freight network elements, such as port facilities, that are vulnerable to climate-change impacts |
| CAPACITY MANAGEMENT/MOBILITY | |
| Use existing facility capacity more efficiently and increase healthy transportation capacity | <ul style="list-style-type: none"> • Improve reliability of transit • Implement roadway management and operations strategies, constructing improvements to the bicycle and pedestrian network, and supporting community-based transportation • Create connected network of bicycle and accessible sidewalk facilities (at both regional and neighborhood scale) by expanding existing facilities and closing gaps • Increase automobile and bicycle parking capacity and usage at transit stations • Increase percentage of population and places of employment within one-quarter mile of transit stations and stops • Increase percentage of population and places of employment with access to bicycle facilities • Improve access to and accessibility of transit and active modes • Support community-based and private-initiative services and programs to meet last mile, reverse commute and other non-traditional transit/transportation needs, including those of the elderly and persons with disabilities • Eliminate bottlenecks on the freight network • Enhance intermodal connections • Emphasize capacity management through low-cost investments; give priority to projects that focus on lower-cost O&M-type improvements such as intersection improvements and Complete Streets solutions |
| CLEAN AIR/CLEAN COMMUNITIES | |
| Create an environmentally friendly transportation system | <ul style="list-style-type: none"> • Reduce greenhouse gases generated in the Boston region by all transportation modes as outlined in the Global Warming Solutions Act • Reduce other transportation-related pollutants • Minimize negative environmental impacts of the transportation system • Support land use policies consistent with smart and healthy growth |
| TRANSPORTATION EQUITY | |
| Provide comparable transportation access and service quality among communities, regardless of income level or minority population | <ul style="list-style-type: none"> • Target investments to areas that benefit a high percentage of low-income and minority populations • Minimize any burdens associated with MPO-funded projects in low-income and minority areas • Break down barriers to participation in MPO-decision making |
| ECONOMIC VITALITY | |
| Ensure our transportation network provides a strong foundation for economic vitality | <ul style="list-style-type: none"> • Minimize the burden of housing and transportation costs for residents in the region • Prioritize transportation investments that serve targeted development sites • Prioritize transportation investments consistent with the compact-growth strategies of MetroFuture |

Source: Central Transportation Planning Staff.





Together, the vision, goals, and objectives lay the groundwork for the MPO's performance-based planning practice, which in turn informs all of the work conducted by the MPO, including evaluating and selecting projects and programs for the LRTP, selecting projects for the TIP, and selecting planning studies for the UPWP. The MPO's performance-measurement work is discussed in detail in Chapter 6.

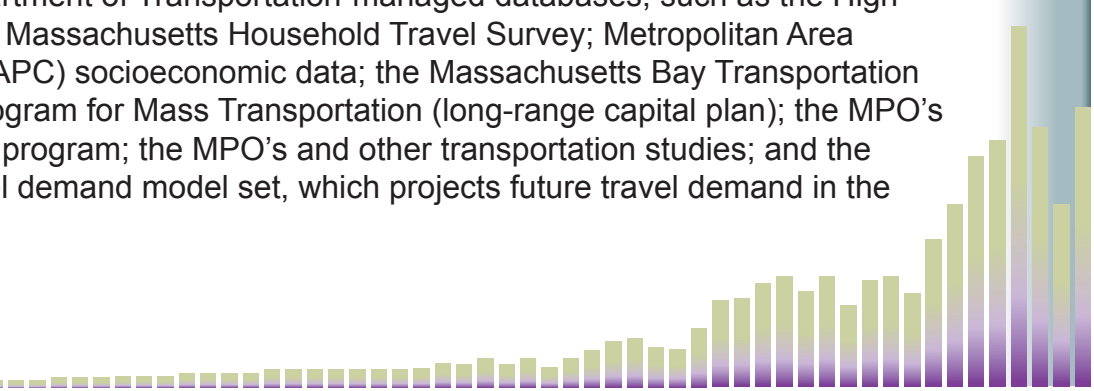
During development of the vision, goals, and objectives, the MPO reached out to members of the general public in a variety of ways (see the

Public Participation section of this chapter) to seek input; then considered this feedback, which is reflected in the final set of goals.

ASSESSING THE REGION'S TRANSPORTATION NEEDS

The second step in developing this LRTP was assessing the region's transportation needs based on an inventory of its transportation issues. This process allowed the MPO to make decisions about which capital projects, as well as which UPWP planning studies, would best meet the identified needs. The assessment of needs established the baseline against which future projections were compared for this plan. This baseline assessment will also be the foundation for performance-based planning, and will allow the MPO to track trends over time and assess progress toward achieving its goals.

The data for the Needs Assessment were drawn from a variety of sources to document current demographics and existing conditions for the region's transportation network. Sources included the MPO's Congestion Management Process (CMP); various Massachusetts Department of Transportation-managed databases, such as the High-Crash Database; the Massachusetts Household Travel Survey; Metropolitan Area Planning Council (MAPC) socioeconomic data; the Massachusetts Bay Transportation Authority (MBTA) Program for Mass Transportation (long-range capital plan); the MPO's transportation equity program; the MPO's and other transportation studies; and the MPO's regional travel demand model set, which projects future travel demand in the



region. See Chapter 3 for a summary of transportation needs identified via the needs-assessment process. For full documentation of the Needs Assessment, as well as an interactive application that provides access to the data, visit the MPO's website at <http://www.ctps.org/map/www/apps/lrtpNeedsAssessmentApp/index.html>.

The MPO made the needs assessment data available to all interested parties via the internet not only to help educate the public and make the planning process more transparent, but also to provide an opportunity for other planners, academics, and the general public to interact with, download, and analyze the data for their own purposes. In addition, being able to access all of the data via the website allows MPO staff to easily update and disseminate this information as new data become available.

ANALYZING FUTURE TRANSPORTATION SCENARIOS

The third step in the LRTP planning process was analyzing and deliberating about the transportation investments that the MPO should make between now and 2040 to help achieve its vision. MPO staff used a variety of analytic tools to shed light on the future outcome of different investment strategies in order to provide information for MPO discussions and decision making. For *Charting Progress to 2040*, staff enlisted a number of new and/or enhanced planning tools and techniques to expand the scope of its traditional analytic methods.

New Tools and Data Sources

The MPO upgraded its regional travel demand model set and inputs to the model with data from the most recent statewide household travel survey, and data from INRIX, a company that obtains real-time traffic data from drivers' mobile devices. For analytic purposes, historical INRIX data provides a level of detail that was previously unavailable. Another new vehicle was TREDIS (Transportation Economic Development Impact System), a suite of tools that provides economic impact forecasts, including the effects of changes in the transportation network on the movement of freight via truck in the region.

The MPO will continue to use these tools as it develops its performance-



based planning practice. They also would be used to explore key policy questions and to help the MPO understand the trade-offs among various capital investments.

Scenario Planning

This LRTP represents a revitalized foray into scenario planning; a technique that, on an analytical level, allows stakeholders to compare the relative effects of different possible transportation solutions on variables of interest.

The MPO's use of scenario planning helped shed light on the relative merits of two different approaches to one of the objectives related to congestion: Using its target funds, should the MPO continue to use a *congestion*

reduction approach by investing in major arterials and express highways? Or, should the MPO adopt a *capacity management* approach by investing in smaller-scale, but more diverse and geographically dispersed, O&M-type projects? To answer these questions, staff compared three scenarios to a base-case scenario using both the regional travel demand model set and off-model analyses, focusing for the most part on highway projects:

1. Current-LRTP Scenario—portrayed the MPO's current capital spending patterns
2. Operations and Management Scenario—took a congestion management approach that focused on lower-cost improvements, such as intersection improvements and Complete Streets
3. High-Capital Investment (High-Cap) Scenario—focused on high-cost capital projects, such as interchange upgrades and major bottleneck reconstruction

Because O&M-type projects generally do not increase capacity and cost less than \$20 million per project, the MPO is not required to list them individually in the LRTP. Therefore, MPO staff developed a set of four O&M programs, each of which comprised a representative group of low-cost projects of a specific nature. These projects were drawn from the MPO's Needs Assessment and from the Universe of Projects (described in the Finalizing the LRTP section). For the purposes of this scenario-planning exercise, five investment programs were analyzed, including four programs that include O&M-type projects and one program that includes major capital investment projects:



1. Intersection Improvements
2. Complete Streets
3. Bicycle Network and Pedestrian Connections
4. Community Transportation and Parking
5. Major Infrastructure

Figure 2.2 provides more detail about these programs. Again, the scenario planning process done as part of this LRTP development focused mainly on highway projects to help the MPO to determine how it should program its target funds. Transit expansion and state of good repair projects were not included in these scenarios at this time because transit investments are based on recommendations from the MBTA, the regional transit agencies, and MassDOT's Rail and Transit Division. Low cost transit improvements were included in both scenarios (i.e. park and ride, shuttle services, and community-based transportation). Major transit projects will be addressed as part of MassDOT's Program for Mass Transportation and the MBTA's Capital Investment Program and in future scenario planning activities done as part of the MPO's performance-based planning program.



The results of the scenario analyses (Figure 2.3) show that there are greater benefits associated with the O&M approach than with large-scale infrastructure projects.

Results of the analysis helped the MPO finalize its goals and objectives and move toward the selection of a set of programs and projects to analyze in order to determine which ones to include in the LRTP. The MPO also adopted the O&M approach to programming in the LRTP. This new policy direction signaled a pivotal change in the MPO's approach to programming transportation investments. See Appendix A for detail about the scenario-planning process and its results.

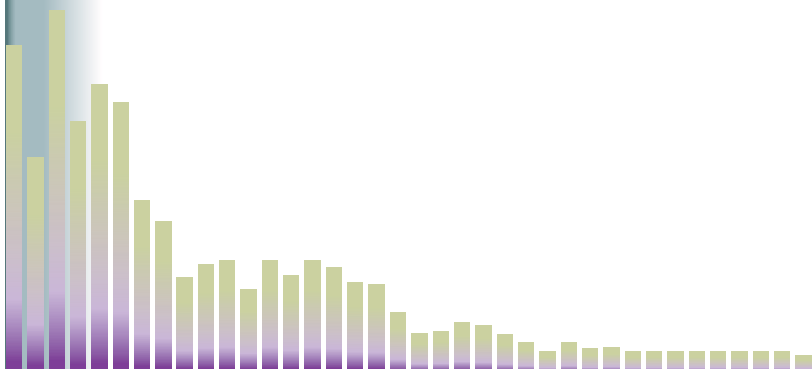


FIGURE 2.2
Investment Programs

PROGRAMS FOR ADDRESSING TRANSPORTATION NEEDS

INTRODUCTION

The five programs included in the scenarios are described on the right. The descriptions provide information about how MPO staff estimated costs for types of projects that the program would fund.

To gauge the scenarios' performance, staff selected a number of indicators that correspond to the MPO's goals. To measure programs and projects that could have a regional impact, add capacity to the system, or change an attribute of the system—for example, change the amount of delay or capacity, add an alternative travel option, and so forth—staff utilized the MPO's regional travel demand model set. Staff used off-model sketch-planning techniques to generate performance data for other projects, particularly those that are lower in cost and have smaller footprints.

KEY: MPO GOALS

- Safety
- System Preservation
- Capacity Management/
Congestion Reduction
- Clean Air/Clean Communities
- Transportation Equity
- Economic Vitality



INTERSECTION IMPROVEMENTS



Description: Modernizes existing signals or adds signals to improve safety and mobility. Improvements could also consist 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 transit reliability.

Sample intersections for this program, which were used to estimate project benefits, were drawn from the TIP Universe of Projects, locations identified in past MPO studies, and the LRTP Needs Assessment. These projects were prioritized—first through determining if they are high-crash locations to address the MPO's safety goal, and then if they are located in high-priority-development, environmental justice, or Title VI areas.

Estimated cost of intersection improvement projects: Average of \$2.8 million per intersection



COMPLETE STREETS



Description: Modernizes roadways to improve safety and mobility for all users. Improvements could consist of continuous sidewalks and bicycle lanes, cycle tracks, and other bicycle facilities, as well as updated signals at intersections along a corridor. Improvements will reduce delay and improve transit reliability. Expanded transportation options and better access to transit will improve mobility for all and encourage mode shift.

Estimated cost of Complete Streets projects: \$6 million per mile



BICYCLE NETWORK AND PEDESTRIAN CONNECTIONS



Description: Expands the bicycle and pedestrian networks to improve safe access to transit, school, employment centers, and shopping destinations. Could include constructing new, off-road bicycle or multi-use paths, improving bicycle and pedestrian crossings, or building new sidewalks.

Sample bicycle and pedestrian projects for this program were selected using evaluated TIP projects, the MPO's Bicycle Network Evaluation, and bicycle travel market information from the 2011 Massachusetts Household Survey.

Estimated cost of bicycle and pedestrian projects: Varies (analysis uses available preliminary cost, or average of \$2 million per mile)



COMMUNITY TRANSPORTATION AND PARKING



Description: 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.
Estimated cost: Assumed to cost \$5 million over the 25-year life of the plan.
- **Park-and-Ride:** Targets funding to construct additional parking at transit stations that now are at capacity.
Estimated cost: The average cost per parking space is \$35,000.
- **Clean Air and Mobility Program:** Provides funding to projects (such as bike share projects or shuttle bus services) to improve mobility and air quality and promote mode shift.
Estimated cost: Assumed to cost \$50 million over the 25-year life of the plan.



MAJOR INFRASTRUCTURE



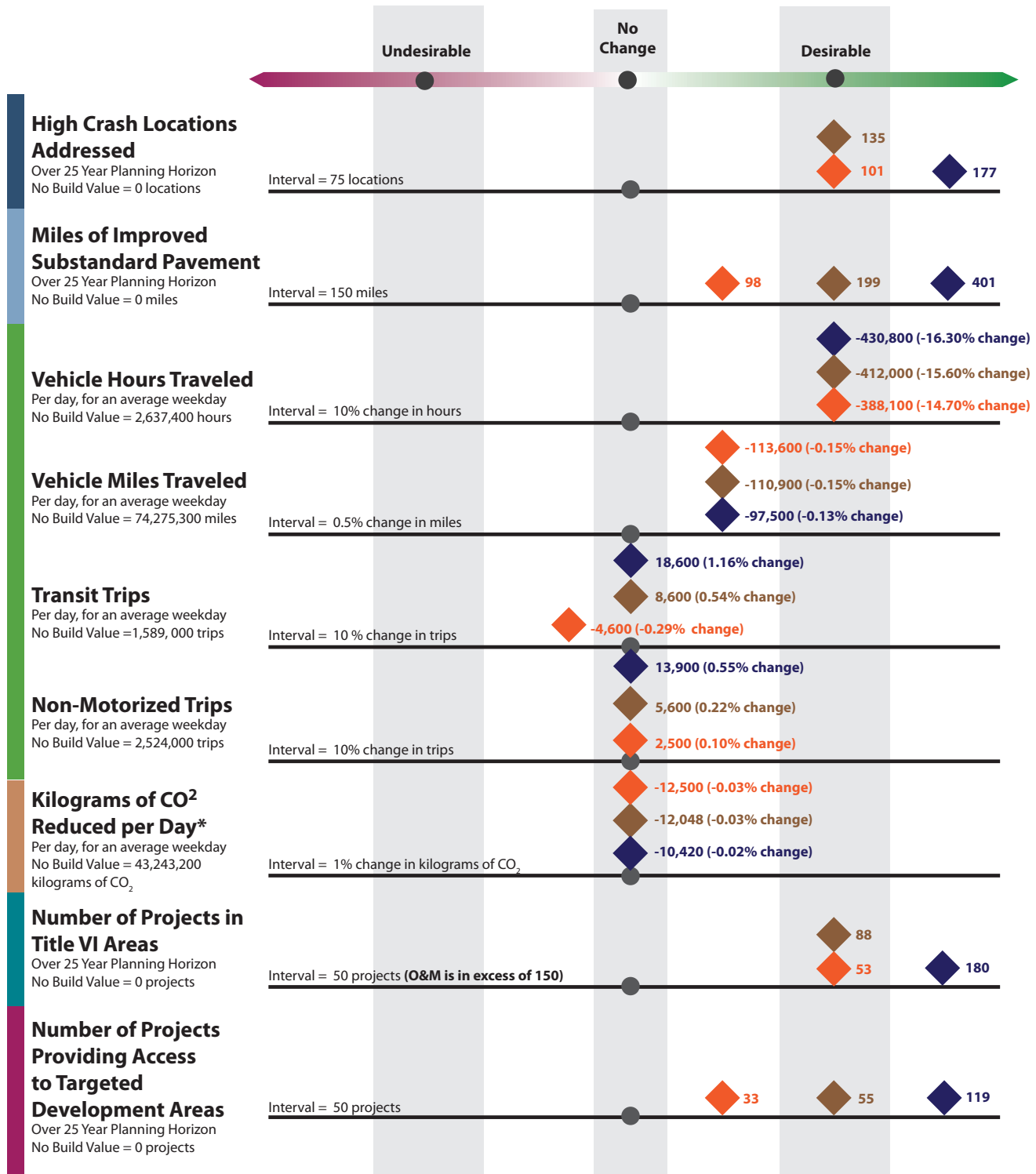
Description: Modernizes and/or expands major highways and arterials to reduce congestion and improve safety. Projects could include constructing expressway interchanges to eliminate weaving and reduce the likelihood of rollovers, adding travel lanes on expressways, or adding/removing grade separations on major arterials. The LRTP also considers transit (Green Line Extension from College Avenue to Mystic Valley Parkway/Route 16) using highway funds flexed to transit and bridge projects.

Estimated cost per project: Costs were associated with each project based on costs in current or past LRTPs, adjusted to current dollars, or costs from studies that were performed for selected locations, also adjusted to current dollars. Assumes eight interstate bottlenecks and five arterial projects.

Source:
Central Transportation Planning Staff

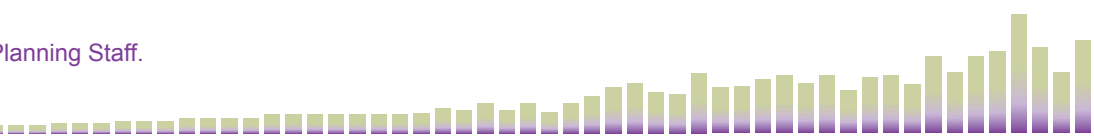
FIGURE 2.3 Scenario Analyses Results

◆ Current L RTP
 ◆ High-Cap
 ◆ O&M



*Emission generated using MOVES 2010B

Source: Central Transportation Planning Staff.



FINALIZING THE LRTP

The final phase of LRTP development included selecting and analyzing projects and programs to include in the LRTP. The previous steps in the planning process discussed in this chapter laid the groundwork for finalizing the LRTP. Also of critical importance to selecting projects and programs was the MPO's public participation process (discussed in the Public Participation section).

Universe of Projects and Programs

The projects and programs selected for the LRTP were drawn from the Universe of Projects and Programs: a comprehensive list of regional highway and transit projects compiled by MPO staff. Each project is associated with one of the five programs used in scenario planning (see Figure 2.2) or a sixth program — transit. The MPO used the Universe to develop the draft list of projects and programs for public review and the final list to include in this LRTP. The Universe of Projects and Programs includes the following projects that:

- Already have been programmed in the LRTP and TIP (excluding the first year of the current TIP) for highway and transit modes
- Are identified as important for meeting the region's transportation needs, as described in the MPO Needs Assessment
- Have emerged as recommended from studies conducted by the MPO and other entities in the region
- Are included in the current MBTA Program for Mass Transportation and in the MBTA Capital Investment Program, and others recommended by the MBTA

The projects in the Universe of Projects and Programs list are sorted by program type, and are cited in Appendix B of this document.

Project Evaluation

The MPO applied its goals and objectives as criteria in a qualitative evaluation of the major infrastructure and capacity-adding highway projects in the Universe of Projects and Programs that had been sufficiently well-defined to allow for analysis. The assessment of how well projects would address the MPO's goals and objectives helped the MPO identify priority projects for its major infrastructure program. See Appendix C for project evaluations and documentation on the evaluation process.

Based on its decision to support the programming of more O&M-type projects, the MPO set aside a specific amount of funding for each of its six investment programs:

Intersection Improvements, Complete Streets, Bicycle Network and Pedestrian Connections, Community Transportation and Parking, Flex to Transit, and Major Infrastructure. The MPO then allocated funding in the six programs across the five-year time bands within this LRTP (federal fiscal years 2016–20, 2021–25, 2026–30, 2031–35, and 2036–40).

Transportation Finances

The finance plan is an important part of the LRTP, which is required to be a financially constrained document. While the financial assumptions for this LRTP include an increase in funding during the first five years of this 25-year LRTP, there is less funding available for the remaining 20 years of the LRTP. The previous LRTP allowed for an increase in revenue of three percent per year; the revenue assumption for this LRTP was reduced to one-and-a-half percent per year. Therefore, the MPO needed to scale back its commitments to projects that were included in the previous LRTP. Project cost increases because of applying inflationary factors (four percent per year) also affected funding availability in the later time bands. The MPO's decision to set aside funding for O&M programs helped the MPO adapt to these funding constraints. See Chapter 4 for detailed information about finances for this LRTP.

Project Selection

The next step in defining the draft list of recommended projects and programs involved balancing two MPO policies. First, the MPO has a policy of maintaining its previous LRTP and TIP programming commitments, which favored funding major infrastructure. Second, as discussed above, during the LRTP development process the MPO adopted the O&M approach to programming, and a new policy of giving priority to low-cost projects. Overall, it is the MPO's intent to ensure that its goals are advanced through project and program selection.

To understand the balance between these policies, the MPO asked staff to develop two funding alternatives for consideration: one that continues to program all of the projects in *Paths to a Sustainable Region* (the previous LRTP) in *Charting Progress to 2040*; and a second alternative that programs approximately half of the MPO's target funds (those over which the MPO has decision-making power) to major infrastructure projects and reserves the rest for O&M programs. These two alternatives were examined and discussed by the MPO over the course of four meetings. The MPO ultimately adopted the second alternative to program half of its target funds to major infrastructure and the other half for O&M programs.

Chapter 5 presents a detailed description of the project selection process, along with a list of the projects and programs selected for this LRTP.

Final Steps

MPO staff performed the following analyses on the MPO's draft list of recommended projects and programs:

- Air Quality Conformity Analysis—ensures that the LRTP is consistent with the Commonwealth's plans for attaining and maintaining air-quality standards (see Chapter 8 for details)
- Transportation Equity (TE) Analysis—ensures that the recommended set of projects and programs provides equitable benefits to both TE and non-TE populations (see Chapter 7 for details)
- Greenhouse Gas Analysis—documents the process for reporting carbon dioxide emissions associated with the projects and programs being included in the LRTP, as required for implementing the Massachusetts Global Warming Solutions Act. (See Chapter 8 and a separate air quality report to be released at the end of August 2015 for details)

The MPO subsequently adopted the draft list of recommended projects and programs for public review. The MPO received comments from the public and reviewed and responded to them. *Charting Progress to 2040* was endorsed by the MPO on July 30, 2015.

PUBLIC PARTICIPATION

Background

In several important ways, the public involvement process for this LRTP was more extensive and effective than any other previously conducted by the MPO. Largely, this was because of the recent update of the Public Participation Plan, which details the MPO's outreach via its Public Participation Program. The updated plan and program reinforced the MPO's commitment to, respect for, and enthusiasm about the needs and interests of members of the public. The MPO is working to make public participation convenient, inviting, and engaging for everyone. It has stepped up activities to break down barriers for people who have traditionally participated only minimally in the 3C process, such as those with limited English proficiency or disabilities.

Updating the LRTP was the MPO staff's first opportunity to implement many of the new activities in the Public Participation Program. Public outreach for the LRTP consisted of public meetings, workshops, and forums throughout the year-and-a-half preceding the MPO's endorsement of the LRTP. Electronic media and web-based tools were important avenues for public outreach and information gathering, and were crucial in expanding the conversation to more people and diverse populations. Translating notices of meetings and other events into several languages and collaborating with MAPC opened

doors to new constituencies and set up communication paths that are both comfortable for members of the public and fruitful for generating input to the MPO. In addition, MPO staff continued to use graphics and other visual presentations to communicate information to the public and seek their feedback.

Public Outreach Methods

PUBLIC MEETINGS, WORKSHOPS, AND FORUMS

While this LRTP was being developed, staff conducted public outreach through a number of different means for a variety of audiences:

- *Regional Transportation Advisory Council:* The Advisory Council is an independent group charged with providing public input to the MPO, and specifically, input for the MPO's certification documents, such as the LRTP. Monthly Advisory Council meetings provide a forum for broad-based and robust discussions of transportation issues. MPO staff briefed the Advisory Council, or its LRTP Committee, on the LRTP nine times within the year-and-a-half before adopting the draft LRTP; in each briefing, staff provided information, answered questions, and recorded Advisory Council members' comments.
- *Fall Forum:* The MPO hosted a fall forum at the Boston Public Library on September 22, 2014, to gather public feedback on the vision, goals, and objectives of *Charting Progress to 2040*. The forum included a presentation on developing the LRTP, followed by a question-and-answer session.

Public notification for that and all other MPO-sponsored events followed the MPO's standard practice: the invitation to participate was distributed through all MPO media, including the MPOinfo email distribution list, website news flashes, press releases, and Twitter. Notices were translated into Spanish, Portuguese, Chinese, and Vietnamese. Invited participants included transportation, environmental, land-use planning agencies, interest groups; state, regional, and municipal officials; transportation equity contacts (which include councils on aging, social service organizations, community-action organizations, and neighborhood groups working in, or supporting, low-income or minority communities); professional and advocacy groups involved in transportation and environmental issues; business organizations; entities involved with the movement of freight; and transit service providers.

- *MAPC Subregional¹ Outreach Meetings:* During the public outreach period for the MPO's vision, goals, and objectives and the Needs Assessment (fall 2014), MPO staff attended meetings of all eight MAPC subregional groups, which are made

1 The MAPC region is geographically divided into eight subregions.

up of municipal officials, and a meeting of the I-495/MetroWest Partnership.² Staff provided information and received a number of comments, which were summarized and presented to the MPO (see Appendix D). Staff also attended five multi-subregional meetings in the spring of 2015 to solicit feedback and additional guidance on the draft LRTP.

- *MAPC Winter Council Meeting:* On February 25, 2015, MAPC devoted its annual winter council meeting to a discussion of the LRTP. Attendees participated in an interactive exercise to experience the challenges of meeting the region's transportation needs with existing resources and to weigh in on transportation priorities for the region. Feedback from the exercise was summarized and presented to the MPO (see Figure 2.5 below and information in Appendix D).
- *Focus-Group-Style Open House:* The MPO held a public Open House specifically designed to facilitate ad hoc focus group participation in accordance with the participants' interests. MPO staff facilitated discussions at topic-related stations to engage interested participants in conversation about transportation issues, needs, and solutions. Topic stations included:
 - Climate Change, the Environment, and Air Quality
 - Active Transportation Modes/Sustainability
 - Transportation Equity
 - Transit and Community Transportation
 - Freight Planning
 - Funding Investment Strategies

Participants in the Focus-Group-Style Open House had the opportunity to provide recommendations about the MPO's funding allocations among various investment programs.

- *Draft LRTP Input Meetings:* The MPO sponsored two workshops in June 2015, during the public comment period on the draft LRTP, one held in Boston and the other in Everett.

ELECTRONIC MEDIA AND TOOLS

In keeping with contemporary communication techniques, staff utilized electronic media and other tools to engage the public and solicit their feedback:

2 The I-495/MetroWest Partnership is a public-private collaboration of businesses, municipalities, and other stakeholders that meet to cultivate sustainable growth in the MetroWest region.

- *Charting Progress to 2040 Webpage*: The MPO’s website is a vital medium to provide the public with information and collect feedback. This webpage contains background information about how the LRTP was developed and how the public could be involved throughout the process, as well as materials that were used in developing the LRTP.
- *Interactive Online Needs Assessment Application*: This tool allows the public to view, download, and map transportation and socioeconomic data used by the MPO and its staff to evaluate the region’s transportation needs. It also allows interested parties to submit comments about the region’s transportation needs.
- *Online Surveys*: MPO staff developed online surveys to solicit feedback, first on the draft vision, goals, and objectives, and then, in the spring of 2015, on various issues related to the draft LRTP. Staff analyzed results from the responses received from the first survey, which were analyzed, reported to the MPO, and used by the MPO as it defined its vision, goals, and objectives (see Incorporating Feedback from the Public section below and Appendix D).

During the public comment period for the draft *Charting Progress to 2040* LRTP, a series of seven mini-surveys, administered during May and June 2015, were circulated to collect feedback on the MPO’s list of recommended projects and programs. They captured specific feedback from participants at MPO-sponsored or MAPC-sponsored meetings, and online participants, many of whom may have been unable to attend one of the meetings (see Appendix D).

- *Other Electronic Media*: Staff utilized a number of other electronic tools to distribute information and collect input, including the News Flash feature of the MPO’s website, to publicize public participation opportunities and new materials; an email distribution list, MPOinfo, to distribute LRTP-related information and notices; *TransReport*, the MPO’s electronic newsletter; Twitter, to quickly communicate LRTP-related news; press releases emailed to news outlets; and the comment section of the website to solicit public input.

Incorporating Feedback from the Public

VISION, GOALS, AND OBJECTIVES

Public feedback on the MPO’s vision, goals, and objectives was obtained through the fall forum, subregional outreach meetings, and the online surveys described above, as well as from written comments submitted through the website and via email. Several trends identified from the public feedback were reflected in the final vision, goals, and objectives, such as:

1. A more transformative vision that reflects and supports new technologies
2. A more direct link between the goals of congestion reduction and transportation options/healthy modes



- Promotion of increased transit choices, improved transit reliability, and transit that goes beyond the needs of typical commuters in the transportation options/healthy modes goal

A snapshot of the feedback on the vision, goals, and objectives generated from the first online survey is shown in Figure 2.4. The ranking of the goals makes clear that the public's top priority is transportation options/healthy modes, as well as safety. It also shows that, overall, the MPO's vision aligns well with the public's vision for the future of transportation in the region.

FIGURE 2.4
Public Ranking of Goals
 (Raw scores in parentheses; a lower score indicates a higher priority.)

-
- 1. Transportation Options/Healthy Modes (132)**
 - 2. Safety (175)**
 - 3. Greenhouse Gas (GHG)/Air Pollution/Environment (253)**
 - 4. System Preservation (263)**
 - 5. Transit Equity (265)**
 - 6. Congestion Reduction (267)**
 - 7. Economic Vitality and Freight Movement (317)**
-

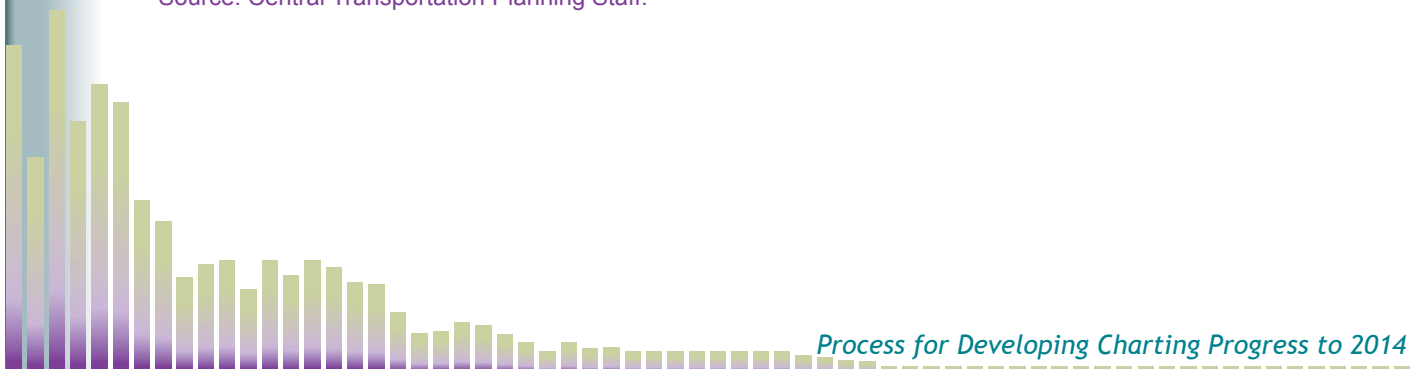
When asked the following question:

How well does the MPO's proposed vision for transportation in the region align with your own vision?

Members of the public on average felt the MPO's vision match their vision as well (3.9 out of 5).



Source: Central Transportation Planning Staff.



REGIONAL NEEDS

The overwhelming majority of public comments on regional needs were related to transit and non-motorized modes, which is consistent with the public's prioritization of the transportation options/health modes goal. Many respondents:

- Saw areas of need for all modes, including bike/pedestrian infrastructure, increased train and bus transit options, more commuter rail service, expanded ferry service, and better links to existing transit
- Commented on the need for more transit in suburban environments, first-mile-last-mile transit connections, increased parking at transit stations, and transit service that accommodates an aging population
- Expressed concern about pedestrian safety in the region
- Voiced concern about congestion on arterials throughout the region

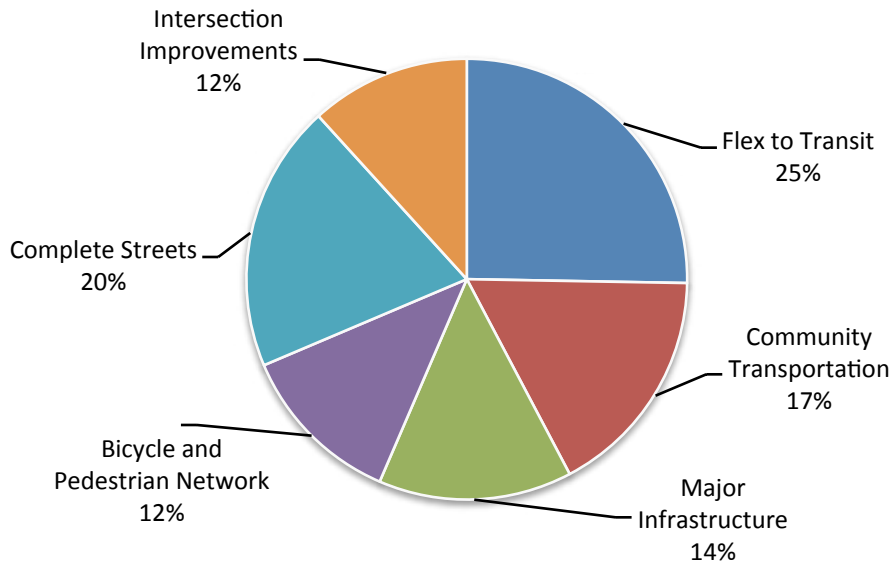
See Appendix D for a full summary of comments on regional needs.

INVESTMENT STRATEGIES

At the MAPC winter council meeting, participants at 15 tables completed an exercise in which they had to decide how much funding to allocate to each LRTP program. Overall, the average of the allocations of the “tables” suggests a more balanced allocation of funding for transportation investments than the MPO has practiced (see Figure 2.5). Responses from all the tables:

- Demonstrated a preference for increasing the share of resources directed to the Community Transportation and Parking program (17 percent, on average), an increase from the MPO's past two percent investment
- Showed a preference for spending substantially less on Major Infrastructure (14 percent, on average) a decline from the 54 percent that the MPO has allocated in the past
- Indicated a preference for allocating a substantial portion of the MPO's budget to the Flex to Transit program (25 percent, on average), an increase from the MPO's past allocation of three percent to transit (from highway funding) in the past

FIGURE 2.5
Average Allocation of Funding for MPO Projects



Source: Central Transportation Planning Staff.

See Appendix D for details on the winter council meeting results and a summary of comments received during the LRTP development process.

In addition, a second online survey, consisting of seven mini-surveys was released between May 15 and July 15, 2015, to collect additional feedback from the public on investment strategies. Respondents were asked their views about transportation needs in the region and where they think funding should be allocated. A summary of the survey results is provided in Appendix D.



3

TRANSPORTATION NEEDS IN THE BOSTON REGION

BACKGROUND

A critical early step in developing the LRTP was to gather, organize, and analyze available sources of data about the existing transportation system. This process resulted in the MPO's Needs Assessment, an interactive online database of transportation, population, and employment conditions. MPO staff used the Needs Assessment application to analyze various components of the transportation system, their capacity, serviceability, and current and projected use. The Needs Assessment also includes a report that summarizes the region's future transportation requirements based on staff's analysis.

Not only did the Needs Assessment analysis guide the MPO when deciding how to address the region's needs through the LRTP, it also will guide future decision making about which projects to fund in the TIP, and which studies to conduct through the UPWP. The Needs Assessment also establishes a baseline for the MPO's performance-measurement process, which will track progress over time to determine whether planned changes to the transportation system are moving the MPO toward its goals and objectives.

This chapter presents a summary of the region's needs (described in full in a separate Needs Assessment document). Both the Needs Assessment document and the interactive Needs Assessment application may be accessed through the MPO's website at http://www.ctps.org/Drupal/charting_2040_needs.

Information in this chapter—and the online Needs Assessment document—has been organized according to the LRTP's goals (Chapter 1), which staff used to evaluate projects for scenario planning and project selection for the recommended LRTP (Chapter 5), and are related to the topics of:

- Safety
- System Preservation
- Capacity Management and Mobility
- Clean Air and Clean Communities
- Transportation Equity
- Economic Vitality

The online Needs Assessment document includes the following chapters, which contain details about the needs, as well as the conditions that create the needs:

- Chapter 1 – Introduction: describes the study area and data resources used to inventory and assess the region’s transportation needs
- Chapter 2 – Land Use in the Boston Region MPO: provides an overview of the region’s current land use, and that which is projected to occur between now and 2040
- Chapter 3 – Travel Patterns in the Boston Region MPO: describes the region’s current travel patterns (under base-case 2012 conditions), and those which are projected to occur between now and 2040 if there are no improvements to the transportation system (no-build conditions)
- Chapter 4 – Regionwide Needs Assessment: reports on the regional high-priority needs for the next 25 years

DEFINITION OF THE STUDY AREA

For transportation planning purposes, the MPO maintains a travel demand model, which includes the 101 municipalities in the MPO region plus an additional 63 municipalities adjacent to the MPO area (see Figure 3.1). While the Needs Assessment addresses only the needs of the municipalities in the MPO, it does take into consideration conditions and travel activity in other parts of the larger region that affect the MPO.

INFORMATION INCLUDED IN THE NEEDS ASSESSMENT

The Needs Assessment incorporates information from previous and ongoing transportation planning work—including the *Paths to a Sustainable Region* LRTP, the MBTA’s *Program for Mass Transportation*, the MPO’s Congestion Management Process (CMP), transportation equity outreach, MPO studies, and special studies—for data inputs.

Staff also used the MPO’s travel demand model and draft demographic projections in the Needs Assessment, as existing and projected socioeconomic information (population, housing, and employment data) and the existing and proposed transportation network were important factors in determining transportation needs. In the modeling process, the adopted LRTP used a base year of 2012 and a future year of 2040 for the transportation network and socioeconomic data.

PRIORITIZED REGIONAL NEEDS

The following sections offer an overview of transportation system's needs for the next twenty-five years. Detailed information about each goal may be found in Chapter 4 of the Needs Assessment, which also includes:

- The goals and related objectives for each goal
- Background information for each goal
- The policy context that surrounds each goal, including:
 - Related initiatives and directives
 - Relevant studies, reports, and documents.
- Contributing resources
- Public input on transportation needs
- Potential programs that would help address each goal

Safety

SAFETY PROBLEM STATEMENT

Overall, safety in the region's transportation system has been improving. However, at the same time certain types of crashes and resultant injuries have increased. Reducing the number of transportation-related accidents, injuries, and fatalities—as well as related property damage, pain, and suffering—is the MPO's highest priority.

SAFETY NEEDS

Despite the overall reduction in the number of crashes, fatalities, and injuries between 2006 and 2012, the number of crashes and injuries involving pedestrians and bicyclists rose: pedestrian crashes increased by 18 percent, and injuries grew by 31 percent; bicycle crashes increased by 36 percent, and injuries jumped by 46 percent. Roughly two-thirds of pedestrian and bicycle crashes resulted in an injury.

Staff identified safety needs by analyzing data for high crash locations, intersections, and lane departures, as well as accidents involving pedestrians, bicyclists, and trucks. Tables 3.1–3.3 display summary information about the region's safety needs.

TABLE 3.1
Safety Needs in the Boston Region MPO

| Emphasis Area | Problem | Description of Needs |
|----------------------|---|---|
| High Crash Locations | The number of all crashes should be reduced. Pedestrian and bicycle crashes and injuries are rising; 46% of these result in injury. | <p>Top 25 Crash Locations (see Table 3.2 for a list of locations)</p> <p>Facilities to improve safety for bicycles and pedestrians are needed.</p> |
| Intersections | More than one in five fatalities occurs at an intersection. | <p>Seventy-nine of the state's Top-200 Crash Locations are in the Boston Region. Roadway corridors with multiple Top-200 Crash Locations are:</p> <ul style="list-style-type: none"> • Route 9, Natick and Framingham • Route 18, Weymouth • Route 107, Lynn • Route 16, Newton and Wellesley • Route 126, Bellingham • Route 16, Milford |
| Lane Departures | <p>Lane departure crashes cause 55% of roadway fatalities and 24% of incapacitating injuries.</p> <p>Interstates make up 5% of lane miles, yet account for 15% of lane departure crashes.</p> <p>Arterials account for less than 25% of lane miles but more than 50% of lane departure crashes.</p> | <p>Roadways with significant numbers of lane departure crashes include:</p> <ul style="list-style-type: none"> • I-93 between I-90 and I-95 Northbound and Southbound • I-495 between I-90 and I-95 • Route 3, Weymouth • Route 1, Chelsea and Revere • The Jamaicaaway, Boston • Soldiers Field Road, Boston |
| Pedestrians | <p>One of the state's nine strategic areas and an ongoing focus of the Boston Region MPO.</p> <p>In the Boston region, pedestrians comprise a growing share of crashes and a disproportionately high share of injuries.</p> | <p>MassDOT Highway Safety Improvement Program (HSIP) Crash Cluster locations:</p> <p><i>Downtown areas of:</i> Boston, Chelsea, Framingham, Lynn, Malden, Natick, Peabody, Salem, Waltham, and Wellesley</p> <p><i>Corridors in:</i></p> <ul style="list-style-type: none"> • Cambridge (Massachusetts Avenue) • Quincy (Hancock Street) • Newton (Newton Centre) • Watertown (Watertown Square) • Somerville (Davis Square) <p><i>Suburban Areas:</i> many arterials and local roadways where sidewalk coverage is inadequate</p> |

TABLE 3.1
Safety Needs in the Boston Region MPO (cont.)

| Emphasis Area | Problem | Description of Needs |
|---------------|---|--|
| Bicyclists | In the Boston region, bicyclists comprise a growing share of crashes and a disproportionately high share of injuries. | <p>MassDOT HSIP Bicycle Cluster locations: <i>Downtown areas of:</i> Beverly, Chelsea, Framingham, Lexington, Lynn, Natick, and Salem</p> <p><i>Corridors in:</i></p> <ul style="list-style-type: none"> • Boston (Commonwealth Avenue) • Brookline (Harvard Street) • Arlington (Massachusetts Avenue) • Cambridge, (Massachusetts Avenue) • Waltham (Main Street) • Somerville (Beacon Street and Somerville Avenue) <p>Regionwide: bicycle infrastructure is limited; bike paths and other infrastructure are needed in all areas of the region.</p> |
| Trucks | One of the state's four proactive emphasis areas; trucks account for a greater proportion of crash severity than other modes—approximately five percent of crashes and nine percent of fatalities between 2006 and 2012 | <p>MPO Compiled High Crash locations are at older interchanges with obsolete designs:</p> <ul style="list-style-type: none"> • I-95 interchanges at I-93 in Woburn • I-90 in Weston • I-93 in Canton • I-95 interchanges at Route 1 in Dedham • I-95 and Middlesex Turnpike in Burlington • I-95 and Route 138 in Canton |

Source: Central Transportation Planning Staff.

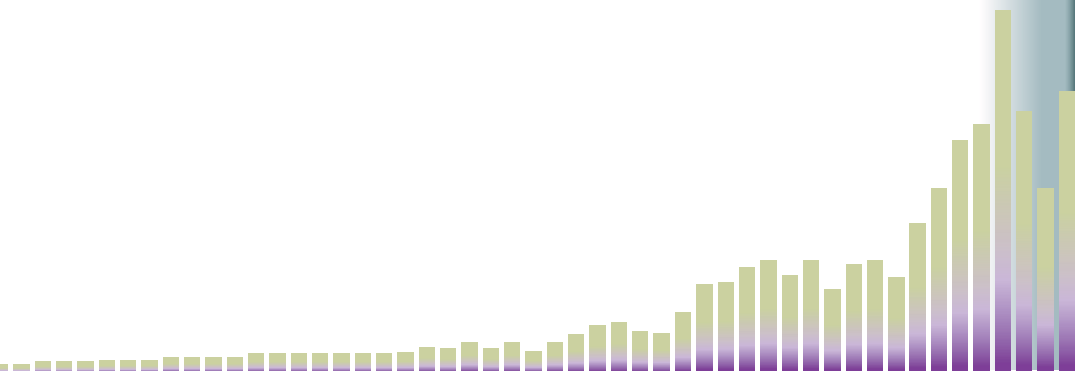


TABLE 3.2
Top-25 Highway Crash Locations in the Boston Region MPO

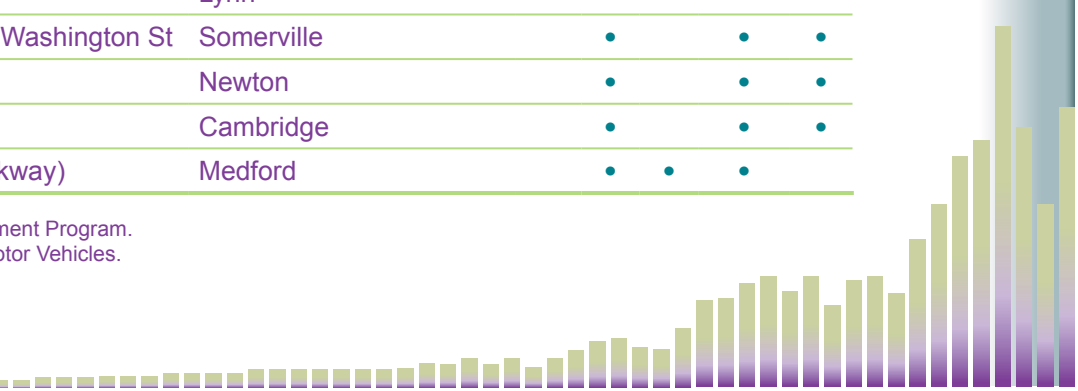
| Location | Municipalities | EPDO | Top 200 | HSIP Crash Cluster | Truck Crash Cluster | Pedestrian Crash Cluster | Bicycle Crash Cluster |
|--|-----------------|------|---------|--------------------|---------------------|--------------------------|-----------------------|
| Interstate 93 at Columbia Rd | Boston | 464 | • | • | • | | • |
| Middlesex Turnpike at Interstate 95 | Burlington | 388 | | • | • | | |
| Rte 3 at Rte 18 (Main St) | Weymouth | 339 | | • | • | | |
| Interstate 93 (Near Ramps for Furnace Brook Parkway) | Quincy | 330 | | • | • | | |
| East St Rotary at Rte 1 and Rte 128 | Westwood | 328 | | • | • | | |
| Interstate 95 at Interstate 93 | Reading | 326 | • | • | • | | |
| I-93 at Granite Ave (Exit 11) | Milton | 325 | | • | • | | |
| Interstate 95 at Route 2 | Lexington | 324 | | • | • | | |
| Rte 9 at Interstate 95 | Wellesley | 320 | | • | • | | |
| I-93 at North Washington St | Boston | 319 | | • | | • | |
| I-93 at Rte 138 (Washington St) | Canton | 316 | | • | • | | |
| I-93 at Rte 3A (Gallivan Blvd/Neponset Ave) | Boston | 271 | | • | • | | |
| Interstate 95 at Rte 4 (Bedford St) | Lexington | 270 | | • | • | | |
| Rte 18 (Main St) at West St | Weymouth | 247 | • | • | • | | |
| Interstate 93 at Rte 37 (Granite St) | Braintree | 245 | • | • | • | | |
| Rte 139 (Lindelof Ave) at Rte 24 | Stoughton | 240 | | • | | | |
| Interstate 93 at Leverett Connector | Boston | 236 | | • | | | |
| Interstate 93 at Route 28 | Medford | 233 | • | • | • | | |
| Rte 128 at Rte 114 (Andover St) | Peabody | 219 | | • | • | | |
| I-93 at Rte 28 and Mystic Ave | Somerville | 214 | • | • | • | | |
| Storrow Dr at David G. Mugar Way | Boston | 212 | | • | | | |
| Rte 28 (Randolph Ave) at Chickatawbut Rd | Milton | 203 | • | • | | | |
| Rte 2 – Crosby's Corner | Concord/Lincoln | 200 | • | • | | | |
| Rte 1 at Route 129 | Lynnfield | 194 | | • | • | | |
| Rte 1 at Route 129 (Walnut St) | Saugus | 193 | | • | | | |

EPDO = Equivalent Property Damage Only. HSIP = Highway Safety Improvement Program.
Source: MassDOT Registry of Motor Vehicles.

TABLE 3.3
Locations with Multiple Safety Needs

| Location | Municipalities | Top 200 | HSIP Crash Cluster | Truck Crash Cluster | Pedestrian Crash Cluster | Bicycle Crash Cluster |
|---------------------------------------|----------------------------------|----------------|---------------------------|----------------------------|---------------------------------|------------------------------|
| Downtown Framingham | Framingham | • | • | • | • | • |
| Rte 20 (Main St) and Moody St | Waltham | • | • | • | • | • |
| Watertown Square | Watertown | • | • | • | • | • |
| Washington St | Salem | • | • | • | • | • |
| Everett Ave | Chelsea | • | • | • | • | • |
| Essex St | Lynn | • | • | | • | • |
| Rte 107 (Western Ave) | Lynn | • | • | • | • | |
| Massachusetts Ave | Arlington | • | • | • | • | |
| Rte 16 (Alewife Brook Parkway) | Arlington, Somerville, Cambridge | • | • | • | | • |
| Broadway | Chelsea | | • | • | • | • |
| Newtonville | Newton | | • | • | • | • |
| Rte 16 (East Main Street) | Milford | • | • | • | | |
| I-495 at Rte 126 (Hartford Ave) | Bellingham | • | • | • | | |
| Downtown Quincy | Quincy | • | • | | • | |
| I-95 at Rte 16 (Washington St) | Newton | • | • | • | | |
| Rte 16 (Revere Beach Parkway) | Revere, Everett, Medford | • | • | • | | |
| I-495 at Route 1A (South Street) | Wrentham | • | • | • | | |
| Rte 20 (East Main Street) | Marlborough | • | • | • | | |
| Rte 9 | Framingham, Natick | • | • | • | | |
| Downtown Natick | Natick | | • | | • | • |
| Downtown Lynn | Lynn | | • | | • | • |
| Rte 1A | Lynn | | • | • | • | |
| Rte 28 (McGrath Hwy) at Washington St | Somerville | | • | | • | • |
| Newton Center | Newton | | • | | • | • |
| Cambridge Street | Cambridge | | • | | • | • |
| Rte 16 (Mystic Valley Parkway) | Medford | | • | • | • | |

HSIP = Highway Safety Improvement Program.
Source: MassDOT Registry of Motor Vehicles.



System Preservation

SYSTEM PRESERVATION PROBLEM STATEMENT

The region's transportation infrastructure is aging and heavily used, and demands on roadway and transit facilities have stressed them to the point that routine maintenance is insufficient to keep up with necessary repairs. The result is a significant backlog of maintenance and SGR projects on all parts of the transportation system, including bridges, roadway pavement, transit rolling stock, and traffic and transit control equipment. In addition, parts of the transportation system may be compromised if climate-change trends continue as projected.

SYSTEM PRESERVATION NEEDS

The system needs to be brought into an SGR, maintained at that level, and enhanced to ensure personal mobility, efficient movement of goods, and protection from potential sea-level rising and storm-induced flooding.

The region's financial constraints require the MPO to set priorities, considering the most crucial maintenance needs and the most effective ways to deploy funding. At the same time, the MPO must improve the resiliency of infrastructure that could be affected by climate change.

The MPO's uses its TIP evaluation criteria to determine whether a project improves substandard pavement, signal operations, intermodal accommodations and connections to transit; it implements intelligent operations system strategies to assess and prioritize the system's preservation and maintenance needs for projects it considers for funding (see Table 3.4).

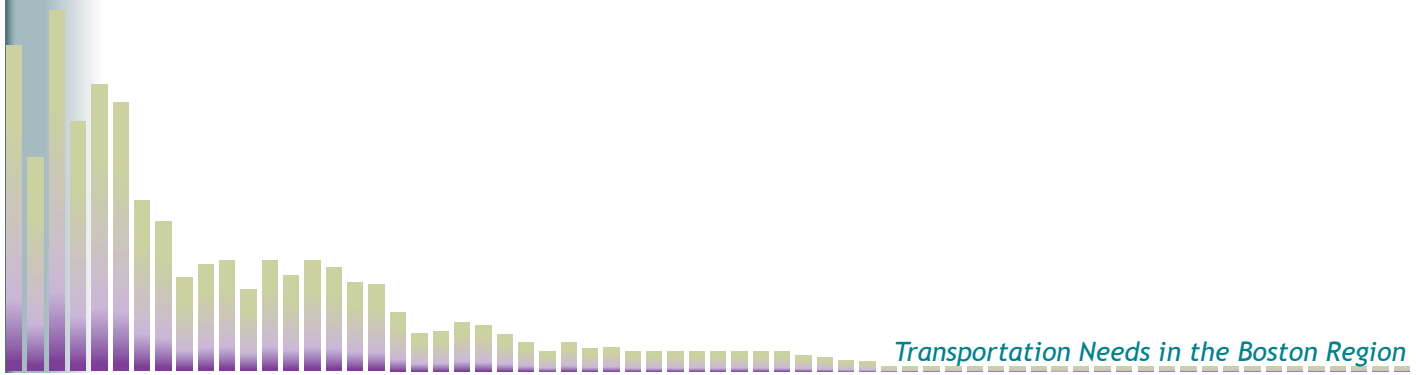
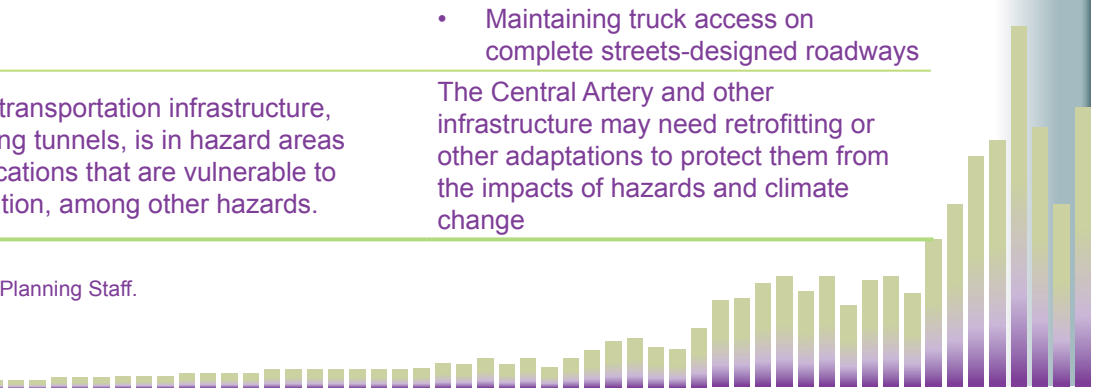


TABLE 3.4
System Preservation Needs in the Boston MPO Region

| Emphasis Area | Problem | Description of Needs |
|--|--|---|
| Bridges | <p>Of the 2,866 bridges in the region:</p> <ul style="list-style-type: none"> • 559 (19%) are functionally obsolete • 154 (5%) are structurally deficient <p>Bridge Health Index:</p> <ul style="list-style-type: none"> • 33% are in good condition (a score of 85 or higher) • 36% are in less-than-good condition (1.5% are in the worst condition – 0) • 31% do not have recorded core element data to calculate a rating | <p>Meet the MassDOT performance measure to prevent the number of structurally deficient bridges from exceeding 463 statewide</p> <p>Meet the MassDOT performance measure to maintain a systemwide bridge health index of at least 81.98</p> |
| Pavement Management | <p>MassDOT-maintained roadways:</p> <ul style="list-style-type: none"> • 70% in good condition • 25% in fair condition • 5% in poor condition | <p>MassDOT-maintained arterial roadways make up 62% of monitored roadways, however 90% of the arterial roadways are in poor condition; larger expanses of arterials in poor condition are located in: Boston, Cambridge, Chelsea, Everett, Lynn, Malden, Medford, Newton, Revere, and Somerville</p> |
| Transit Infrastructure and Rolling Stock | <p>Transit system needs to be brought into SGR</p> <p>Maintaining existing capital assets must be the highest priority</p> | <p>SGR and Maintenance Needs:</p> <ul style="list-style-type: none"> • Green Line signals • Commuter rail bridges (44 structurally deficient) • Commuter rail coaches and locomotives • Rapid transit cars (Red and Orange Lines) • Presidential Conference Cars (PCC) for Mattapan High Speed Line • Station Accessibility (33 commuter rail and 38 rapid transit) |
| Freight Network | <p>Many express highways are built to outdated design standards for trucks</p> | <p>Needs include:</p> <ul style="list-style-type: none"> • Maintaining and modernizing the roadway network • Improved connections between intermodal facilities and regional road network • Maintaining truck access on complete streets-designed roadways |
| Climate Change Adaptation | <p>Some transportation infrastructure, including tunnels, is in hazard areas and locations that are vulnerable to inundation, among other hazards.</p> | <p>The Central Artery and other infrastructure may need retrofitting or other adaptations to protect them from the impacts of hazards and climate change</p> |

Source: Central Transportation Planning Staff.



Capacity Management and Mobility

CAPACITY MANAGEMENT AND MOBILITY PROBLEM STATEMENT

Reducing congestion and managing the capacity of all transportation infrastructure and services is essential to increase mobility, decrease vehicle emissions, promote healthy travel options, and ease disruption and economic losses caused by travel delay.

CAPACITY MANAGEMENT AND MOBILITY NEEDS

Although increasing capacity has long been a strategy to reduce congestion, its effects have not proved long lasting. The MPO now is adopting capacity and mobility strategies that enhance the system through O&M type projects, such as improving access and connectivity to transit services, closing gaps and reducing bottlenecks for all modes, completing the bicycle and pedestrian networks, and providing for first- and last-mile connections.

The MPO identified capacity and mobility needs by analyzing the reliability and capacity of roadway and transit infrastructure and services, and the connectivity of transit, pedestrian, and bicycle infrastructure (see Table 3.5).

TABLE 3.5
Capacity Management and Mobility Needs in the Boston Region MPO

| Emphasis Area | Problem | Description of Needs |
|---------------------------|---|---|
| Roadway Reliability Needs | The Needs Assessment identified a priority set of expressway and arterial congested locations using speed- and travel-time indices, volume-to-capacity ratios, and crashes as factors. Addressing these locations will also address truck freight concerns. | <p>Priority congested locations – Expressways:</p> <ul style="list-style-type: none"> • I-93 between I-95 in Woburn and the Leverett Connector • I-93 between the Braintree Split and the Massachusetts Ave Interchange • US 1 between Route 60 in Revere and Route 99 in Saugus • Route 128 at Lowell Street, Exit 26, in Peabody • I-90 between Interchanges 16 and 17 in Newton • I-95 between I-93 in Woburn and US 1 in Lynnfield <p>Priority congested locations – Arterial Corridors 24 locations (see Figure 3.2):</p> <ul style="list-style-type: none"> • Northeast (3) • Northeast/Central (1) • North (1) • North/Central (2) • Northwest (4) • Northwest/Central (2) • West (5) • Southwest (2) • Southeast (4) |

TABLE 3.5

Capacity Management and Mobility Needs in the Boston Region MPO (cont.)

| Emphasis Area | Problem | Description of Needs |
|---------------------------|---|--|
| Transit Reliability Needs | Maintain the MBTA performance measures for transit reliability | <p>Needs include service standards adherence:</p> <ul style="list-style-type: none"> • Only 7.6 percent of all bus routes passed the MBTA service-adherence standard • On-time performance goals (95%) were not met by the Orange Line or the commuter rail system • The commuter rail system did not meet the locomotive mean miles between failures goal |
| Transit Capacity Needs | A number of major infrastructure constraints on the MBTA system limit capacity and hinder expansion | <p>Infrastructure constraints include:</p> <ul style="list-style-type: none"> • South Station – additional tracks, terminal expansion, and related layover capacity (for current and future high-speed, intercity, and commuter rail service) • Single track sections of the Haverhill, Fitchburg, Franklin, Stoughton, Needham, and Old Colony Lines • The Green Line’s central subway tunnel (currently operating at capacity) • Orange Line peak hours capacity between Downtown Crossing and North Station • Park-and-Ride lots at transit stations; 20 percent are utilized at 85 percent of their capacity, or greater |
| Transit Capacity Needs | Future demand for transit will increase needs for transit investments | <p>Future Needs Include:</p> <ul style="list-style-type: none"> • More service to: <ul style="list-style-type: none"> ○ Peabody, Beverly, Salem ○ Acton, Concord, and Westford ○ Framingham, Marlborough, and Natick (communities served by MetroWest Regional Transit Authority (MWRTA)) ○ Needham and Wellesley (MWRTA provides some service to Wellesley) ○ Stoughton, Canton, Norwood, Walpole ○ Lynn ○ Malden ○ Weymouth • More service on MBTA bus routes to address overcrowding; potential operations improvements (bus prioritization and bus lanes) • Suburban transit • Faster crosstown service to better access locations along radial corridors • Service to Everett |

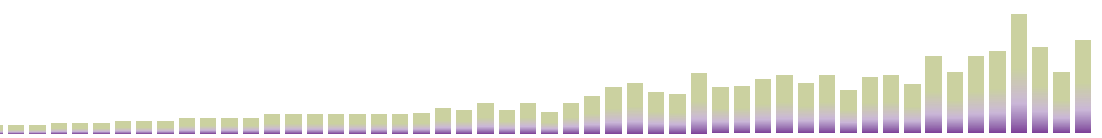
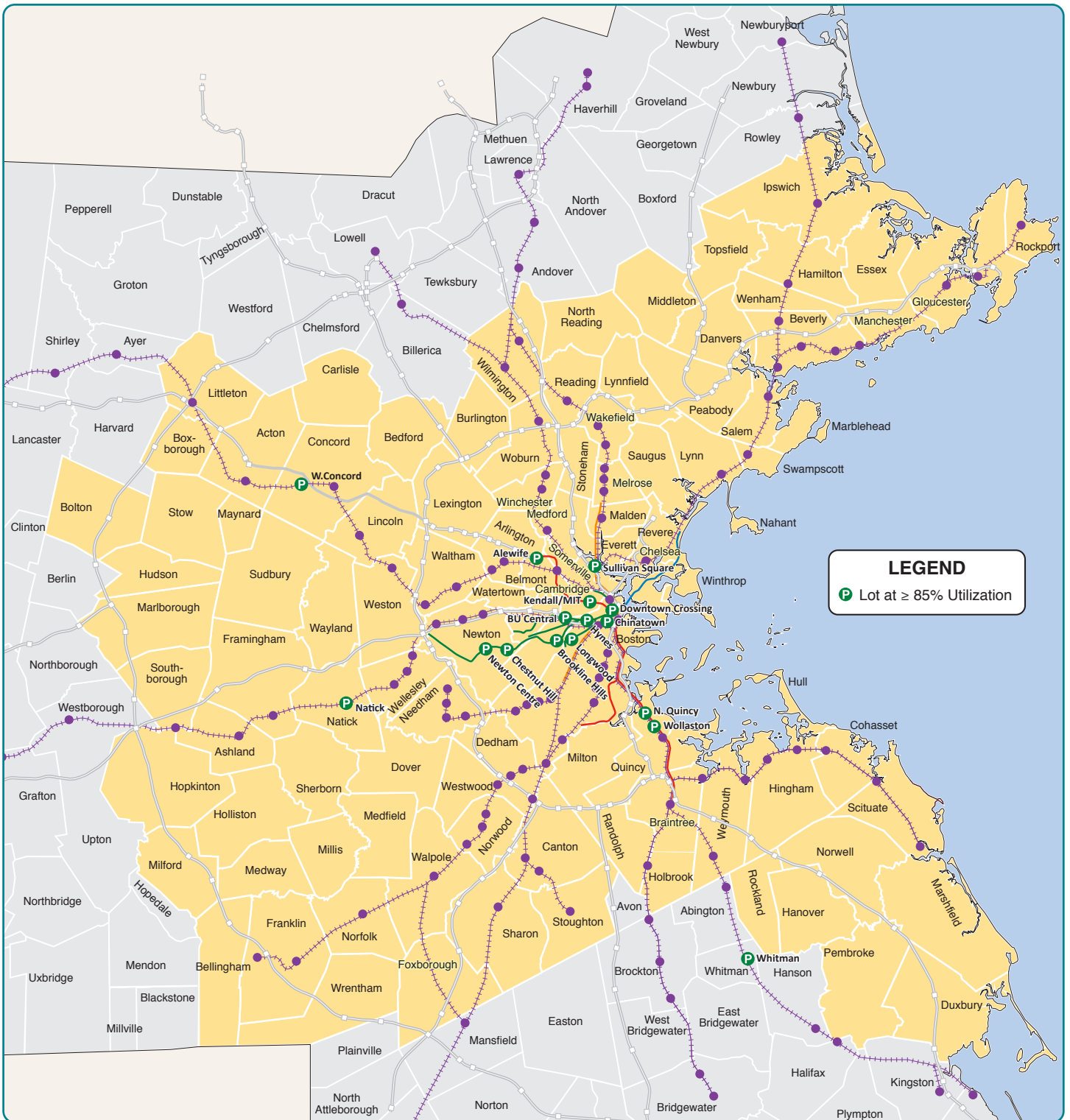


TABLE 3.5
Capacity Management and Mobility Needs in the Boston Region MPO (cont.)

| Emphasis Area | Problem | Description of Needs |
|---|---|---|
| Transit Connectivity | Congested transit- or bicycle-parking facility | <ul style="list-style-type: none"> • Park-and-Ride lots at more than 85% utilization: (see Figure 3.3, Map of Stations at or more than 85% utilization) • Bicycle parking facilities at more than 85% utilization: (see Figure 3.4, Map of Bicycle Parking Facilities at or more than 85% utilization) • Numerous other access improvements for transit, including: <ul style="list-style-type: none"> ○ Bicycle access, rapid transit system wide ○ Bicycle and pedestrian access to north-side Orange Line stations, the Blue Line, and southern parts of the Red Line ○ Pedestrian and bicycle access to commuter rail stations |
| | General Access Needs | <ul style="list-style-type: none"> • Areas for Access Improvements include: <ul style="list-style-type: none"> ○ Alewife Station ○ Crosstown bus routes ○ Improved suburban links to existing transit service (Park-and-Rides, transit station parking, shuttle services, and other facilities and services that support last-mile connections) ○ Improved connections between the regional transit authorities |
| Bicycle and Pedestrian Network Connectivity | Eleven top priority bicycle gaps to be addressed | Top priority bicycle gaps are shown in Figure 3.5 |
| | Baystate Greenway (BSG) Priority 100 corridor projects in the Boston Region | BSG 100 priority corridor projects are shown in Figure 3.5 |
| | General Bicycle and Pedestrian Improvements | Bike trails to Boston from the northeast, north, and southeast |
| | Only 52 percent of the region's non-limited-access roadways have a sidewalk on at least one side of the street. | Sidewalks on at least one side of all streets |
| | Inadequate snow removal reduces mobility | |

Source: Central Transportation Planning Staff.

FIGURE 3.4
Bicycle Parking Facilities with a Utilization Rate of More than 85%



Clean Air and Clean Communities

CLEAN AIR AND CLEAN COMMUNITIES PROBLEM STATEMENT

The MPO has made significant progress toward improving air quality in the region, which is now in attainment for ozone and particulate matter and remains in maintenance for carbon monoxide.¹ Continued vigilance is needed to keep emissions of these pollutants at acceptable levels.

The largest environmental threat the MPO now faces is the need to reduce greenhouse gas emissions that contribute to climate change, which if unchecked, could impair our transportation system and way of life. In addition, transportation can negatively affect environmental resources and land use patterns if they induce sprawl or development in or near priority preservation areas (see Economic Vitality section and Figure 3.8).

CLEAN AIR AND CLEAN COMMUNITIES NEEDS

To comply with federal and state requirements, as well as MPO policy, the MPO tracks air quality by continuously monitoring estimated or projected levels of pollutants, including volatile organic compounds (VOC), nitrogen oxides (NOx), carbon monoxide (CO), particulate matter (PM), and carbon dioxide (CO₂). In the LRTP and TIP project-selection processes, the MPO reviews and rates individual projects on how well they meet criteria established to protect the environment.

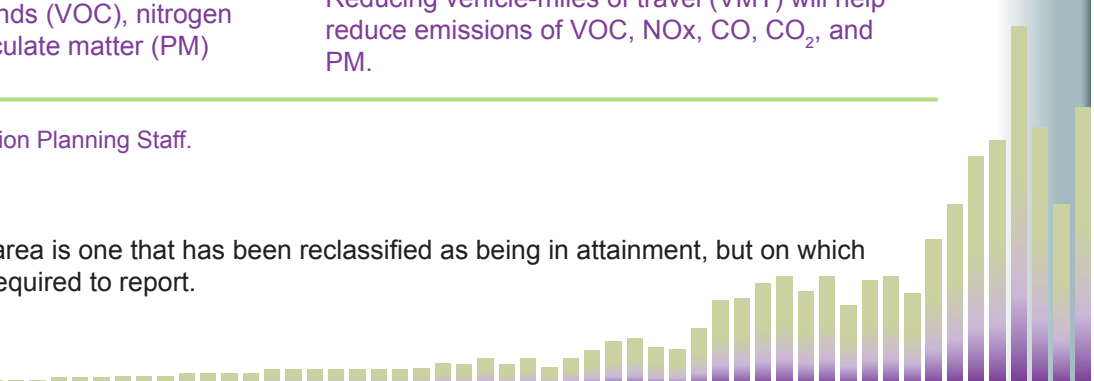
Addressing some of the needs identified under the Capacity Management and Mobility goal also will help the MPO achieve the Clean Air and Clean Communities goal, as programs that reduce vehicle-miles traveled (VMT) contribute to lower emissions of VOC, NOx, CO, CO₂, and PM.

TABLE 3.6
Clean Air and Clean Communities Needs in the Boston Region MPO

| Problem | Description of Needs |
|--|--|
| The MPO must continue monitoring levels of carbon monoxide (CO) and carbon dioxide (CO ₂) and should continue monitoring the pollutants volatile organic compounds (VOC), nitrogen oxides (NOx), and particulate matter (PM) | Identify projects and programs that can meet criteria established to protect the environment Reducing vehicle-miles of travel (VMT) will help reduce emissions of VOC, NOx, CO, CO ₂ , and PM. |

Source: Central Transportation Planning Staff.

¹ A maintenance area is one that has been reclassified as being in attainment, but on which the MPO is still required to report.



Transportation Equity

TRANSPORTATION EQUITY PROBLEM STATEMENT

Historically, some minority and economically disadvantaged areas have endured the negative effects of the transportation system disproportionately—for example, via placement of infrastructure from which they do not benefit; poor access to, or maintenance of, necessary services; and by not being included in the transportation-planning process. In addition, youth, the elderly, and people with disabilities of various kinds face special challenges when using the transportation system. Although progress has been made to remedy these problems, much remains to be done to identify affected populations and ensure equal treatment and access to transportation services, mobility, and decision making.

TRANSPORTATION EQUITY NEEDS

The MPO determines the transportation needs of people in transportation equity (TE) areas—those with higher concentrations of minority and/or low-income residents (see Figures 3.6 and 3.7 and Chapter 7)—in a number of ways. Staff post a needs survey on the MPO’s website; the MPO conducts forums and meetings to solicit input; staff attend various meetings where needs and transportation gaps are discussed; and staff keep current on reports and studies that identify these needs, which generally fall into several categories, including:

- Transit service improvements
- Transit and roadway infrastructure improvements
- Improved intermodal connections
- Coordination of various services

The MPO addresses regional transportation equity through TIP evaluation criteria, where projects that address a transportation issue in an TE neighborhood can score points. MPO staff give positive ratings to projects that could benefit TE areas, and negative ratings to projects that might burden these areas. This scoring system gives projects that address transportation equity issues an advantage, as the MPO considers these ratings when deciding which projects should be funded in the LRTP or TIP.

TABLE 3.7
Transportation Equity Needs in the Boston Region MPO

| Problem | Description of Needs |
|--|---|
| Lack of adequate transit service to environmental-justice communities | Identified needs: <ul style="list-style-type: none"> • Transit service improvements • Transit and roadway infrastructure improvements |
| Some transportation needs are addressed system wide and some are location specific | <ul style="list-style-type: none"> • Improved intermodal connections • Coordination of various services |

Source: Central Transportation Planning Staff.

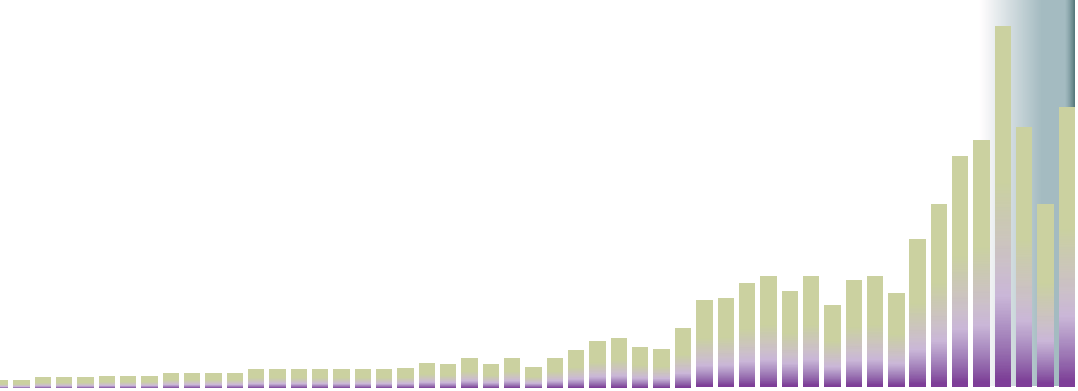
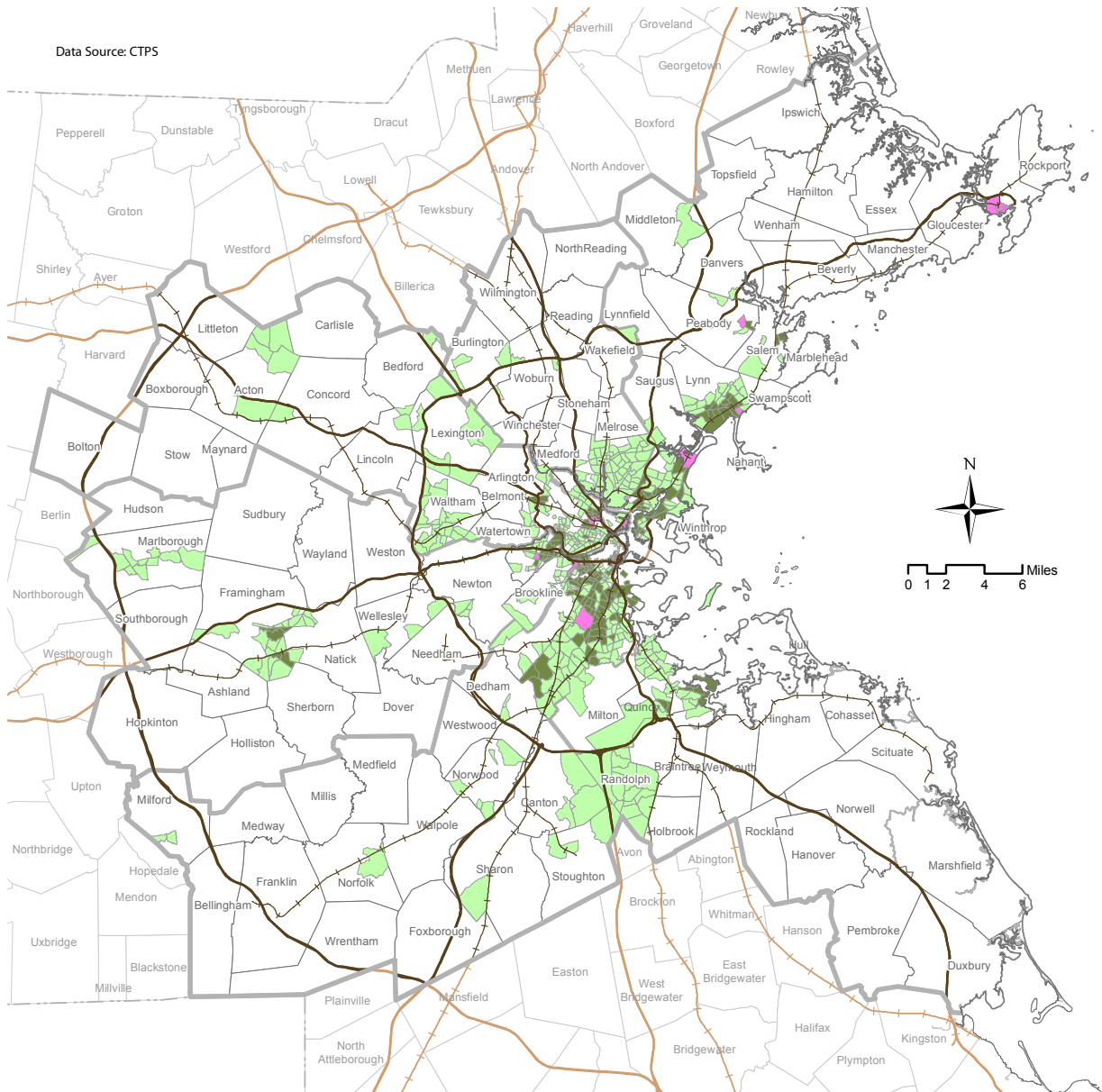


FIGURE 3.6
Transportation Equity Areas in the Boston Region MPO Regionwide



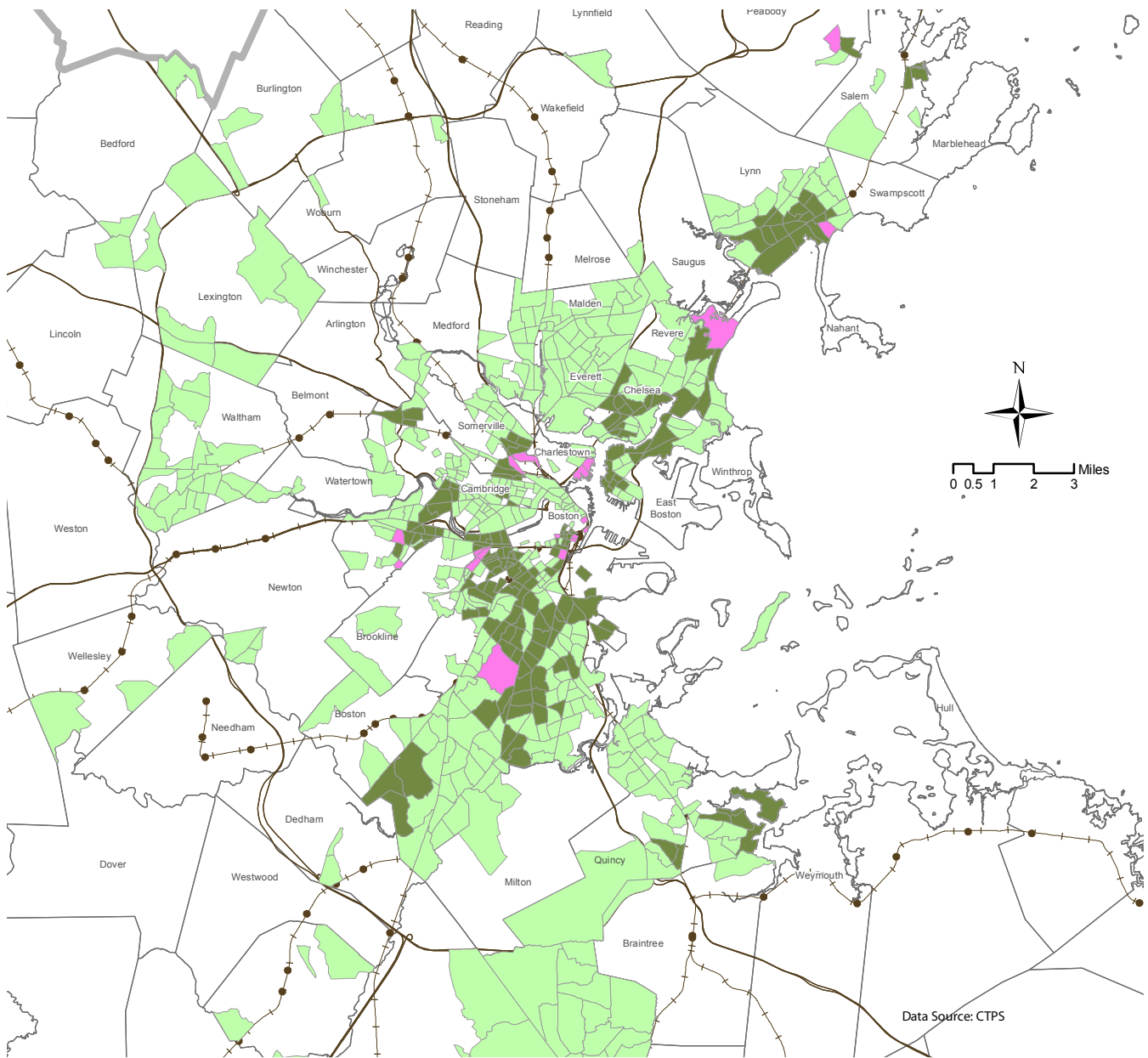
**Transportation Analysis Zones (TAZs)
 That Meet Equity Analysis Zone
 Criteria***

- Not minority or low-income
- Minority zone
- Low-income zone
- Both low-income and minority

***Criteria for Equity Analysis Zones
 under Title VI (2010 Data)**

A TAZ in which the median household income in 2010 was equal to or less than 60% of the MPO median of \$70,829 (\$42,497) or in which the 2010 population was more than 27.8% minority.

FIGURE 3.7
Transportation Equity Areas in the Boston Region MPO Central Area

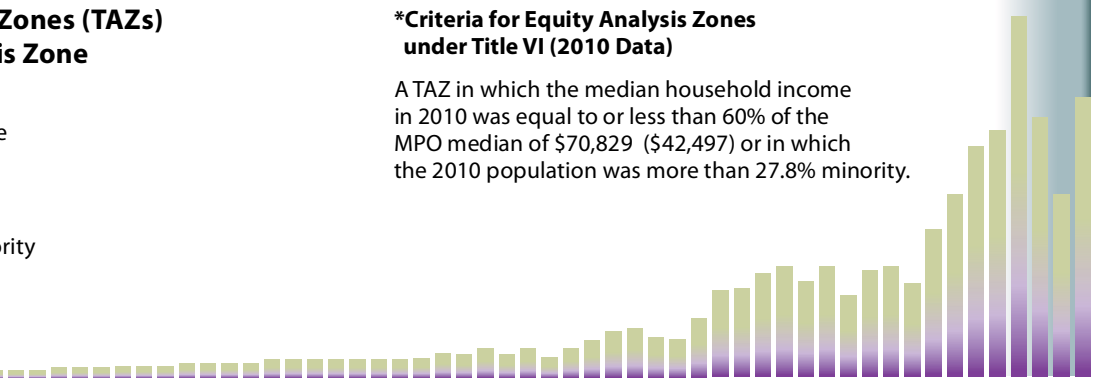


**Transportation Analysis Zones (TAZs)
 That Meet Equity Analysis Zone
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- Not minority or low-income
- Minority zone
- Low-income zone
- Both low-income and minority

***Criteria for Equity Analysis Zones
 under Title VI (2010 Data)**

A TAZ in which the median household income in 2010 was equal to or less than 60% of the MPO median of \$70,829 (\$42,497) or in which the 2010 population was more than 27.8% minority.



Economic Vitality

ECONOMIC VITALITY ISSUES STATEMENT

Land use, demographics, the economy, the environment, and the transportation system are closely interrelated, and changes to any one factor can affect the others negatively. The MPO can support economic development by focusing attention on the transportation infrastructure needs of MAPC-identified priority development and preservation areas in the region (Figure 3.8) as it prioritizes its limited regional funding.

ECONOMIC VITALITY NEEDS

The Massachusetts Executive Office of Housing and Economic Development (EOHED), the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), and MAPC collaborated on a process to identify local, regional, and state-level priority development and preservation areas in municipalities within the MPO area. These areas can support additional housing, employment growth, creation and preservation of open space, and the type of continued economic vitality and future growth that the market demands, and which communities desire. The MPO has worked with MAPC and state agencies to understand the infrastructure needs of these areas and to identify transportation projects that could address them.

TABLE 3.8
Economic Vitality Needs in the Boston Region MPO

| Problem | Description of Needs |
|--|--|
| The region's economic vitality depends on a high-performing, multi-modal transportation system | Infrastructure improvements are needed to support growth in the priority development areas |

Source: Central Transportation Planning Staff.

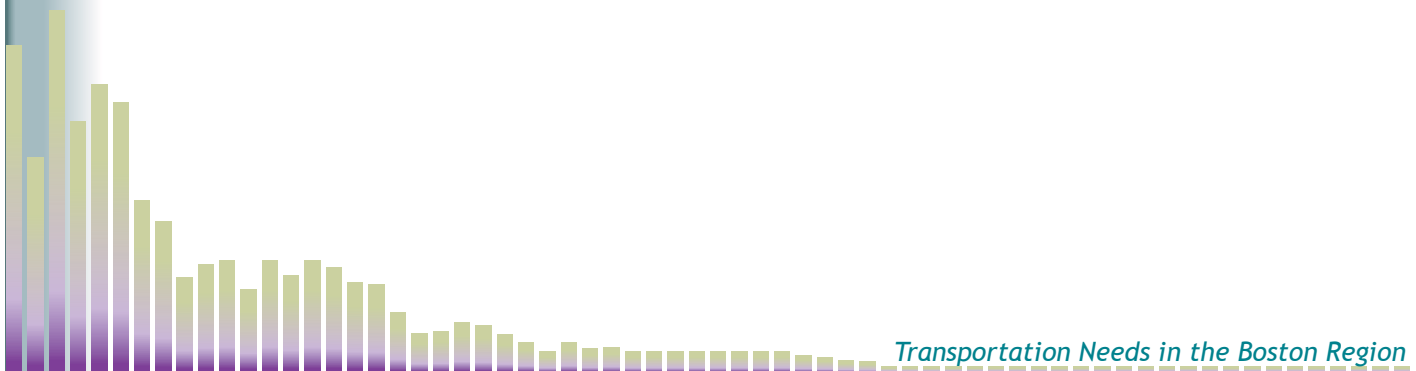
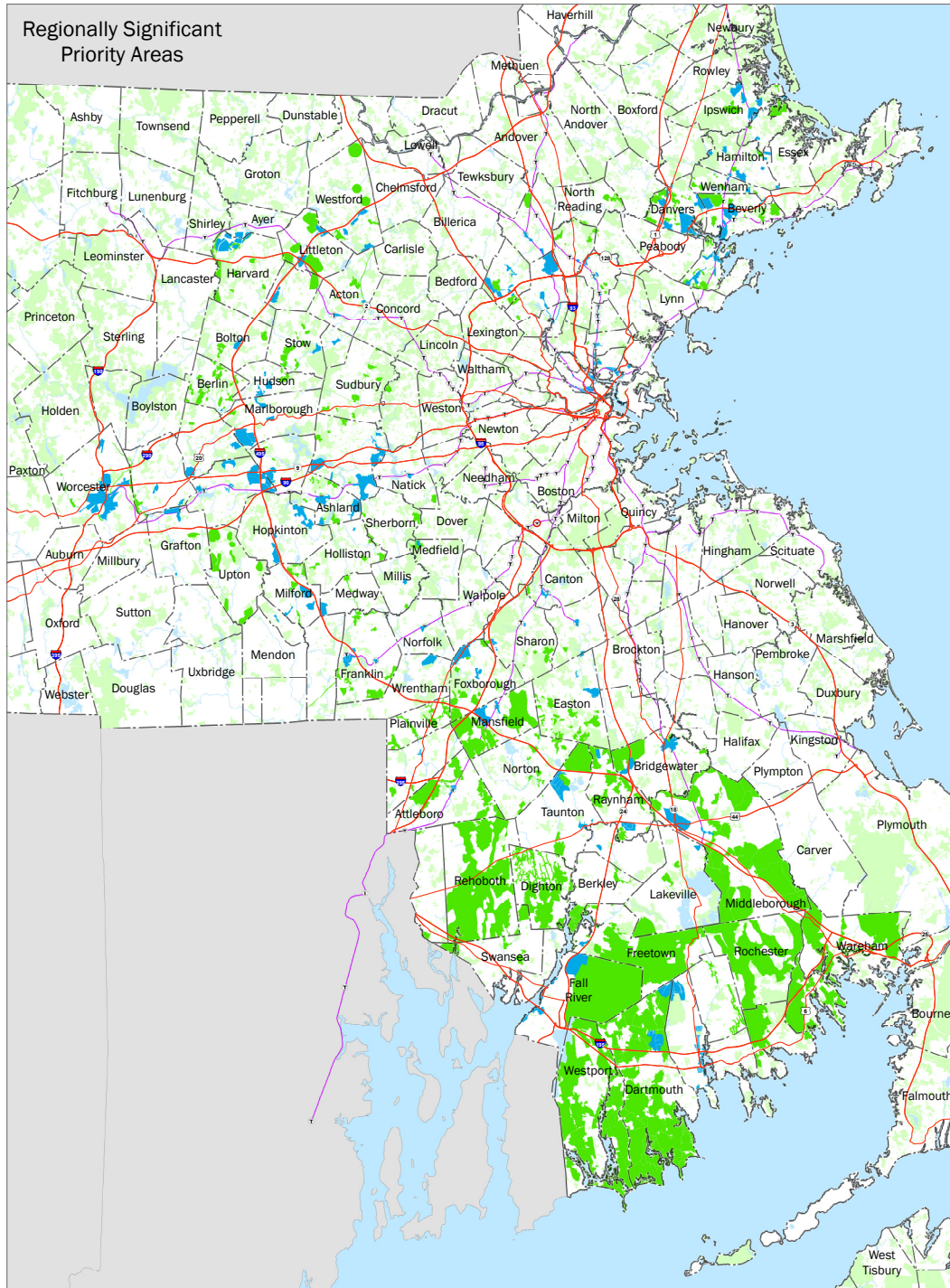
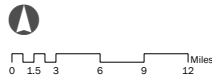


FIGURE 3.8
Regionally Significant Priority Development and Preservation Areas

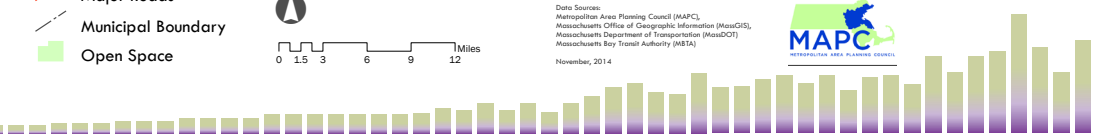


Regional Priority Areas

- Development
- Preservation
- ✱ Commuter Rail Station
- Commuter Rail Line
- Major Roads
- Municipal Boundary
- Open Space

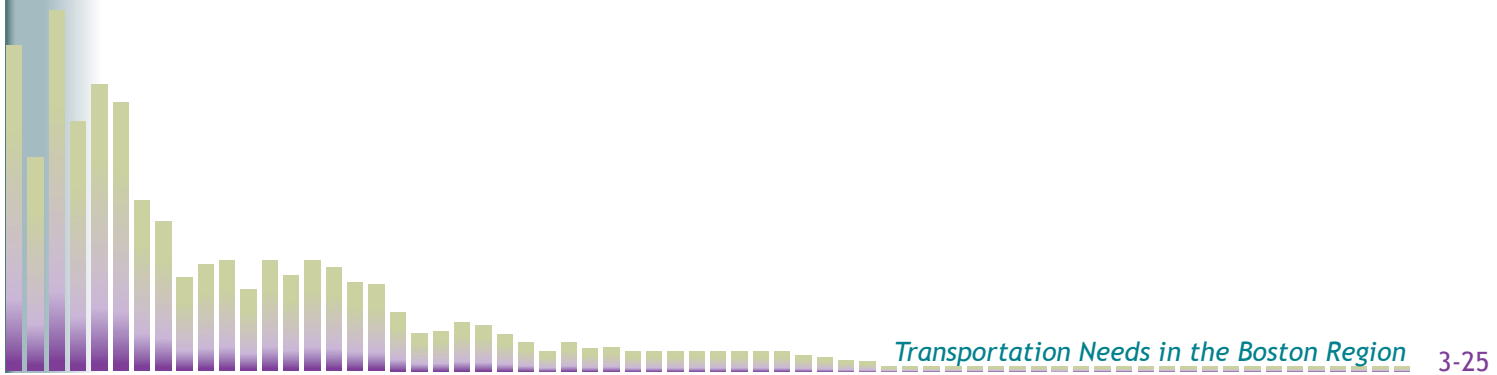


Data Sources:
 Metropolitan Area Planning Council (MAPC),
 Massachusetts Office of Geographic Information (MassGIS),
 Massachusetts Department of Transportation (MassDOT),
 Massachusetts Bay Transit Authority (MBTA)



CONCLUSION

Clearly, the Boston region has extensive transportation maintenance and modernization requirements, and must continue to address safety and mobility for all modes. In fact, all of the MPO's goal areas contain certain inadequacies that the MPO should confront in its multimodal approach to meeting the region's needs through 2040. However, MPO staff estimate that attending to these needs likely would exceed anticipated financial resources between now and 2040. Therefore, the MPO will face difficult decisions as it prioritizes when and how to allocate resources to guide transportation investment decisions throughout this LRTP's time span.





4 FUNDING THE TRANSPORTATION NETWORK

OVERVIEW

For the Boston Region MPO to be eligible to receive federal aid for transportation projects, it is required by federal law to prepare a fiscally constrained LRTP every four years to document the estimated costs and describe the regionally significant surface transportation projects and programs planned for construction or implementation for a 25-year time period. Regionally significant projects and programs are those that would increase the capacity of the transportation system, or that would cost more than \$20 million.

Over the life of this LRTP, from FFY 2016 to 2040, the Boston Region MPO has the discretion to program \$2.85 billion in federal funds for highway transportation projects in the region. This amount is significantly less than was available four years ago when the MPO programmed approximately \$3.8 billion in *Paths to a Sustainable Region*. The difference is a result of new projections for revenue growth, which are lower for *Charting Progress to 2040* than for *Paths to a Sustainable Region*. In *Paths to a Sustainable Region*, revenue growth was assumed to be 3 percent a year, while *Charting Progress to 2040* assumes a 1.5 percent a year increase, as discussed below.

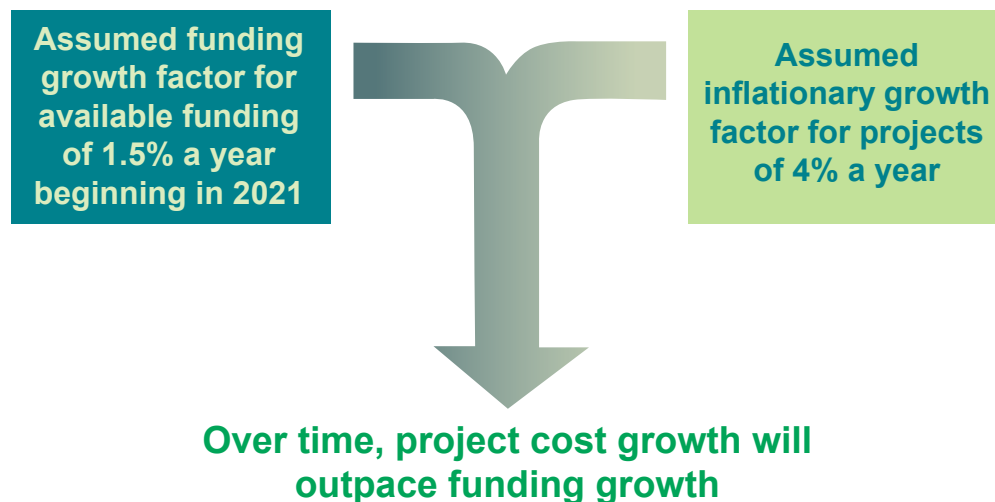
In addition to documenting MPO discretionary spending, this LRTP reports on nearly \$6 billion in planned spending on highway projects prioritized by the Commonwealth through statewide funding programs. It also recounts capital resources and operations and maintenance resources available to the three regional transit authorities (RTAs) operating in the Boston Region: the Massachusetts Bay Transportation Authority (MBTA), the MetroWest Regional Transit Authority (MWRTA), and the Cape Ann Transportation Authority (CATA).

Capital resources available to the MBTA are projected to amount to more than \$10.3 billion during the life of this plan (approximately \$9.1 billion in aid through the federal transit program and \$1.2 billion in MBTA revenue bonds to match federal funds). The MBTA's operations and maintenance revenues are generated from the state sales tax, assessments paid by municipalities in the MBTA's service area, fare revenues, and other sources (discussed later in this chapter); these revenues are projected to reach \$70.9 billion during the life of this LRTP, covering an estimated \$69 billion in costs.

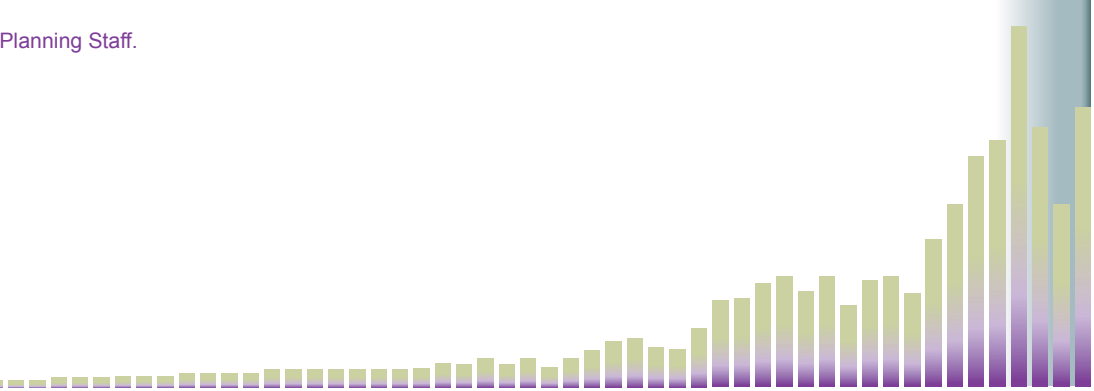
The MWRTA is expected to have \$51 million in federal capital resources over the life of the LRTP. The MWRTA's operations and maintenance costs are projected to total \$253.7 million for this same period. Revenues are expected to fully cover those costs. The CATA is expected to have \$16 million in federal capital resources over the life of the LRTP. The CATA's operations and maintenance costs are projected to total \$98.8 million for this same period with revenues projected to be \$97.8 million. Thus, additional operating funding would be required to maintain and improve transit services in the future.

The financial plan outlined in this LRTP is based on federally approved projections for revenue growth over the 25 years of the plan. As this plan was being prepared, Congress had not yet passed new federal legislation that would provide long-term revenue projections. (Moving Ahead for Progress in the 21st Century, or MAP-21, is the currently active legislation that is set to expire at the end of October 2015.) Therefore, for planning purposes, the federal agencies advised the MPO to assume that revenues will increase by 1.5 percent each year starting in federal fiscal year (FFY) 2021 and extending through FFY 2040. This growth factor is based on analyzing actual federal funding allocations that the region received in recent years. For the same period, project costs are anticipated to inflate by 4 percent each year.

FIGURE 4.1
Revenue and Growth Assumptions for LRTP Development

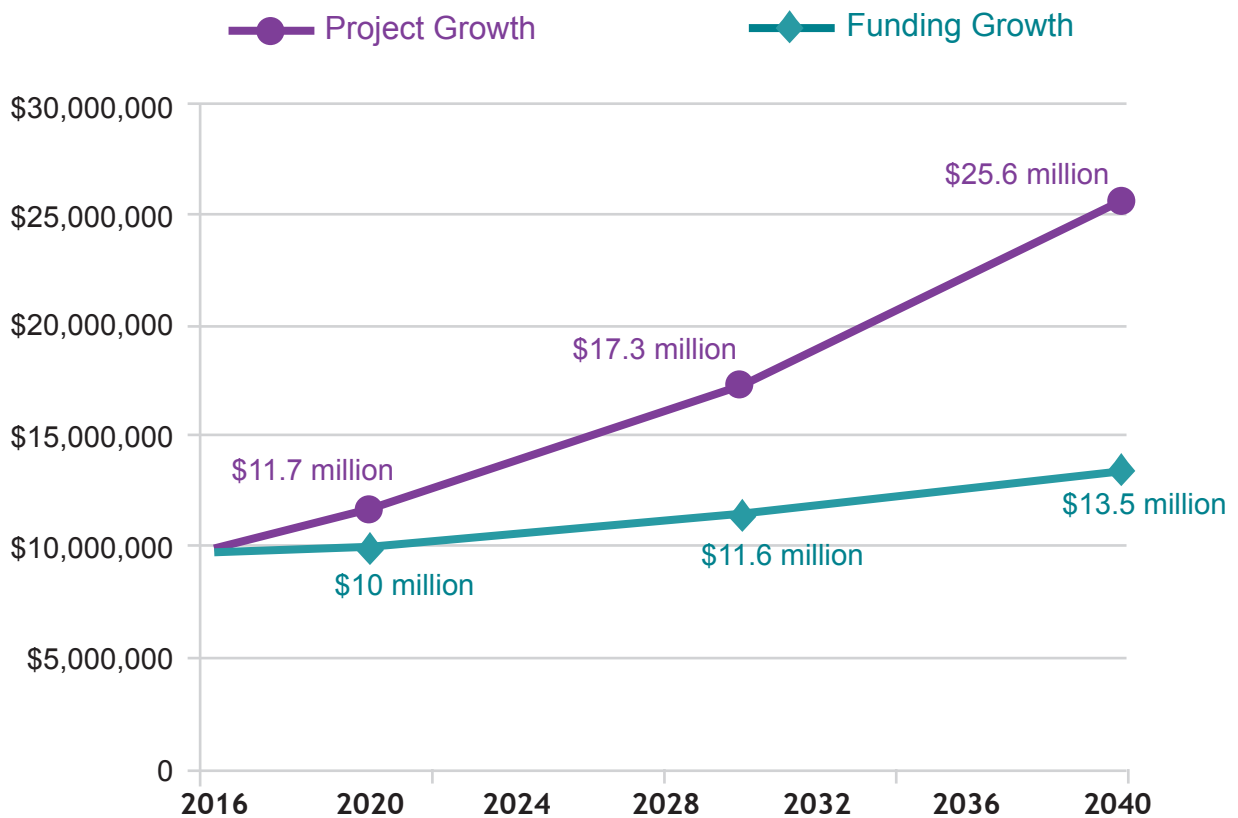


Source: Central Transportation Planning Staff.



If these projections hold true, project costs will outpace available revenues, resulting in diminished buying power in future years. A project costing \$10 million if constructed in FFY 2016, for example, would cost increasingly more if programmed in the outer years of the LRTP. To deliver the same project in FFY 2040, the cost would be \$25.6 million, while the available revenues for that project would have increased by only \$3.5 million. (See Figure 4.2 below.)

FIGURE 4.2
Project Cost Growth versus Funding Growth, FFYs 2016-2040



Source: Central Transportation Planning Staff.

HIGHWAY FUNDING

Highway revenues programmed in the LRTP consist of federal funds approved by Congress and distributed through the Federal-Aid Highway Program and state funds approved by the Massachusetts Legislature. The various funding sources available for roadway and bridge projects in Massachusetts are outlined below.

Federal Aid

Federal funds support construction and rehabilitation of highways and bridges on federal-aid eligible routes (as determined by the roadway's functional classification) as well as projects and programs targeted for improvements in particular focus areas, such as improving safety or air quality, building bicycle and pedestrian networks, or interstate maintenance. Congress has established various funding programs for appropriating federal funds to these key focus areas, some of which are discussed later in this chapter.

Federal highway funds for states are typically authorized by Congress through a multi-year act. The most recent act was MAP-21, which authorized funding for FFY 2013 and 2014, and was extended through July 2015 and then again through October 2015.

Congress apportions funds to the states based on formulas specified in federal law. Each year, a state may spend its apportionment only up to a ceiling or the "obligation authority," a limit set by Congress to control federal expenditures. The obligation authority represents the federal government's commitment to reimburse the state for eligible expenditures on approved projects.

The state must program its obligation authority before the close of the federal fiscal year, September 30, otherwise the state will forfeit the un-programmed funds and the federal government will make those funds available to other states that have the wherewithal to spend them, i.e., projects that are ready for construction. In past years, the Commonwealth has been the recipient of these so-called redistribution funds that became available when other states did not program up to their obligation authority. While the Commonwealth has benefited from these bonuses, it also, like other states, has been subject to rescissions, when the federal government rescinded or pulled back the unused balances of previously authorized funds.

Within the obligation limits, the Federal Highway Administration (FHWA) reimburses states for costs of federal-aid eligible projects out of the Highway Trust Fund. The primary source of revenue for the Highway Trust Fund is the federal tax on motor fuels; additional revenue comes from other transportation-related fees. Recently, the Highway Trust Fund has been at risk of insolvency, in part, because its revenues are heavily dependent on the gas tax; as vehicles become more fuel efficient and vehicle miles traveled trend downward, this revenue source has become less robust.

In regions with metropolitan areas that have populations greater than 50,000, transportation projects or programs to receive federal aid must be programmed through the MPO certification process. Projects that are regionally significant, i.e., those that would add capacity to the transportation system or that cost more than \$20 million, must be programmed in the LRTP, along with project descriptions and cost estimates.

Projects that are scheduled to be implemented in the near term—regardless of cost or regional impact—must be programmed in the Transportation Improvement Program (TIP),

a four-year planning document that is updated annually. The TIPs from all the MPOs in a state are combined to form the State Transportation Improvement Program (STIP), which recounts the federal-aid funded projects to be implemented statewide over a four-year period.¹ TIP funding levels are the basis for funding projections for the LRTP.

The TIP and STIP document the federal, state, and local shares of funding for projects and programs. Typically, federal dollars must be matched in some portion by state or local dollars, as dictated by the funding split formula of each particular federal funding program. Federal funds usually cover 80 percent of a project's cost, and the state or local government covers 20 percent. Some federal programs offer a 90 percent federal share or full funding. Congressional earmarks in federal transportation bills often provide full funding for specific projects; however, there were no earmarks in MAP-21.

In addition to documenting federally funded projects for which the state has obligation authority, the TIP and STIP also document projects that would be funded using the Advance Construction financing method. In these cases, a state may receive approval from FHWA to begin a project before the state has received the necessary obligation authority. This pre-qualification allows a project to move forward initially with state funding, and to request federal reimbursements later.

The Massachusetts Department of Transportation (MassDOT) is the recipient of federal highway aid to the Commonwealth. After deducting the Commonwealth's debt service payments owed to the federal government (discussed further in the Debt Service section below), MassDOT allocates the remaining federal funds to statewide road and bridge programs for projects prioritized by MassDOT, and to the MPOs in the Commonwealth for projects prioritized by these regional bodies. The funds provided to MPOs are referred to as Regional Targets.

The Regional Targets for MPOs are determined by a formula established by the Massachusetts Association of Regional Planning Agencies (MARPA), which factors in each region's share of the state population. Of the ten MPOs and three regional planning commissions/councils in the Commonwealth, the Boston Region receives the largest portion of funding through this formula-based distribution. Because of the Boston Region MPO's larger population, it receives nearly 43 percent of these funds for programming at its discretion. Again, these funds must be programmed in the TIP and STIP before construction can be authorized using federal-aid funds.

State Aid

The Massachusetts Legislature authorizes the issuance of bonds for transportation expenditures through passage of transportation bond bills. This allows the Commonwealth to provide matching funds to federal-aid projects, to pay for fully state-

¹ The Boston Region MPO recently approved the production of a five-year TIP.

funded (non-federal aid) projects, and to offer support to municipalities through local-aid programs such as Chapter 90 (discussed later under Local Priorities).

The primary source of state-aid for transportation projects in the Commonwealth is generated by the state gasoline tax, motor fuel excises, and fees from motor vehicle licensing and registration. These funds, which are deposited in the Commonwealth Transportation Fund, are used to pay debt service on bonds issued for transportation projects, and to fund MassDOT, the MBTA, and other RTAs in the Commonwealth.

These state revenues have been affected by passage of a 2014 referendum that repealed a law requiring the state gasoline tax to be automatically adjusted annually based on inflation.

The following sections provide details about highway financing in the Commonwealth.

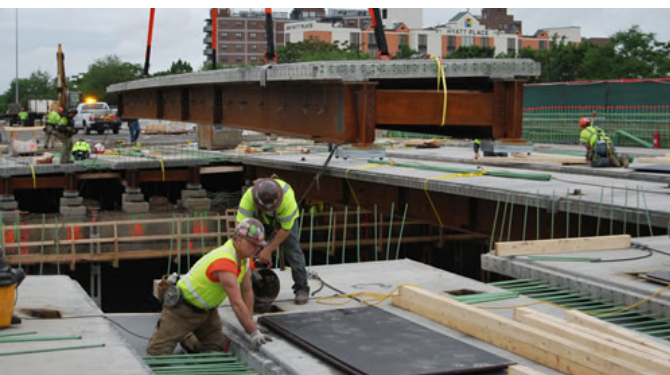
Debt Service

In recent years, the Commonwealth has used a highway project financing mechanism known as grant anticipation notes (GANS) to pay for major highway projects. GANS are bonds issued by the state that are secured by anticipated, future federal highway funds.

In the late 1990s, the Commonwealth issued \$1.5 billion in GANS to finance construction of a portion of the Central Artery/Ted Williams Tunnel Project. The majority of the project was completed in 2006. The Commonwealth made its final payment on this debt in 2014.

While the Central Artery/Tunnel repayments were winding down, the Commonwealth issued GANS again in 2010 for the Accelerated Bridge Program. This followed the passage in 2008 of the Accelerated Bridge Program Act, which authorized issuance of as much as \$1.108 billion in GANS and \$1.876 billion in special obligation bonds of the Commonwealth.

This \$3 billion, eight-year program financed the design, construction, reconstruction, and



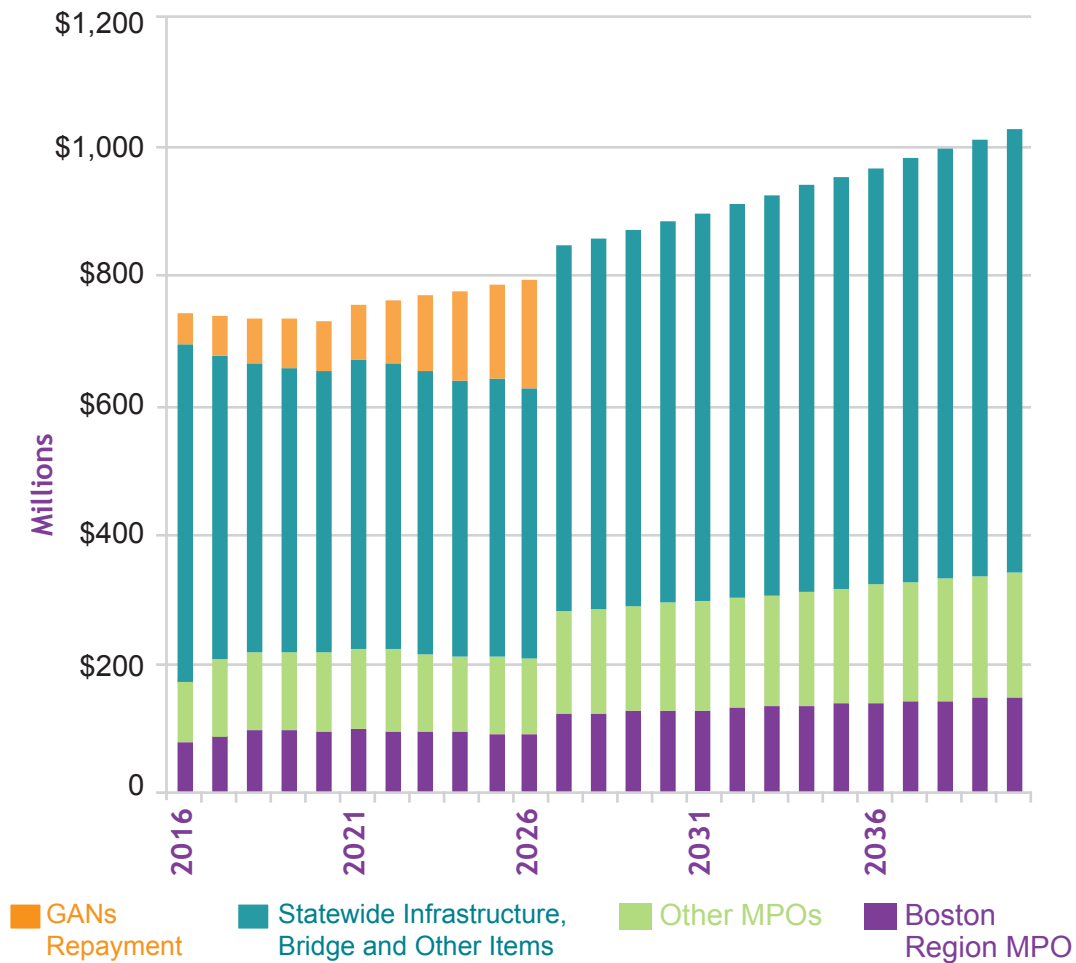
repair of structurally deficient bridges across the Commonwealth. It has used novel project development and construction techniques that deliver projects on an accelerated schedule. One such project that received national attention was “Fast 14,” which replaced 14 bridges on Interstate 93 in one construction season by using prefabricated bridge deck panels.

The Accelerated Bridge Program concludes in 2016, but the Commonwealth will continue to



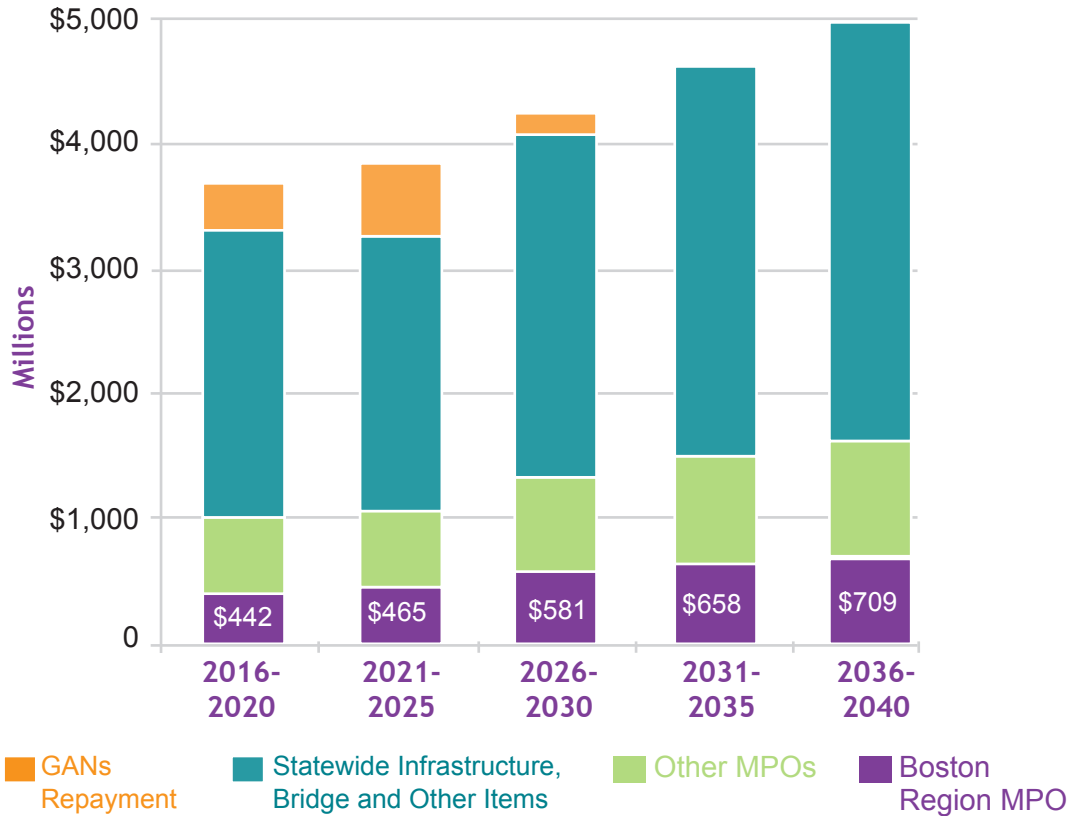
pay on the debt incurred during the next decade. The GANS for the Accelerated Bridge Program will mature between state fiscal years (SFY) 2015 and 2027. The repayment amounts, which are documented in this LRTP, are \$1.108 billion for the life of the LRTP. Based on the financial projections for the LRTP, these debt payments will consume approximately 6 percent of available federal funding in FFY 2016 and increase over time to consume nearly 27 percent of the federal funding in FFY 2026. (See Figures 4.3 and 4.4 below.)

FIGURE 4.3
Federal Highway Program, FFYs 2016-2040



Source: Central Transportation Planning Staff.

FIGURE 4.4
Federal Highway Program, FFYs 2016-2040 by Time Band



Source: Central Transportation Planning Staff.

State Priorities

BRIDGES

MassDOT is responsible for prioritizing bridge projects statewide. In addition to the Accelerated Bridge Program, bridge preservation and maintenance projects are funded through the Statewide Bridge Program.

Funds for the Statewide Bridge Program come from two federal-aid highway programs: the National Highway Performance Program (NHPP) and the Surface Transportation Program (STP). The NHPP funds bridges that are on the federal-aid system, while the STP funds bridges on public roads that are not on the federal-aid system. Projects funded through the Statewide Bridge Program typically receive 80 percent federal funding with a 20 percent non-federal match.

Approximately one-quarter of the bridges in the Commonwealth are in the Boston Region MPO area. Therefore, it is expected that MassDOT will allocate one-quarter of the amount of federal funding in the Statewide Bridge Program to the Boston Region MPO for the life of the LRTP.

Based on the financial assumptions for the LRTP, this region can expect to receive \$1.16 billion in federal aid for bridge projects for the life of this LRTP. The allocation is expected to increase from \$193.5 million in the FFYs 2016–20 time band to \$285.6 million in the FFYs 2036–40 time band.

Additional non-federal aid for bridges and roadways is distributed to the regions based on the MARPA formula. The Boston Region MPO expects its 43 percent share, which amounts to \$1.1 billion for the life of the LRTP.

INTERSTATE MAINTENANCE AND PAVEMENT MANAGEMENT

MassDOT allocates funds for interstate maintenance and highway pavement resurfacing projects to the regions through its Statewide Interstate Maintenance Program and Statewide National Highway Preservation Program. The federal funding source for these programs is the NHPP.

Similar to allocation of federal-aid bridge monies, MassDOT determines the allocation of federal-aid funds for interstate maintenance and pavement management to each region of the Commonwealth based on the amount of infrastructure that must be maintained in each region.

Approximately 38 percent of the interstate lane miles in the Commonwealth are in the Boston MPO region, thus this region can expect to receive that proportion of Statewide Interstate Maintenance Funds for the life of the LRTP. As such, the Boston MPO region expects to program a total of \$784.5 million in interstate maintenance projects during the life of the LRTP.

The Boston Region MPO contains nearly 32 percent of the lane miles of non-interstate highways (principal arterials) that are eligible to receive funding through the Statewide National Highway System Program. Consequently, this region can expect to receive that proportion of funding for highway preservation projects, which amounts to \$341 million during the life of the LRTP.

STATEWIDE MAJOR INFRASTRUCTURE

Traditionally there has been a statewide funding category for Major Infrastructure projects that were prioritized by MassDOT for major highway modernization projects throughout the state. This funding category will be eliminated after the Interstate 91 Viaduct project in Springfield is completed. Beginning in 2017, MassDOT will no longer set aside money in the Statewide Major Infrastructure funding category, but instead will pass the funds through the MPOs for programming. (Note: This Major Infrastructure category is not to be confused with the Boston Region MPO's Major Infrastructure investment program.)

OTHER STATEWIDE PROGRAMS ADDRESSING TRANSPORTATION NEEDS

Federal-aid highway funding for other statewide programs that address a variety of transportation needs are allocated to regions in the Commonwealth based on the MARPA formula. Again, as the most populous region of the Commonwealth, the Boston Region receives the largest share, 43 percent.

The statewide programs that target funding to projects that address specific needs include the Congestion Mitigation and Air Quality Improvement Program (CMAQ), Highway Safety Improvement Program (HSIP), and Transportation Alternatives Program (TAP). CMAQ supports transportation projects that reduce traffic congestion and thereby improve air quality. HSIP focuses on reducing the number and severity of crashes at locations identified as particularly hazardous based on crash reports on file at the Registry of Motor Vehicles. In addition, TAP provides grant funding for projects such as transportation enhancement, multi-use trails, and projects that create safe routes for children to access schools.

Other programs support upgrades to intelligent transportation systems and highway lighting systems, safety improvements at rail crossings, drainage improvements and storm water retrofits, and accessibility upgrades to comply with the Americans with Disabilities Act. Combined, these categories are assumed to make up 43 percent of statewide highway funding programmed in this LRTP, and amount to \$2.57 billion. Table 4.1 below summarizes the funding categories presented above by five-year time bands.

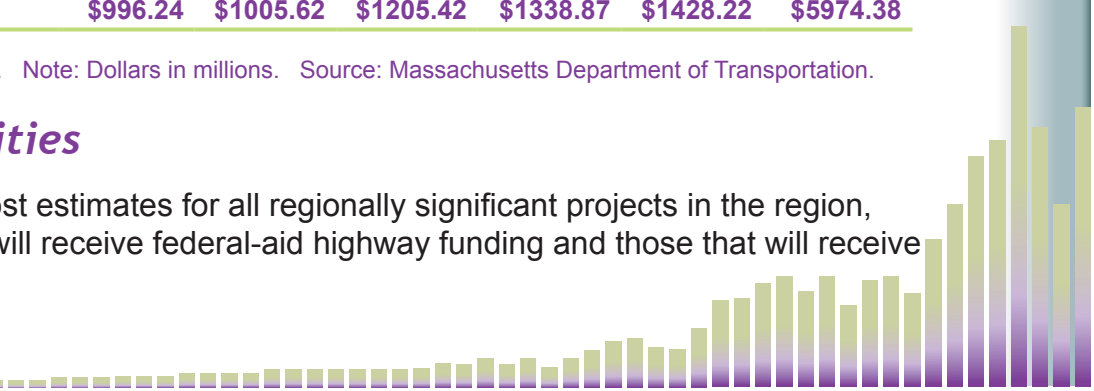
TABLE 4.1
Projected Sources of Funds for Maintenance of the Highway System in Boston Region MPO

| Program | FFYs 2016-20 | FFYs 2021-25 | FFYs 2026-30 | FFYs 2031-35 | FFYs 2036-40 | Total |
|-----------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|------------------|
| Statewide Bridge | \$193.52 | \$187.42 | \$234.20 | \$265.19 | \$285.68 | \$1166.00 |
| Non-Federal Aid Preservation | 214.84 | 218.06 | 221.28 | 224.50 | 227.73 | 1106.40 |
| Statewide Interstate Maintenance | 132.72 | 125.61 | 156.96 | 177.74 | 191.47 | 784.50 |
| Statewide National Highway System | 56.66 | 54.87 | 68.57 | 77.65 | 83.65 | 341.40 |
| Statewide Infrastructure | 16.77 | 16.24 | 20.30 | 22.98 | 24.76 | 101.05 |
| Remaining Statewide Programs | 381.74 | 403.42 | 504.11 | 570.82 | 614.93 | 2475.02 |
| Total | \$996.24 | \$1005.62 | \$1205.42 | \$1338.87 | \$1428.22 | \$5974.38 |

FFYs = Federal fiscal years. Note: Dollars in millions. Source: Massachusetts Department of Transportation.

Regional Priorities

The LRTP reflects cost estimates for all regionally significant projects in the region, including those that will receive federal-aid highway funding and those that will receive



non-federal aid. As such, state funding priorities for the Boston region are reflected in this document, as well as MPO funding priorities.

The LRTP financial planning that occurs at the MPO level focuses on programming that portion of funds over which the MPO has decision-making power. As mentioned previously, MPOs are provided with Regional Targets based on funding projections, which are used for programming projects for the 25-year period of the LRTP. These target funds are divided among the ten MPOs and three regional planning commissions/ councils in the Commonwealth based on the MARPA formula, with the Boston Region MPO receiving a 43-percent share. While the MPOs have discretion over this funding, some restrictions apply. For example, the MPOs must program a particular portion of their target funds for projects and programs that meet the requirements of the CMAQ, HSIP and TAP programs.

During the life of this LRTP, from FFY 2016 to 2040, the Boston Region MPO expects to program approximately \$2.85 billion in federal funds for highway transportation projects in the region. This amount is significantly less than was available four years ago, when the MPO programmed approximately \$3.8 billion in *Paths to a Sustainable Region*. (See Table 4.2 below for a comparison by time band.) Table 4.3 shows all of the projects funded with highway money that are recommended in this LRTP, including major infrastructure projects, regionally significant projects (expansion) with air quality impacts, and/or projects that are funded using highway money for transit (flex funding). Table 5.3 (in Chapter 5) lists these projects by the project name, current costs, and future costs.

In the near term, from FFY 2016 to 2019, the Boston Region MPO will have the discretion to program between \$75 million and \$92 million a year. Each year approximately \$13 million will be targeted to CMAQ projects, approximately \$4 million to HSIP projects, and an average of \$3.5 million to TAP projects.

TABLE 4.2
Comparison of Available Capital Highway Funds in *Charting Progress to 2040* to the Previous LRTP, *Paths to a Sustainable Region*

| | FFYs 2013-15 | FFYs 2016-20 | FFYs 2021-25 | FFYs 2026-30 | FFYs 2031-35 | FFYs 2036-40 | Total |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------|
| <i>Paths to a Sustainable Region</i> Revenue* | \$229.83 | \$557.47 | \$815.61 | \$1018.44 | \$1180.65 | -- | \$3802.00 |
| <i>Charting Progress to 2040</i> Revenue | -- | 441.65 | 464.87 | 580.90 | 657.78 | \$708.60 | \$2853.80 |
| Difference | | (\$115.82) | (\$350.74) | (\$437.54) | (\$522.87) | | (\$948.20) |
| Percentage Change | | -21% | -43% | -43% | -44% | -- | -25% |

FFYS = Federal fiscal years. Note: Dollars in millions. Source: Central Transportation Planning Staff.

* *Paths to a Sustainable Region* is a 23 year LRTP compared to *Charting Progress to 2040*, which is a 25 year LRTP.

TABLE 4.3
Major Infrastructure Projects, Expansion Highway Projects, and
Flex-Funded Transit Projects in the Recommended LRTP

| Projects | Type of Project | Current Cost |
|---|--------------------------------|---------------|
| Ongoing Highway Project | | |
| Rehabilitation/Replacement of 6 Bridges on I-95/Route 128 (Add-a-Lane – Contract V) (Needham and Wellesley) | Expansion/Major Infrastructure | \$57,768,183 |
| New Highway Projects | | |
| Middlesex Turnpike Improvements, from Crosby Drive North to Manning Road, Phase III (Bedford and Billerica) | Expansion/Major Infrastructure | \$26,935,000 |
| Reconstruction of Rutherford Avenue, from City Square to Sullivan Square (Boston) | Major Infrastructure | \$109,967,000 |
| Intersection Improvements at Route 126 and Route 135/MBTA and CSX Railroad (Framingham) | Major Infrastructure | \$115,000,000 |
| Route 4/225 (Bedford Street) and Hartwell Avenue (Lexington) | Major Infrastructure | \$23,221,000 |
| Bridge Replacement, Route 27 (North Main St.) over Route 9 (Worcester St.) and Interchange Improvements (Natick) | Major Infrastructure | \$25,793,000 |
| Reconstruction of Highland Avenue, Needham Street and Charles River Bridge, from Webster Street to Route 9 (Newton and Needham) | Expansion | \$14,298,000 |
| McGrath Boulevard Project (Somerville) | Major Infrastructure | \$56,600,000 |
| Reconstruction and Widening on Route 18 (Main Street) from Highland Place to Route 139 (Weymouth and Abington) | Expansion/Major Infrastructure | \$58,822,000 |
| Reconstruction of Montvale Avenue, from I-93 Interchange to Central Street (Woburn) | Expansion | \$4,225,000 |
| Bridge Replacement, New Boston Street over MBTA (Woburn) | Expansion | \$9,707,000 |
| Highway Funding Flexed to Transit | | |
| Green Line Extension Project (Phase 2), College Avenue to Mystic Valley Parkway/Route 16 (Somerville and Medford) | Expansion/Major Infrastructure | \$190,000,000 |

Source: Central Transportation Planning Staff.

Local Priorities

The Commonwealth's Chapter 90 program reimburses municipalities for local roadway and bridge projects. Municipalities have the discretion to select these projects, which may include maintenance of municipal roadways, sidewalk improvements, right-of-way acquisition, landscaping, drainage improvements, street lighting, and upgrades to traffic control devices. Chapter 90 funding for SFY 2016 totaled \$200 million statewide. That same level of funding is assumed for future years.



TRANSIT FUNDING

The LRTP reports federal funding programmed for the three RTAs that operate primarily within the Boston Region MPO's planning area: the MBTA, MWRTA, and CATA. Transit funds programmed in the LRTP consist of funds distributed through the Federal Transit Administration's (FTA's) formula funding program as well as other federal grants and non-federal aid, including revenue bonds that match federal funds. These funding sources are described in further detail in this chapter.

Long-range revenue projections for the MBTA that are reflected in this LRTP are based on a federally approved systemwide finance plan prepared when the Commonwealth successfully pursued a federal New Starts grant for the Green Line Extension project in Somerville and Medford. The Green Line Extension Finance Plan includes revenue projections through SFY 2035; for the purposes of planning for the LRTP; those projections have been extended to SFY 2040. The bond-issuing strategy associated with the Green Line Extension Finance Plan assumes that the MBTA will issue bonds only to match its federal formula funds. However, this level of bond issuance falls far short of the MBTA's identified needs. The backlog of MBTA projects needed to keep the transit system in a state-of-good-repair is estimated to be \$6.7 billion during the next several decades.

Over the life of this LRTP, capital resources available to the MBTA are projected to be more than \$10.3 billion (approximately \$9.1 billion in federal aid and \$1.2 billion in MBTA revenue bonds to match federal funds). The MBTA's operations and maintenance revenues are projected to total \$70.9 billion for the life of this LRTP, covering an estimated \$69 billion in costs.

The MWRTA is expected to have \$51 million in federal capital resources over the life of the LRTP. The MWRTA's operations and maintenance costs are projected to total \$253.7 million for this same period. Revenues are expected to fully cover those costs. The CATA is expected to have \$16 million in federal capital resources over the life of the LRTP. The CATA's operations and maintenance costs are projected to total \$98.8 million for this same period with revenues projected to be \$97.8 million. Thus, additional operating funding would be required to maintain and improve transit services in the future.

A detailed discussion of the RTAs' capital programs and the MBTA's operating program is provided below.

Capital Programs

MBTA CAPITAL PROGRAM

The capital maintenance needs of the MBTA include infrastructure projects, such as signal and track upgrades; fleet overhauls and replacements; system enhancement

projects; and accessibility projects, such as improvements necessary for complying with the Americans with Disabilities Act. These improvements are funded through the MBTA's capital program, which is primarily funded by two major sources: federal grants and revenue bonds. Other sources are project financing and state appropriations. (Details about short-term capital financing are available in the MBTA's Capital Investment Program. More detail on the MBTA's maintenance programs is provided in Chapter 5 in the descriptions of Transit Capital Investment Programs.)

Over time, it is assumed that the capital maintenance needs of the MBTA will consume almost 100 percent of all MBTA capital revenues (excluding those from any special state appropriations) and that the majority of revenues available during the period of this LRTP will be used to maintain the system in a state-of-good-repair. More detail, however, will be available as the MBTA moves forward with its long-range planning, which will be documented in its Program for Mass Transportation, and in its short-range plan the Capital Investment Program.

As noted above, total proceeds from all MBTA capital program funding sources from SFY 2016 through SFY 2040 are estimated to be nearly \$10.3 billion. Included in this figure are funds from the FTA formula program and federal grants as well as revenue bonds that the MBTA would issue to pay the local share of its capital projects. (See Table 4.4 below.)

TABLE 4.4
MBTA Capital Finances by Five-Year Time Band

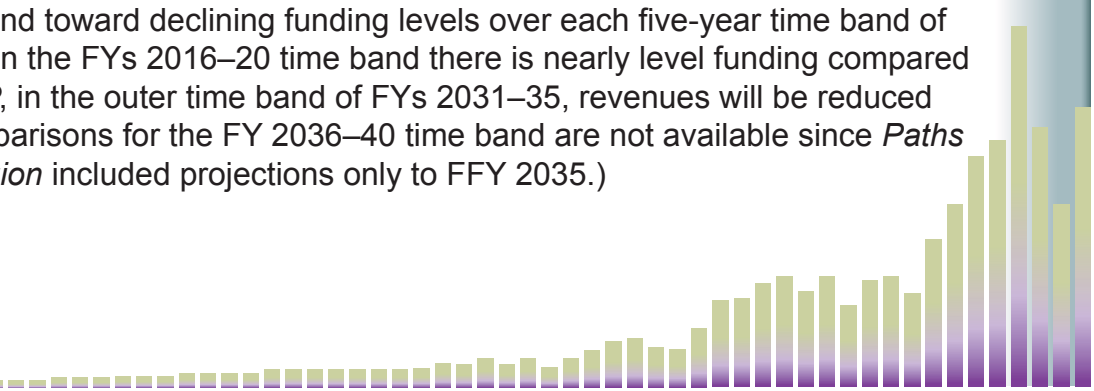
| Funding Source | SFYs 2016-20 | SFYs 2021-25 | SFYs 2026-30 | SFYs 2031-35 | SFYs 2036-40 | Total |
|--|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------|
| Section 5307 | \$732.95 | \$789.60 | \$850.62 | \$916.36 | \$987.18 | \$4276.71 |
| Section 5337 | 628.91 | 677.52 | 729.88 | 786.29 | 847.06 | 3669.66 |
| Section 5339 | 29.98 | 32.30 | 34.79 | 37.48 | 40.38 | 174.93 |
| New Starts, Small Starts, Homeland Security | 732.45 | 296.00 | -- | -- | -- | 1028.45 |
| MBTA Revenue Bonds | 282.05 | 288.23 | 302.93 | 318.39 | -- | 1191.60 |
| Total | \$2406.35 | \$2083.65 | \$1918.23 | \$2058.52 | \$1874.62 | \$10341.36 |

MBTA = Massachusetts Bay Transportation Authority. SFYs = State fiscal years.

Note: Dollars in millions.

Source: Massachusetts Bay Transportation Authority.

Compared to the funding assumptions reported in the last LRTP, *Paths to a Sustainable Region*, there is a trend toward declining funding levels over each five-year time band of this LRTP. Whereas in the FYs 2016–20 time band there is nearly level funding compared to the previous LRTP, in the outer time band of FYs 2031–35, revenues will be reduced by 21 percent. (Comparisons for the FY 2036–40 time band are not available since *Paths to a Sustainable Region* included projections only to FFY 2035.)



This trend reflects an assumption that federal funding levels are declining. As this LRTP was being prepared, Congress had not yet passed new federal legislation that would provide long-term revenue projections. For planning purposes, the federal agencies advised the MPO to assume that revenues will increase by only 1.5 percent each year starting in FFY 2021 and extending through FFY 2040.

TABLE 4.5
Comparison of Available Capital Transit Funds in *Charting Progress to 2040* to the Previous LRTP, *Paths to a Sustainable Region*

| | FFYs 2016-20 | FFYs 2021-25 | FFYs 2026-30 | FFYs 2031-35 | FFYs 2036-40 |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|
| <i>Paths to a Sustainable Region</i> Revenue | \$1410.00 | \$1635.00 | \$1895.00 | \$2197.00 | -- |
| <i>Charting Progress to 2040</i> Revenue | 1391.85 | 1499.42 | 1615.30 | 1740.13 | \$1874.62 |
| Difference | (\$18.15) | (\$135.58) | (\$279.70) | (\$456.87) | -- |
| Percentage Change | -1% | -8% | -15% | -21% | -- |

Note: Dollars in millions.
 Source: Central Transportation Planning Staff.

As mentioned previously, the funding assumptions for this LRTP and the associated bond issuance appears insufficient to meet the MBTA’s state-of-good-repair needs. The MBTA estimates that it would need an additional \$6.7 billion over the next several decades. As this LRTP was being prepared, however, specific projections were not available. In addition, future state commitments to MBTA capital projects were not determined.

In the future, the MBTA intends to use pay-as-you-go financing to fund its capital program. Pay-as-you-go is a financial instrument that uses cash to fund capital projects rather than issuing bonds and incurring debt-service expenses. While the MBTA’s goal is to utilize this tool, it is not reflected in this LRTP.

MWRTA AND CATA CAPITAL PROGRAMS

The capital programs of the two smaller RTAs in the Boston Region, the MWRTA and CATA, are also supported by FTA’s formula and discretionary funding programs, and state appropriations through the Commonwealth’s RTA Capital Assistance Program.

The MWRTA has in recent years used the majority of its capital funds to finance its new maintenance and operations center in Framingham. Paratransit service began operating out of the facility in July 2015; fixed-route service will be transferred to the facility in July



2016. The MWRTA expects to use capital funds to complete rehabilitation work of the facility and to develop regional CNG fueling facilities. Capital funds are also expected to be used to purchase vehicles, tools and parts, and bus support equipment, as well as for safety and technology enhancements projects.

The current funding levels are sufficient to support the MWRTA’s existing levels of service, which provides limited service six days a week. The agency envisions a greater need, however, since ultimately, MWRTA would like to provide more frequent service, including evening and Sunday service. Increasing service to those levels would require additional support from the funding agencies.

The capital costs for the CATA include vehicle replacements as well as enhancement and general maintenance projects, such as technology upgrades and building maintenance. The CATA has implemented an aggressive vehicle replacement schedule over the next several years to bring its fleet into a state-of-good repair. Almost all future capital costs are expected to be for vehicle replacement to maintain the fleet in a state-of-good repair. The CATA will need future additional funding for capital equipment, such as additional vehicles, which are required for service improvements.

Capital funding projections for MWRTA and CATA are depicted in Table 4.6 and 4.7 below. The MWRTA and CATA can expect \$51 million and \$16 million, respectively, in federal Section 5307 funding for the life of this LRTP.

TABLE 4.6
MWRTA Capital Finances by Five-Year Time Band

| Funding Source | SFYs 2016-20 | SFYs 2021-25 | SFYs 2026-30 | SFYs 2031-35 | SFYs 2036-40 | Total |
|-----------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|----------------|
| Section 5307 | \$7.46 | \$9.81 | \$10.56 | \$11.38 | \$12.26 | \$51.47 |
| Section 5337 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Section 5339 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total | \$7.46 | \$9.81 | \$10.56 | \$11.38 | \$12.26 | \$51.47 |

MWRTA = MetroWest Regional Transit Authority.

SFYs = State fiscal years.

Note: Dollars in millions.

Source: Massachusetts Department of Transportation.

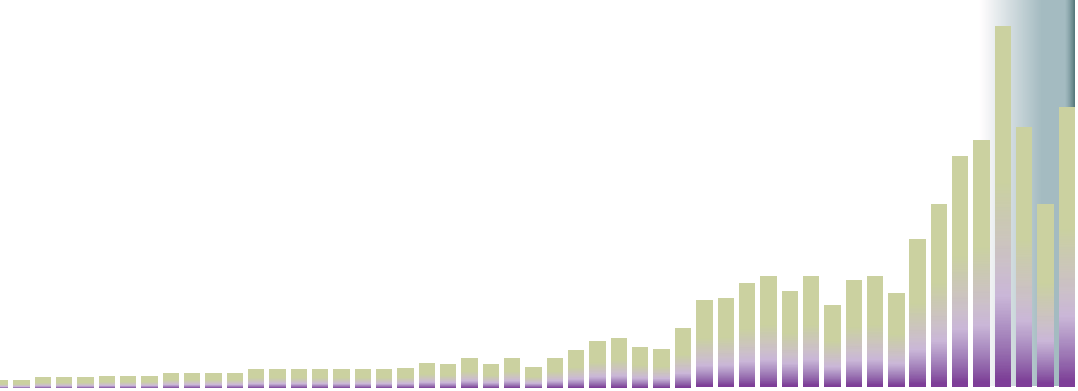


TABLE 4.7
CATA Capital Finances by Five-Year Time Band

| Funding Source | SFYs 2016-20 | SFYs 2021-25 | SFYs 2026-30 | SFYs 2031-35 | SFYs 2036-40 | Total |
|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------|
| Section 5307 | \$2.77 | \$2.99 | \$3.22 | \$3.47 | \$3.73 | \$16.18 |
| Section 5337 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Section 5339 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total | \$2.77 | \$2.99 | \$3.22 | \$3.47 | \$3.73 | \$16.18 |

CATA = Cape Ann Transportation Authority.
SFYs = State fiscal years.
Note: Dollars in millions.

Source: Massachusetts Department of Transportation.

Below is a detailed discussion of the federal funding sources available for the RTAs' capital programs.

FEDERAL FORMULA FUNDING

Federal aid for transit programs has been authorized by Congress through MAP-21. By this authorization, FTA operates its formula funding programs, which allocate funding to states based on demographic data from the US census for each state's urbanized area (UZA). (A UZA is an area defined by the US Census Bureau with a population of 50,000 or more.) For UZAs with populations of more than 200,000, such as the Boston UZA, the allocations also take into account transit service data reported by recipients of the federal funds. The source of this formula funding as of FY 2015 is the Mass Transit Account of the Highway Trust Fund.

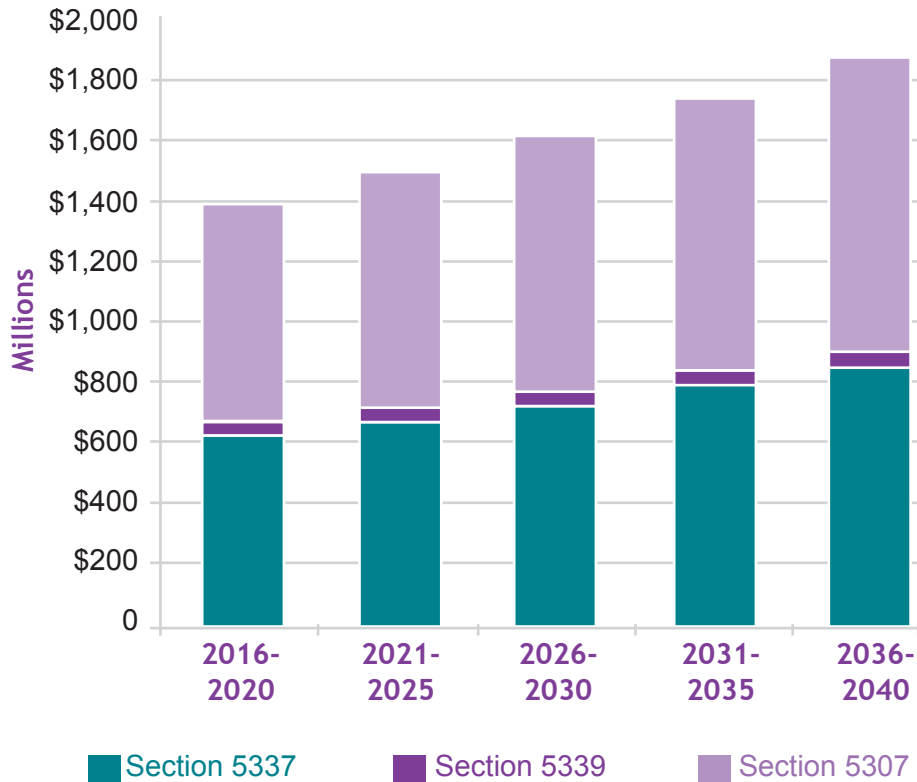
MassDOT is the recipient of this federal aid in the Boston UZA area. MassDOT sub allocates these funds to RTAs based on a negotiated split agreement. The Boston Region MPO programs the formula funds in its TIP and LRTP for the MBTA, MWRTA, and CATA.

The FTA requires a 20 percent non-federal match to the 80 percent federal share of formula grants. In the case of the MBTA, the matching funds are generally revenue bonds. The other RTAs may use funds from the state's RTA Capital Assistance Program or toll credits for the match.

Formula funding reflected in the TIP and LRTP includes funding from FTA program Sections 5307, 5337, and 5339. (See Figure 4.5 below for the MBTA allocation.) Section 5307 is the Urbanized Area Formula Program, which funds capital, planning, job access and reverse-commute projects, and operating assistance for transit agencies. Section 5337, the State-of-Good-Repair Program, supports the maintenance, rehabilitation, and

replacement of transit assets to maintain a state of good repair. Eligible assets include rail, trolley ferries, bus rapid transit, and bus services operating on high-occupancy-vehicle (HOV) facilities. Section 5339, the Bus and Bus Facilities Formula Grants Program, provides funding to replace, rehabilitate, and purchase buses and related equipment as well as construct bus-related facilities.

FIGURE 4.5
MBTA Federal Transit Programs, FFYs 2016-2040 by Time Band



Source: Central Transportation Planning Staff.

NON-FORMULA BASED FEDERAL GRANTS

The LRTP also programs federal grants that are provided to this region through non-formula based or competitive programs. A major award came to the Boston Region in early 2015, for example, when the FTA approved \$996 million in New Starts funding (through Section 5309, the Fixed Guideway Capital Investment Grant Program) for construction of a light rail extension in the cities of Somerville and Medford. The Green Line Extension project has a multi-year federal commitment that will pay for nearly half the costs of the extension of the line to College Avenue in Medford. More than half of the project will be funded by the Commonwealth. Construction and operating funds for the

Green Line Extension project are reflected in the finances of this LRTP.

Other significant grants were awarded following Hurricane Sandy, when the MBTA received monies from the FTA’s Public Transportation Emergency Relief Program to make transit infrastructure more resilient to natural disasters. One \$21.67-million grant supported the Green Line Fenway Portal Flood Proofing project, which would erect flood barriers at subway portals in a flood-prone area of Boston. Another \$13.39-million grant funded the Charlestown Seawall Replacement project, which would protect a bus maintenance facility in Boston from the adjacent Mystic River flooding. In addition, the MBTA receives funding from the Department of Homeland Security, for security measures.

STATE APPROPRIATIONS

Other significant state funding is enabled through the Commonwealth’s transportation finance legislation. Recent legislation has provided for a \$6-billion investment in the MBTA’s transit system over a ten-year period. This investment focuses on projects that will keep the system in a state of good repair and those that will help economic expansion in the Commonwealth. These projects include procurement of Red, Orange, and Green Line vehicles and buses, energy conservation projects, upgrades to transit power and signal systems, the state-funded portion of the Green Line Extension project, and the design of the South Coast Rail commuter rail extension project.

Some state-funded transit improvements are occurring through the State Implementation Plan (SIP), which includes a group of transit projects that are legal commitments of the Commonwealth as they are agreed-upon air-quality mitigation measures associated with the Central Artery/Tunnel project. Ongoing SIP projects include the Green Line Extension (to Union Square and Medford Hillside) and improvements to the Fairmount commuter rail line in Boston. Table 4.8 shows these ongoing transit projects along with the cost of the projects.

TABLE 4.8
Major Ongoing Infrastructure and Expansion Transit Projects in the Recommended LRTP

| Transit Projects | Type of Project | Cost |
|--|--------------------------------|-----------------|
| Fairmount Line Improvements Project (Boston) | Expansion/Major Infrastructure | \$26,500,000 |
| Green Line Extension Project to College Avenue/Union Square (Somerville and Medford) | Expansion/Major Infrastructure | \$1,992,243,000 |

Source: Central Transportation Planning Staff.

Other state funds are made available through the state’s RTA Capital Assistance Program.

Operations and Maintenance

MBTA OPERATIONS AND MAINTENANCE FINANCING

In 2000, the Massachusetts Legislature updated the MBTA's enabling legislation. This update, commonly referred to as Forward Funding, established the current financing structure of the MBTA. It provided 20 percent of the state sales tax as a dedicated revenue stream for the MBTA and expanded the service area to 175 municipalities for the purpose of collecting local annual assessments. Revenues from these sources are used primarily to fund operations and maintenance costs for the MBTA, but also are used to secure revenue bonds that the MBTA uses to match federal funds for capital projects. Other sources of MBTA operating funds include, transit fare revenues, non-fare sources, state contract assistance, state appropriations, and federal operating assistance.

Over the life of this LRTP, revenues for operations and maintenance are projected to be \$70.9 billion, while costs are projected at \$69 billion. (See Table 4.9 below.) The revenue projections account for proceeds from the sales tax, local assessments, fares, and other non-fare revenues. The projections also account for state operating assistance for the Green Line Extension and the South Coast Rail commuter rail extension (which has yet to be constructed), and projects and service-related initiatives implemented as mitigation for delays in constructing the Green Line Extension.

The costs include more than \$60 billion in operations and maintenance costs and \$8.8 billion in debt-service payments. During the life of this LRTP, the MBTA's debt-service payments will account for nearly 13 percent of the MBTA's total operating expenses. The MBTA's debt service is discussed later in this chapter.

TABLE 4.9
MBTA Operations and Maintenance Revenues and Costs
by Five-Year Time Band

| | SFYs 2016-20 | SFYs 2021-25 | SFYs 2026-30 | SFYs 2031-35 | SFYs 2036-40 | Total |
|--|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Operations and Maintenance Revenues: | | | | | | |
| Sales Tax and Local Assessments* | \$5,904 | \$6,373 | \$6,925 | \$7,558 | \$8,263 | \$35,023 |
| Fare Revenue | 3,156 | 3,484 | 3,972 | 4,666 | 5,227 | \$20,505 |
| Non-Fare Revenue** | 1,999 | 2,685 | 3,095 | 3,514 | 4,000 | \$15,293 |
| Federal Funds | 32 | 20 | 20 | 20 | 20 | \$112 |
| Total Operations and Maintenance Revenues | \$11,091 | \$12,562 | \$14,012 | \$15,758 | \$17,510 | \$70,933 |
| Operations and Maintenance Costs: | | | | | | |
| Operations and Maintenance Costs | \$8,616 | \$10,213 | \$11,875 | \$13,730 | \$15,927 | \$60,361 |
| Debt Service | 2,401 | 2,117 | 1,704 | 1,467 | 1,133 | \$8,822 |
| Total Operations and Maintenance Costs | \$11,017 | \$12,330 | \$13,579 | \$15,197 | \$17,060 | \$69,183 |
| Difference Between Revenues and Costs | \$74 | \$232 | \$433 | \$561 | \$450 | \$1,750 |

* includes sales tax and assessments. ** includes GLX Mitigation, State Operating Assistance for GLX and South Coast Rail, and additional state contract assistance

GLX = Green Line Extension Project. SFYs = State fiscal years.

Note: Dollars in millions.

Source: Massachusetts Bay Transportation Authority.

Below is a summary of the various funding sources for the MBTA's operations and maintenance.

Sales Tax

The dedicated revenues from state sales tax are equal to whichever is greater, the amount of actual sales tax receipts generated from the 20 percent of the statewide sales tax dedicated to the MBTA, or a base revenue amount. The annual amount of dedicated sales tax revenues the MBTA receives is subject to annual upward adjustment to a maximum 3 percent increase based on a comparison of the percentage increase of inflation to the increase in actual sales tax receipts.

Legislation enacted in 2014 (Chapter 359 of the Acts of 2014, amending Chapter 10, Section 35T) increased the base revenue amount in SFY 2015 to \$970.6 million, and increased the dedicated sales tax revenue amount to MBTA by an additional \$160 million annually.

During the period SFY 2016 to SFY 2040, sales tax revenue is assumed to increase at an average of approximately 2 percent per year. Therefore, the projected sales tax revenue the MBTA expects to receive for the life of this LRTP equals approximately \$29.7 billion, which would exceed the base revenue amount.

Local Assessments

The MBTA also receives funding through local assessments in accordance with a statutory formula. The 175 municipalities within the MBTA's service district pay an assessment to the MBTA on an annual basis. The amount paid by each municipality varies according to the population and the level of service provided.

Proceeds from local assessments were \$160 million in SFY 2015. Local assessments are assumed to increase 2 percent each year through SFY 2040. During the life of this LRTP, projected local assessment revenue equals approximately \$5.3 billion.

Fare Revenue

Fare revenue projections from the existing system were \$598 million in SFY 2015 and are projected to increase by an average of 3 percent per year to yield \$20.5 billion for the life of the LRTP.

Current legislation sets fare increases at no more than 5 percent every other year with the next one set for SFY 2017. No additional fare increases are assumed in this LRTP.

Non-Fare Revenue

The MBTA derives its non-fare revenue from a variety of sources, including parking fees, advertising, concessions, rent, interest income, utility reimbursements, and non-operating revenues, such as income earned on investments and sale of property.

Non-fare revenue figures reflected in this LRTP include those items as well as revenues from implementing projects and service-related initiatives that mitigate for delays in the operation of the Green Line Extension, state operating assistance for the Green Line Extension and South Coast Rail projects, and additional state contract assistance.

The non-fare revenue in SFY 2015 was \$214 million. During the life of this LRTP, projected non-fare revenue equals approximately \$15.2 billion.

Federal Operating Assistance

Federal operating assistance is received from the FTA Section 5307 Preventative Maintenance funding. The federal operating assistance revenue in SFY 2015 was \$12 million. The level of funding from Section 5307 is presumed to decline during the life of this LRTP, from \$12 million in SFY 2016 to \$8 million in SFY 2017 to \$4 million each year thereafter. For the life of this LRTP, projected federal operating assistance equals approximately \$112 million.

MBTA Operating Expenses and Debt Service

The MBTA's operating expenses include wages, benefits, payroll taxes, materials, supplies, and purchased transportation services. Operating expenses for SFY 2015 were \$1.5 billion. The Green Line Extension Finance Plan also assumes a variable average annual increase in operating costs of 3 to 4 percent, averaging 3 percent from SFY 2016 to SFY 2040. This percentage is based on trend line analysis of known anticipated needs and past operating costs.

Total operating expenses during the life of the LRTP are estimated to be \$69 billion. This cost includes more than \$60 billion in operating and maintenance costs and \$8.8 billion in debt-service payments. Costs are projected to increase during the life of the LRTP from \$8.6 billion in SFY 2016–20 time band to nearly \$16 billion in the outer SFY 2036–40 time band. Meanwhile, debt service payments are scheduled to decline during the life of the LRTP, from a high of \$2.4 billion in the SFY 2016–20 time band to \$1.1 billion in the outer SFY 2036–40 time band.

MBTA bonds were previously backed by the Commonwealth prior to enactment of the Forward Funding legislation. Upon the effective date of the Forward Funding legislation, however, contract payments from the state ceased, and all outstanding debt became the MBTA's responsibility. The \$8.8 billion figure cited here represents both current and prior-obligation debt.

(See Table 4.9 above for operations and maintenance revenues and costs by five-year time band.)

MWRTA and CATA Operations and Maintenance Financing

The operation and maintenance needs of the MWRTA and CATA are funded through a variety of sources: local assessments paid by member communities; State Contract Assistance funds provided through the state legislature; fare revenue; advertising revenue; and federal formula and discretionary funds. CATA also generates operating revenue from rent received from leasing the second floor of its building and contract transportation service.

Both RTAs' operating expenses include administrative staff expenses (salaries, benefits, payroll taxes), materials, supplies, services, and purchased transportation. The purchased transportation costs include the operating expenses of the private companies that, under contractual arrangements, operate the RTA's services, and management fees. The RTAs are required by law to contract out the operation of their transit service to a private company. These operating arrangements are expected to continue in the future.

Over the life of this LRTP, the MWRTA's operations and maintenance costs are projected to total \$253.7 million. This figure includes \$1.25 million in debt service

payments. Revenues are expected to fully cover those costs. It should be noted however, that the MWRTA provides limited service. Future service improvements, including evening and weekend service, will require additional support.

Over the life of this LRTP, the CATA's operations and maintenance costs are projected to total \$98.8 million. This figure includes approximately \$1 million in debt service payments. Revenues are projected to be \$97.8 million. Thus, additional operating funding would be required to maintain and improve transit services in the future.

Summaries of the various funding sources for the MWRTA's and CATA's operations and maintenance are in Tables 4.10 and 4.11 below.

Table 4.10
MWRTA Operations and Maintenance Revenues and Costs
by Five-Year Time Band

| | SFYs 2016-20 | SFYs 2021-25 | SFYs 2026-30 | SFYs 2031-35 | SFYs 2036-40 | Total |
|--|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Operations and Maintenance Revenues: | | | | | | |
| Local Assessments | \$11.30 | \$12.79 | \$14.47 | \$16.37 | \$18.52 | \$73.48 |
| Fare Revenue | 3.28 | 3.71 | 4.20 | 4.75 | 5.37 | 21.33 |
| Non-Fare Revenue | 1.00 | 1.14 | 1.28 | 1.45 | 1.65 | 6.54 |
| State Contract Assistance | 12.78 | 14.46 | 16.36 | 18.51 | 20.95 | 83.08 |
| Federal Funds | 10.65 | 12.05 | 13.64 | 15.43 | 17.46 | 69.25 |
| Total Operations and Maintenance Revenues | \$39.04 | \$44.17 | \$49.97 | \$56.54 | \$63.97 | \$253.70 |
| Operating Costs: | | | | | | |
| Operations and Maintenance Costs | \$38.84 | \$43.95 | \$49.72 | \$56.26 | \$63.65 | \$252.44 |
| Debt Service | 0.19 | 0.21 | 0.24 | 0.28 | 0.31 | 1.25 |
| Total Operations and Maintenance Costs | \$39.04 | \$44.17 | \$49.97 | \$56.54 | \$63.97 | \$253.70 |
| Difference Between Revenues and Costs | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |

Note: Dollars in millions.

Source: MetroWest Regional Transit Authority.

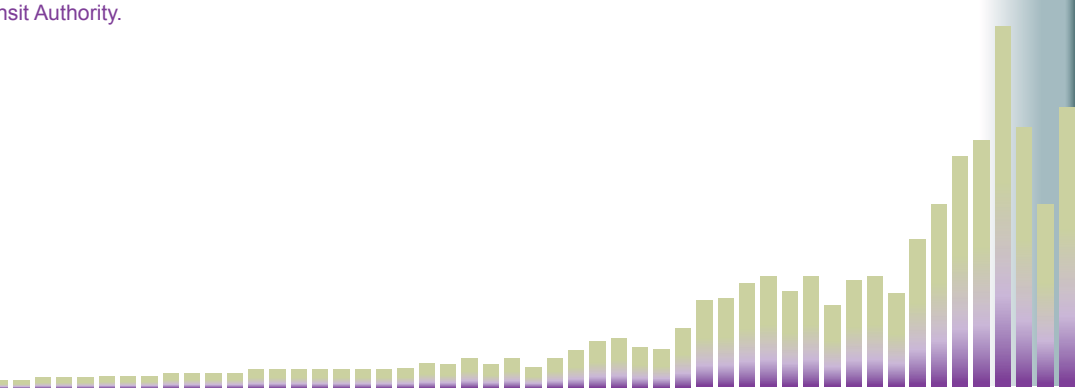
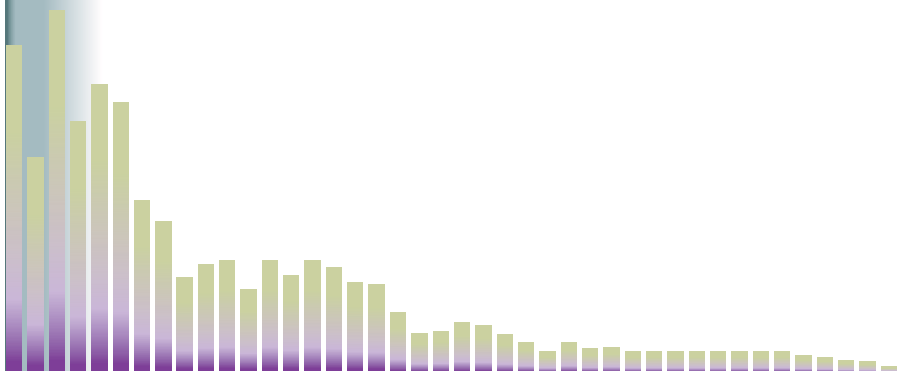


Table 4.11
CATA Operations and Maintenance Revenues and Costs
by Five-Year Time Band

| | SFYs 2016-20 | SFYs 2021-25 | SFYs 2026-30 | SFYs 2031-35 | SFYs 2036-40 | Total |
|--|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Operations and Maintenance Revenues: | | | | | | |
| Local Assessments | \$2.55 | \$2.88 | \$3.26 | \$3.69 | \$4.18 | \$16.58 |
| Fare Revenue | 0.99 | 1.12 | 1.27 | 1.44 | 1.63 | 6.48 |
| Non-Fare Revenue | 1.43 | 1.62 | 1.84 | 2.08 | 2.35 | 9.35 |
| State Contract Assistance | 8.27 | 9.35 | 10.58 | 11.97 | 13.55 | 53.74 |
| Federal Funds | 1.79 | 2.03 | 2.29 | 2.59 | 2.94 | 11.66 |
| Total Operations and Maintenance Revenues | \$15.05 | \$17.03 | \$19.27 | \$21.80 | \$24.66 | \$97.83 |
| Operation and Maintenance Costs: | | | | | | |
| Operation and Maintenance Costs | \$15.05 | \$17.03 | \$19.27 | \$21.80 | \$24.66 | \$97.83 |
| Debt Service | 0.15 | 0.17 | 0.20 | 0.22 | 0.25 | 1.01 |
| Total Operations and Maintenance Costs | \$15.21 | \$17.21 | \$19.47 | \$22.03 | \$24.92 | \$98.85 |
| Difference Between Revenues and Costs | \$(0.15) | \$(0.17) | \$(0.20) | \$(0.22) | \$(0.25) | \$(1.01) |

Note: Dollars in millions.
Source: Cape Ann Transportation Authority.





5

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

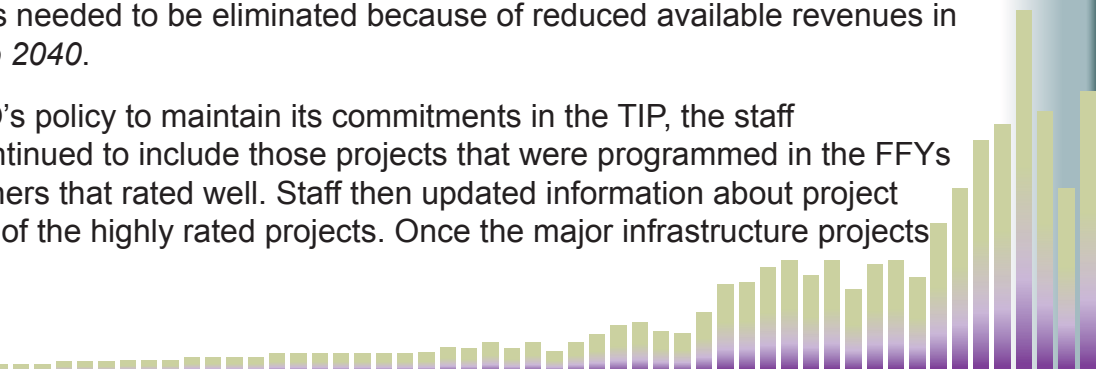
This alternative programmed all of the unfunded major infrastructure projects from *Paths to a Sustainable Region* in the five-year time bands established for *Charting Progress to 2040* (2016–2020, 2021–2025, 2026–2030, 2031–2035, and 2036–2040). Funding was available for all of the projects, although 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.

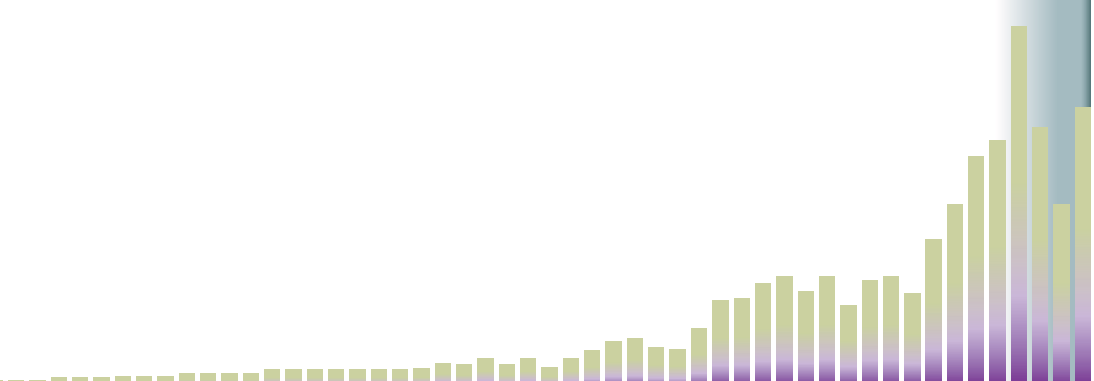
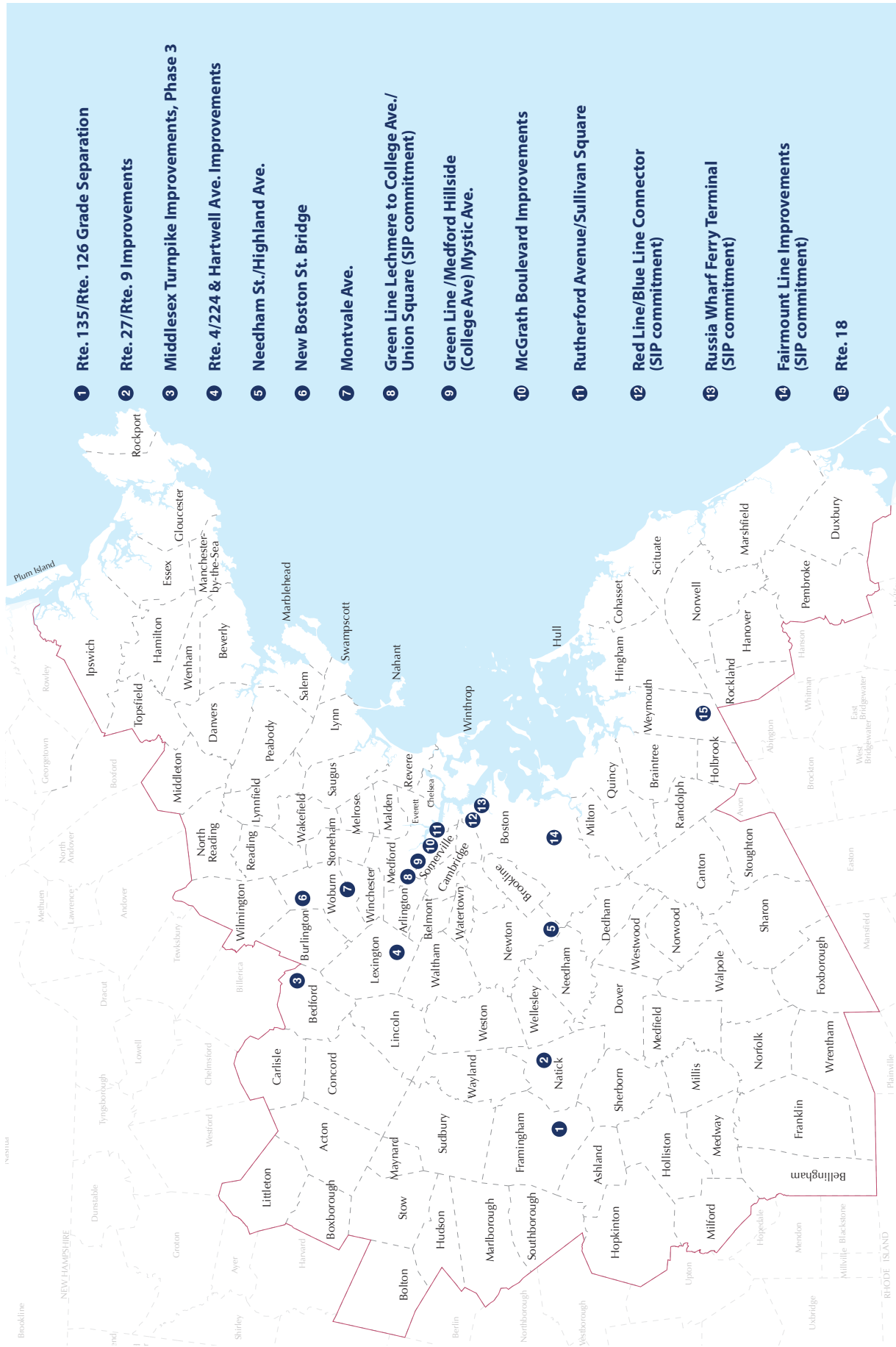


FIGURE 5.1
Major Infrastructure Projects in the Recommended Plan



- 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.

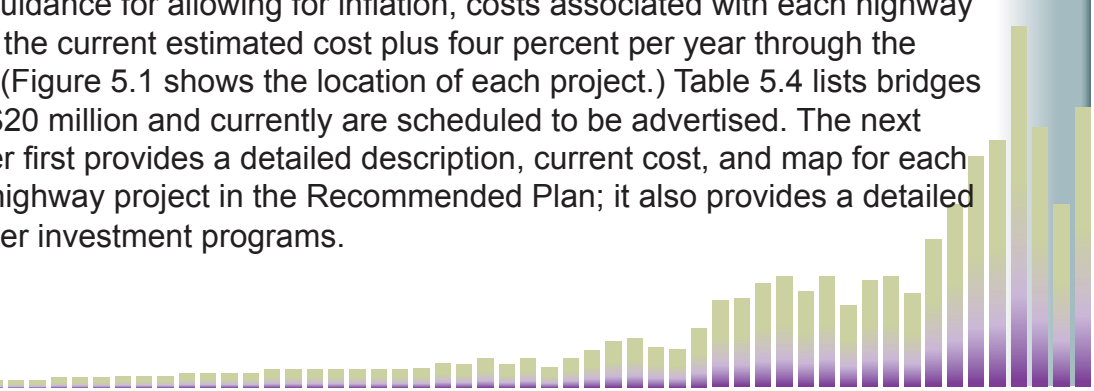


TABLE 5.3

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

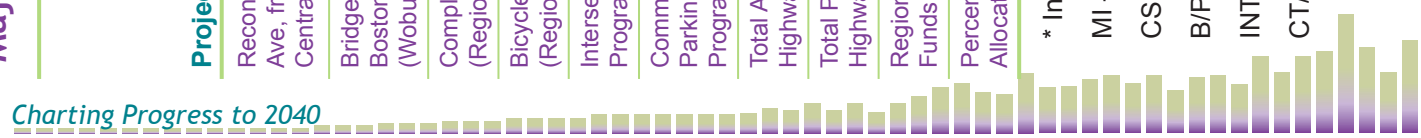
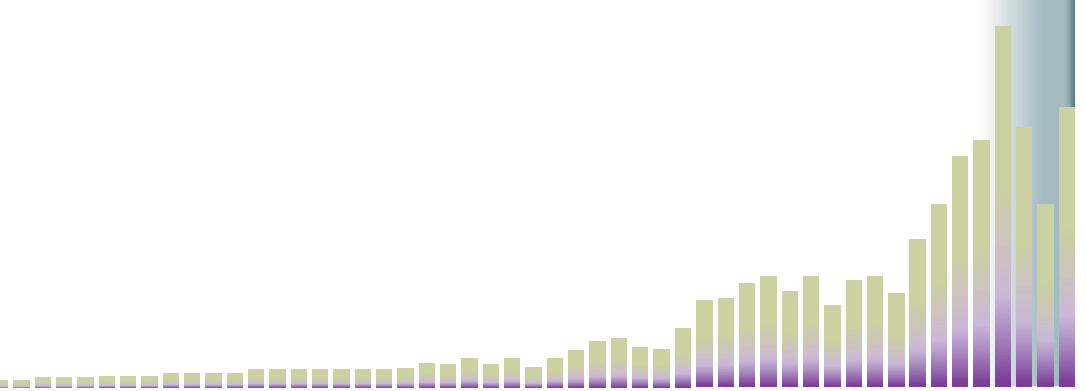


TABLE 5.3 (Cont.)
Major Infrastructure Projects Programmed with Highway Funding in the Recommended Plan with Costs

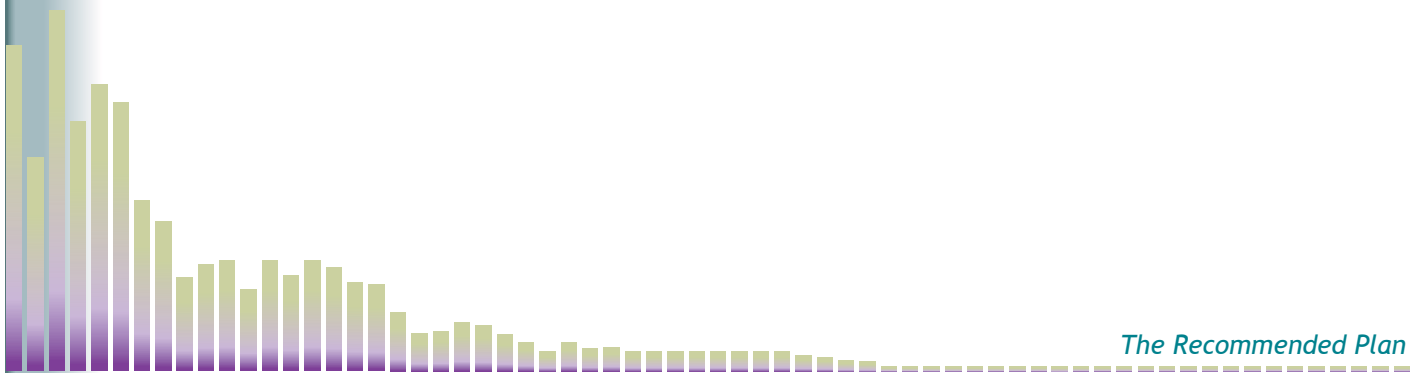
| Project Name | Current Investment Cost Category | FFY 2016–2020 | FFY 2021–2025 | FFY 2026–2030 | FFY 2031–2035 | FFY 2036–2040 | MPO Funding |
|------------------------------------|---|----------------------|----------------------|----------------------|----------------------|----------------------|------------------------|
| 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:

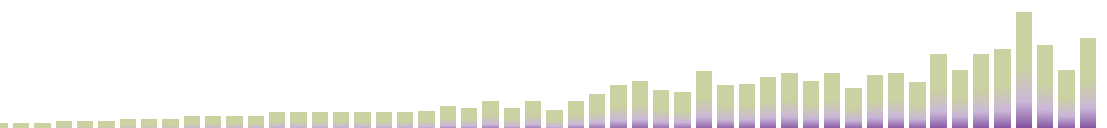
The MBTA and the Lowell Regional Transit Authority (LRTA) provide bus service in this corridor that connects with the downtown areas of Boston and Lowell.

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.

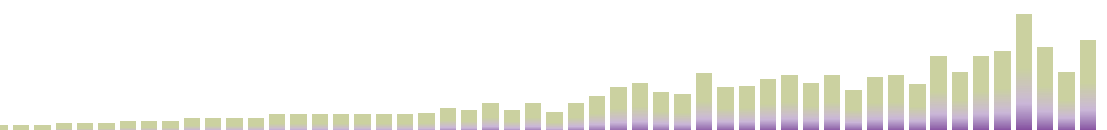
Side streets beyond the immediate vicinity of the intersection would be used to provide connections from eastbound Route 135 to Route 126 and from Route 126 to westbound Route 135. This would include the extension of Hollis Court, probably requiring new signals at the Route 126/Hollis Court and Route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

Project Context and Possible Impacts by MPO Goal

CAPACITY MANAGEMENT/MOBILITY

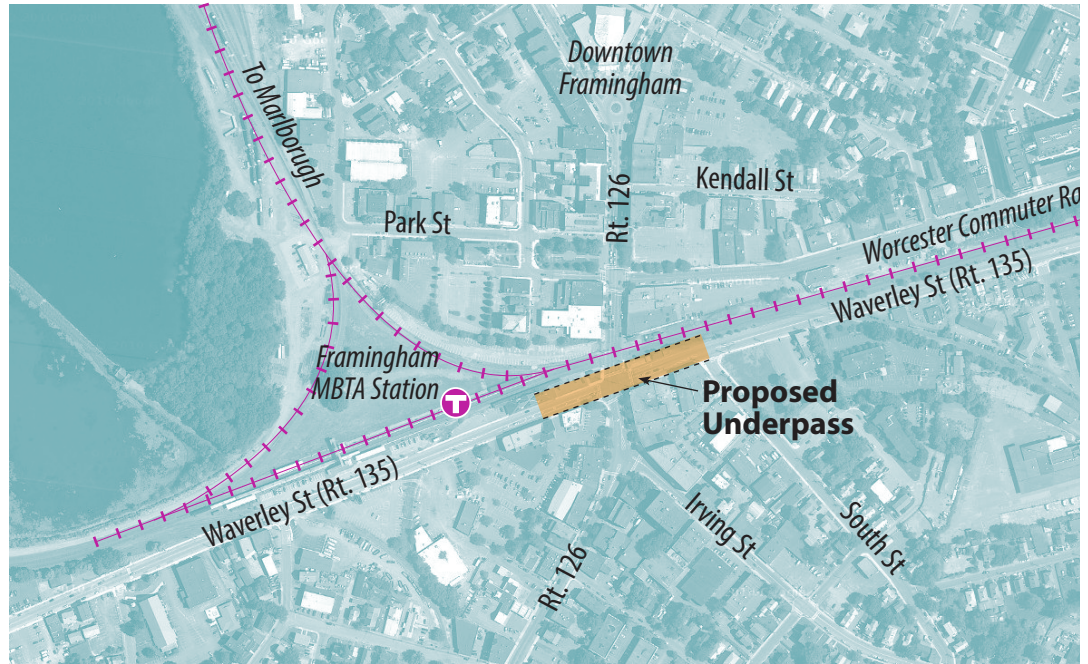
Roadways:

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:

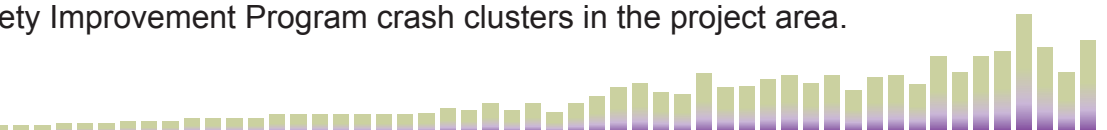
The MBTA provides bus service in this corridor connecting with the Red Line at Alewife station.

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

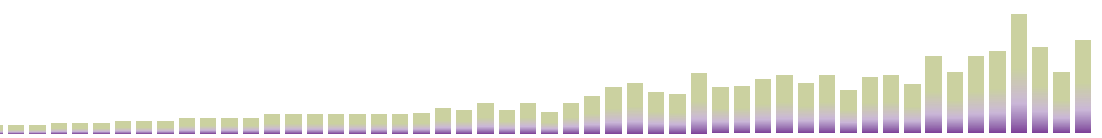
One lane-mile of substandard pavement and one substandard bridge will be replaced as part of this project.

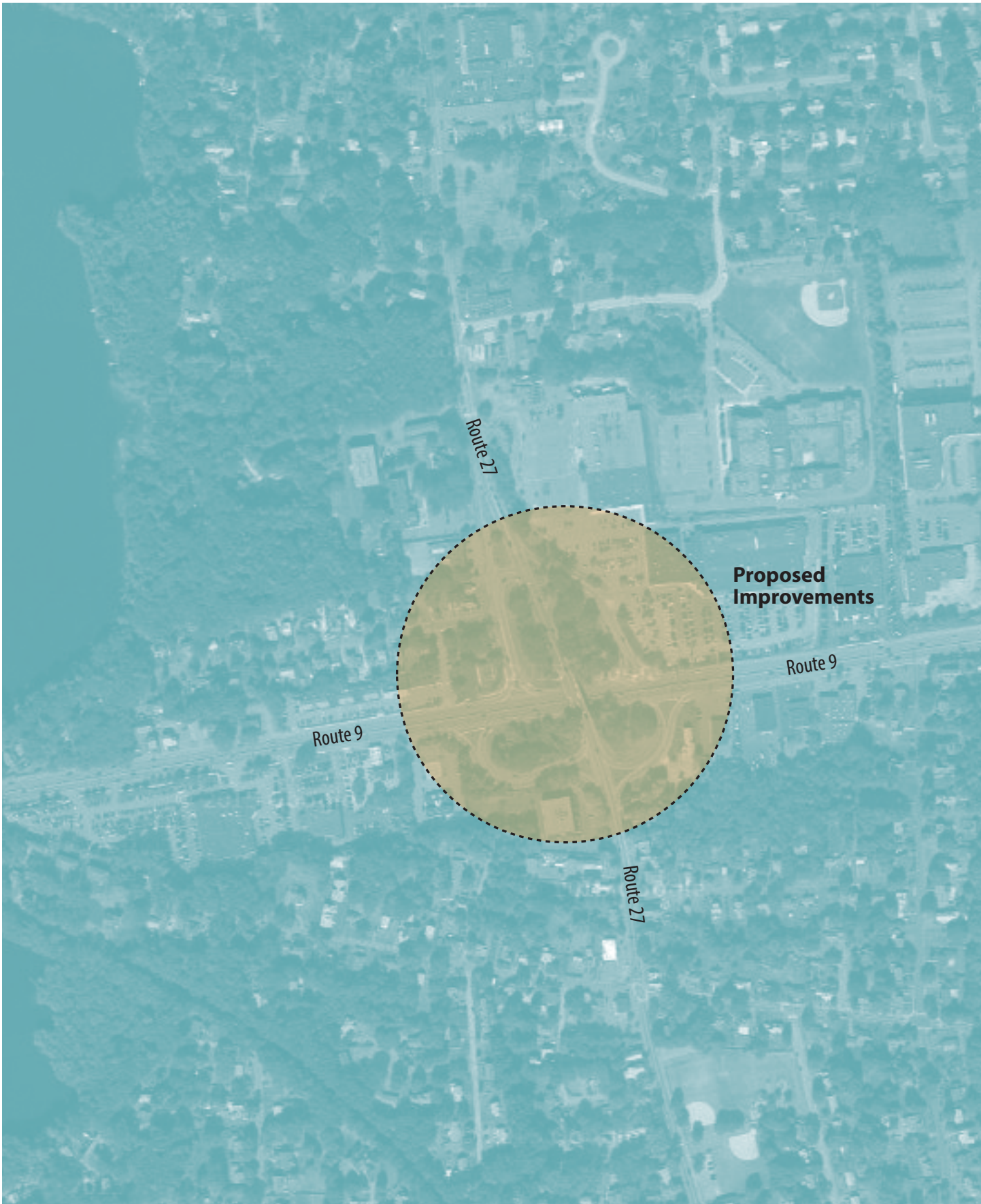
ECONOMIC VITALITY

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:

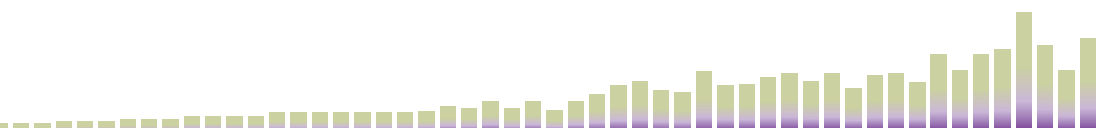
Roadway rehabilitation will include bicycle accommodation, six miles of new sidewalks, reconfigured intersections, and updated traffic signals to facilitate non-motorized travel options.

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:

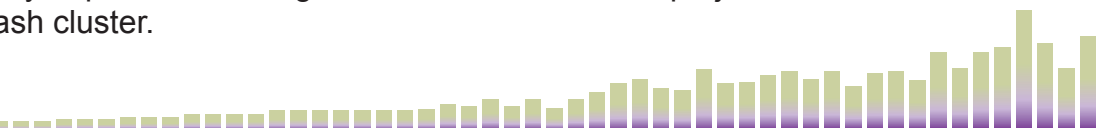
MBTA Routes 80 (Arlington Center to Lechmere) and 88 (Clarendon Hill to Lechmere) provide bus service in this corridor, with connections to the MBTA Green Line at Lechmere Station, and will have direct access to the Green Line Extension in the future, connecting the corridor to Boston, Cambridge, and 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:

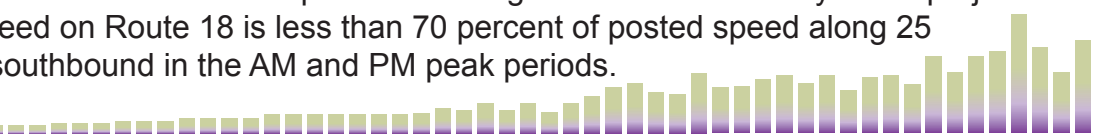
Weymouth:

- 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.

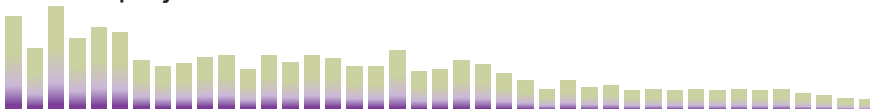
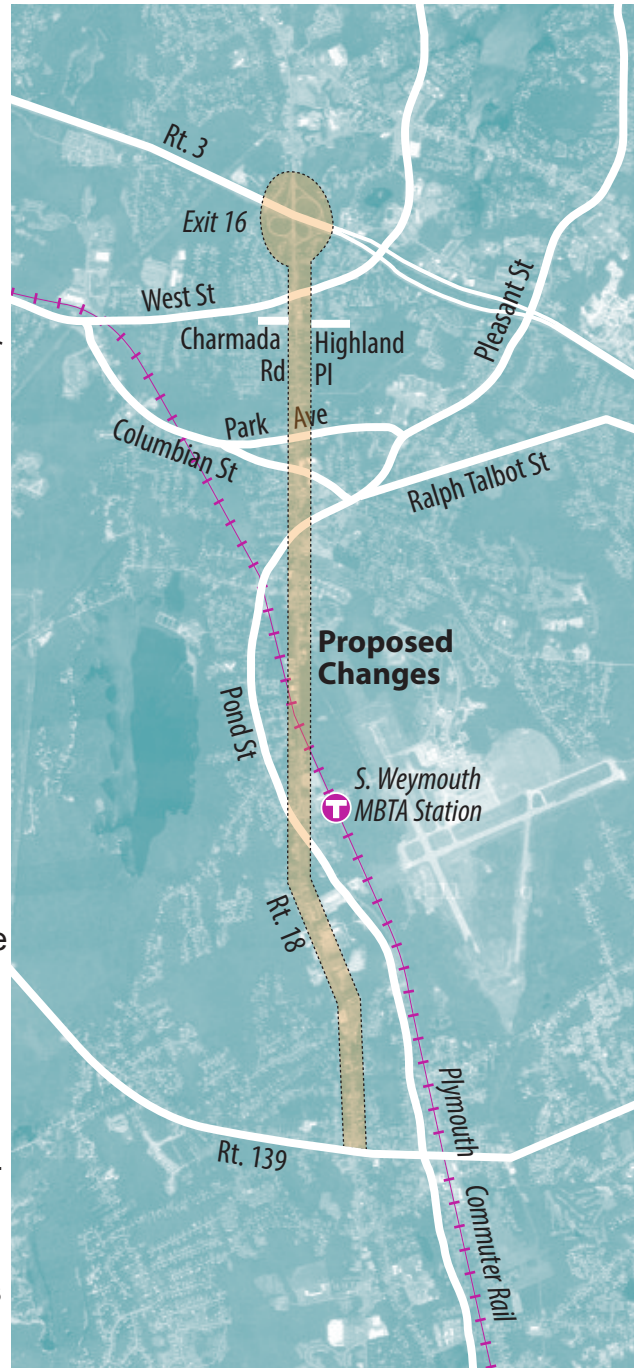
ECONOMIC VITALITY

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

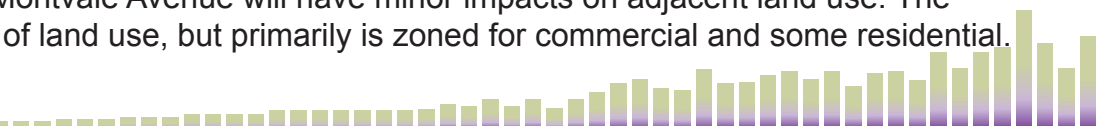
This project is located at one of the top-200 Massachusetts crash locations between 2010 and 2012.

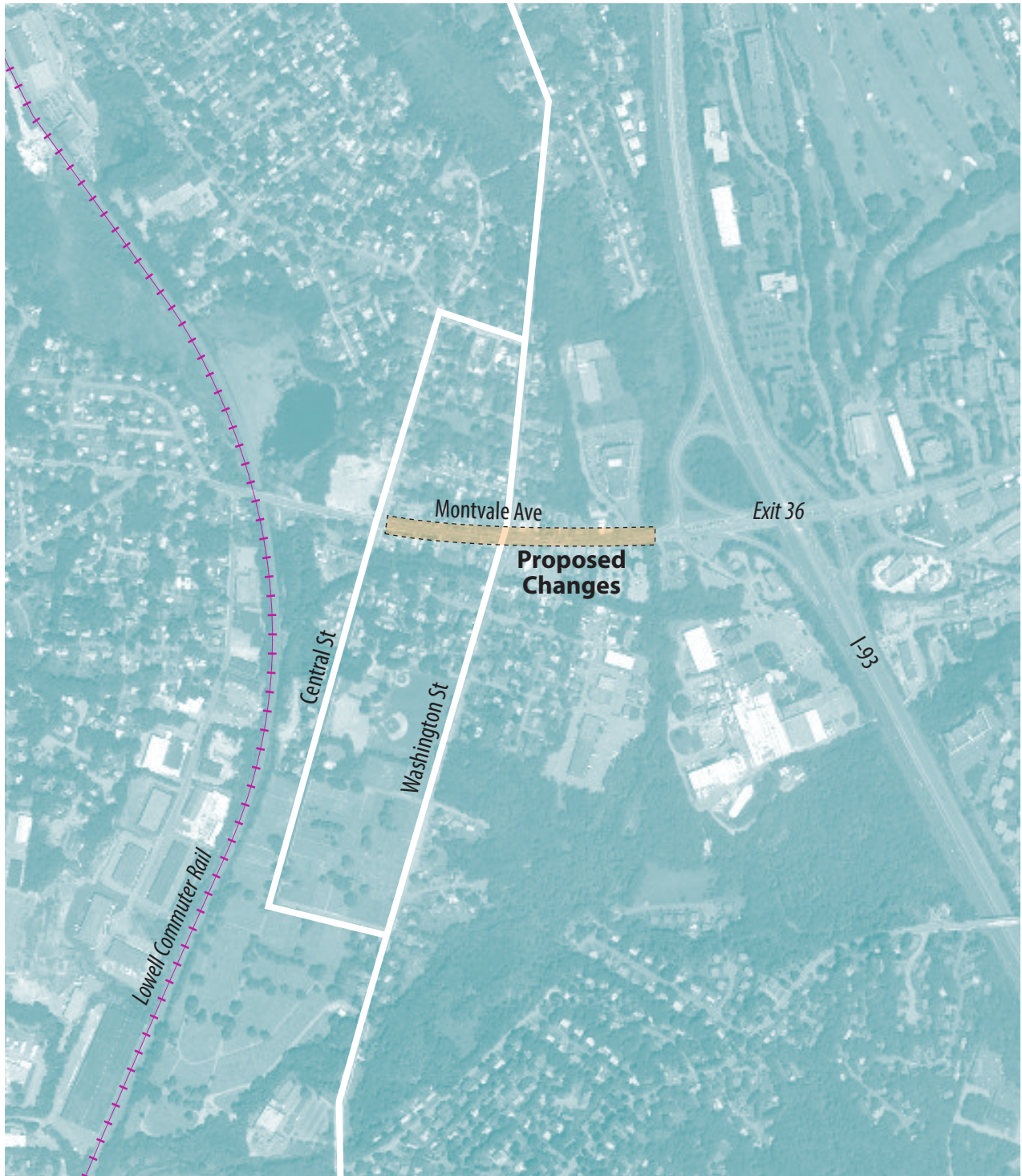
SYSTEM PRESERVATION

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.

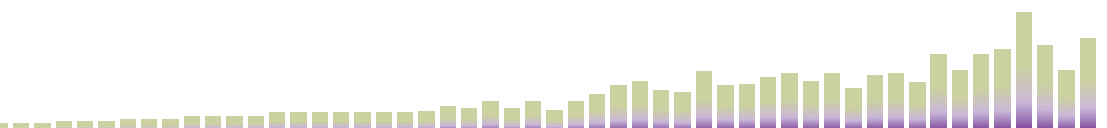
SYSTEM PRESERVATION

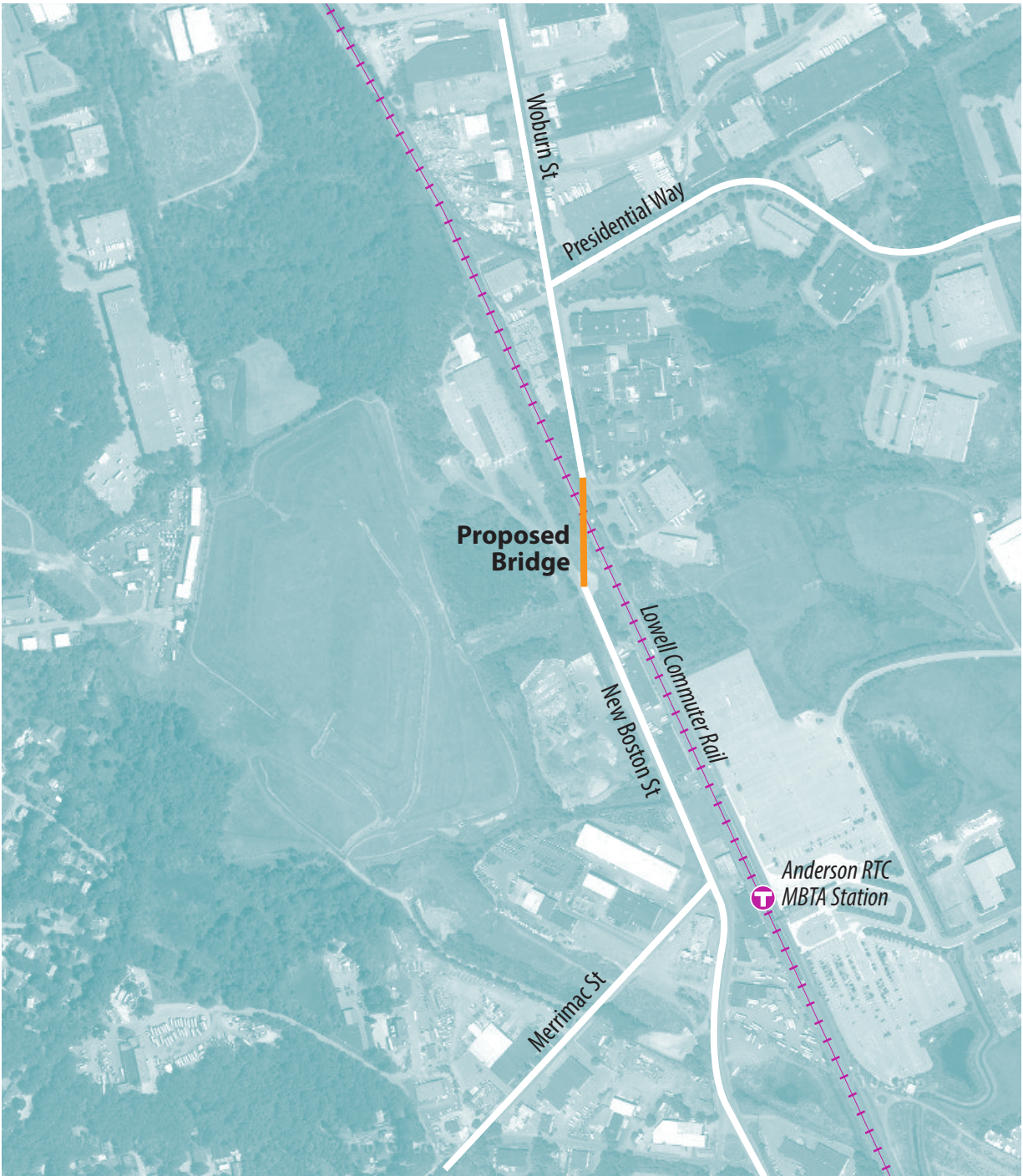
An existing stretch of New Boston Street will be rebuilt as part of this project.

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.

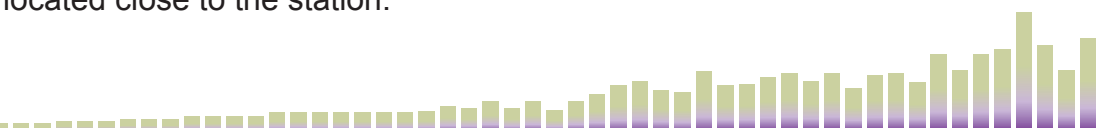
PHASE I

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.

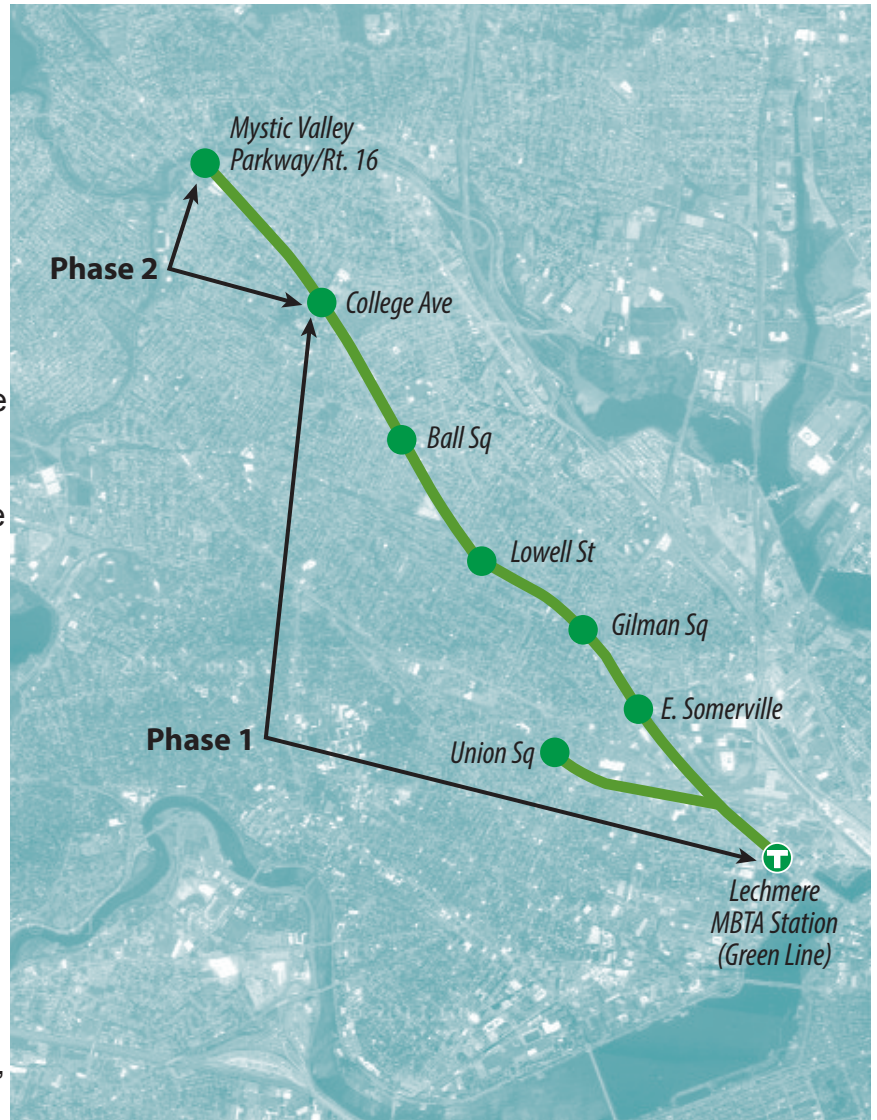
Proposed Stations

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

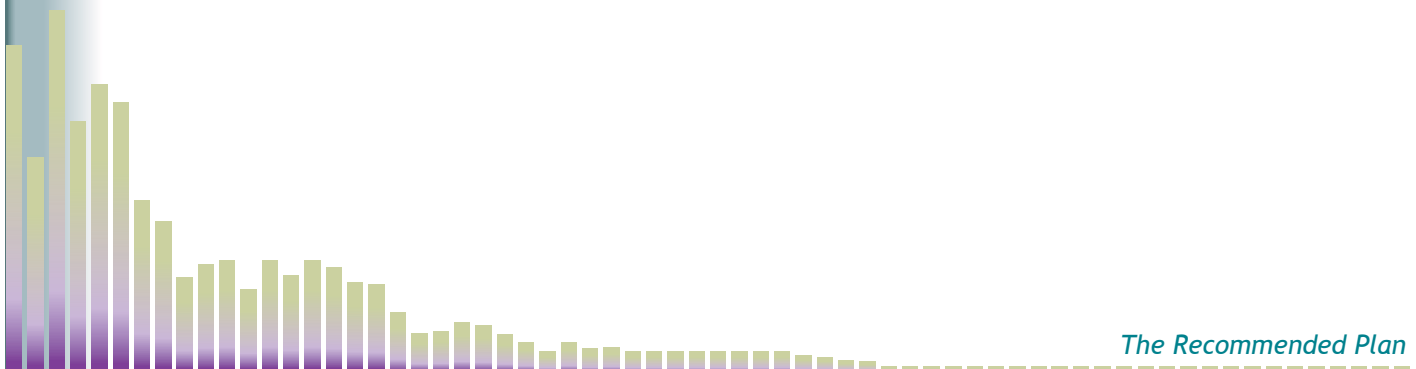
CAPACITY MANAGEMENT/MOBILITY

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.

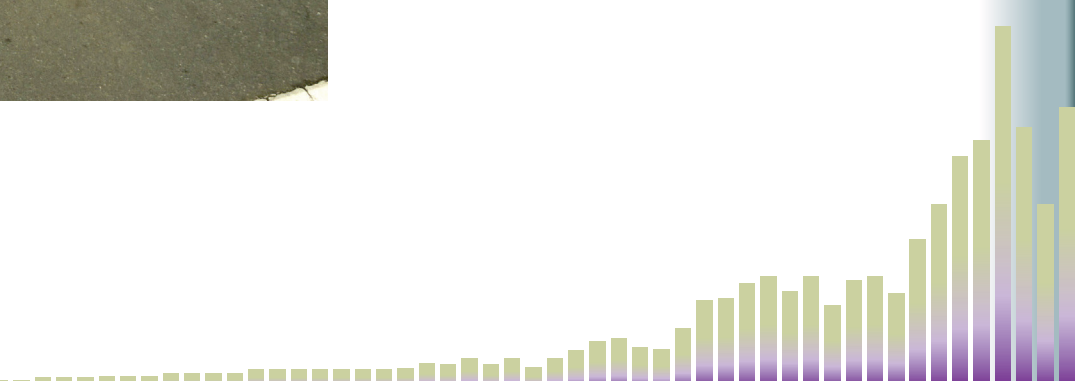
TRANSPORTATION EQUITY



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

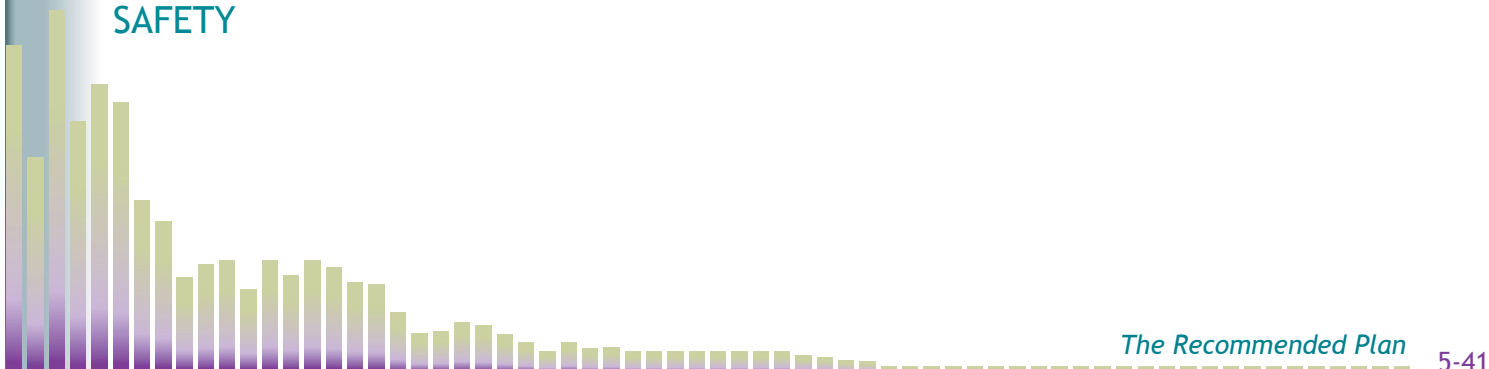
An average cost of six million dollars per mile of Complete Streets improvements was established based on similar projects that the MPO has funded in the past as well as projects that are included in the Universe of Projects in this LRTP (see Appendix B) and awaiting potential funding in future TIPs.

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



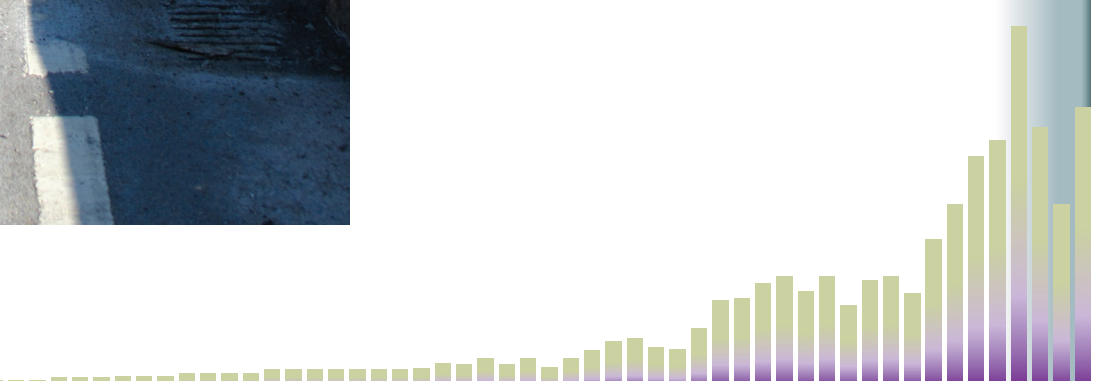
Complete Streets projects can increase transportation options and access to places of employment and centers of economic activity by adding new sidewalks and bicycle facilities and generally improving operations.

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.

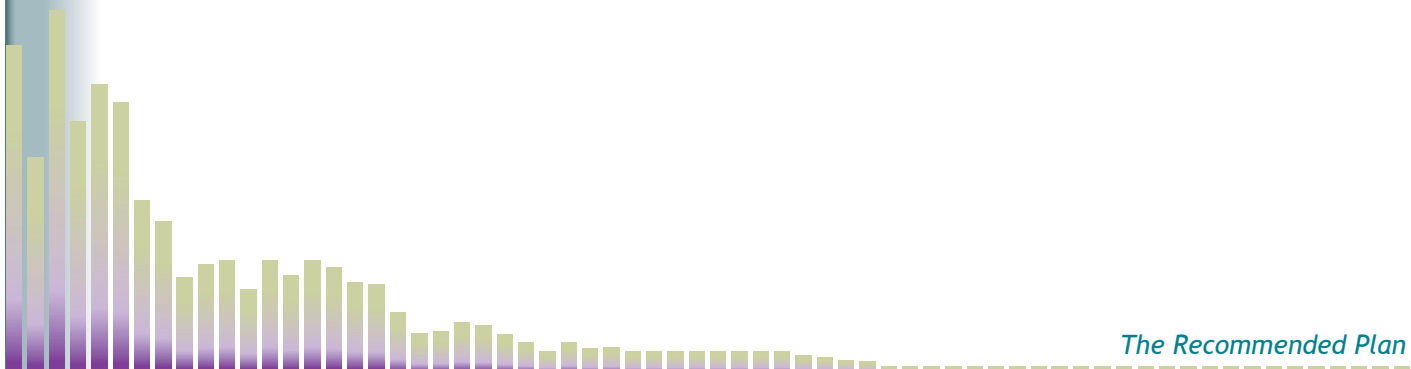
Project Context and Possible Impacts by MPO Goal

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.



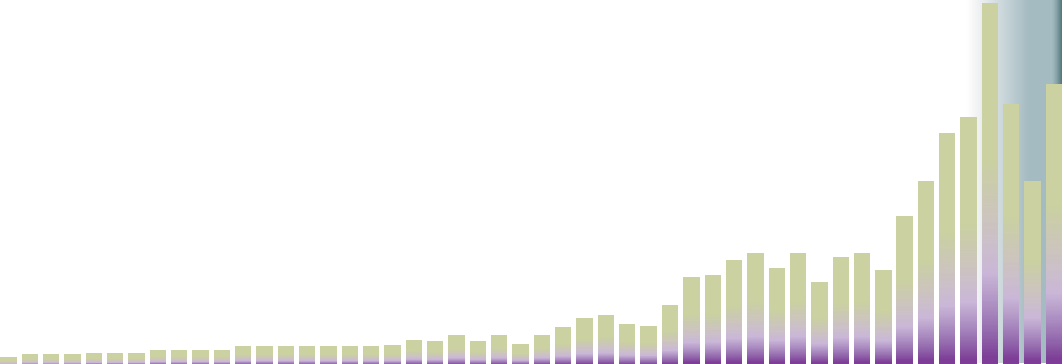


TRANSPORTATION EQUITY

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

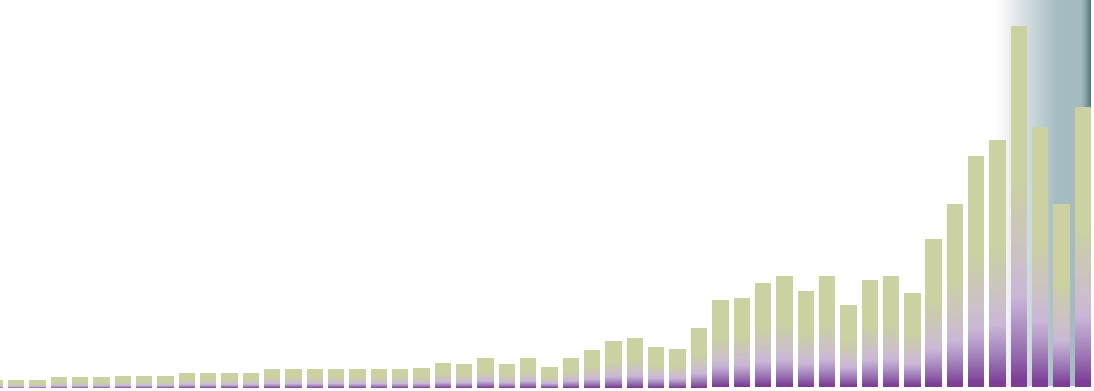
The program can provide funding for starting up new, locally developed transit services and support last-mile connections to places of employment and areas of economic activity.

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

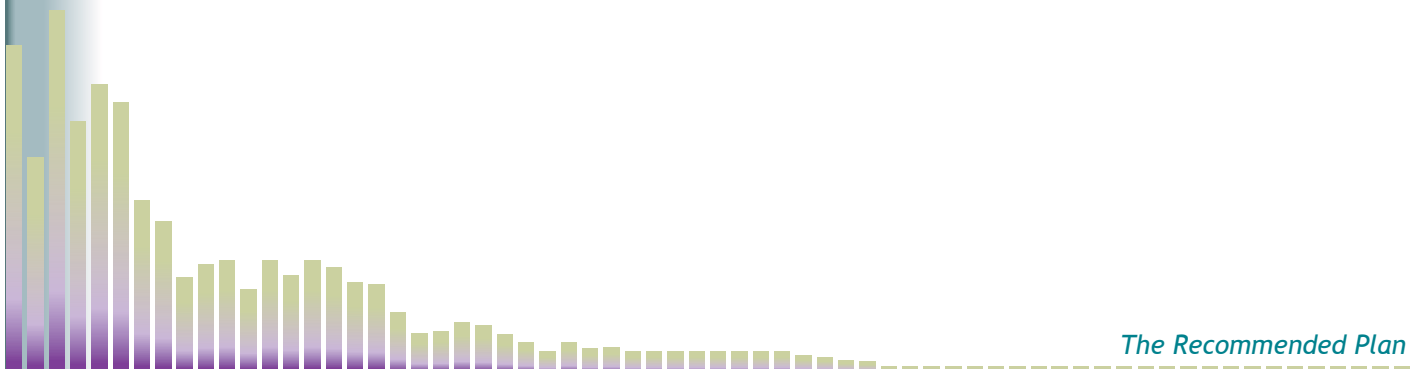
Table 5.5 and 5.6 lists transit projects funded under the capacity expansion program, their costs for the period of construction, and their projected completion dates. (Figure 5.1 shows the locations of projects.) The projects in Table 5.5 are projects that are included as part of the no-build and are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

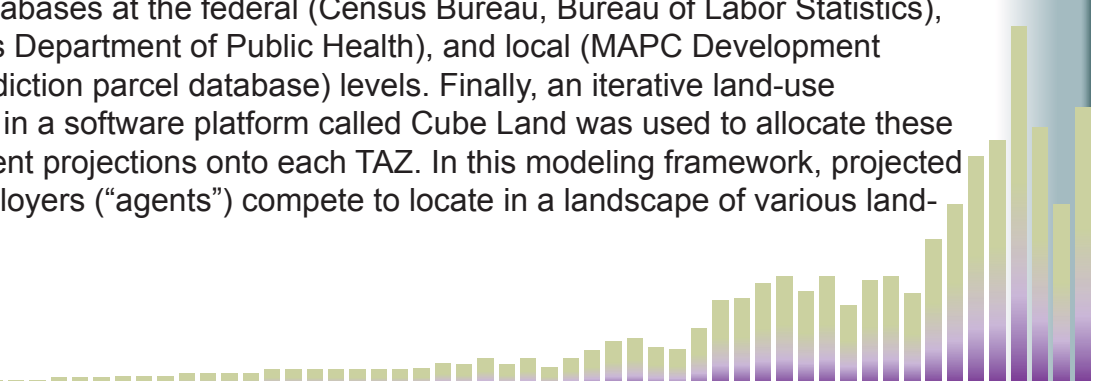
The travel model analysis for the LRTP consisted of several steps. First, staff tested an existing conditions network with existing land-use patterns, to simulate recent 2012 travel conditions. This constituted the model's Base Year. Projects included for analysis in the Base Year model were deemed "regionally 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.

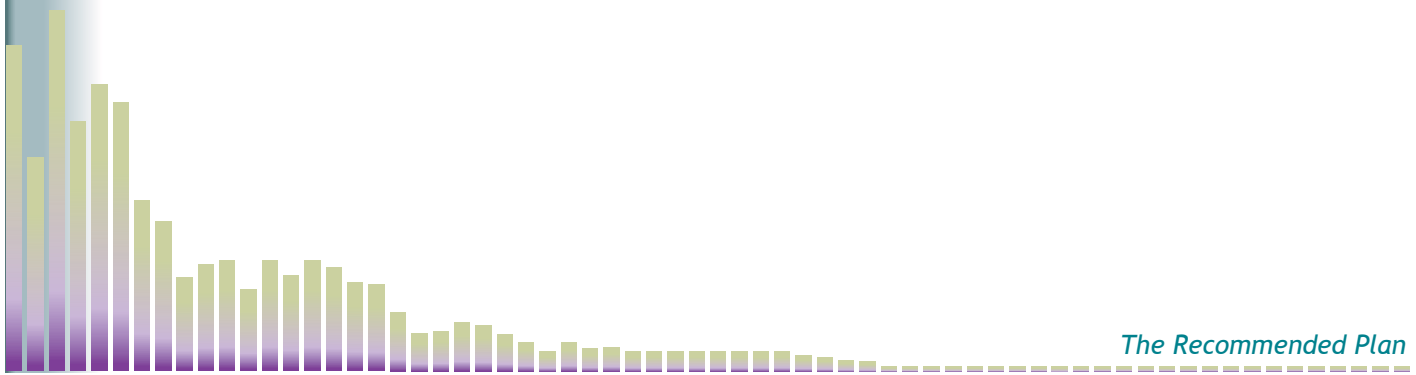


TABLE 5.7
2012 Base Year, 2040 No-Build, and 2040 Build Scenarios

| 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.)

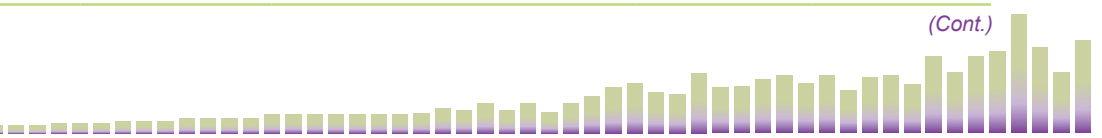


TABLE 5.7 (Cont.)

| 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.

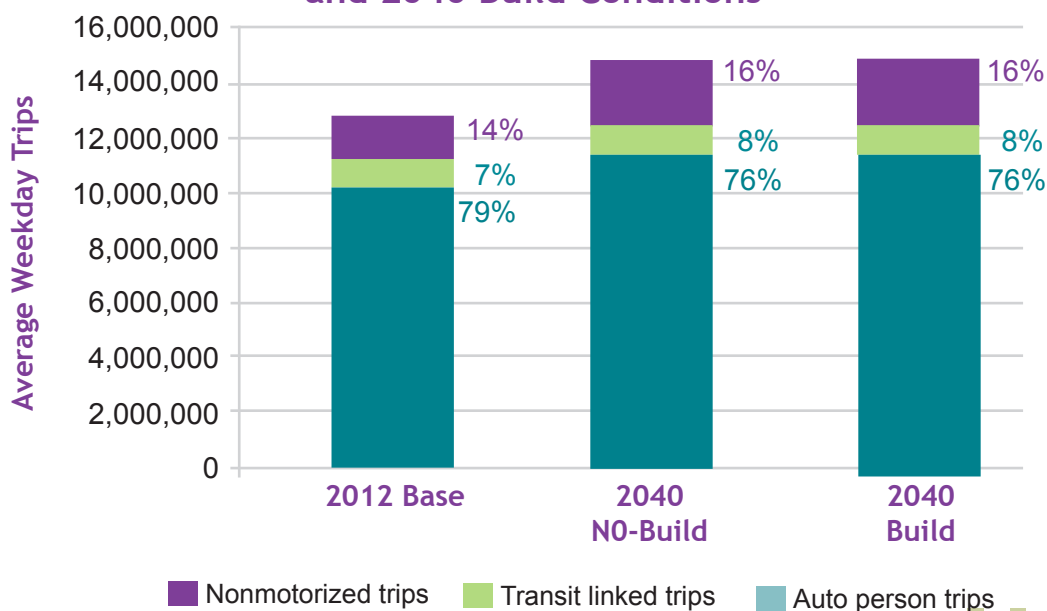
Interpretation of the L RTP

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

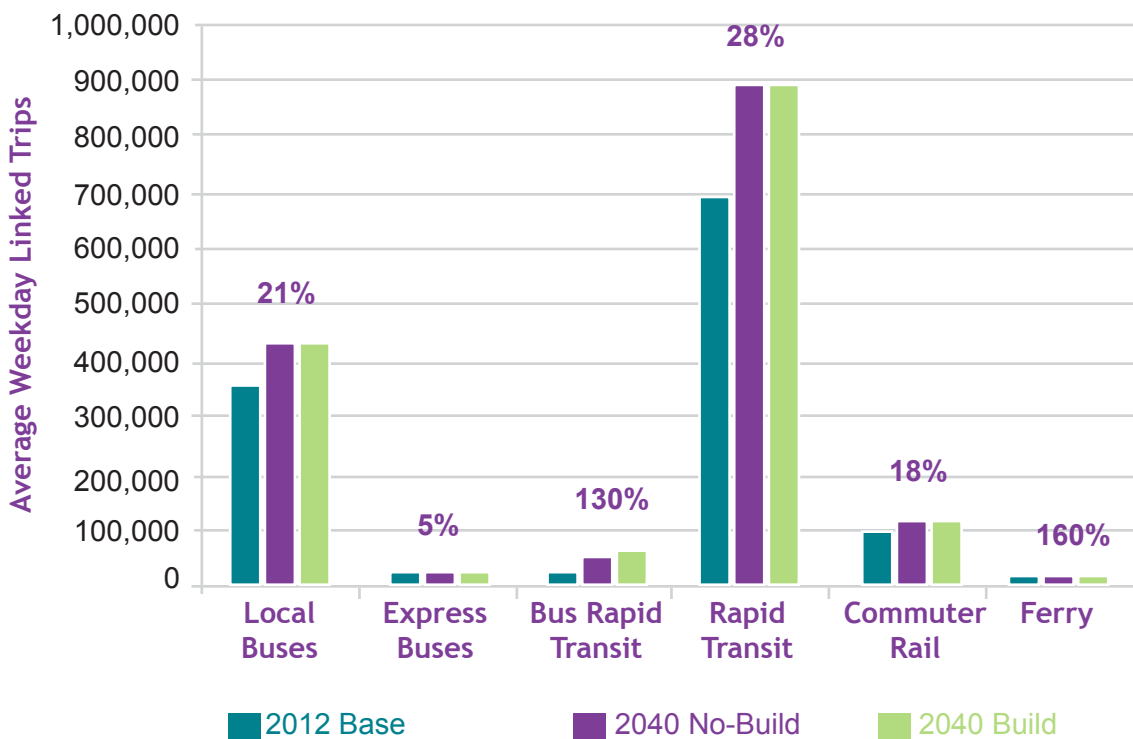


Source: CTPS Travel Demand Model

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

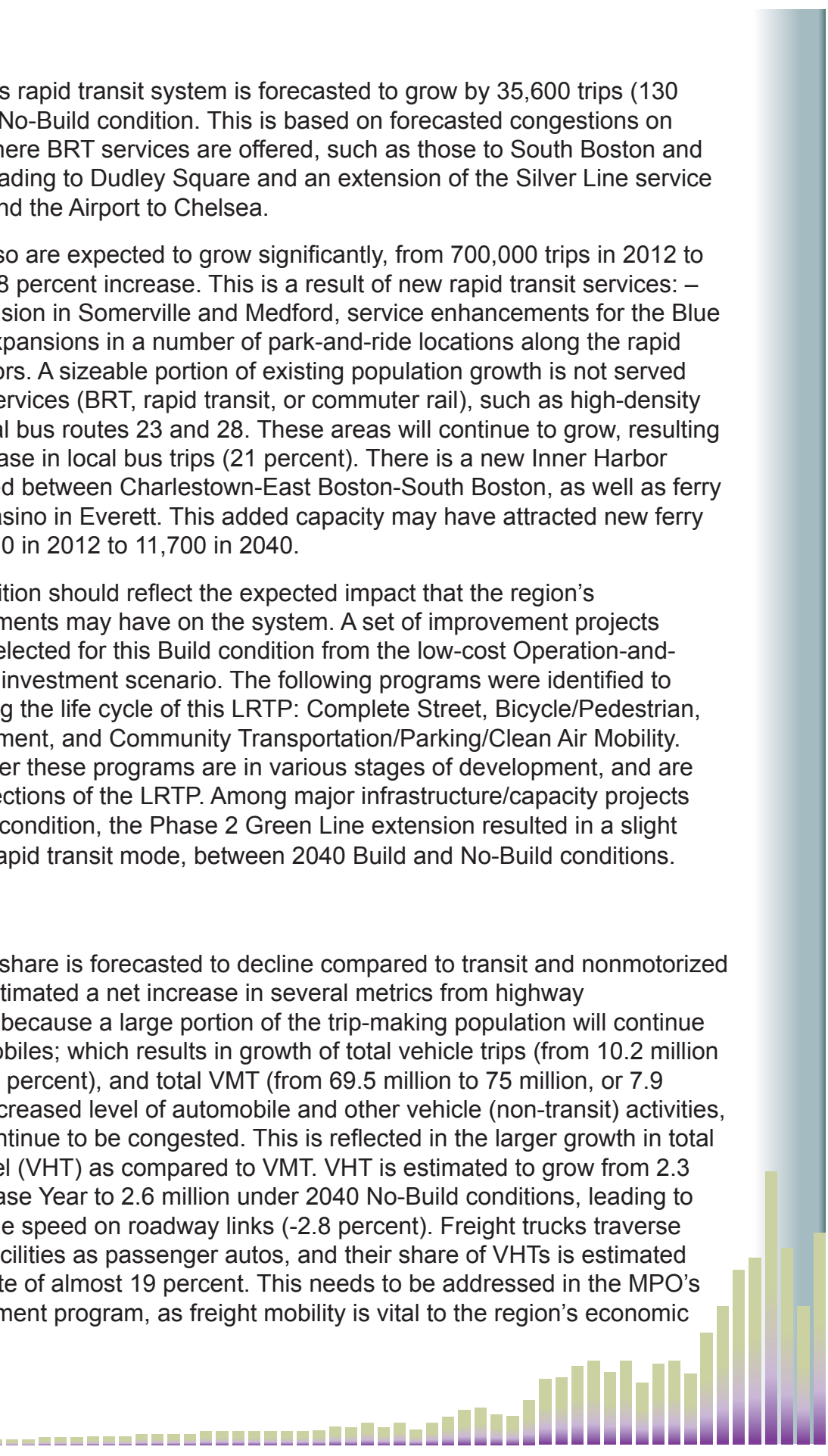
linked trips on the bus rapid transit system is forecasted to grow by 35,600 trips (130 percent) in the 2040 No-Build condition. This is based on forecasted congestions on roadway corridors where BRT services are offered, such as those to South Boston and the corridor south heading to Dudley Square and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

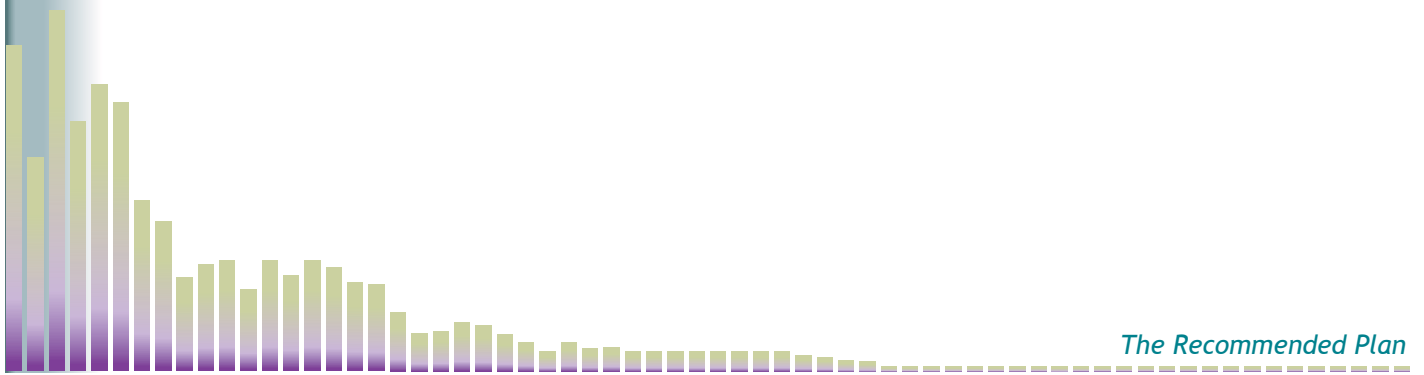
Although auto mode share is forecasted to decline compared to transit and nonmotorized modes, the model estimated a net increase in several metrics from highway assignments. This is because a large portion of the trip-making population will continue to depend on automobiles; which results in growth of 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.





6

CHARTING PERFORMANCE

OVERVIEW OF PERFORMANCE-BASED PLANNING

Background of Performance-Based Planning

Increasingly, over the past two decades, transportation agencies have been utilizing “performance management”—a strategic approach that uses performance data to support decisions to help achieve desired outcomes for their multimodal transportation systems. Performance management is credited with improving project and program delivery, informing investment decision making, focusing staff on leadership’s priorities, and providing greater transparency and accountability to the public.

Performance-based planning and programming (PBPP) refers to transportation agencies’ application of performance management in their planning and programming processes. For MPOs, this includes a range of activities and products undertaken by a transportation agency, together with other agencies, stakeholders, and the public as part of the 3C Metropolitan Transportation Planning Process. This includes developing:

- Long-range transportation plans (LRTPs)
- Other plans and processes (including those that are federally required, such as Strategic Highway Safety Plans, Asset Management Plans, the Congestion Management Process, Transit Agency Asset Management Plans, and Transit Agency Safety Plans, as well as others that are not required)
- Programming documents, including state and metropolitan Transportation Improvement Programs (STIPs and TIPs)

The goal of PBPP is to ensure that transportation investment decisions—both long-term planning and short-term programming—are based on their ability to meet established goals.

The cornerstone of Moving Ahead for Progress in the 21st Century’s (MAP-21) highway program transformation is this movement toward performance- and outcome-based results. States will invest resources in projects to achieve individual targets that collectively will make progress toward national goals.

Requirements of Performance-Based Planning

The US Secretary of Transportation, in consultation with states, MPOs, and other stakeholders, established performance measures for fatalities and serious injuries to fulfill the Highway Safety Improvement Program; proposed performance measures for pavement conditions for Interstate and National Highway System (NHS) bridge conditions, and general performance of the Interstate and NHS; and drafted performance measures to assess traffic congestion and on-road mobile source emissions. States and MPOs will set performance targets to support these measures; and state and metropolitan plans will describe how program and project selection would help to achieve the targets.

Status of Performance-Based Planning

The Boston Region MPO's transition to performance-based planning is underway in anticipation of MAP-21 performance-measure requirements. The MPO has:

- Established goals and objectives that align with national goals
- Developed performance measures
- Analyzed some performance measure trends over time to identify priorities and prioritized investments that advance its goals and objectives

The following sections of this chapter demonstrate how transportation investments over the next 25 years would advance the MPO's goals and objectives. Using PBPP, the MPO will track progress and adjust priorities, if necessary, to ensure this advancement.

DEMONSTRATING PROGRESS TOWARD GOALS AND OBJECTIVES

MPO investments over the life of the LRTP commit funding to specific projects and reserve future funding for different project types through investment programs. In reporting the benefits of specific projects, MPO staff conducted project-level assessments to determine each project's impact in advancing MPO goals through performance measures.

In order to estimate the impact of future projects to be funded through investment programs, MPO staff used sketch-planning and travel demand modeling techniques to forecast progress toward MPO goals through performance measures. For the Intersection Improvements, Complete Streets, Bicycle and Pedestrian, and Community Transportation programs, MPO staff first analyzed a sample of past investments to determine typical project costs and benefits. MPO staff then used these assumptions to estimate the impact of future investments, and anticipated progress toward goals and objectives.

Safety

The set of LRTP projects and programs advance the MPO's safety goal to provide safe transportation for all modes by prioritizing improvements at high-crash locations. High-crash locations are those with the highest crash severity based on fatalities, injuries, and property damage.

HIGH-CRASH LOCATIONS

Overall, safety is improving in the region. Between 2006 and 2012, traffic fatalities declined by 11 percent, and included fewer automobile, truck, pedestrian, and bicycle fatalities. Similarly, total traffic crashes and injuries declined by 21 percent and 27 percent, respectively.

Despite these overall gains, crashes and injuries for pedestrians and bicyclists specifically rose during this same period. Bicyclists and pedestrians remain vulnerable to injury; between 2006 and 2012, roughly two-thirds of pedestrian and bicycle crashes resulted in injury. In addition, there are still a number of high-crash locations throughout the Boston MPO region, including nearly 80 of the Top-200 Crash Locations statewide.

LRTP investments propose safety improvements at approximately 120 high-crash locations, including multiple truck, bicycle, and pedestrian high-crash locations to reduce fatalities and serious injuries in the region.

Major Infrastructure investments consist of 12 projects that would implement safety improvements at 26 high-crash locations, including seven (7) truck high-crash locations. The Route 128 Add-a-Lane project will widen 3.25 miles of I-95 in Needham and Wellesley to install an additional 12-foot travel lane and 10-foot shoulder in each direction. This will address serious safety issues. Adding a fourth full-time travel lane will eliminate using the breakdown lane during peak periods. Adding collector roads between Highland Avenue and Kendrick Streets will provide safer weaving movements between the interchanges.



L RTP intersection investments will provide safety improvements for automobiles, trucks, bicyclists, and pedestrians at 16 locations. Within the FFY 2016–20 time band, intersection improvements at Derby Street, Whiting Street (Route 53) and Gardner Street in Hingham and Middle Street, Libbey Industrial Parkway and Tara Drive in Weymouth will address two high crash locations. Beyond 2020, allocation of nearly \$445 million to the Intersection Improvement Program would allow approximately 31 projects to improve safety at 14 high-crash locations in the future.



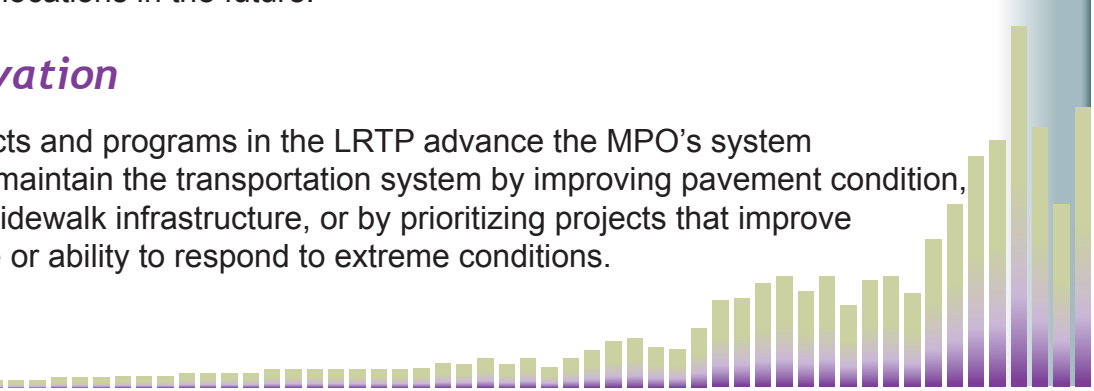
The combination of Complete Streets projects to be implemented in the FFYs 2016–20 TIP and future projects to be identified through the Complete Streets program beyond 2020 would implement safety improvements at nearly 70 high-crash locations. Within the FFYs 2016–20-time band, 13 corridor investments will provide safety improvements for automobiles, trucks, bicyclists, and pedestrians. Nine of the 13 Complete Streets projects improve safety at one or more high-crash locations.

In addition, these 13 corridors will provide safe and continuous accommodations for non-motorized users by adding 24 miles of new bicycle facilities and more than six miles of new sidewalk. For example, reconstructing Massachusetts Avenue in Lexington will add new bicycle lanes throughout this 0.7-mile section of the corridor, enhancing safe access to the Minuteman Commuter Bikeway. The Gateway East project along Route

9 in Brookline will provide added safety for bicyclists by implementing cycle tracks that physically separate the bicycle lane from the travel lane to reduce conflicts between motorists and bicyclists. In addition, reserving nearly \$920 million for the Complete Streets Program in 2021–40 would apportion approximately 70 projects to improve safety at nearly 50 high-crash locations in the future.

System Preservation

Virtually all the projects and programs in the LRTP advance the MPO’s system preservation goal to maintain the transportation system by improving pavement condition, bridge condition, or sidewalk infrastructure, or by prioritizing projects that improve emergency response or ability to respond to extreme conditions.



PAVEMENT CONDITION

Recent trends indicate that pavement condition has remained constant between 2008 and 2012, yet arterials with substandard pavement condition continue to account for a disproportionate share of the roadway lane miles. While arterials comprise 62 percent of the monitored roadways, they account for 90 percent of roadways that are in poor condition.

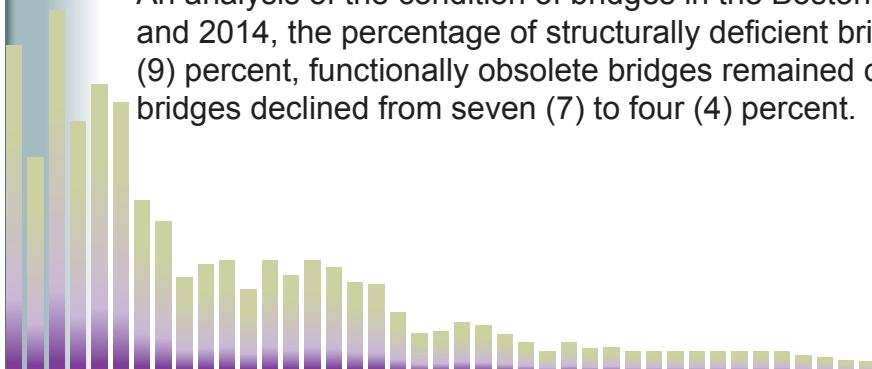
The proposed projects and programs would improve approximately 240 lane miles of substandard pavement, primarily along arterial corridors in the region. The combination of Complete Streets projects to be implemented in the FFYs 2016–20 TIP and future projects to be identified through the Complete

Streets program beyond 2020 would address more than 180 lane miles of substandard pavement. Specific corridor reconstruction projects include Ferry Street in Everett, Route 1A (Main Street) in Walpole, and Route 30 (Main Street) in Southborough. The Intersection Improvement Program would also address some substandard pavement by improving more than 10 lane miles of such pavement at arterial intersections beyond 2020.

Major Infrastructure investments to modernize or expand major arterials would resurface or reconstruct more than 40 lane miles of substandard pavement through projects like reconstruction of Highland Avenue and Needham Street in Newton and Needham and Middlesex Turnpike Improvements, Phase III in Bedford, Billerica and Burlington.

BRIDGE CONDITION

An analysis of the condition of bridges in the Boston region indicates that between 2007 and 2014, the percentage of structurally deficient bridges increased from six (6) to nine (9) percent, functionally obsolete bridges remained constant at 19 percent, and posted bridges declined from seven (7) to four (4) percent.





Although the MassDOT Bridge Program (not included in the MPO's target program) is the primary funding source for replacement or rehabilitation of substandard bridges, LRTP investments would contribute modestly to bridge preservation by addressing an estimated 25 substandard bridges. Major Infrastructure investments would address 13 substandard bridges through projects like the reconstruction of Rutherford Avenue in Boston and Route 128 Add-a-Lane in Needham and Wellesley. The remaining substandard bridges would be addressed through the Complete Streets Program in the 2021–40-time bands.

SIDEWALK INFRASTRUCTURE CONDITION

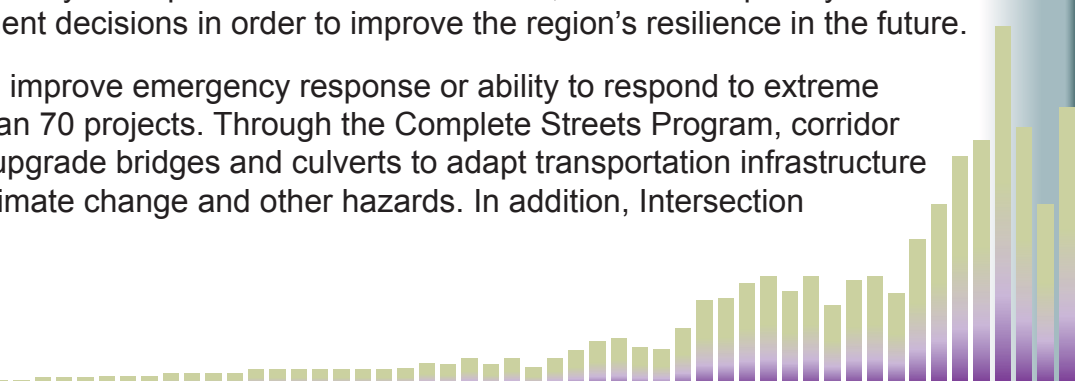
Outdated and inadequate information on sidewalk data prevents reporting a baseline condition for sidewalk infrastructure in the region; however there are gaps and barriers throughout the network in need of repair.

LRTP investments would improve more than 160 miles of sidewalk, primarily along arterial corridors like Route 27 in Natick or Massachusetts Avenue in Lexington, and out-of-compliance intersections in the region. More than 100 miles of improved sidewalk would be implemented through Complete Streets Program funding from 2021–40.

EMERGENCY RESPONSE

The MPO's All-Hazards Planning application highlights the need to improve emergency response and the ability to respond to extreme conditions by displaying transportation infrastructure vulnerable to climate change and other hazards, evacuation routes, and emergency support locations. Although the MPO is not responsible for emergency response nor has the ability to respond to extreme conditions, it remains a priority in transportation investment decisions in order to improve the region's resilience in the future.

LRTP investments will improve emergency response or ability to respond to extreme conditions for more than 70 projects. Through the Complete Streets Program, corridor improvements would upgrade bridges and culverts to adapt transportation infrastructure that is vulnerable to climate change and other hazards. In addition, Intersection



Improvement Program investments would improve emergency response by updating intersections along evacuation routes and those in close proximity to emergency support locations.

Capacity Management/Mobility

To advance the MPO's Capacity Management/Mobility goal of utilizing existing facilities more efficiently and increasing healthy transportation options, LRTP investments aim to address MPO-identified bottleneck locations, improve transit access and reliability, and expand the bicycle and pedestrian network.

MPO-IDENTIFIED BOTTLENECK LOCATIONS

As part of the LRTP Needs Assessment, MPO staff analyzed several congestion measurements for both current and future conditions based on travel time, travel speed, and volume/capacity ratios to identify the worst bottleneck locations in the region. Although staff identified numerous major infrastructure projects that would address MPO-identified bottleneck locations, less available funding over the life of the plan limited the number of these projects that the MPO could prioritize for funding. Yet, there are still two LRTP investments that would significantly improve mobility at MPO-identified bottleneck locations by adding roadway capacity:

- The Route 128 Add-a-Lane project will improve one MPO-identified express highway bottleneck location by widening 3.25 miles of I-95 in Needham and Wellesley
- Reconstruction of Route 18 (Main Street) in Weymouth will improve one MPO-identified arterial bottleneck location by widening a four-mile section of the corridor from two to four lanes



TRANSIT ACCESS AND RELIABILITY

State transportation funding (non-federal aid) is the primary funding source for targeted expansion of the transit system. The MPO recognizes the importance and necessity of transit expansion, and LRTP investments will further extend the Green Line from College Avenue to Route 16/Mystic Valley Parkway in Medford and Somerville. The additional one-mile transit extension would improve access to existing centers of economic activity and services, and support non-single-occupant-vehicle travel.

Complete Streets investments also improve transit access and transit service by implementing traffic and operational improvements along corridors. In the FFYs 2016–20-time band, these investments will improve access to transit along 11 corridors that serve 18 bus routes, operating nearly 1,000 bus trips on a typical weekday. Reconstruction of Main Street (Route 30) in Southborough will add continuous sidewalks and bicycle lanes along the corridor to support existing MetroWest Regional Transit Authority bus service. In addition, reconstruction of Ferry Street in Everett will reduce delay for MBTA Route 110 service along the corridor through traffic signal upgrades.

BICYCLE AND SIDEWALK NETWORK



LRTP investments will make significant progress in expanding the bicycle and pedestrian network to increase healthy transportation options and promote active modes. Over the next 25 years, MPO investments propose to add more than 170 miles of on-road bicycle facilities, nearly 90 miles of new sidewalks, and approximately 120 miles of off-road paths and trails. Most of the new bicycle and pedestrian network will be funded through the Complete Streets and Bicycle and Pedestrian Programs between 2021 and 2040. In addition, projects like Rutherford Avenue in Boston will incorporate a new shared-use path along the project corridor, and Route 126 (Pond Street) in Ashland will transform the corridor by adding sidewalks and bicycle lanes where no facilities currently exist.



Transportation Equity

To advance the MPO's Transportation Equity (TE) goal of providing comparable transportation access and service quality among communities regardless of income level or minority status, the MPO targets investments to areas that benefit a high percentage of low-income and minority populations.

MPO-IDENTIFIED TRANSPORTATION ISSUES IN TRANSPORTATION EQUITY AREAS

The proposed projects and programs in the LRTP target investments at approximately 100 TE areas that contain an above-average percentage of low-income and minority populations.

Major infrastructure investments like grounding McGrath in Somerville and improving Route 126 and Route 135 in Framingham will address MPO-identified transportation issues for TE populations. Grounding McGrath will help reconnect two TE areas, and improving Downtown Framingham will enhance MetroWest Regional Transit Authority service for many low-income and minority riders.

Complete Streets investments such as reconstructing Route 85 (Maple Street) in Marlborough, Ferry Street in Everett, and Route 129 (Lynnfield Street) in Lynn will improve safety and mobility for TE populations. Improvements will consist of upgraded sidewalks and improved crossings for pedestrians, and updated signals at intersections for better traffic flow for automobiles and buses. In addition, approximately 90 projects are expected to improve transportation in TE areas with funding set aside in the Complete Streets, Intersection Improvements, and Bicycle and Pedestrian programs beyond 2020.

Clean Air/Clean Communities

The MPO's Clean Air/Clean Communities goal of creating an environmentally friendly transportation system prioritizes investments that reduce greenhouse gas (GHG) emissions and other transportation-related pollutants.

GHG EMISSIONS

The proposed projects and programs in the LRTP are estimated to reduce GHG emissions by approximately 5,000 tons of CO₂ annually. These GHG emission



reductions are primarily derived from Complete Streets, Intersection Improvements and Major Infrastructure projects between FFYs 2016 and 2020. These investments reduce automobile delay through traffic signal improvements and encourage mode shift by expanding transportation options.

In addition, the Green Line Extension from College Avenue to Route 16 in Medford and Somerville would contribute to reducing GHG emission by supporting new transit trips previously made by automobile.

Economic Vitality

The MPO's transportation investments advance economic vitality by prioritizing projects that support access to targeted development areas for multiple modes.



ACCESS TO TARGETED DEVELOPMENT AREAS

One of MAPC's MetroFuture implementation strategies is to focus on economic growth, and coordinate transportation investments to guide such growth in the region.

During the past few years, MAPC has worked with the Executive Office of Housing and Economic Development (EOHED) and the Executive Office of Energy and Environmental Affairs (EOEEA) to identify local, regional, and state priority development and preservation areas in municipalities within the MPO region to identify those locations most suitable for added housing and places of employment, as well as the creation and preservation of open space.

The proposed projects and programs in the LRTP support this smart growth planning work by

improving transportation access to approximately 90 targeted development areas across the region.

Major Infrastructure investments along six major arterials would improve access to residential and employment areas that are well suited to support continued economic



vitality and future growth. The reconstruction of Rutherford Avenue in Boston, Route 18 (Main Street) in Weymouth, and Highland Avenue and Needham Street in Newton and Needham will expand transportation options and enhance access to transit to facilitate new development. In addition, the Green Line Extension from College Avenue to Route 16 will extend rapid transit service to provide access to existing centers of economic activity and services, as well as support transit-oriented development.

Complete Streets investments will also improve multimodal access to targeted development areas well suited to support continued economic vitality and future growth. Within the FFYs 2016–20 time band of the LRTP, there are nine projects that support access to targeted development areas, including

- Reconstruction of Route 85 (Maple Street) in Marlborough that will support access for all modes to a 43D site located at the former Lucent site in Marlborough
- Reconstruction of Route 27 (North Main Street) that will provide bicycle, pedestrian, and automobile access to a 40R site located on the former Paperboard site at 182 North Main Street in Natick

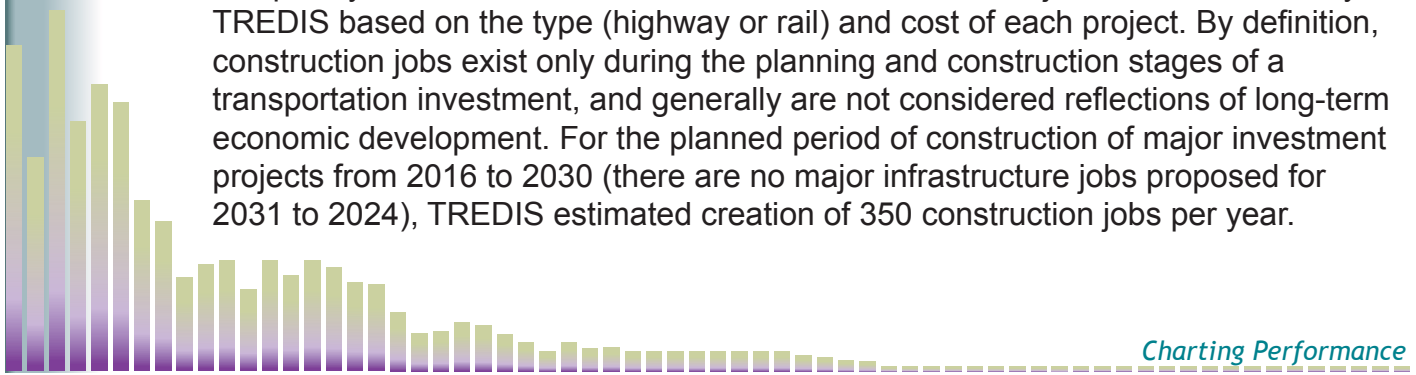
In addition, approximately 70 projects are projected to support targeted development areas with funding set aside in the Complete Streets, Intersection Improvements, and Bicycle and Pedestrian programs beyond 2020.

ECONOMIC IMPACT ANALYSIS

MPO staff used Transportation Economic Development Impact System (TREDIS) software to estimate traveler cost savings and the number of jobs created by the set of major investment projects programmed into the LRTP. Traveler cost savings accrue as users benefit from mobility and reliability improvements in the region’s transportation network. TREDIS estimated these costs savings for households and businesses by comparing the relationship between vehicle miles traveled, vehicle hours traveled, and the fraction of congested roadway between the build and no-build scenarios. For the set of major investment projects, TREDIS estimated a total of \$40.4 million (in 2015 dollars) in traveler cost savings for 2040, including \$18.5 million in total savings for commute and personal-type trips, and \$21.9 million in total savings for freight trips.

The estimated number of jobs created by the set of major investment projects fell into two categories:

- Temporary Construction Jobs: The number of construction jobs was estimated by TREDIS based on the type (highway or rail) and cost of each project. By definition, construction jobs exist only during the planning and construction stages of a transportation investment, and generally are not considered reflections of long-term economic development. For the planned period of construction of major investment projects from 2016 to 2030 (there are no major infrastructure jobs proposed for 2031 to 2024), TREDIS estimated creation of 350 construction jobs per year.



- **Permanent Full-Time Jobs:** The estimated number of permanent full-time jobs is a measure of long-term economic development, and is generated as a product of the full set of direct, indirect, and induced impacts of the major investment projects on the regional economy. TREDIS estimated the number of permanent full-time jobs by incorporating results of the traveler cost savings into a regional economic impact model. For the year 2040, TREDIS estimated that 150 permanent full-time jobs would be created by the set of major investment projects.

NEXT STEPS IN PERFORMANCE-BASED PLANNING

Performance-based planning is an ongoing process and will evolve as the MPO monitors and evaluates its progress using performance measures. The MPO will advance performance-based planning through its core planning documents by:

- Continuing scenario planning to explore how various transportation investments support goals through the LRTP
- Considering performance-based planning needs and issues when deciding what activities to fund through the UPWP
- Tracking annual progress toward goals and objectives through the TIP

In FFY 2016, the MPO will continue to monitor system-level trends and propose performance targets to guide investment decisions. If, in its annual monitoring, the MPO sees it is not making progress toward its targets, then the organization would need to consider modifying investment or policy priorities, and weigh the tradeoffs involved. For example, allocating a greater share of funding to intersection improvements at high-crash locations may make significant progress toward reducing traffic fatalities and serious injuries; however, it also may impact the MPO's ability to meet system-preservation targets for pavement or bridge conditions. By continuously monitoring and evaluating its progress, the MPO will be able to make these difficult decisions across competing goals and objectives in a more informed manner, resulting in greater outcomes for all concerned.



7

TRANSPORTATION EQUITY

THE TRANSPORTATION EQUITY PROGRAM

The purpose of the MPO's transportation equity (TE) program is to ensure that populations protected under various federal and state civil rights statutes, executive orders, and regulations (TE populations) are provided equal opportunity to participate fully in the MPO's transportation planning and decision-making process. The program also ensures that TE populations share equitably in the benefits and burdens of past, present, and planned future transportation projects, programs, and service. The TE program includes three types of activities: 1) outreach to TE populations; 2) systematic consideration of equity in the planning and programming process; and 3) analyses to identify TE populations and their transportation needs, and to estimate the equity impacts of MPO funding decisions.

Environmental Justice (EJ) Executive Order 12898 of February 11, 1994 laid the groundwork for the MPO's TE program. This executive order required each federal agency to achieve environmental justice by identifying and addressing any disproportionately high adverse human health or environmental effects—including interrelated social and economic effects—of its programs, policies, and activities on minority or low-income populations. The EJ executive order was intended not to create new mandates, but to encourage implementation of existing statutes, such as Title VI of the Civil Rights Act of 1964, which states that, "No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance." Executive Order 13166 of August 11, 2000 extended Title VI national origin protections to individuals with limited English proficiency (LEP). As recipients of federal funding, MPOs are subject to EJ and Title VI requirements.

Because the MPO's TE program grew out of EJ requirements, initially it was designed to serve minority and low-income populations (EJ populations). More recently, in response to Federal Transit Administration (FTA) and Federal Highway Administration (FHWA) LEP requirements and the extension of protections based on age, sex, and disability through the FHWA Title VI/Nondiscrimination program, the MPO is assessing how to expand its TE program to consider systematically the needs of additional protected populations.

TRANSPORTATION EQUITY OUTREACH FOR THE LRTP

TE outreach is an integral part of the MPO's overall public participation program designed specifically to communicate with low-income and minority residents, the elderly, persons with disabilities, and persons with LEP. The purpose of TE outreach is to identify transportation needs of specific populations served by the TE program and promote their involvement in the planning process. Through this outreach, the MPO hopes to develop relationships that will heighten awareness and sow seeds of mutual understanding, appreciation, and trust to encourage broader participation of TE populations.

Outreach targets both individuals and organizations representing the interests of TE populations, such as social-service organizations, community-development corporations, regional employment boards, civic groups, business and labor organizations, transportation advocates, environmental groups, EJ and civil-rights groups, and the state's regional coordinating councils (RCCs)—recently formed through the Statewide Mobility Management Program to coordinate human-service transportation services.

The MPO maintains an email list of TE contacts to provide them general information about the MPO and its planning processes, and give them information about topics and events of specific interest to the communities served by the TE program. During the past year and a half, staff has worked to increase significantly the number of valid contacts on this list.

Initial TE outreach for the LRTP began in fall 2014 with a series of public meetings to solicit comments on the MPO's revised Public Participation Plan (P3) and inform members of the public about the MPO's TE program. These meetings were held in areas with high concentrations of minority, low-income, and LEP residents, including Framingham, Lynn, Quincy, and the Fields Corner neighborhood of Dorchester in Boston. The focus of these meetings was to provide information about and solicit input on the P3, which describes the public involvement process for the LRTP and other major MPO documents and activities. These meetings set the stage for specific LRTP public engagement, as the P3 provides information about the LRTP development schedule and the types and timing of opportunities for participation. Subsequent email notifications to the TE contacts kept them apprised of all public meetings for the LRTP and MPO-sponsored meetings at which the LRTP was discussed. Chapter 2 (Public Participation - Public Outreach Methods section) discusses the public meetings and other outreach opportunities specifically for this LRTP.

Notices for all MPO-sponsored public meetings are routinely translated into the three languages, other than English, that are most frequently spoken in the MPO area: Spanish, Portuguese, and Chinese. P3 public meeting notices also were translated into Vietnamese because the Fields Corner meeting was held at the VietAID Center as part of the MPO's effort to forge closer ties with specific organizations as a way of facilitating communication with their constituent populations. Although the TE email list is good for reaching many groups quickly, MPO staff sees personal contact as a more effective way to foster meaningful engagement in the future.

TRANSPORTATION EQUITY AND THE PLANNING PROCESS

The MPO systematically integrates equity concerns into the transportation planning process in a number of ways. At the highest level, equity is part of the MPO's central vision statement, and therefore is reflected in the MPO's goals and objectives. Equity concerns are also integrated by considering feedback from all outreach activities, including TE outreach, and the ongoing public involvement that routinely occurs during development of the LRTP, TIP, UPWP, and other MPO studies.

In addition, equity is one of the factors the MPO considers when selecting studies for the UPWP, and it is integrated into the project selection criteria for the LRTP and TIP. Finally, as discussed below, staff performs equity analyses on the recommended projects in the draft LRTP to evaluate the effects on access, mobility, congestion, and air quality for TE populations, and determine whether the recommendations should be changed before a final LRTP is adopted.

TRANSPORTATION EQUITY ANALYSES

Demographic Analyses

The MPO analyzes demographic data to identify the geographic locations and concentration of protected populations. This is done to understand their transportation needs relative to existing and planned infrastructure, and to pinpoint areas where public outreach could be most beneficial and fruitful. For this LRTP, the analysis of benefits and burdens (equity analysis) was based on minority and low-income populations, as defined using federal guidance, census data, and geography.

GEOGRAPHIC LEVEL OF ANALYSIS

The MPO region is divided into 1,943 Transportation Analysis Zones (TAZs) for the purposes of forecasting travel behavior using the MPO's regional travel demand model set. 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 full geographic area covered by the MPO's travel demand model set, which also includes municipalities adjacent to the MPO's 101 cities and towns, comprises 2,727 TAZs.

Using TAZ geography and thresholds established through federal guidance, the MPO has developed demographic profiles that identify areas with concentrations of minority and low-income populations for analyzing benefits and burdens. The MPO has also developed demographic profiles for areas with concentrations of LEP residents, the elderly, and people with disabilities. However, the MPO has yet to develop thresholds for these populations to identify specific areas for the purposes of performing an equity analysis.

MINORITY AND LOW-INCOME THRESHOLDS

Minority Populations

The MPO uses the US Census Bureau's racial and ethnic minority group definitions to determine minority status in the region. The census defines non-minority as persons who identify as white and not Hispanic or Latino. Minorities include:

- American Indian/Alaskan Native
- Asian/Native Hawaiian/Other Pacific Islander
- Black/African American
- Another race or multiple races
- Hispanic/Latino of any race

The FTA Title VI circular (FTA C 4702.1B) defines a predominantly minority area as one where the proportion of minority persons residing in that area exceeds the average proportion of minority persons in the MPO region. Using this definition, a minority TAZ is one in which the minority population is greater than 27.8 percent.

Low-Income Populations

The FTA Title VI circular suggests that a low-income person be defined as one whose median household income is at or below the Department of Health and Human Services' poverty guidelines. However, the circular allows MPOs to develop their own definitions of low-income, as long as their thresholds meet or exceed the federal definition of low-income. The Boston Region MPO defines a low-income person as an individual living in a household with a median income that is less than or equal to 60 percent of the median household income in the MPO region. The MPO chose this threshold, which is higher than federal poverty guidelines, because the cost of living in the MPO region is higher than the national average.

According to the 2010 census, the median MPO household income was \$70,829. Therefore, using the MPO's definition, a low-income TAZ is one in which the average median household income is less than or equal to \$42,497.

Equity Analysis Zones

The MPO uses the above definitions to identify equity analysis zones—TAZs that meet the threshold for minority and/or low-income—as the basis for its analysis of the benefits and burdens of transportation programs and projects. Figure 7.1 shows the MPO's equity analysis zones, of which 11 percent are low-income TAZs, 33 percent are minority, and 10 percent are both low-income and minority. Also included are the locations of major infrastructure projects recommended in this LRTP. Investments like grounding McGrath

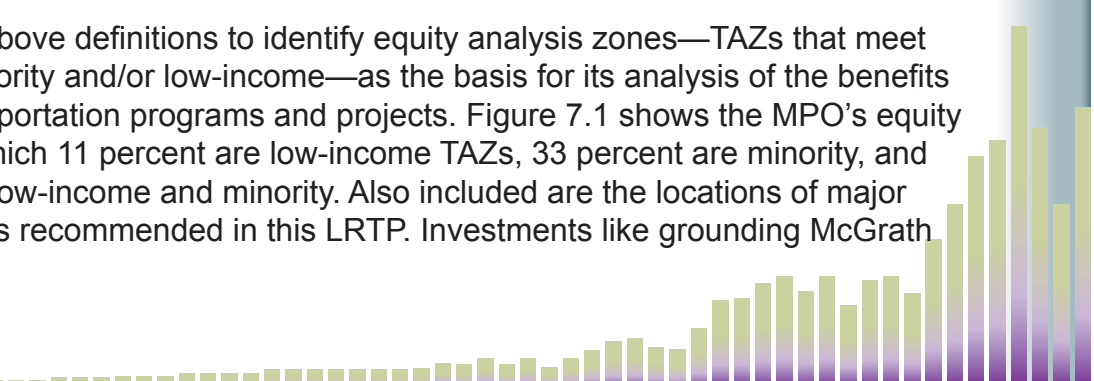
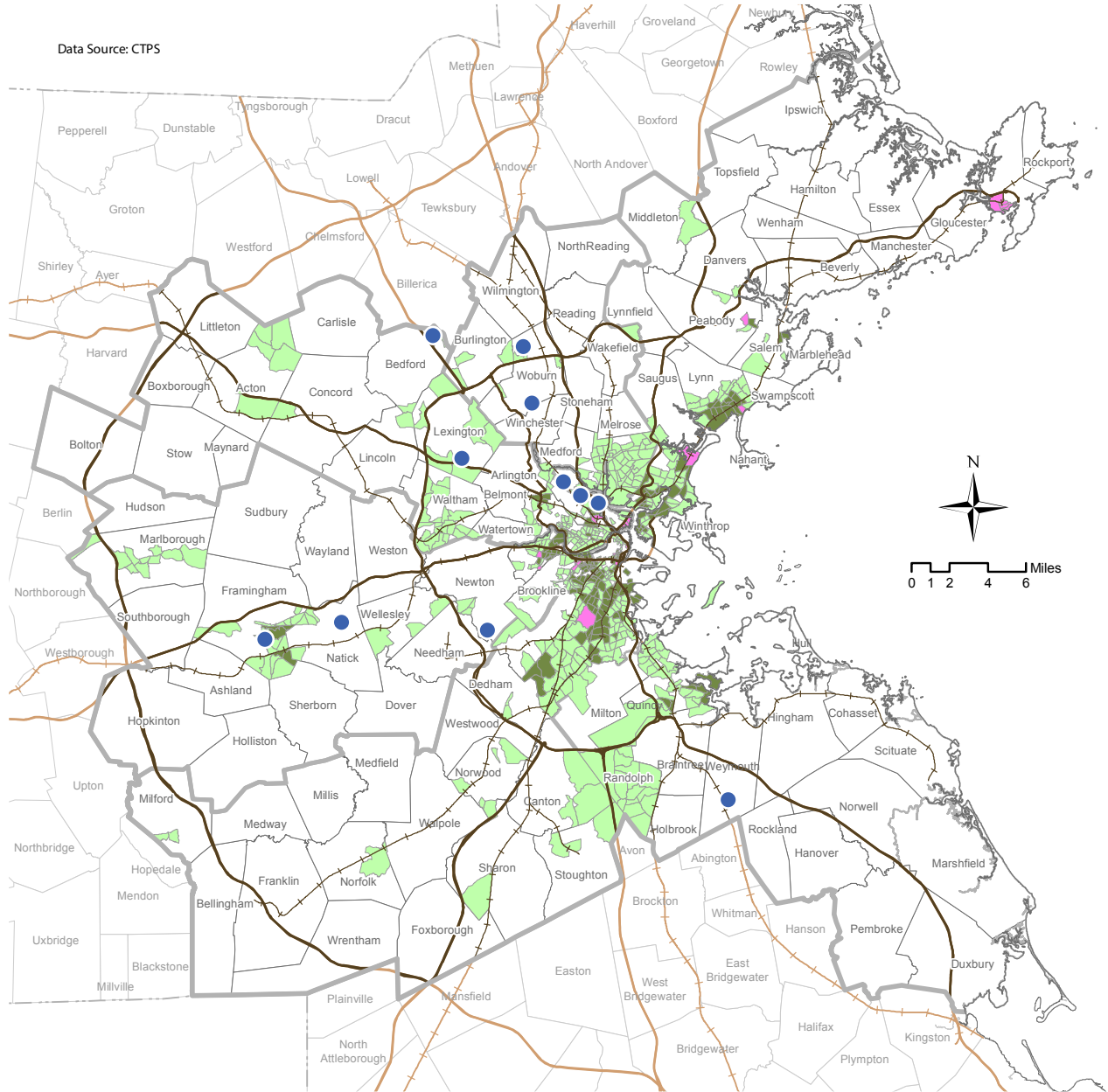


FIGURE 7.1
Equity Analysis Zones

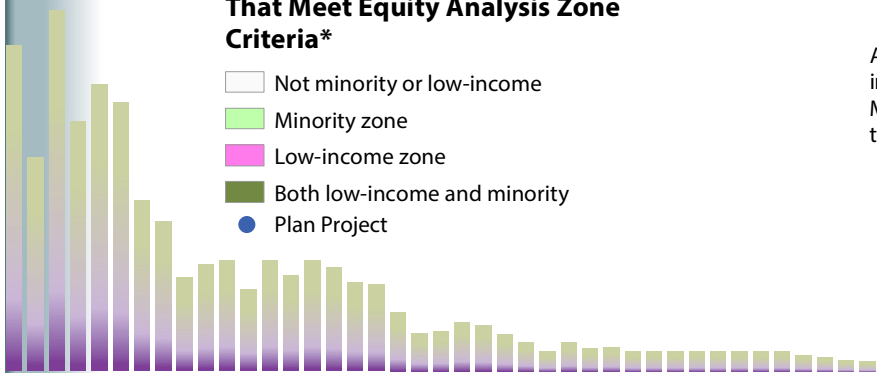


Transportation Analysis Zones (TAZs) That Meet Equity Analysis Zone Criteria*

- Not minority or low-income
- Minority zone
- Low-income zone
- Both low-income and minority
- Plan Project

***Criteria for Equity Analysis Zones under Title VI (2010 Data)**

A TAZ in which the median household income in 2010 was equal to or less than 60% of the MPO median of \$70,829 (\$42,497) or in which the 2010 population was more than 27.8% minority.



Highway in Somerville, reconstructing Rutherford Avenue in Boston, and improving Route 126 and Route 135 in Framingham will address MPO-identified transportation issues for equity populations. Grounding McGrath will help reconnect two transportation equity areas. Reconstructing Rutherford Avenue will improve community access to the Orange Line and bus terminal and will enhance bus operations. Improving Downtown Framingham will enhance MetroWest Regional Transit Authority service for many low-income and minority riders.

For the purposes of analyzing the transportation system in 2040, the MPO assumed that the distributions of equity analysis zones would remain unchanged, and that the population growth rate for these zones would be the same as that forecast by MAPC for the overall population of the region. Based on these demographic projections, staff used the regional travel demand model set to forecast the unique distributions of trip flows for the differing transportation networks in the 2040 No-Build and Build alternatives.

Measuring Impacts

To determine whether the benefits and burdens of projects, programs, and service are equitably distributed, the MPO has proposed a policy to measure the following types of disparities, in keeping with federal requirements:

- Disparate impact: a facially neutral policy or practice that disproportionately affects members of a group identified by race, color, or national origin, where the policy or practice lacks a substantial legitimate justification and where there exists one or more alternatives that would serve the same legitimate objectives, but with less disproportionate effects on the basis, of race, color, or national origin.
- Disproportionate burden: a neutral policy or practice that disproportionately affects low-income populations more than non-low income populations. A finding of disproportionate burden requires evaluation of alternatives and mitigation of burdens where practicable.

The MPO's proposed policy sets thresholds to distinguish an acceptable level of impact from a level of impact that has a meaningful effect for the factors analyzed. For LRTP equity analyses that are completed using the regional travel demand model set, the MPO has proposed the following thresholds:

- A disparate burden would exist if minority TAZs were projected to sustain more than 20 percent additional burden than nonminority TAZs. Therefore, a projected burden would be found if the analysis results for minority TAZs were more than 1.2 times the projected burden for nonminority TAZs.
- A disproportionate burden would exist if low-income TAZs were projected to sustain more than 20 percent additional burden than non-low-income TAZs. Therefore, a projected burden would be found if the analysis results for low-income TAZs were more than 1.2 times the projected burden for non-low-income TAZs.

- A disparate benefit would exist if minority TAZs were projected to receive less than 80 percent of the benefit that nonminority TAZs receive. Therefore, a projected benefit would be found if the analysis results for minority TAZs were more than 0.80 times the projected burden for nonminority TAZs.
- A disproportionate benefit would exist if low-income TAZs were projected to receive less than 80 percent of the benefits that non-low-income TAZs receive. Therefore, a projected benefit would be found if the analysis results for low-income TAZs were less than 0.80 times the projected burden for nonminority TAZs.

Staff proposed a 20 percent threshold based on the belief that a 10 percent differential would be meaningful, plus the model's 10 percent margin of error. The full disparate impact/disproportionate burden policy will undergo public review and comment before it is adopted by the MPO.

Equity Analysis Methods

MPO staff used the travel demand model to perform two types of equity analyses (discussed below) each of which calculated differences between the No-Build and Build¹ alternatives for equity analysis zones (minority TAZs and low-income TAZs) and the difference for non-equity analysis zones (nonminority TAZs and non-low-income TAZs). For each analysis, the rate of change from the No-Build to the Build alternatives was compared for minority versus nonminority TAZs to determine whether there was a disparate impact and for low- versus non-low-income TAZs to determine whether there was a disproportionate burden.

For the 2040 Build alternative, only major infrastructure projects (those on the recommended list of projects discussed in Chapter 5 and shown in Figure 7.1) were modeled. Specific projects in the O&M-type investment programs are not identified in the LRTP, as they will be selected through the TIP programming process. Because most bike and pedestrian improvements will be part of the O&M-type investment programs, they were not captured in the LRTP equity analysis. However, the TIP project-selection process seeks to minimize burdens and maximize benefits for protected populations, and many projects in the TIP go through the National Environmental Policy Act (NEPA) process, which includes an EJ evaluation.

ACCESSIBILITY ANALYSIS

For the purposes of this analysis, accessibility was based on both the ability to reach desired destinations and the ease of doing so. This analysis investigated the number of employment opportunities, health care facilities, and higher education facilities that could be reached from equity analysis zones and non-equity analysis zones along with average

¹ The No-Build alternative includes projects that are currently under construction, advertised for construction, or programmed in the first year of the 2015-2018 TIP. The Build alternative includes the projects that are recommended in this LRTP.

transit and highway travel times to these destinations. Analysis of transit travel times included destinations within a 40-minute transit trip, while analysis of highway travel times included destinations within a 20-minute auto trip.

Staff used the following factors to examine differences in accessibility between the 2040 No-Build network and the 2040 Build network:

- Average travel time to industrial, retail, and service jobs within a 40-minute transit trip and a 20-minute auto trip
- Number of industrial, retail, and service jobs within a 40-minute transit trip and a 20-minute auto trip
- Average travel time to hospitals, weighted by number of beds, within a 40-minute transit trip and a 20-minute auto trip
- Number of hospitals, weighted by number of beds, within a 40-minute transit trip and a 20-minute auto trip
- Average travel time to two- and four-year institutions of higher education, weighted by enrollment, within a 40-minute transit trip and a 20-minute auto trip
- Number of two- and four-year institutions of higher education, weighted by enrollment, within a 40-minute transit trip and a 20-minute auto trip

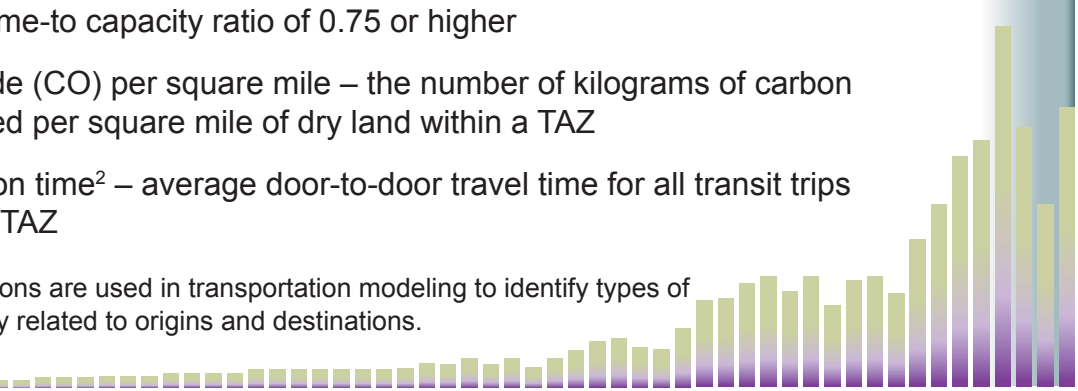
MOBILITY, CONGESTION, AND AIR-QUALITY ANALYSIS

For the purposes of this analysis, mobility is defined as the ability to move from place to place, and congestion is defined as the level at which transportation system performance becomes unacceptable because of traffic congestion. The MPO's mobility and congestion analysis focused on the average door-to-door travel time and average vehicle-miles traveled (VMT) under congested conditions. The air quality-analysis focused on carbon monoxide, a pollutant that results primarily from incomplete combustion of fossil fuels and accumulates in localized areas creating hot spots that negatively affect human health.

Staff used the following mobility, congestion, and air-quality factors in the equity analysis:

- VMT per square mile – number of vehicle-miles traveled (VMT) per square mile of dry land within a TAZ
- Congested VMT – the volume of vehicle-miles traveled within a TAZ on highway links with a volume-to capacity ratio of 0.75 or higher
- Carbon monoxide (CO) per square mile – the number of kilograms of carbon monoxide emitted per square mile of dry land within a TAZ
- Transit production time² – average door-to-door travel time for all transit trips produced in the TAZ

² Productions and attractions are used in transportation modeling to identify types of trip ends and are loosely related to origins and destinations.



- Highway production time – average door-to-door travel time for all highway trips produced in the TAZ
- Transit attraction time – average door-to-door travel time for all transit trips attracted to the TAZ
- Highway attraction time – average door-to-door travel time for all highway trips attracted to the TAZ

TRANSPORTATION EQUITY ANALYSIS RESULTS

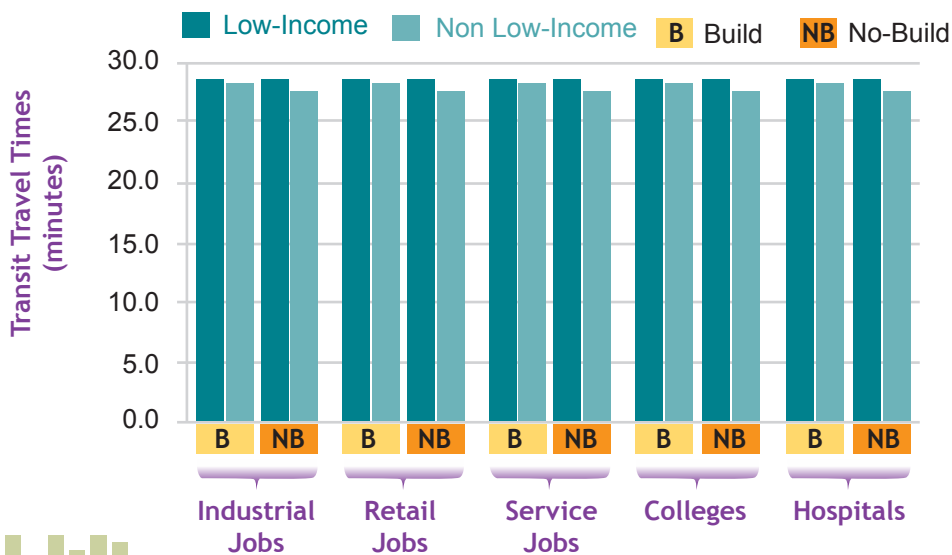
Accessibility Results

The accessibility analysis first compared the change in transit and highway travel times to various types of employment between the 2040 No-Build and Build alternatives for low-income, non-low-income, minority, and nonminority TAZs, respectively.

The second part of the accessibility analysis compared the ratio of the change from the 2040 No-Build to the Build alternative for low-income versus non-low-income TAZs to determine whether there was a disproportionate burden, and for minority versus nonminority TAZs to determine whether there was a disparate impact for each type of employment evaluated. The results of the accessibility analyses are illustrated in the following figures and tables.

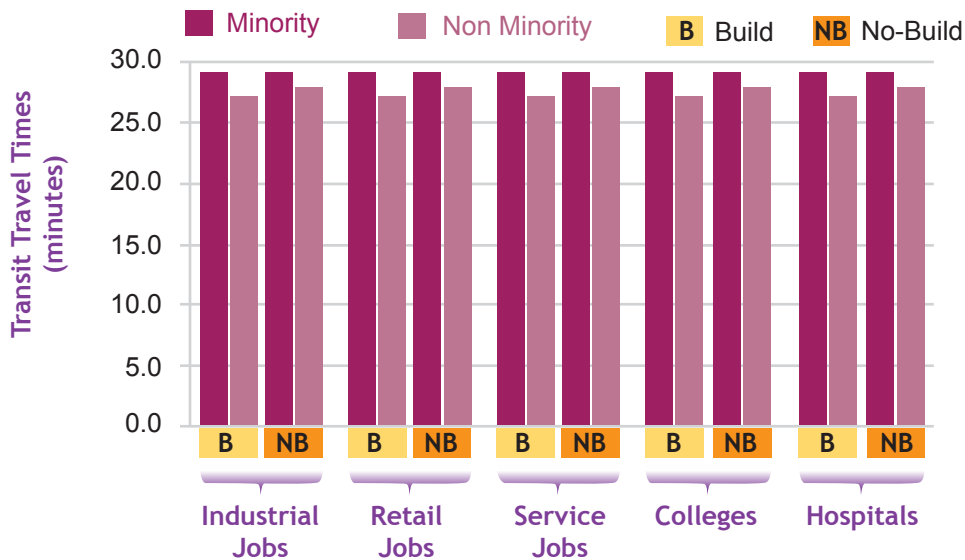
Figures 7.2 and 7.3 show that average transit travel times to employment destinations are lower for non-low-income and non-minority TAZs than for low-income and minority TAZs, respectively; but the changes for each type of equity analysis zone between the 2040 No-Build and Build alternatives are not statistically significant.

FIGURE 7.2
Average Transit Travel Times to Destinations for Equity Analysis Zones (Low-Income) in the 2040 No-Build and 2040 Build Networks



Source: Central Transportation Planning Agency.

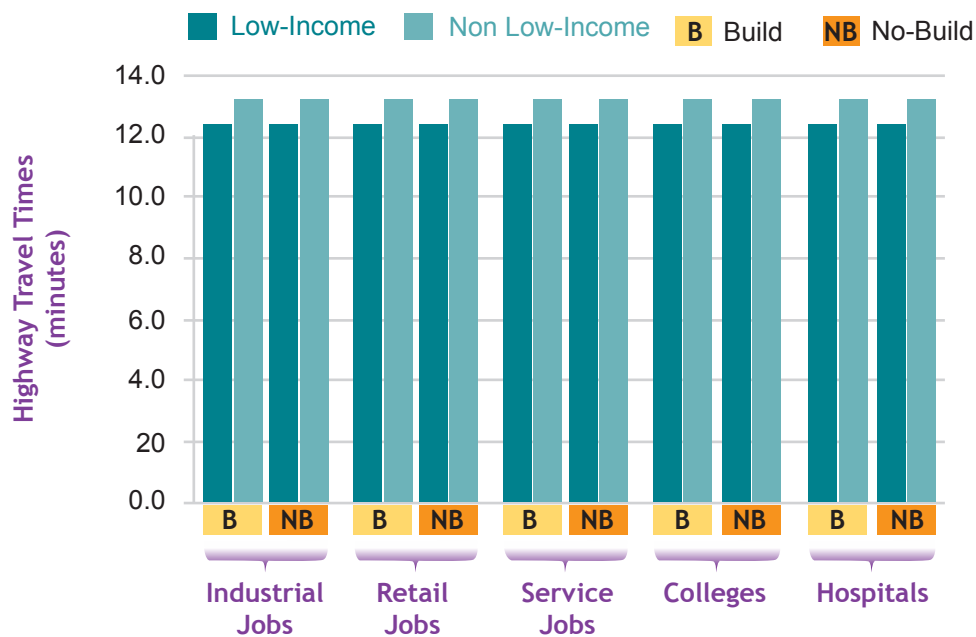
FIGURE 7.3
Average Transit Travel Times to Destinations for Equity Analysis Zones (Minority) in the 2040 No-Build and 2040 Build Networks



Source: Central Transportation Planning Agency.

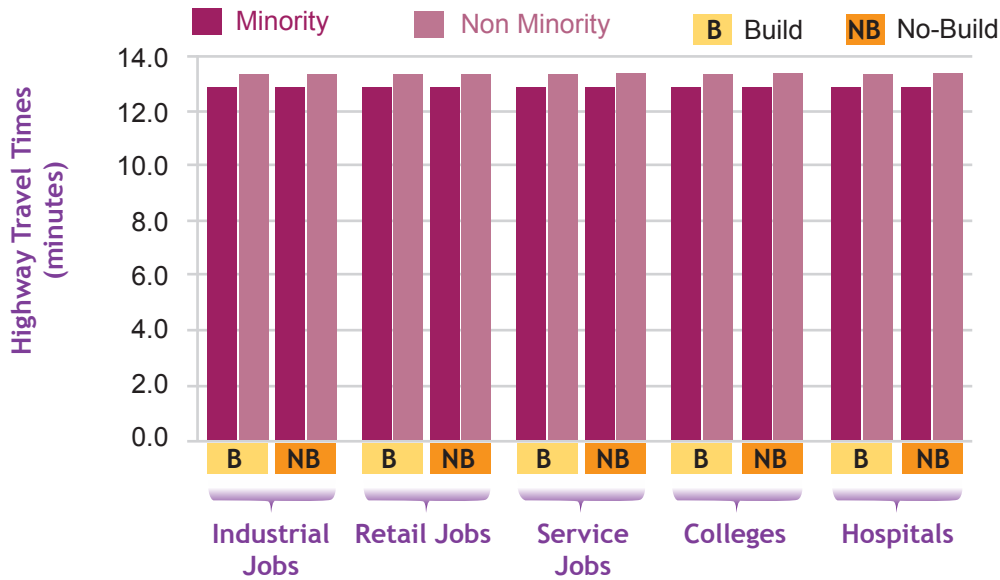
Figures 7.4 and 7.5 show that average highway travel times to employment destinations are slightly lower for low-income and minority TAZs than for non-low-income and non-minority TAZs, respectively, but the changes for each type of equity analysis zone between the 2040 No-Build and Build alternatives are not statistically significant.

FIGURE 7.4
Average Highway Travel Times to Destinations for Equity Analysis Zones (Low-Income) in the 2040 No-Build and 2040 Build Networks



Source: Central Transportation Planning Agency.

FIGURE 7.5
Average Highway Travel Times to Destinations for Equity Analysis Zones (Minority) in the 2040 No-Build and 2040 Build Networks



Source: Central Transportation Planning Agency.

Tables 7.1 and 7.2 show that there are neither disproportionate burdens nor disparate impacts in average transit and highway travel times to employment destinations, as all differences fall within the MPO’s disproportionate burden/disparate impact threshold.

TABLE 7.1
Benefits and Burdens Analysis for Average Transit Travel Times to Employment Destination Types

| | Industrial | | | Retail | | | Service | | |
|---|------------|-------|---------------------------|----------|-------|---------------------------|----------|-------|--|
| | No-Build | Build | Pct. Travel-Time Increase | No-Build | Build | Pct. Travel-Time Increase | No-Build | Build | Pct. Travel-Time Increase ^a |
| Population | | | | | | | | | |
| Low-Income | 28.7 | 28.7 | 0.0% | 28.7 | 28.7 | 0.0% | 28.7 | 28.7 | 0.0% |
| Non Low-Income | 28.3 | 28.3 | 0.0% | 28.3 | 28.3 | 0.0% | 28.3 | 28.3 | 0.0% |
| Ratio | -- | -- | 0.00 | -- | -- | 0.00 | -- | -- | 0.00 |
| Burden Threshold | -- | -- | -- | -- | -- | -- | -- | -- | >1.20 |
| Result: No Disproportionate Burden | | | | | | | | | |
| Population | | | | | | | | | |
| Minority | 29.1 | 29.1 | 0.0% | 29.1 | 29.1 | 0.0% | 29.1 | 29.1 | 0.0% |
| Non-Minority | 28.0 | 28.0 | 0.0% | 28.0 | 28.0 | 0.0% | 28.0 | 28.0 | 0.0% |
| Ratio | -- | -- | 0.00 | -- | -- | 0.00 | -- | -- | 0.00 |
| Burden Threshold | -- | -- | -- | -- | -- | -- | -- | -- | >1.20 |
| Result: No Disparate Impact | | | | | | | | | |

^aAll changes are within the model’s margin of error.

Source: Central Transportation Planning Agency.

TABLE 7.2
Benefits and Burdens Analysis for Average Highway Travel Times to
Employment Destination Types

| | Pct. Travel-Time Increase | | | Pct. Travel-Time Increase | | | Pct. Travel-Time Increase ^a | | |
|---|---------------------------|-------|------|---------------------------|-------|------|--|-------|-------|
| | No-Build | Build | | No-Build | Build | | No-Build | Build | |
| | Industrial | | | Retail | | | Service | | |
| Population | | | | | | | | | |
| Low-Income | 12.4 | 12.4 | 0.0% | 12.4 | 12.4 | 0.0% | 12.4 | 12.4 | 0.0% |
| Non Low-Income | 13.2 | 13.2 | 0.0% | 13.2 | 13.2 | 0.0% | 13.2 | 13.2 | 0.0% |
| Ratio | -- | -- | 0.00 | -- | -- | 0.00 | -- | -- | 0.00 |
| Burden Threshold | -- | -- | -- | -- | -- | -- | -- | -- | >1.20 |
| Result: No Disproportionate Burden | | | | | | | | | |
| Population | | | | | | | | | |
| Minority | 12.9 | 12.9 | 0.0% | 12.9 | 12.9 | 0.0% | 12.9 | 12.9 | 0.0% |
| Non-Minority | 13.3 | 13.3 | 0.0% | 13.3 | 13.3 | 0.0% | 13.3 | 13.3 | 0.0% |
| Ratio | -- | -- | 0.00 | -- | -- | 0.00 | -- | -- | 0.00 |
| Burden Threshold | -- | -- | -- | -- | -- | -- | -- | -- | >1.20 |
| Result: No Disparate Impact | | | | | | | | | |

^aAll changes are within the model's margin of error
Source: Central Transportation Planning Agency.

Mobility and Congestion Results

The mobility and congestion analyses first compared the change in average door-to-door travel time, congested VMT, and VMT per square mile for all transit and highway trips produced in, or attracted to, equity analysis zones between the 2040 No-Build and Build alternatives for low-income, non-low-income, minority, and nonminority TAZs, respectively.

The second part of the mobility and congestion analysis compared the ratio of the change from the 2040 No-Build to the Build alternatives for low- versus non-low-income TAZs to determine whether there was a disproportionate burden, and for minority versus nonminority TAZs to determine whether there was a disparate impact for each of the factors evaluated. The results of the mobility and congestion analyses are illustrated in the following figures and tables.

Figures 7.6 and 7.7 show that average transit and highway travel times for attractions and productions are shorter for low-income and minority TAZs than for non-low-income and non-minority TAZs, respectively, in both alternatives; but the changes for each type of equity analysis zone between the 2040 No-Build and Build alternatives are not statistically significant.

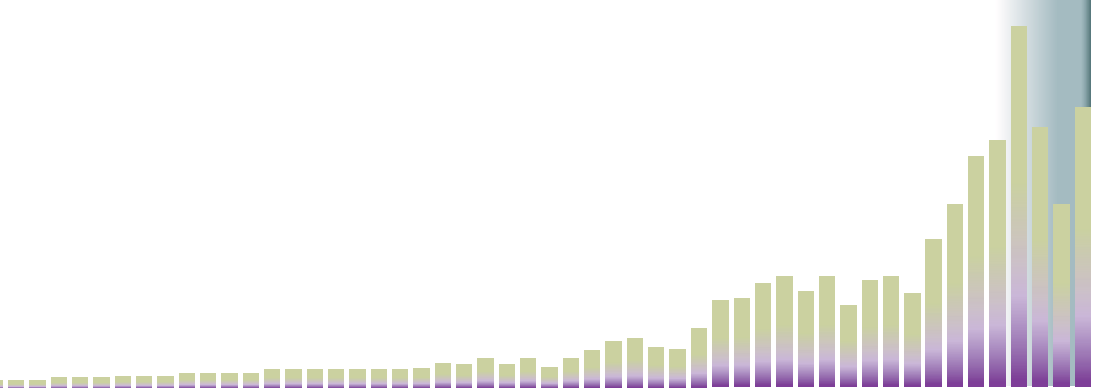
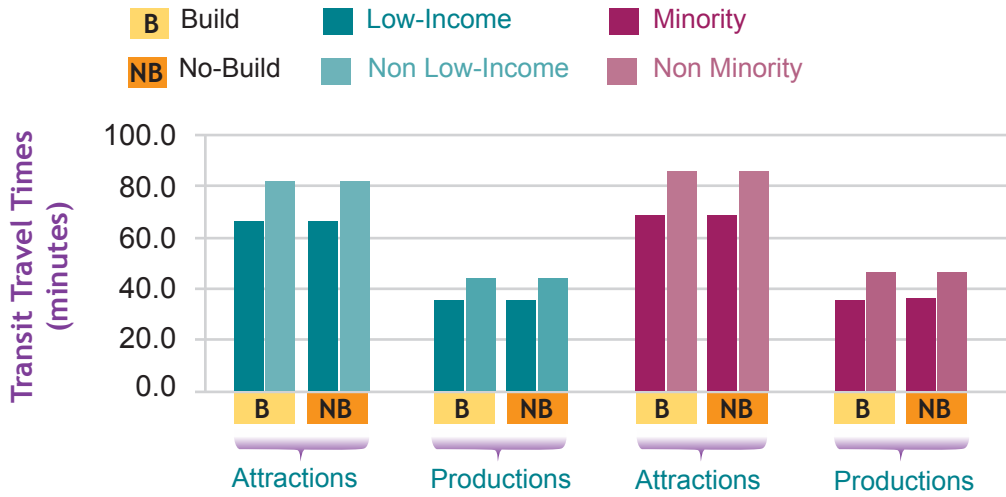
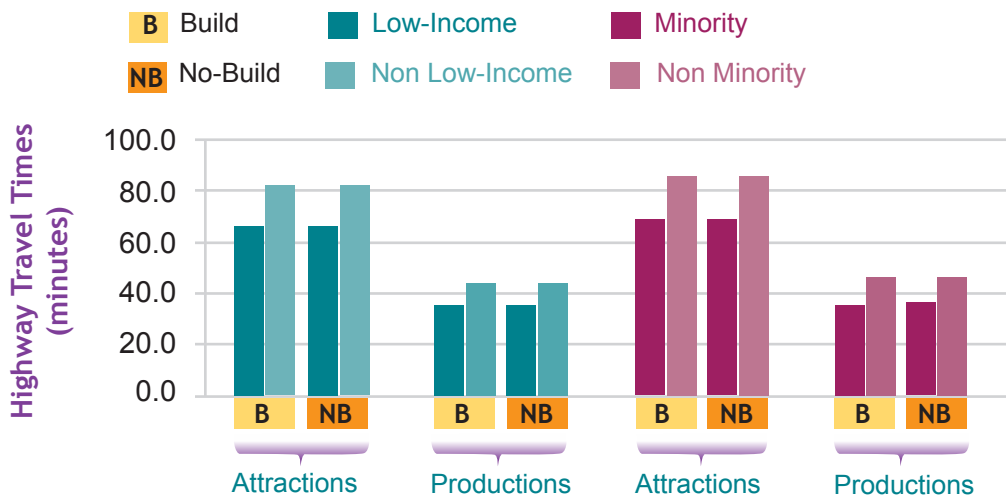


FIGURE 7.6
Average Transit Travel Times for Equity Analysis Zones in the 2040
No-Build and 2040 Build Networks



Source: Central Transportation Planning Agency.

FIGURE 7.7
Average Highway Travel Times for Equity Analysis Zones in the 2040
No-Build and 2040 Build Networks



Source: Central Transportation Planning Agency.

Tables 7.3 and 7.4 show that there are neither disproportionate burdens nor disparate impacts in average transit and highway travel times.

TABLE 7.3
Benefits and Burdens Analysis for Average Transit Travel Time

| | No-Build | Build | No-Build | Build | Percentage Travel-Time Increase ^a |
|---|-------------|-------|-------------|-------|--|
| | Attractions | | Productions | | |
| Population | | | | | |
| Low-Income | 63.8 | 65.0 | 34.3 | 35.0 | 1.8% |
| Non Low-Income | 74.0 | 75.2 | 39.8 | 40.5 | 1.6% |
| Ratio | | | | | 1.14 |
| Burden Threshold | | | | | >1.20 |
| Result: No Disproportionate Burden | | | | | |
| Population | | | | | |
| Minority | 66.4 | 67.6 | 35.8 | 36.4 | 1.8% |
| Non-Minority | 76.1 | 77.3 | 41.0 | 41.6 | 1.6% |
| Ratio | | | | | 1.15 |
| Burden Threshold | | | | | >1.20 |
| Result: No Disparate Impact | | | | | |

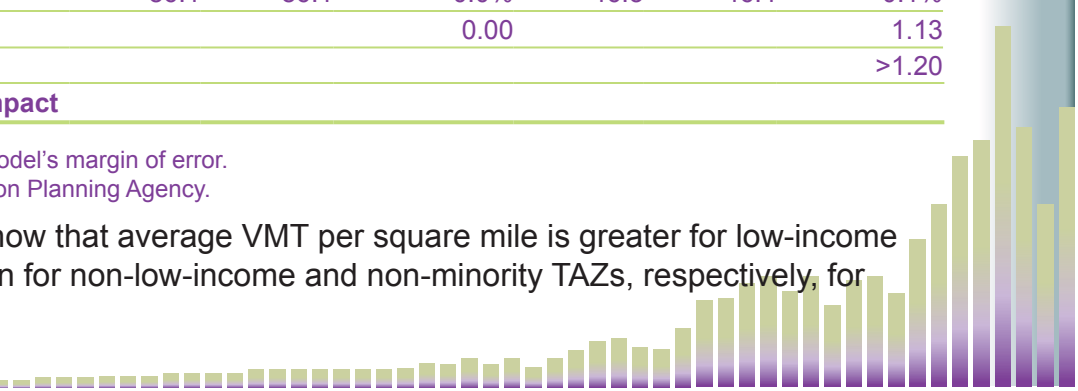
^aAll changes are within the model's margin of error.
Source: Central Transportation Planning Agency.

TABLE 7.4
Benefits and Burdens Analysis for Average Highway Travel Time

| | No-Build | Build | Percentage Travel-Time Increase | No-Build | Build | Percentage Travel-Time Increase ^a |
|---|-------------|-------|---------------------------------|-------------|-------|--|
| | Attractions | | | Productions | | |
| Population | | | | | | |
| Low-Income | 66.4 | 66.5 | 0.0% | 35.7 | 35.8 | 0.0% |
| Non Low-Income | 82.2 | 82.3 | 0.1% | 44.2 | 44.3 | 0.1% |
| Ratio | | | 0.35 | | | 0.35 |
| Burden Threshold | | | | | | >1.20 |
| Result: No Disproportionate Burden | | | | | | |
| Population | | | | | | |
| Minority | 69.5 | 69.5 | 0.0% | 35.8 | 36.4 | 1.8% |
| Non-Minority | 86.1 | 86.1 | 0.0% | 46.3 | 46.4 | 0.1% |
| Ratio | | | 0.00 | | | 1.13 |
| Burden Threshold | | | | | | >1.20 |
| Result: No Disparate Impact | | | | | | |

^aAll changes are within the model's margin of error.
Source: Central Transportation Planning Agency.

Figures 7.8 and 7.9 show that average VMT per square mile is greater for low-income and minority TAZs than for non-low-income and non-minority TAZs, respectively, for



both alternatives, and that average congested VMT is less for low-income and minority TAZs than for non-low-income and non-minority TAZs, respectively, for both alternatives. However, the changes for each type of equity analysis zone between the 2040 No-Build and Build alternatives are not statistically significant.

FIGURE 7.8
Average VMT for Equity Analysis Zones in the 2040 No-Build and 2040 Build Networks



Source: Central Transportation Planning Agency.

FIGURE 7.9
Average Congested Vehicle Miles Traveled for Equity Analysis Zones in the 2040 No-Build and 2040 Build Networks



Source: Central Transportation Planning Agency.

Tables 7.5 and 7.6 show disproportionate burdens and disparate impacts for average VMT, and a disproportionate burden for congested VMT. However, because the changes between the 2040 No-Build and Build alternatives for each type of equity/non-equity analysis zone comparison are within the margin of error of the model, it is unlikely that the ratio of the changes is meaningful.

The MPO will carefully monitor these possible burdens and impacts over time and, if necessary, address them at the program level through the TIP project selection process and equity analyses.

TABLE 7.5
Average Vehicle Miles Traveled

| | No-Build | Build | Percentage Increase ^a |
|--|----------|---------|----------------------------------|
| Population | | | |
| Low-Income | 261,156 | 263,048 | 0.72% |
| Non Low-Income | 146,043 | 145,905 | -0.09% |
| Ratio | | | -7.66 |
| Burden Threshold | | | >1.20 |
| Result: Disproportionate Burden^b | | | |
| Population | | | |
| Minority | 196,710 | 197,452 | 0.38% |
| Non-Minority | 139,224 | 138,973 | -0.18% |
| Ratio | | | -2.09 |
| Burden Threshold | | | >1.20 |
| Result: Disparate Impact^b | | | |

^aAll changes are within the model's margin of error.

^bBecause the changes themselves are within the margin of error of the model, this comparison probably does not show a meaningful difference.

Source: Central Transportation Planning Agency.

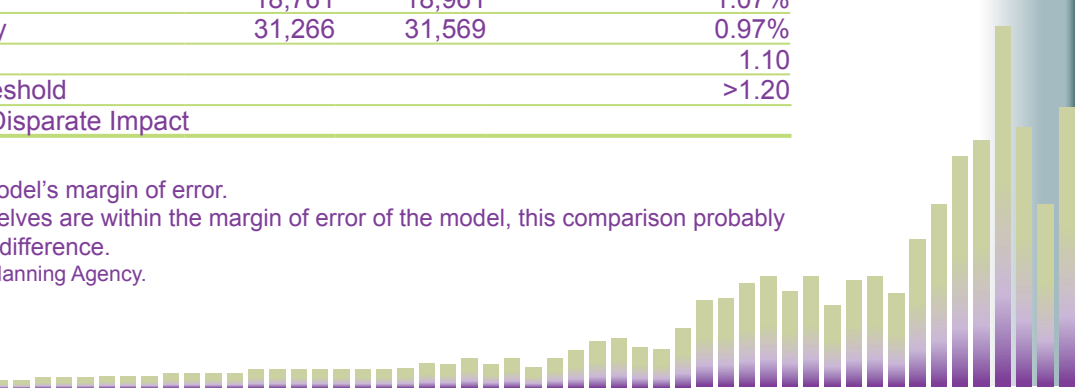
TABLE 7.6
Benefits and Burdens Analysis for Congested Vehicle Miles Travelled

| | No-Build | Build | Percentage Increase ^a |
|--|----------|--------|----------------------------------|
| Population | | | |
| Low-Income | 12,493 | 12,832 | 2.72% |
| Non Low-Income | 28,843 | 29,103 | 0.90% |
| Ratio | | | 3.01 |
| Burden Threshold | | | >1.20 |
| Result: Disproportionate Burden^b | | | |
| Population | | | |
| Minority | 18,761 | 18,961 | 1.07% |
| Non-Minority | 31,266 | 31,569 | 0.97% |
| Ratio | | | 1.10 |
| Burden Threshold | | | >1.20 |
| Result: No Disparate Impact | | | |

^aAll changes are within the model's margin of error.

^bBecause the changes themselves are within the margin of error of the model, this comparison probably does not show a meaningful difference.

Source: Central Transportation Planning Agency.



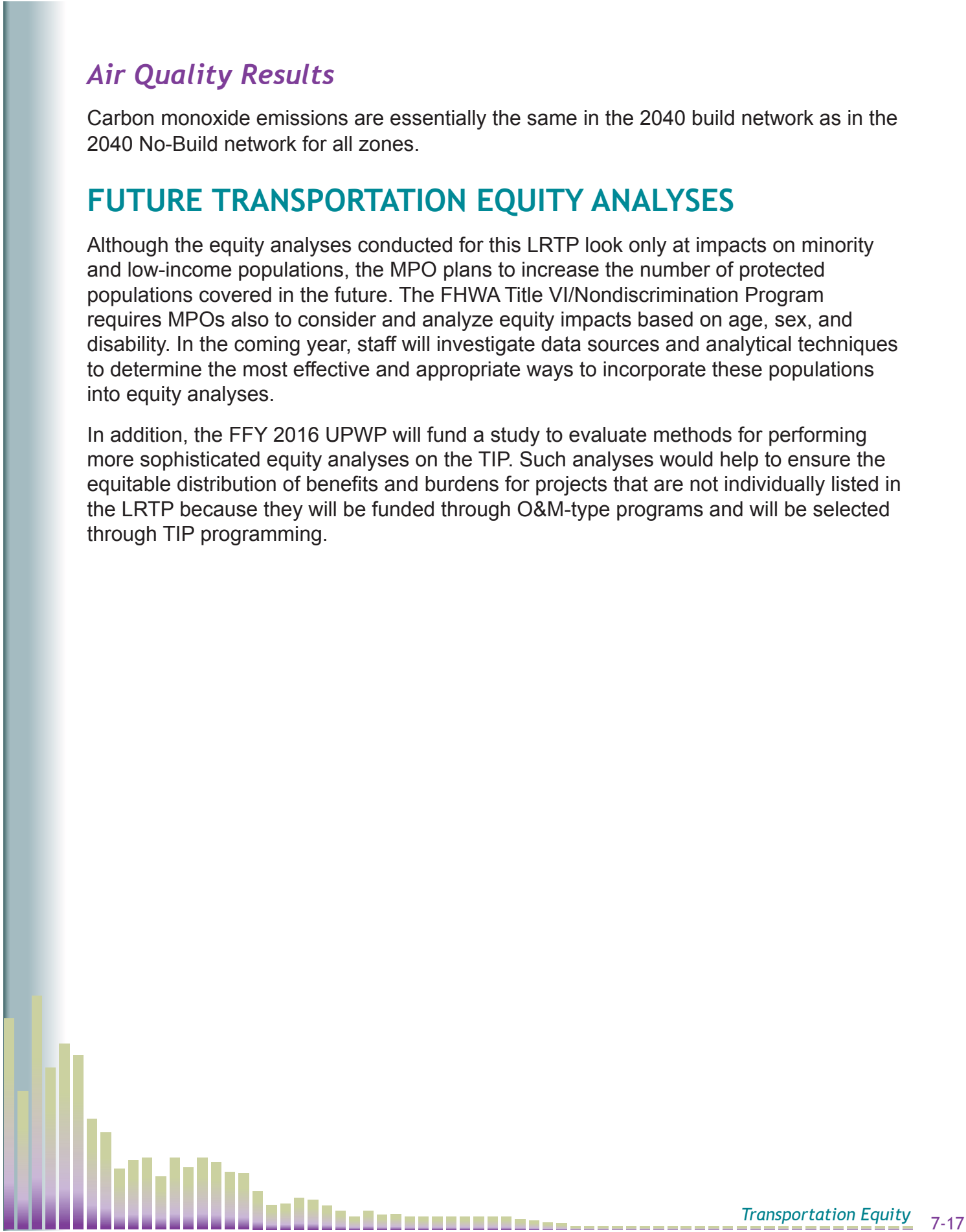
Air Quality Results

Carbon monoxide emissions are essentially the same in the 2040 build network as in the 2040 No-Build network for all zones.

FUTURE TRANSPORTATION EQUITY ANALYSES

Although the equity analyses conducted for this LRTP look only at impacts on minority and low-income populations, the MPO plans to increase the number of protected populations covered in the future. The FHWA Title VI/Nondiscrimination Program requires MPOs also to consider and analyze equity impacts based on age, sex, and disability. In the coming year, staff will investigate data sources and analytical techniques to determine the most effective and appropriate ways to incorporate these populations into equity analyses.

In addition, the FFY 2016 UPWP will fund a study to evaluate methods for performing more sophisticated equity analyses on the TIP. Such analyses would help to ensure the equitable distribution of benefits and burdens for projects that are not individually listed in the LRTP because they will be funded through O&M-type programs and will be selected through TIP programming.





8

AIR-QUALITY CONFORMITY DETERMINATION AND GREENHOUSE GAS ANALYSIS

INTRODUCTION

This chapter presents information about the air quality analyses that are required by both federal and state legislation. The first section discusses analysis results of the air-quality conformity determination for projects in the LRTP, as required by federal regulations (40 CFR Part 93) and Massachusetts Conformity Regulations (310 CMR 60.03). It specifically addresses carbon monoxide emissions in the required maintenance area (see description below). The second section outlines the legislation and regulations requiring carbon dioxide (CO₂) emission reductions by the MPO as required by the Massachusetts Global Warming Solutions Act and its requirements for the Transportation Sector and the Massachusetts Department of Transportation (310 CMR 60.05). It specifically addresses emissions of carbon dioxide at the state level.

AIR-QUALITY CONFORMITY DETERMINATION

Introduction

The 1990 Clean Air Act Amendments (CAAA) require metropolitan planning organizations within nonattainment and maintenance areas to perform air-quality conformity determinations prior to the approval of LRTPs and TIPs, and at such other times as required by regulation. A nonattainment area is one that the United States Environmental Protection Agency (EPA) has designated as not meeting certain air-quality standards. A maintenance area is a nonattainment area that now meets the standards and has been redesignated as maintaining the standard. A conformity determination is a demonstration that a region's plans, programs, and projects are consistent with the State Implementation Plan (SIP) for attaining the air-quality standards. The CAAA requirement to perform a conformity determination ensures that federal approval and funding go to transportation activities that are consistent with air-quality goals. In addition to containing analyses of the air-quality conformity determination for the projects in the LRTP, this section also includes the regulatory framework, conformity requirements, planning assumptions, mobile-source emission budgets, and conformity consultation procedures related to the determination.

LEGISLATIVE BACKGROUND

The 1970 Clean Air Act defined a one-hour national ambient air-quality standard (NAAQS) for ground-level ozone. The 1990 CAAA further classified degrees of nonattainment of the one-hour standard based on the severity of monitored levels of the pollutant. The entire commonwealth of Massachusetts was classified as being in serious nonattainment for the one-hour ozone standard, with a required attainment date of 1999; this was later extended first to 2003, then to 2007.

In 1997, the EPA proposed a new, eight-hour ozone standard to replace the one-hour standard, effective June 15, 2005. Research shows that ozone can affect human health at lower levels than previously thought, and for longer exposure times than one hour. The new standard was challenged in court, and after a lengthy legal battle; the courts upheld the standard, which was finalized in June 2004. The eight-hour standard is 0.08 parts per million (ppm), averaged over eight hours and not to be exceeded more than once per year. Nonattainment areas were again further classified based on the severity of eight-hour values. Massachusetts as a whole was classified as being in moderate nonattainment for the eight-hour standard, but it was separated into two nonattainment areas—Eastern Massachusetts and Western Massachusetts.

The Eastern Massachusetts Ozone Nonattainment Area included all of Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Suffolk, and Worcester counties. Because of this nonattainment classification, the CAAA required the Commonwealth to reduce its emissions of volatile organic compounds (VOCs) and nitrogen oxides (NOx), the two major precursors of ozone formation, to achieve attainment of the eight-hour ozone standard by 2009.

In addition, on April 1, 1996, the cities of Boston, Cambridge, Chelsea, Everett, Malden, Medford, Quincy, Revere, and Somerville were classified as being in attainment for carbon monoxide (CO) emissions. As part of the LRTP, an air-quality conformity analysis still must be completed for these communities, as they have a carbon monoxide maintenance plan approved as part of the SIP. The 2010 CO motor-vehicle emission budget established for the Boston CO attainment area with a maintenance plan is 228.33 tons of CO per winter day.

As of April 22, 2002, the community of Waltham was re-designated as being in attainment for CO, with an EPA-approved limited-maintenance plan. In areas that have approved limited-maintenance plans, federal actions requiring conformity determinations under the transportation conformity rule are considered to satisfy the “budget test” (since budgets are not treated as being constraining in these areas for the length of the initial maintenance period). Any requirements for future “project-level” conformity determinations for projects located within this community will continue to use a “hot-spot” analysis to ensure that any new transportation projects in this CO attainment area do not cause or contribute to CO nonattainment.

In March 2008, EPA published revisions to the eight-hour ozone NAAQS that established a level of 0.075 ppm in the Federal Register (FR) (March 27, 2008; 73 FR 16483). In 2009, the EPA announced it would reconsider this standard because it fell outside of the range recommended by the Clean Air Scientific Advisory Committee. However, the EPA never took final action on the reconsideration so the standard would remain at 0.075 ppm. After reviewing data from Massachusetts monitoring stations, the EPA sent a letter on December 16, 2011, proposing that only Dukes County would be designated as being in nonattainment for the new, proposed 0.075 ozone standard. Massachusetts concurred with these findings.



On Monday, May 21, 2012, the final rule (77 FR 30088) was published in the Federal Register, defining the 2008 NAAQS at 0.075 ppm, the standard that was promulgated in March 2008. A second rule (77 FR 30160), published on May 21, 2012, revoked the 1997 ozone NAAQS, which was to become effective one year after the 2008 NAAQS became effective (July 20, 2012). Also on Monday, May 21, 2012, the air-quality designation areas for the 2008 NAAQS were published in the Federal Register. In this Federal Register, the only area in Massachusetts that was designated as being in nonattainment for ozone was Dukes County. All other counties were classified as unclassifiable/attainment. Therefore, the Boston Region MPO is not required to perform a conformity determination for ozone for this LRTP.

All the Massachusetts MPOs and MassDOT continue to meet the requirements of air quality conformity according to the Code of Federal Regulations, and as evaluated through inter-agency consultation. Specifically:

On March 6, 2015, (80 FR 12264, effective April 6, 2015) EPA published the Final Rulemaking, "Implementation of the 2008 National Ambient Air Quality Standards (NAAQS) for Ozone: State Implementation Plan Requirements; Final Rule." This rulemaking removed transportation conformity to the 1997 Ozone NAAQS (the standard was the subject of a 12/23/14 DC Circuit Court decision).

Link to Final EPA Rulemaking: <http://www.gpo.gov/fdsys/pkg/FR-2015-03-06/pdf/2015-04012.pdf>

Since the RTPs have been developed, reviewed, and will be approved after April 6, 2015, air quality conformity determinations to the 1997 Ozone NAAQS are no longer required, as those standards and all associated area designations have been permanently

replaced by the 2008 NAAQS, which (with actually a stricter level of allowable ozone concentration than the 1997 standards) no longer designate Massachusetts as a non-attainment area(s) for ozone except for Dukes County as discussed above.

Through the Interagency air quality consultation process (involving U.S. DOT, EPA, DEP, MassDOT, and the MPOs) the latest EPA rulemakings, the referenced court decision, ozone standards and area designations were all reviewed. Specific transportation conformity requirements in Massachusetts for this LRTP are as follows:

- No conformity determination is required for the 2008 Ozone NAAQS, as Dukes County (the only designated non-attainment area) is classified as an “isolated rural nonattainment area” and therefore only needs to evaluate transportation conformity when the Martha Vineyard Commission has a “regionally significant” project that would trigger conformity.
- The Boston carbon monoxide attainment area with a current maintenance plan in place (with a carbon monoxide motor vehicle emission budget) will prepare a carbon monoxide air quality analysis for the Boston Area (see below).
- The Lowell, Waltham, Worcester and Springfield Areas are classified attainment with a limited maintenance plan in place. No regional air quality analysis is required in limited maintenance plan areas as emissions may be treated as essentially not constraining for the length of the maintenance period because it is unreasonable to expect that such areas will experience so much growth in that period that a violation of the carbon monoxide NAAQS would result. Therefore, in areas with approved limited maintenance plans, Federal actions requiring conformity determinations under the transportation conformity rule are considered to satisfy the “budget test.” All other transportation conformity requirements under 40 CFR 93.109(b) continue to apply in limited maintenance areas, including project level conformity determinations based on carbon monoxide hot spot analyses under 40 CFR 93.116.

In addition, the MPO is required to implement the SIP’s transportation control measures (for example, the Central Artery/Tunnel (CA/T) project mitigation commitments).

In consideration of the comments received during the public comment period of this LRTP, combined with MassDOT’s greenhouse gas (GHG) reporting requirements for the Commonwealth’s Global Warming Solutions Act (310 CMR 60.05), MassDOT will conduct a “conformity-related” emissions analysis for ozone precursors, consistent with the 1997 NAAQS standards (currently superseded by the 2008 NAAQS). This emissions analysis will be for informational purposes only (as it is currently NOT federally required), and will be contained in a separate air quality document (also to include GHG emissions analysis, as discussed below) that will be completed at the end of August 2015 – the results of which will then be available to the MPOs, the Massachusetts Executive Office of Energy and Environmental Affairs (and affiliate agencies), and all other interested parties.

CONFORMITY REGULATIONS

Designated MPOs are required to perform conformity determinations by nonattainment or maintenance area for their LRTPs and TIPs. Section 176 of the CAAA defines conformity to a SIP as conforming to the plan's purpose of eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of standards. Regarding the activities outlined in the LRTP and TIP, the Boston Region MPO must certify that no activity will:

- Cause or contribute to any new violation of any standard in any area
- Increase the frequency or severity of any existing violation of any standard in any area
- Delay the timely attainment of any standard or any required interim emission reductions or other milestones in any area

The EPA issued final conformity regulations in the November 24, 1993, Federal Register, and the Massachusetts Department of Environmental Protection (DEP) issued conformity regulations that became effective December 30, 1994. They stated requirements for determining conformity of LRTPs, TIPs, and individual projects. The federal conformity regulations were amended several times through August 2010. Components of the required conformity analysis are listed below and are explained in detail subsequently.

- Conformity Criteria
- Horizon years
- Latest planning assumptions
- Latest emission model used
- Timely implementation of transportation control measures (TCMs)
- Conformity in accordance with consultation procedures and SIP revisions
- Public participation procedures
- Financially constrained document

Procedures for Determining Regional Transportation Emissions: The Conformity Test

The conformity test must be consistent with emission budgets described in the SIP. This conformity determination will show the LRTP's consistency with the CO emission budget for the Boston, Cambridge, Chelsea, Everett, Malden, Medford, Quincy, Revere, and Somerville maintenance areas.

Conformity Determination Criteria

This conformity determination has been prepared in accordance with 40 CFR Part 93, Transportation Conformity Rule Amendments: Flexibility and Streamlining: Final Rule. It shows that the LRTP has been prepared following all guidelines and requirements of the Rule.

HORIZON YEAR REQUIREMENTS

The horizon years for regional model analysis were established to comply with 40 CFR 93.106(a) of the Federal Conformity Regulations. Listed below are the years for which emissions are calculated:

- 2020 – Milestone Year and Analysis Year: Used to show conformity with the CO budget in the Boston nonattainment area
- 2030 – Analysis Year
- 2040 – Horizon Year: Last forecast year of the LRTP

LATEST PLANNING ASSUMPTIONS

Section 93.110 of the Federal Conformity Regulations outlines requirements for the most recent planning assumptions that must be in place at the time of conformity determination. Assumptions must be derived from current estimates and future projections of population, household, employment, travel, and congestion data developed by the MPO staff. Analysis for the LRTP is based on US census data and information obtained from MAPC, MassDOT, and other sources. Listed below are the sources of data used for model calibration in this analysis:

- Population, households, and household size: Year 2010 data at a community level received from the US Census Bureau. Community to TAZ-level distribution is based on Census 2010 allocation.
- Employment: MAPC purchased employment data from a commercial vendor, InfoUSA, and shared it with CTPS. InfoUSA uses a firm-based, multi-tiered, serial collection and update method. The InfoUSA 2010 dataset represented a base upon which CTPS built an employment database referred to as the Eastern Massachusetts Site-Level Employment Database for 2010. CTPS classifies employment data into three types: basic, retail, and service.
- Household income, resident workers, and vehicle ownership: Data was obtained from Summary File 3 data for Massachusetts from the 2010 US Census of Population and Housing.
- Household workers: 2010 data were obtained from Census Transportation Planning Package Part 1 for Massachusetts from the 2010 US Census of Population and Housing.

- Traffic volumes: Roadway volume counts and some speed data have been collected. Highway traffic volume data is obtained from MassDOT 2010 Traffic Volumes for the Commonwealth of Massachusetts. Traffic counts taken for external stations and screen lines were used.
- Population, household, and employment forecasts: Population, households and employment by type are major inputs to the future-year travel-model process, as they are variables upon which trip generation is based. The land-use scenario for the forecast years is developed in cooperation with MAPC and MassDOT. Forecasts of households and employment for 101 cities and towns in the Boston Region MPO and for the 63 cities and towns outside of the Boston Region MPO were developed by MAPC in close coordination with MassDOT. An assumption using these forecasts seeks to channel regional growth and development by targeting the majority of growth to denser areas with already available water, sewer, and transit infrastructure. This scenario assumes that a greater percentage of residents will be living within walking distance of transit facilities and major activity centers.
- Project-level data: Obtained from the responsible implementing agency.

TRANSIT SERVICE POLICY ASSUMPTIONS

The transit service assumptions used in ridership modeling for the LRTP were based on MBTA service in the spring of 2012. The model calibration was performed using the following data:

- Ridership and Service Statistics, MBTA Blue Book, 2012
- MBTA Systemwide Passenger Survey, 2008–09

EMISSION INVENTORY ASSUMPTIONS

For the LRTP, conformity is determined in relation to the SIP mobile-source CO emission projections that have been set for the nine cities in the Boston area that are classified as being in attainment for CO. An emissions attainment inventory for CO of 501.53 tons per winter day was established for all sources of CO emissions (mobile, industrial, and all other sources) for the re-designation year 1993. Of the 501.53 tons, 305.43 tons per winter day were allocated for mobile sources. In addition to the attainment year inventory, the EPA required that emissions projections for every five years through 2010 be developed for all sources to ensure that the combination of all CO emissions would not exceed the 501.53 tons per winter day maximum allowance in the future. The mobile-source emissions projection of 228.33 tons per winter day was set for 2010. Emissions from those nine towns in the Boston area may not exceed the amount in the last year of the maintenance plan (2010).

The Boston Region MPO estimated results for the nine towns collectively using the Boston Region MPO's regional travel demand model set, based on the latest planning assumptions for the conformity analysis.

LATEST EMISSIONS MODEL

Factors used for calculating emissions changes were determined using the EPA's latest emissions model, Motor Vehicle Emissions Simulator (MOVES) 2014. Emission factors for motor vehicles are specific to each model year, pollutant type, temperature, and travel speed. MOVES 2014 requires a wide range of input parameters, including inspection and maintenance program information and other data, such as fuel formulation and supply, speed distribution, vehicle fleet mix, and fleet age distribution. Inputs used for 2020 through 2040 were received from the DEP; and include information about programs that were submitted to the EPA as the strategy for the Commonwealth to attain ambient air-quality standards.

TIMELY IMPLEMENTATION OF TRANSPORTATION CONTROL MEASURES

Transportation control measures (TCMs) were required in the SIP in revisions submitted to the EPA in 1979 and 1982 and in those submitted as part of the CA/T project. The TCMs included in the 1979 and 1982 submissions were accomplished through construction or implementation of ongoing programs.

The TCMs submitted as part of the CA/T project mitigation have been included in the conformity of the LRTP as recommended or completed projects with the exception of the following three projects:

- Completion of a final design of the Red Line–Blue Line Connector from the Blue Line at Government Center to the Red Line at Charles Station
- Fairmount Line Improvements
- Enhanced Green Line extended beyond Lechmere Station to Medford Hillside and Union Square

MassDOT worked with the DEP to address these projects and continues to keep the Boston Region MPO informed of their status through monthly reports at the MPO's regularly scheduled meetings. The Boston Region MPO will continue to include these projects in the LRTP and TIP until the process has been completed, assuming that any interim projects or programs will provide equal or better emissions benefits. When the process has been completed, the MPO will amend the LRTP and future TIPs and their conformity determinations to include any changes (including any interim projects or programs).

A Status Report of the Uncompleted SIP Projects

The status of these projects has been updated using the SIP Transit Commitments Status Report, which was submitted by MassDOT to DEP in July 2015. Highlights of the report are presented below. For a more detailed description of the status of these projects, please visit MassDOT's website at the following link:

<https://www.massdot.state.ma.us/planning/Main/PlanningProcess/StateImplementationPlan/SIPTransitCommitmentSubmissions.aspx>

Red Line-Blue Line Connector – Final Design – SIP Required Completion by December 2011

Project Status

MassDOT initiated a process to amend the SIP to permanently and completely remove the obligation to perform final design of the Red Line–Blue Line Connector. To that end, MassDOT officially sought approval from DEP to support a SIP amendment process. MassDOT is not proposing to substitute any new projects in place of the Red Line–Blue Line Connector commitment, given the absence of any air-quality benefits associated with the current Red Line–Blue Line commitment (final design only). Correspondence from MassDOT to DEP formally initiating the amendment process was submitted on July 27, 2011, and is posted on the MassDOT website.

On September 13, 2012, DEP held two hearings (at 1:00 PM and 5:00 PM) to take public comment on MassDOT's proposed amendments to 310 CMR 7.36, Transit System Improvements, including eliminating the requirement to complete final design of the Red Line–Blue Line Connector. Between the two hearings, there were 16 attendees, 10 of whom gave oral testimony. All those who spoke at the hearings were in favor of DEP not removing the commitment. DEP accepted written testimony until September 24, 2012.

On August 23, 2013, EPA sent a letter to FHWA providing an update on Massachusetts Air Quality Conformity. In that letter, EPA noted that the Red Line–Blue Line Connector Design project had not met the completion date on December 2011, but that MassDOT was not obligated to implement interim emission-reduction projects because no emission reductions are associated with the design project.

On October 8, 2013, the DEP approved a request made by MassDOT in July 2011 to revise 310 CMR 7.36 to remove the requirement for MassDOT to complete the design of the Red Line/Blue Line Connector. This revision to the State Implementation Plan must now also be approved by EPA. The text of the revision is available on the MassDOT website at:

<http://www.massdot.state.ma.us/Portals/17/docs/sip/October13UpdatedSIPReg.pdf>

On December 1, 2014, EPA published a proposed rule to approve a State Implementation Plan (SIP) revision submitted by the Commonwealth of Massachusetts in the Federal

Register on November 6, 2013. This proposal, if finalized, would remove the design of the Red Line/ Blue Line Connector as a requirement in the SIP.

Funding Source

MassDOT is proposing to nullify this commitment

Fairmount Line Improvements Project – SIP Required Completion by December 2011

Project Status

The Four Corners and Newmarket Stations opened for service on July 1, 2013. The Talbot Avenue Station opened in November 2012.

A station at Blue Hill Avenue has been the subject of significant community controversy during the past-five years. The redesign of the station is now moving forward, and is 60 percent complete. The 90 percent design plans were received in July 2015 and 100 percent plans will be submitted in fall 2015. Construction is scheduled to begin in spring 2016, and the station to open in summer 2018.

MassDOT and the MBTA prepared a Petition to Delay and an Interim Emission Offset Plan to be implemented for the duration of the delay of the Fairmount Line Improvements project. MassDOT estimated the reduced emissions that are expected to be generated by implementing the new Fairmount Line station and, with input from Fairmount Line stakeholders, proposed offset measures. MassDOT estimated that the potential offset measures would meet emissions-reduction targets. The measures include shuttle bus service from Andrew Square to Boston Medical Center and increased service on bus Route 31, which serves Dorchester and Mattapan. These measures were implemented on January 2, 2012, and currently are in place.

Funding Source

The Commonwealth

Green Line Extension to Somerville and Medford Project – SIP Required Completion by December 2014

Project Status

State-level environmental review (Massachusetts Environmental Policy Act (MEPA)) was completed in July 2010. Federal-level environmental review (National Environmental Policy Act (NEPA) documents were submitted to the Federal Transit Administration in September 2011, and a public hearing was held on October 20, 2011. A Finding of No Significant Impact (FONSI) was issued by the Federal Transit Administration (FTA) on July 9, 2012.

On January 5, 2015, the US Secretary of Transportation and the MBTA signed the Full Funding Grant Agreement (FFGA) for the Green Line Extension project, approving \$996,121,000 of FTA New Starts funding to support design and construction of the

project. The execution of the FFGA was the result of many years of planning, design and pre-construction efforts by MassDOT and the MBTA, in collaboration with the FTA and its Project Management Oversight Consultant. The federal funding is scheduled to be paid between FFY 2015 and FFY 2022. As noted in the current MassDOT Capital Investment Plan (released January 2014), MassDOT and the MBTA will use Commonwealth funds in addition to federal funding to support the design and construction activities.

To tailor the project-delivery method to best mitigate the larger project risks, MassDOT and MBTA are implementing a four-phased project-delivery plan:

Phase 1 is using the traditional design-bid-build approach to deliver the contract for widening the Harvard Street and Medford Street railroad bridges and demolishing the 21 Water Street building. The contract award occurred in December 2012, and the Notice to Proceed was issued on January 31, 2013.

The MBTA has also added some retaining wall construction to the Phase 1 contract that had previously been programmed for Phase 4 in that area. By constructing this work under the Phase 1 contract, this retaining/noise wall should be completed in time to better support and facilitate track relocation as part of the construction of Phase 4. The addition of this work has extended the end date of the Phase 1 contract by six months to October 2015, and as of this writing, the contractor is on track to complete it by then. In Medford at Harvard Street, the new T2 track installation was completed in July 2015.



Phase 2/2A will extend service from the (new) Lechmere Station to the Washington Street and Union Square Stations and relocate the bus facility and vehicle storage at Lechmere Station. The projected completion date for Phase 2/2A initial Green Line service is likely mid-2018.

Phase 3 will construct the vehicle-maintenance facility and storage facility. As the full yard and maintenance facility are not needed to support the initial passenger service to Washington Street and Union Square, this phase has been scheduled for completion approximately six months ahead of the date for revenue service to College Avenue.

Phase 4 will provide service from Washington Street Station (completed as part of Phase 2, above) to College Avenue Station, which was targeted to be completed in June 2020, roughly a year ahead of the FFGA completion date. Although enabling construction

is already underway in this segment, the design of this package is being revised to incorporate value engineering scope changes. This reworking will extend the period to complete the 100% final design for pricing and may extend the bidding and award into early 2016, as opposed to the planned November 2015 Notice to Proceed (NTP) date.

New Green Line Vehicles: The MBTA Vehicle Procurement contract to purchase 24 Type 9 Vehicles was awarded to CAF USA Inc. in the amount not to exceed \$118,159,822 at the MassDOT Board Meeting held on May 14, 2014. The NTP for this contract was issued on September 4, 2014.

CAF is in the process of developing drawing packages for the Preliminary Design, and the MBTA Project Team and the Contractor CAF continue to hold technical working sessions and project meetings. In addition, weekly project management meetings are held between MBTA and CAF to discuss project status, short-term schedules and priorities as well as monthly project status meetings where all project issues, schedules, deliverables and milestones are reviewed and discussed.

The first vehicle is to be delivered no later than 36 months from NTP. The pilot car delivery is scheduled for September 2017. The pilot car will receive comprehensive testing for six months followed by delivery of the remaining 22 vehicles, the last car to be delivered by July 2018. All vehicles are expected to be in service in early 2019.

Somerville Community Path: Originally the Green Line Extension project included just the design of the extension of the Somerville Community Path from south of Lowell Street to the Inner Belt area of Somerville. In May 2014, MassDOT and the City of Somerville announced an agreement to add construction of the Community Path, including a connection to the Cambridge/Northpoint area, to the scope of the program. The Path Extension is not part of the SIP commitment.

Potential Challenges

MassDOT has met the first four interim milestones associated with the Green Line Extension project—filing an Expanded Environmental Notification Form, procuring multiple design consultants, and publishing both Draft and Final Environmental Impact Reports. The project has transitioned from planning and environmental review phases to design, engineering, and construction.

In the 2011 SIP Status Report, MassDOT reported that the Green Line Extension project would not meet the legal deadline of December 31, 2014. At that time, MassDOT projected a period for the introduction of passenger service on the Green Line Extension. The points within the period are associated with different probabilities, as shown below:

- 10% Probability of Not Exceeding – Autumn 2018
- 90% Probability of Not Exceeding – Summer 2020

FTA's projected completion date is June 2021, which includes one year of schedule contingency beyond the MBTA's Target date. Presently, the Green Line Extension team

anticipates that the completion date of Phase 4 will be extended from June 2020 to late summer/early fall 2020.

MassDOT and the MBTA continue to seek measures to accelerate the project timeline wherever possible. The receipt of the FFGA was a key milestone, as it allowed completion of the bidding process and the start of construction for the bulk of the Phase 2/2A and Phase 4 work.

Although the goal of the phased project delivery approach is to complete components in an incremental way, the timeline for overall project completion listed above represents a substantial delay beyond the current SIP deadline of December 31, 2014. Consequently, this schedule triggers the need to provide interim emission reduction offset projects and measures for the period of the delay (beginning January 1, 2015). Working with the Central Transportation Planning Staff, MassDOT and the MBTA calculated the reductions of VOC, CO, and NO_x—reductions equal to or greater than the reductions projected for the Green Line Extension itself, as specified in the SIP regulation—that will be required for the period of the delay.

In June 2012, MassDOT released a list of potential mitigation ideas received from the public that could be used as offset measures. In the summer and fall of 2012, MassDOT solicited public comments on these potential measures. The MBTA created an internal working group to determine a final portfolio of interim mitigation measures to implement by December 31, 2014, the legal deadline for the implementation of the Green Line Extension.

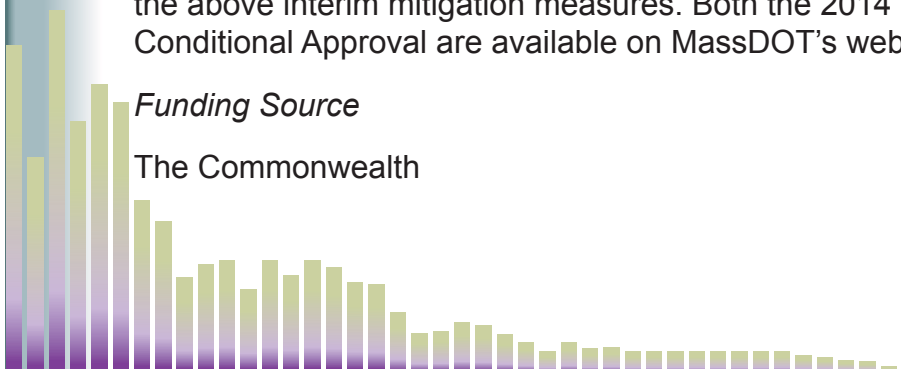
This work resulted in a recommendation to implement the following three interim mitigation measures, which collectively would meet the emissions reduction target for the project:

- Additional off-peak service along existing routes serving the GLX corridor, including the Green Line, and bus routes 80, 88, 91, 94 and 96
- Purchase of 142 new hybrid electric vehicles for THE RIDE
- Additional park-and-ride spaces at the Salem and Beverly intermodal facilities

The Petition to Delay, submitted to DEP on July 22, 2014, expands further on the analysis and determination of the interim offset measures. These measures went into effect in the beginning of 2015. In a letter dated July 16, 2015, DEP conditionally approved MassDOT's request to delay the Green Line Extension project and the implementation of the above interim mitigation measures. Both the 2014 Petition to Delay and the July 2015 Conditional Approval are available on MassDOT's website.

Funding Source

The Commonwealth



Russia Wharf Ferry Terminal

Project Status

Former MassDOT Secretary Richard Davey approved construction of the permitted ferry facility and a \$460,000 ferry-service startup subsidy in October 2012. The 2005 facility plans and specifications were revised to meet the latest MassDOT Highway Division standards. The bid package was issued in the fall of 2013. A contractor was selected and the Notice to Proceed was issued in April 2014. Pre-construction activities progressed, but contractual issues have led MassDOT to decide to rebid the contract and complete the facility in 2015. There is no regularly scheduled passenger water transportation service in this area, nor are there any plans to provide such a service. The City of Boston, however, is undertaking design and engineering work to address the Old Northern Avenue Bridge's vessel-clearance constraint, and is purchasing two ferry vessels for Inner Harbor use, which could include this ferry terminal as a destination.

Funding Source

The Commonwealth

CONSULTATION PROCEDURES

Conformity regulations require the MPO to make a conformity determination according to consultation procedures outlined in state and federal regulations and to follow public involvement procedures established by the MPO under federal metropolitan transportation-planning regulations.

Both state and federal regulations require that the Boston Region MPO, MassDOT, DEP, EPA, and the Federal Highway Administration (FHWA) consult on the following issues:

- Selection of regional emissions analysis models, including model development and assessment of project design factors for modeling
- Selection of inputs to the most recent EPA-approved emissions factor model
- Selection of CO hot-spot modeling procedures, as necessary
- Identification of regionally significant projects to be included in the regional emissions analysis
- Identification of projects that have changed in design and scope
- Identification of exempt projects
- Identification of exempt projects that should be treated as nonexempt because of adverse air-quality impacts
- Identification of the latest planning assumptions and determination of consistency with SIP assumptions

These issues have all been addressed through consultation among the agencies listed above.

PUBLIC PARTICIPATION PROCEDURES

Title 23 CFR Sections 450.324 and 40 CFR 90.105(e) requires that development of the LRTP, TIP, and related certification documents provide an adequate opportunity for public review and comment.

Section 450.316(b) establishes the outline for MPO public participation programs. The Boston Region MPO's public participation program was adopted in June 2007, revised in April 2010, and updated in May 2012 and October 2014. The development and adoption of this program conform to these requirements. The program guarantees public access to the LRTP and TIP and all supporting documentation; provides for public notification of the availability of the LRTP and TIP and the public's right to review the draft documents and comment on them; and provides a public review and comment period prior to adoption of the LRTP and TIP and related certification documents by the MPO.

On June 25, 2015 a public notice was sent to the MPO's email contact list inviting the recipients to comment on this draft document. On July 30, 2015, the Boston Region MPO voted to approve the draft LRTP and its Air-Quality Conformity Determination. This allowed many opportunities for public comment and MPO review of the draft document. These procedures comply with the associated federal requirements.

FINANCIAL CONSISTENCY

Title 23 CFR Section 450.324 and 40 CFR 93.108 require the LRTP and TIP to "be financially constrained by year and include a financial plan that demonstrates which projects can be implemented using current revenue sources and which projects are to be implemented using proposed revenue sources." This Boston Region MPO's LRTP is financially constrained to projections of federal and state resources that are reasonably expected to be available during the appropriate period. Projections of federal resources are based on the estimated apportionment of the federal authorizations contained in Moving Ahead for Progress in the 21st Century (MAP-21), the transportation reauthorization bill, as allocated to the region by the state or as allocated among the various Massachusetts MPOs according to federal formulas or MPO agreement. Projections of state resources are based on the allocations contained in the current state Transportation Bond Bill and on historic trends. Therefore, this LRTP complies with federal requirements relating to financial planning.

Procedures for Determining Regional Transportation Emissions

The federal conformity regulations set forth specific requirements for determining transportation emissions. The requirements and the procedures used for the LRTP are summarized below.

DEMOGRAPHICS, EMPLOYMENT, AND TRANSPORTATION DEMAND

Specific sources of population, household, employment, and traffic information used in the LRTP are listed above in the Latest Planning Assumptions section. Tables 8.1 and 8.2, below, outline recommendations for specific projects for the period ending in 2040.

Only regionally significant projects are required to be included in the travel-demand modeling efforts. Federal conformity regulations define regionally significant as follows:

“A transportation project (other than an exempt project) that is on a facility that serves regional transportation needs (such as access to and from the area outside of the MPO region; major activity centers in the region; major planned developments, such as new retail malls and sport complexes; and transportation terminals (as well as most terminals themselves) and would be included in the modeling of a metropolitan area’s transportation network, including at a minimum all principal arterial highways and all fixed-guideway transit facilities that offer an alternative to regional highway travel.”

In addition, specific projects are exempt from regional modeling emissions analysis. The categories of exempt projects include:

- Intersection channelization projects
- Intersection signalization projects at individual intersections
- Interchange reconfiguration projects
- Changes in vertical and horizontal alignment
- Truck size and weight inspection stations
- Bus terminals and transfer points

The Recommended Networks in this conformity determination are composed of projects proposed in the approved TIPs and LRTP, and projects in the MBTA capital budget. A list of the projects that meet these criteria and are included in the recommended transportation networks and this conformity determination is provided in Table 8.1 (projects under construction) and Table 8.2 (recommended LRTP and TIP projects). The list includes all regionally significant projects in the Boston Region MPO area.

TABLE 8.1
Regionally Significant Projects Included in the Regional Transportation Models for the Boston Region MPO Recommended LRTP Projects: Projects under Construction

| Analysis Year | Municipality | Project Name |
|----------------------|-----------------------|---|
| 2020 | Needham and Wellesley | Rehabilitation/Replacement of 6 Bridges on I-95/Route 128 (Add-a-Lane – Contract V) |

TABLE 8.2
Regionally Significant Projects Included in the Regional Transportation Models for the Boston Region MPO Recommended LRTP Projects: Recommended Projects

| Analysis Year | Municipality | Project Name |
|----------------------|------------------------|--|
| 2020 | Bedford and Billerica | Middlesex Turnpike Improvements, from Crosby Drive North to Manning Road, Phase III |
| 2020 | Newton and Needham | Reconstruction of Highland Avenue, Needham Street & Charles River Bridge, from Webster Street to Route 9 |
| 2020 | Weymouth and Abington | Reconstruction and Widening on Route 18 (Main Street) from Highland Place to Route 139 |
| 2020 | Woburn | Reconstruction of Montvale Avenue, from I-93 Interchange to Central Street |
| 2020 | Woburn | Bridge Replacement, New Boston Street over MBTA |
| 2030 | Boston | Reconstruction of Rutherford Avenue, from City Square to Sullivan Square |
| 2030 | Framingham | Intersection Improvements at Route 126 and Route 135/MBTA & CSX Railroad |
| 2030 | Lexington | Route 4/225 (Bedford Street) and Hartwell Avenue |
| 2030 | Natick | Bridge Replacement, Route 27 (North Main St.) over Route 9 (Worcester St.) and Interchange Improvements |
| 2030 | Somerville and Medford | Green Line Extension Project (Phase 2), College Avenue to Mystic Valley Parkway/Route 16 |
| 2030 | Somerville | McGrath Boulevard Project |

CHANGES IN PROJECT DESIGN AND CONSTRUCTION SCHEDULE SINCE THE LAST CONFORMITY DETERMINATION ANALYSIS

The Commonwealth requires that any changes in the mix of projects, project design, and construction schedule from the previous conformity determination for the region be identified. The last conformity determination was performed for the Boston Region FFYs 2015–18 TIP in July 2014. The mix of projects included in the conformity determination for this LRTP has changed with the development of a new LRTP. The status of uncompleted SIP projects has been updated. In addition, the new MOVES 2014 emission model was used for the projection of carbon monoxide emissions.

MODEL-SPECIFIC INFORMATION

40 CFR Part 93.111 outlines requirements pertaining to the network-based transportation demand models. These requirements include the modeling methods and functional relationships that are to be used in accordance with accepted professional practice and are to be reasonable for purposes of estimating emissions. The Boston Region MPO used the methods described in the conformity regulations for the analysis in this LRTP.

HIGHWAY PERFORMANCE MONITORING SYSTEM ADJUSTMENTS

As stated in EPA guidance, all carbon monoxide nonattainment areas must use the FHWA's Highway Performance Monitoring System (HPMS) to track daily vehicle-miles of travel (VMT) prior to attainment to ensure that the state is in line with commitments made in reaching attainment of ambient air-quality standards by the required attainment dates. MassDOT provided HPMS information to DEP. DEP used this information in setting the mobile-source budget for CO in all SIP revisions prior to 1997.

An HPMS adjustment factor was developed by comparing the 1990 CO emissions of the nine cities and towns (Boston and eight surrounding communities in the Boston maintenance area) resulting from the 1990 base-year model run to the 1990 HPMS-generated CO emissions data submitted as part of the SIP. The HPMS data were divided by the model data to determine the CO adjustment factor to be applied to all modeled CO emissions for future years. The CO HPMS adjustment factor is 0.71.

The Conformity Test

CONSISTENCY WITH THE EMISSION BUDGETS SET FORTH IN THE SIP

The Boston Region MPO conducted an air-quality analysis for the Boston Region MPO's LRTP. The purpose of the analysis is to evaluate the air-quality impacts on the SIP of the projects included in the LRTP. The analysis evaluated the change in CO emissions because of implementing the LRTP. The modeling procedures and assumptions used in this air-quality analysis follow the EPA's conformity regulations. They are also consistent with the procedures used by the DEP to develop Massachusetts's "1990 Base-Year

Emission Inventory,” “1996 Reasonable Further Progress Plan,” “Post-1996 Reasonable Further Progress Plan,” and “1996 Rate of Progress Report.” All consultation procedures were followed to ensure that a complete analysis of the LRTP was performed and was consistent with the SIP.

The primary test for showing conformity with the SIP is demonstrating that the emissions generated by projects in this LRTP is consistent with the emission budget set forth in the SIP. The CO mobile-source attainment inventory for 1993 for the nine cities in the Boston area reclassified as being in attainment is 305.43 tons per winter day. The projection of mobile sources for the Boston maintenance area is 228.33 tons per winter day for 2010. Estimates of CO emissions for the nine cities in the Boston maintenance area for various years are shown in Table 8.3. The CO emissions are less than the CO emission budget in each year.

TABLE 8.3
Winter CO Emissions Estimates for the CO Maintenance Area for the Nine Cities in the Boston Area

| Year | Boston Region MPO Build Emissions | Emission Budget | Difference (Build Minus Budget) |
|------|---|--------------------|---------------------------------------|
| 2020 | 34.56 | 228.33 | -193.77 |
| 2030 | 23.32 | 228.33 | -205.01 |
| 2040 | 18.90 | 228.33 | -209.43 |

Note: Emissions are cited in tons per winter day.

Conclusion

The Clean Air Act Amendments of 1990 established air-quality conformity requirements for transportation plans, programs, and projects. The EPA published a final rule in the November 24, 1993, Federal Register, with several amendments through 2010, providing procedures to be followed by the US Department of Transportation in determining conformity of transportation plans, programs, and projects with the SIP for meeting air-quality standards. Boston, Cambridge, Chelsea, Everett, Malden, Medford, Quincy, Revere, and Somerville are designated a maintenance area for the CO standard. Federal conformity regulations require that the impact of transportation plans, programs, and projects on maintenance areas be evaluated.

The Boston Region MPO conducted an air-quality analysis for projects in this LRTP. The purpose of the analysis was to evaluate the air-quality impacts of the LRTP projects on the SIP. The analysis evaluates the change in CO emissions based on implementing the LRTP. The modeling procedures and assumptions used in this air-quality analysis follow the EPA’s and the Commonwealth’s guidelines and are consistent with all present and past procedures used by the Massachusetts DEP to develop and amend the SIP.

Boston Region MPO has found the emission levels from the Boston area CO Maintenance Area, including emissions resulting from implementation of the LRTP, to be in conformance with the SIP according to state and federal conformity criteria. Specifically, the CO emissions for the build scenarios of the MPO's regional travel demand model set are less than the projections for analysis years 2020 through 2040 for the nine cities in the Boston CO Maintenance area.

In accordance with Section 176(c)(4) of the Clean Air Act as Amended in 1990, the Boston Region MPO has completed this review and hereby certifies that the LRTP, and its latest conformity determination, conditionally conforms with 40 CFR Part 93 and 310 CMR 60.03 and is consistent with the air-quality goals in the Massachusetts State Implementation Plan.

GREENHOUSE GAS ANALYSIS

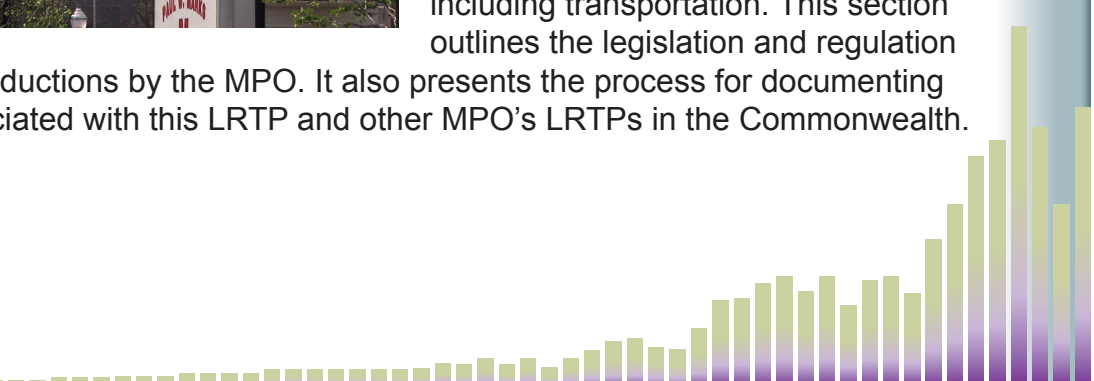
Greenhouse Gas Analysis Introduction

The largest environmental threat the MPO faces is the need to reduce greenhouse gas (GHG) emissions that contribute to climate change, which if unchecked, could impair our transportation system and way of life. Climate change will likely have significant impacts

on the Boston region if climate trends continue as projected. In order to minimize the negative impacts, the MPO is taking steps to decrease our carbon footprint and to simultaneously adapt 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 the quality of life in the region.

In addition, the Commonwealth has enacted regulations to reduce greenhouse gases from all sectors including transportation. This section outlines the legislation and regulation

requiring emission reductions by the MPO. It also presents the process for documenting CO₂ emissions associated with this LRTP and other MPO's LRTPs in the Commonwealth.



Legislative Requirements

Former Governor Deval Patrick signed the Global Warming Solutions Act (formally called the Climate Protection and Green Economy Act) in August 2008. The Act requires reductions of GHG emissions below 1990 levels by 25 percent by 2020, and 80 percent reduction by 2050.

As part of the Global Warming Solutions Act (GWSA), the Executive Office of Energy and Environmental Affairs developed the Massachusetts Clean Energy and Climate Plan for 2020 that outlines programs to attain the 25 percent reduction by 2020. In that plan, a 7.6 percent reduction will be attributed to state transportation programs. One of the programs in

the Massachusetts Clean Energy and Climate Plan is MassDOT's sustainability initiative, also known as GreenDOT. The GreenDOT Policy directive was developed in accordance with the GWSA. Its three goals are:

1. To reduce GHG emissions by reducing emissions from construction and operations, using more efficient fleets, implementing travel demand management programs, encouraging eco-driving, and providing mitigation for development projects
2. To promote healthy transportation modes by improving pedestrian, bicycle, and public transit infrastructure and operations
3. To support smart growth development by making transportation investments that enable denser, smart growth development patterns that can support reduced GHG emissions

Subsequently, the DEP established a regulation—Global Warming Solutions Act Requirements for the Transportation Sector and the Massachusetts Department of Transportation (310 CMR 60.05). The purpose of this regulation is to assist the Commonwealth in achieving their adopted GHG emission reduction goals by:

- Requiring MassDOT to demonstrate its GHG reduction commitments and targets are achieved
- Requiring each MPO to evaluate and track the GHG emissions and impacts of its LRTP and TIP



- Requiring each MPO, in consultation with MassDOT, to develop and utilize procedures to prioritize and select projects in its LRTP and TIP based on factors that include GHG emissions and impacts

The MPO's Role in Reducing Greenhouse Gas Emissions

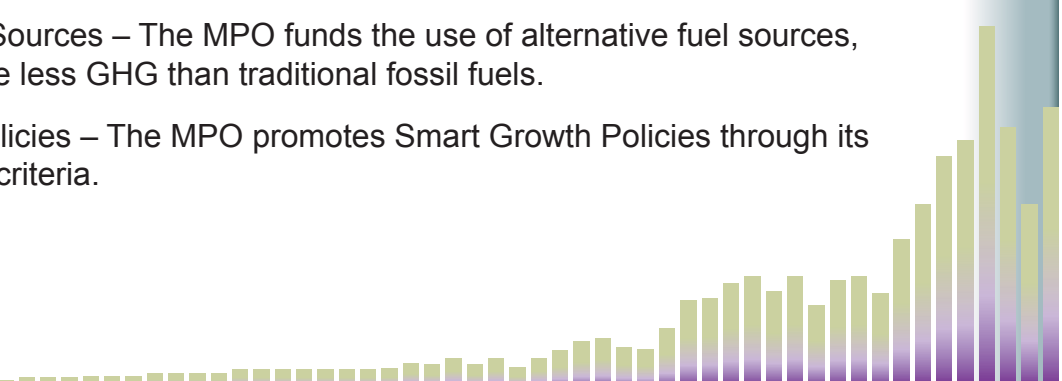
The Boston Region MPO is involved in helping to achieve the GreenDOT goals. The MPO is most directly involved in helping to achieve reductions through prioritizing and programming an appropriate balance of roadway, transit, bicycle, and pedestrian investments, and will assist in the third goal—supporting smart growth development



patterns through the creation of a balanced multimodal transportation system. The Boston MPO's Clean Air and Clean Communities goal and related objectives are used as criteria in selecting projects for both the LRTP and TIP to further the MPO's vision for a sustainable, healthy, livable, and economically vibrant region. The MPO's goal will help MassDOT to achieve the GreenDOT goals. The MPO's objective is to reduce GHG emissions generated in the region by all transportation modes as outlined in the Global Warming Solutions Act.

The MPO is contributing to the statewide implementation of GreenDOT in a number of other ways:

- Alternative Modes of Travel – The MPO funds projects that provide people with transportation options other than single-occupancy vehicles (SOVs). Alternative modes to SOVs include transit, bicycling, walking, and carpooling.
- Reduction of Vehicle-Miles of Travel and Roadway Congestion – The MPO funds projects that reduce the need to drive and ease roadway congestion, therefore reducing emissions through its Community Transportation/Parking/Clean Air and Mobility Program.
- Alternative Fuel Sources – The MPO funds the use of alternative fuel sources, which can release less GHG than traditional fossil fuels.
- Smart Growth Policies – The MPO promotes Smart Growth Policies through its project selection criteria.



- Public Outreach – The MPO can also help by educating the public through its many avenues of outreach and by supporting future federal and state programs that reduce GHG emissions.

Documenting the MPO's Greenhouse Gas Reduction for GreenDOT Implementation

MassDOT coordinated with MPOs and regional planning agency (RPA) staffs to implement GHG tracking and evaluate development of each MPO's 2012 LRTPs, which were adopted in September 2011. This collaboration has continued for the MPOs' 2016 LRTPs and 2016–19 TIPs. Working together, MassDOT and the MPOs have attained the following milestones:

- MassDOT and the Boston MPO are in the process of modeling and projecting long-range GHG statewide emissions that result from the transportation sector. Using the Boston Region MPO's regional travel demand model and the statewide travel demand model for the remainder of the state, GHG emissions will be projected for 2020 no-build and build conditions, and for 2040 no-build and build conditions. The results of this modeling will be available in a separate statewide air quality report at the end of August 2015. MPO staff will present the results to the MPO once it is completed.
- All of the MPOs will include a discussion of climate change and a statement of MPO support for reducing GHG emissions as a regional goal.

The Boston Region MPO and MassDOT will provide the Boston Region MPO with statewide estimates of CO₂ emissions based on the collective list of all recommended projects in all the Massachusetts LRTPs combined (and supplemented by CO₂ emission-reduction results for smaller, "off-model" projects supplied by the MPO). Emissions will be estimated using the new MOVES 2014 model, and will incorporate the latest planning assumptions including updated socio-economic projections for the Commonwealth.

The project mix from this, and all other LRTPs—modeled for both 2020 and 2040 using a build versus no-build analysis to determine CO₂ emissions attributed to all MPOs' mix of projects and smart-growth land-use assumptions—is expected to show a neutral shift toward meeting the statewide greenhouse gas emissions reduction goal of 25 percent less than 1990 levels by the year 2020, and 80 percent below 1990 levels by 2050. The reason for the anticipated neutral shift is that early indicators have shown that major infrastructure projects, both individually and collectively, would not trigger a significant change in GHG emission levels.

Working closely with MassDOT, the Boston Region MPO—via its planning activities—continues to make progress toward meeting the GHG reductions targets and complying with the GWSA's requirements. As part of this activity, the MPO will provide further public

information on the topic and continue to advocate for steps needed to accomplish the MPO's and Commonwealth's goals.

Many other types of projects that cannot be accounted for in the travel demand model (such as bicycle and pedestrian facilities, shuttle services, intersection improvements, etc.) are further analyzed for CO₂ reductions in the TIP development cycle. In order to monitor and evaluate the GHG impacts of TIP projects, MassDOT and the MPOs have developed approaches for identifying the anticipated GHG emission impacts of different project types. All TIP projects have been sorted into two main categories for analysis: projects with quantified impacts and projects with assumed impacts. Projects with quantified impacts consist of capacity-adding projects from the LRTP and projects from the TIP that underwent a Congestion Mitigation and Air Quality (CMAQ) spreadsheet analysis. Projects with assumed impacts include those that would be expected to produce a minor decrease or increase in emissions and that would be assumed to have no CO₂ impact. A detailed description of project evaluations included in the TIP is cited in Appendix C of the FFY 2016–2020 TIP (<http://www.bostonmpo.org/Drupal/tip>). The collective GHG reductions from the TIP projects are approximately 4,300 tons per year.

Working closely with MassDOT, the Boston Region MPO will continue to report on its actions to comply with the GWSA and help meet the GHG reduction targets. As part of this activity, the MPO will provide further public information on the topic and will advocate for steps needed to accomplish the MPO's and state's goals for greenhouse gas reductions.

The MPO acknowledges the importance of adaptation measures to moderate potential damage from climate change impacts. Its System Preservation goal helps by selecting projects that improve the ability of the transportation system to withstand extreme conditions. Projects that improve an evacuation route or an access route to an emergency support location earn higher ratings in the project evaluation process. Similarly, the evaluation process rewards projects that address sea-level rise and flooding, meet current seismic design standards, and protect critical infrastructure. These criteria will help identify future transportation investments to address the impacts of climate change.



A APPENDIX SCENARIO PLANNING

INTRODUCTION

As described in Chapter 2, the MPO used scenario planning to help shed light on the relative merits of two different approaches to congestion: Should the MPO continue to use a congestion-reduction approach by investing in major arterials and express highways? Or, should the MPO adopt a capacity-management approach by investing in smaller-scale, but more diverse and geographically dispersed, operations and management (O&M)-type projects? To answer these questions, staff compared three scenarios to a base-case scenario using both the regional travel demand model set and off-model analyses. Included in this appendix is a summary of the scenario-planning process that was undertaken as part of this LRTP development.

Results of the analysis helped the MPO finalize its goals and objectives and select a set of programs and projects to analyze to determine which ones to include in the LRTP. The MPO adopted the O&M approach to programming in the LRTP. This new policy direction signaled a pivotal change in the MPO's approach to programming transportation investments.

For the Long-Range Transportation Plan (LRTP), Charting Progress to 2040, the Boston Region MPO examined how allocating available dollars to various strategies would best address the region's transportation needs, while advancing the MPO's vision, goals and objectives. Themes of the MPO's goals are:

1. Safety
2. System Preservation
3. Capacity Management/Mobility
4. Clean Air/Clean Communities
5. Transportation Equity
6. Economic Vitality

To support the plan's development, MPO staff conducted scenario planning to help the MPO and the public weigh the benefits and tradeoffs of different investment strategies.

Policy Question for Scenario Planning

The MPO considered two different approaches to addressing mobility needs during the next 25 years, focusing on a specific policy question related to a proposed objective within its Capacity Management and Mobility goal:

“Should the MPO give priority in a congestion reduction program to major arterials and express highways throughout the region which serve transit and/or existing population and places of employment?”

This policy would shape the MPO’s approach to future transportation investments. One approach was to program primarily high-cost roadway projects, while another option concentrated on lower-cost, often multimodal types of investments. The purpose of this scenario planning was to help clarify the degree to which each of these approaches would help the MPO progress toward its goal of improving mobility, along with its other stated goals.

Four Scenarios for Analysis

To shed light on the policy question cited above, the MPO established one base-case scenario and three alternatives. Each scenario reflected a different hypothetical investment approach that the MPO could follow over the next 25 years. These scenarios have several elements in common:

- All four scenarios look out to the LRTP horizon year of 2040.
- The socioeconomic (population, household, and employment) data is the same for all scenarios.
- By 2040, the population in the MPO’s model region (164 communities) is expected to rise by 12.9 percent to approximately 4,854,000 people. Employment in the same region is expected to rise by 7.7 percent to approximately 2,579,000 jobs.
- All scenarios are financially constrained to the MPO’s target funding and its share of federal major infrastructure funding, which, assuming current dollars, is about \$2 billion during the plan’s 25-year life span.

The MPO gathered a large amount of information about the Boston region’s transportation needs, both through analysis conducted by MPO staff and others, and via outreach to municipalities and groups in the region. MPO staff identified the following scenarios with these needs in mind. Although the scenarios focus on congestion management and mobility, each takes a different approach in addressing this goal.

2040 No-Build Scenario (Base Case): No improvements to the existing transportation network other than those that are currently under construction, advertised for construction, or included in the first year of the Federal Fiscal Years 2015–18 Transportation Improvement Program (TIP) of the Boston Region MPO and TIPs of adjacent MPOs.

Current-LRTP Scenario: Reflects the MPO’s current spending patterns. Includes all of the projects listed in the Boston Region MPO’s LRTP that are not yet funded, plus additional projects and programs (not listed in the LRTP). Assumes that unallocated funding from the current LRTP would be programmed over the next 25 years in the same proportions as the MPO has programmed its funding during the previous 10 years.

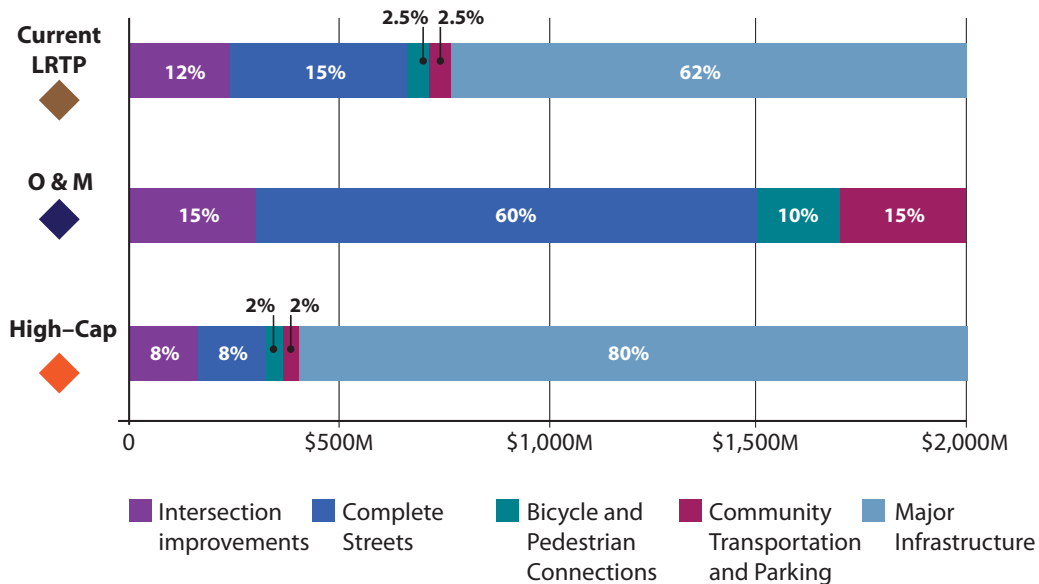
Operations and Management (O&M) Scenario: A congestion management approach focusing on lower-cost O&M improvements, such as intersection improvements and Complete Streets solutions, to improve mobility on the roadway network. Emphasizes capacity management through low-cost investments.

High-Capital Investment (High-Cap) Congestion Management Scenario: Includes a large percentage of high-cost capital infrastructure improvements, such as interchange upgrades and major bottleneck reconstructions. Includes a small percentage of lower-cost projects that do not add capacity to the region’s transportation system.

Scenario Features

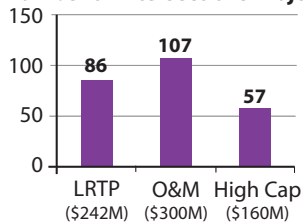
For the alternative scenarios, MPO staff allocated the \$2 billion in available funding across five hypothetical programs. The programs (described on the following pages) would address in a thematic way one or more categories of identified transportation needs. The portion of funds allocated to a program depends upon each scenario's purpose and key characteristics.

Funding Distribution

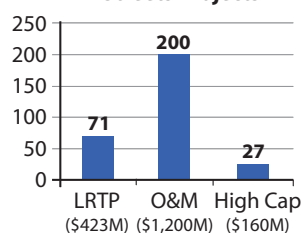


Projects in Scenarios

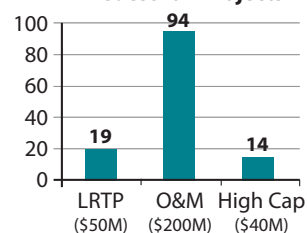
Number of Intersections Projects



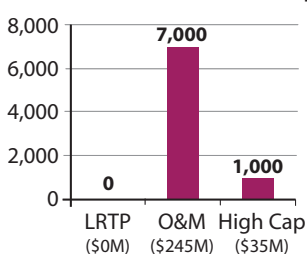
Miles of Complete Streets Projects



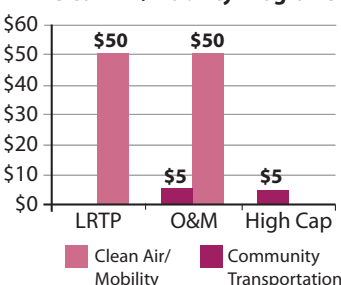
Miles of Bicycle and Pedestrian Projects



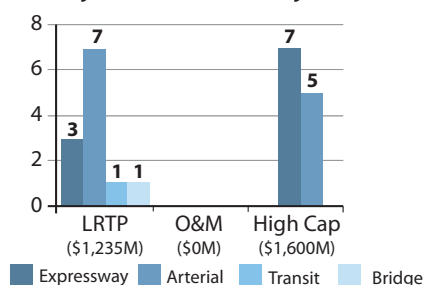
Number of Park and Ride Spaces



Spending on Community Transportation and Clean Air/Mobility Programs



Major Infrastructure Projects



PROGRAMS FOR ADDRESSING TRANSPORTATION NEEDS

INTRODUCTION

The five hypothetical programs included in the scenarios are described on the right. The descriptions provide information about how MPO staff estimated costs for types of projects that the program would fund. As shown on the previous page, each scenario allocates different portions of the \$2 billion in LRTP funding to each program.

To gauge the scenarios' performance, staff selected a number of indicators that correspond to the MPO's goals. To measure programs and projects that could have a regional impact, add capacity to the system, or change an attribute of the system—for example, change the amount of delay or capacity, add an alternative travel option, and so forth—staff utilized the MPO's regional travel demand model set. Staff used off-model sketch-planning techniques to generate performance data for other projects, particularly those that are lower in cost and have smaller footprints.

KEY: MPO GOALS

-  Safety
-  System Preservation
-  Capacity Management/
Congestion Reduction
-  Clean Air/Clean Communities
-  Transportation Equity
-  Economic Vitality



INTERSECTION IMPROVEMENTS



Description: Modernizes existing signals or adds signals to improve safety and mobility. Improvements could also consist 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 transit reliability.

Sample intersections for this program, which were used to estimate project benefits, were drawn from the TIP Universe of Projects, locations identified in past MPO studies, and the LRTP Needs Assessment. These projects were prioritized—first through determining if they are high-crash locations to address the MPO's safety goal, and then if they are located in high-priority-development, environmental justice, or Title VI areas.

Estimated cost of intersection improvement projects: Average of \$2.8 million per intersection



COMPLETE STREETS



Description: Modernizes roadways to improve safety and mobility for all users. Improvements could consist of continuous sidewalks and bicycle lanes, cycle tracks, and other bicycle facilities, as well as updated signals at intersections along a corridor. Improvements will reduce delay and improve transit reliability. Expanded transportation options and better access to transit will improve mobility for all and encourage mode shift.

Estimated cost of Complete Streets projects: \$6 million per mile



BICYCLE NETWORK AND PEDESTRIAN CONNECTIONS



Description: Expands the bicycle and pedestrian networks to improve safe access to transit, school, employment centers, and shopping destinations. Could include constructing new, off-road bicycle or multi-use paths, improving bicycle and pedestrian crossings, or building new sidewalks.

Sample bicycle and pedestrian projects for this program were selected using evaluated TIP projects, the MPO's Bicycle Network Evaluation, and bicycle travel market information from the 2011 Massachusetts Household Survey.

Estimated cost of bicycle and pedestrian projects: Varies (analysis uses available preliminary cost, or average of \$2 million per mile)



COMMUNITY TRANSPORTATION AND PARKING



Description: 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.
Estimated cost: Assumed to cost \$5 million over the 25-year life of the plan.
- **Park-and-Ride:** Targets funding to construct additional parking at transit stations that now are at capacity.
Estimated cost: The average cost per parking space is \$35,000.
- **Clean Air and Mobility Program:** Provides funding to projects (such as bike share projects or shuttle bus services) to improve mobility and air quality and promote mode shift.
Estimated cost: Assumed to cost \$50 million over the 25-year life of the plan.



MAJOR INFRASTRUCTURE



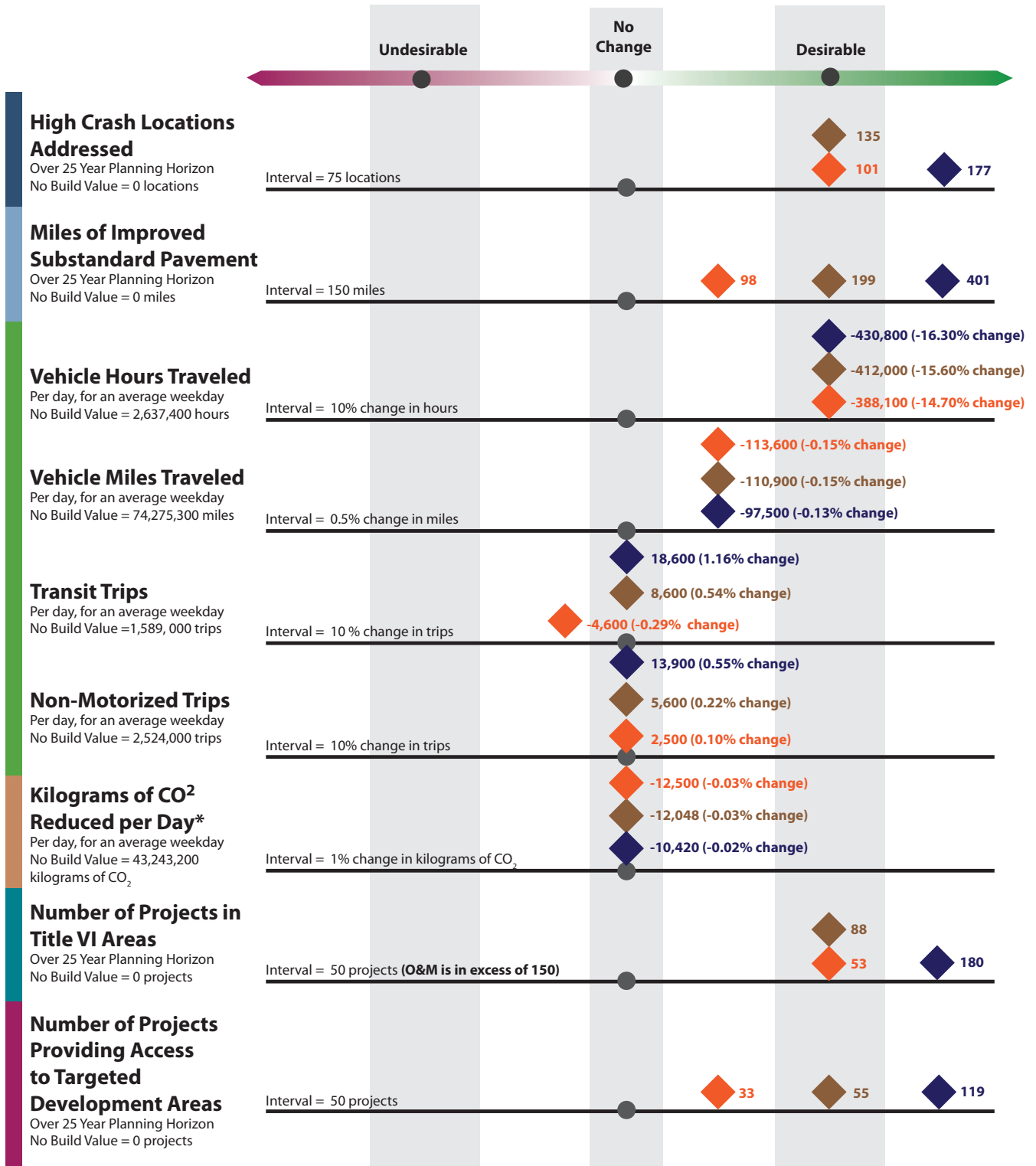
Description: Modernizes and/or expands major highways and arterials to reduce congestion and improve safety. Projects could include constructing expressway interchanges to eliminate weaving and reduce the likelihood of rollovers, adding travel lanes on expressways, or adding/removing grade separations on major arterials. The current LRTP also considers transit (Green Line Extension from College Avenue to Mystic Valley Parkway/Route 16) and bridge projects.

Estimated cost per project: Costs were associated with each project based on costs in current or past LRTPs, adjusted to current dollars, or costs from studies that were performed for selected locations, also adjusted to current dollars. Assumes eight interstate bottlenecks and five arterial projects.

Scenario Results

The values for the alternative scenarios are shown relative to the values for the No-Build scenario. When scenario symbols are stacked, the scenarios with symbols toward the top of the stack perform better.

◆ Current L RTP
 ◆ High-Cap
 ◆ O&M



*Emission generated using MOVES 2010B

Conclusions

The results of these scenarios provided insight on the MPO's policy question:

“Should the MPO give priority in a congestion reduction program to major arterials and express highways through the region which serve transit and/or existing population and places of employment?”

The scenario planning results show how different sets of projects and programs would address the MPO's goals, including capacity management and mobility. The MPO used these results in conjunction with other information, such as the LRTP Needs Assessment and public feedback, to answer the policy question and develop projects and programs for investing federal funds over the next 25 years. The results showed that:

- The O&M scenario is the most effective at addressing a diverse set of MPO goals. It performs similar to or better than other scenarios that address Capacity Management and Mobility, which is the goal that members wanted to explore through this planning.
- More than any other, the O&M scenario perhaps provides greater opportunities to ensure geographic equity (money can be distributed throughout the region, as opposed to being concentrated in a few specific projects).
- Though all three scenarios performed well in safety—a top-rated MPO goal—the O&M scenario performed the best. The O&M scenario also performed significantly better than the other two scenario options in terms of improvements to substandard pavement, which addresses the MPO's system preservation goal.
- There is little difference between scenarios in terms of CO₂ reduction, and reductions are minor compared to the “No-build” scenario.
- Similarly, all alternative scenarios create desirable change in terms of vehicle hours traveled, but they do not differ much from one another. They generate slight desirable change in terms of vehicle miles traveled.
In general, under the three scenarios, people are covering the same amount of distance, but spending less time traveling.

Staff Policy Recommendation

Based on the conclusions from scenario planning, staff recommended that the MPO not adopt the objective of giving priority to a congestion reduction program as posed in the policy question above.

To complete the set of objectives in the Capacity Management/Mobility goal, staff recommended adopting the following revised objective:

“Emphasize capacity management through low-cost investments; give priority to projects that focus on lower-cost O&M-type improvements such as intersection improvements and Complete Streets solutions.”

The implications of this are that the MPO is moving toward a programmatic approach to allocating funding in the LRTP.

What Happened Next?

Below were questions the MPO considered during its meetings as they finalized *Charting Progress to 2040*.

1. What percentage of funding should be allocated to each program (intersection improvements, complete streets, bicycle and pedestrian connections, community transportation and parking, and major infrastructure)?
2. Will highway funding be flexed to transit?
3. Will any funding be left unallocated?



B APPENDIX UNIVERSE OF PROJECTS

INTRODUCTION

One of the primary outcomes of the LRTP process is to create a list of major capital expansion projects and a set of programs for implementation during the next-25 years. Thus, the MPO created a Universe of Projects and Programs list to identify all potential projects and programs. This appendix contains that list for both highway and transit projects.

Each project is associated with one of the six established MPO programs:

1. Intersection Improvements
2. Complete Streets
3. Bicycle Network and Pedestrian Connections
4. Community Transportation and Parking
5. Major Infrastructure
6. Transit

The MPO used the “Universe” list to develop a draft list of projects and programs for public review and the final list to include in this LRTP. The Universe of Projects and Programs includes the following projects that:

- Already have been programmed in the LRTP and TIP (excluding the first year of the current TIP) for highway and transit modes
- Are identified as important for meeting the region’s transportation needs, as described in the MPO Needs Assessment
- Have emerged as recommended from studies conducted by the MPO and other entities in the region
- Are included in the current MBTA Program for Mass Transportation and in the MBTA Capital Investment Program, and others recommended by the MBTA

The projects in the Universe list are presented in three categories and sorted by program type. Table B.1 lists all major infrastructure projects that were included in the last LRTP, *Paths to a Sustainable Region*. Table B.2 lists all projects that add capacity to the transportation system or that cost more than \$20 million. These projects must be listed in the LRTP before they can be programmed for construction in the TIP. Table B.3 lists all projects that do not add capacity to the transportation system and cost less than \$20 million. These projects can be programmed directly in the TIP without being mentioned in the LRTP. They generally fall into one of the programs that are included in the LRTP and are listed above.

Information in each of the tables includes:

1. Project Type (the project falls into one of the following categories):

- Arterial and Intersection
- Bicycle and Pedestrian
- Major Highway
- Transit
- Freight
- Bridge
- Enhancement

2. Investment Program (the project falls into one of the following programs):

- Bottleneck
- Intersection Improvement
- Interchange
- Major Infrastructure
- Complete Streets
- Bike Network
- Pedestrian Connections
- Major Infrastructure
- Bridge
- Transit Capacity
- Freight Movement

- Ferry Services
 - Clean Air and Mobility
3. PROJIS Number: projects in MassDOT's project-tracking system are given a number; projects not in the system have no number.
 4. Project Proponent: project sponsor
 5. Project Name
 6. TIP/LRTP Status (one of the following):
 - Conceptual: a functional design report has not been submitted (the design status is pre-25% design)
 - Pre-TIP: any project in which a 25% functional design report has been submitted to MassDOT (design status can range from 25% to 100%)
 - Programmed in the LRTP
 7. CTPS Study: past UPWP-funded studies or reports were conducted within the project area
 8. Estimated Cost
 9. Project Length in miles
 10. Whether it is included in the 2015–2018 TIP

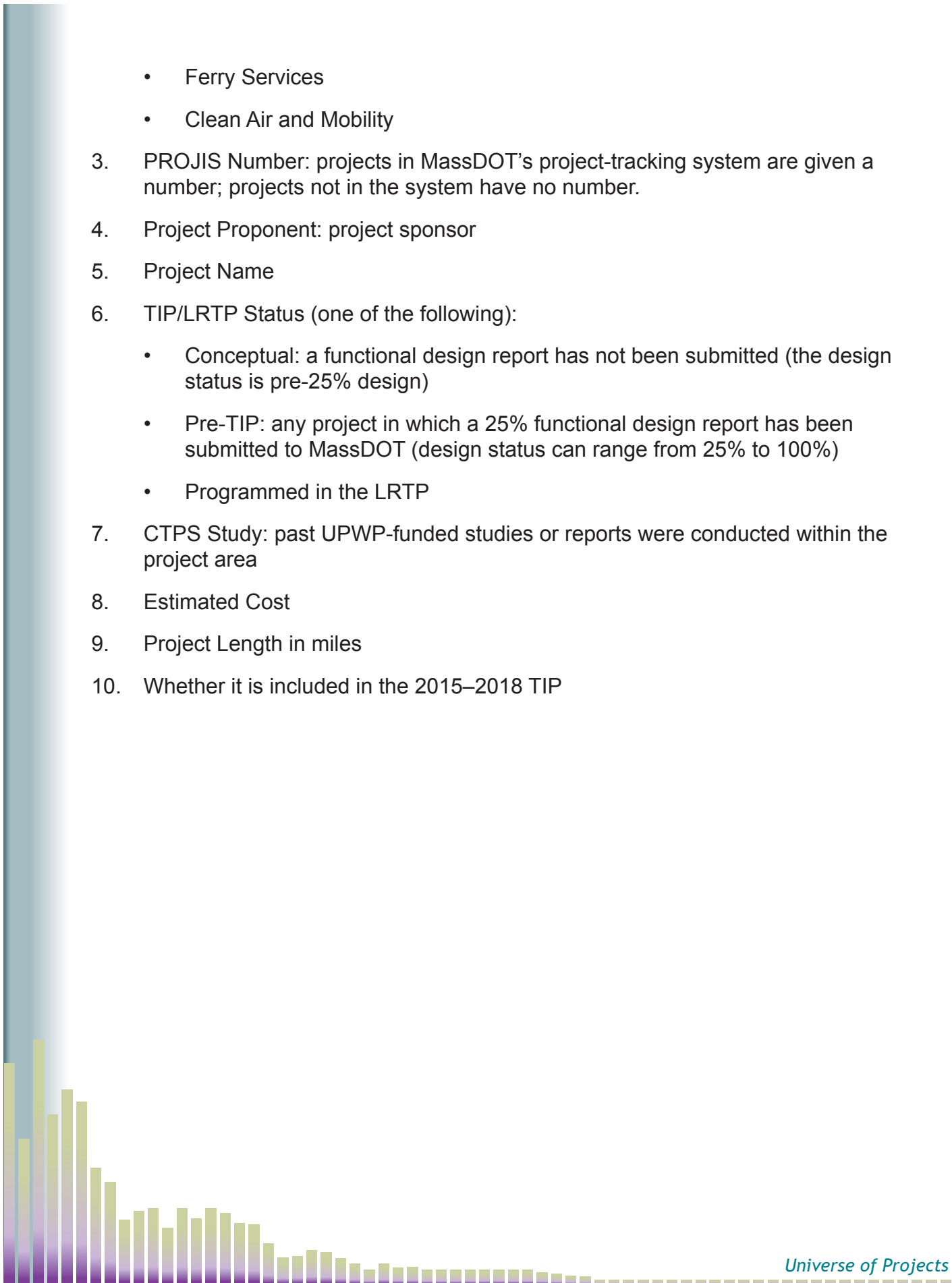


TABLE B.1
L RTP - Universe of Projects - Projects Listed in the Previous L RTP, *Paths to a Sustainable Region*

| Project Type | Investment Program | PROJIS | Proponent(s) | Project Name | TIP/L RTP Status | CTPS Study | Estimated Cost | Project Length | 2015-2018 TIP |
|---------------------------|----------------------|-------------------------|--|--|------------------|------------|----------------|----------------|---------------|
| Arterial and Intersection | Bottleneck | 5399 | Salem | Reconstruction of Bridge Street, from Flint Street to Washington Street | L RTP 2016-20 | N/A | \$16,613,000 | 0.4 | N/A |
| Arterial and Intersection | Bottleneck | 601630 | Weymouth | Route 18 Widening | L RTP 2016-20 | N/A | \$59,000,000 | 4.0 | X |
| Arterial and Intersection | Bottleneck | 604935 | Woburn | Montvale Avenue Widening | L RTP 2016-20 | N/A | \$4,225,256 | | X |
| Arterial and Intersection | Major Infrastructure | 29492 | Bedford | Middlesex Turnpike Phase III | L RTP 2016-20 | N/A | \$26,935,171 | | X |
| Arterial and Intersection | Major Infrastructure | 606226 | Boston | Reconstruction of Rutherford Avenue, from City Square to Sullivan Square | L RTP 2016-20 | N/A | \$109,967,000 | 2.9 | N/A |
| Arterial and Intersection | Major Infrastructure | 606109 | Framingham | Intersection Improvements at Route 126/135/MBTA & CSX Railroad | L RTP 2026-30 | N/A | \$115,000,000 | 0.2 | N/A |
| Arterial and Intersection | Major Infrastructure | 606635 | Newton, Needham (MassDOT) | Reconstruction of Highland Avenue, Needham Street & Charles River Bridge, from Webster Street to Route 9 | L RTP 2021-25 | N/A | \$18,000,000 | 3.0 | N/A |
| Bicycle and Pedestrian | Bike Network | N/A | Stow, Hudson | Assabet River Rail Trail | L RTP 2016-20 | N/A | \$16,285,600 | 3.6 | N/A |
| Bridge | | 604996 | Woburn | Bridge Replacement, New Boston Street over MBTA | L RTP 2016-20 | N/A | \$8,297,198 | 0.3 | N/A |
| Major Highway | Bottleneck | N/A | Braintree (MassDOT) | I-93/Route 3 Interchange (Braintree Split) | L RTP 2031-35 | 2006 | \$53,289,000 | N/A | N/A |
| Major Highway | Major Infrastructure | 605012 | Malden, Revere, Saugus (MassDOT) | Reconstruction & Widening on Route 1, from Route 60 to Route 99 | L RTP 2031-35 | N/A | \$236,078,000 | 2.1 | N/A |
| Major Highway | Major Infrastructure | 605605 (608097; 608096) | Reading, Stoneham, Wakefield, Woburn (MassDOT) | "Interchange Improvements to I-93/I-95 ((1) Washington Street Bridge over I-95 (2) Improvements along Route 128/I-95 MB Add-a-Lane/Exit 38/Route 28 Reconfiguration (3) Modifications to Interchange 38 in Reading, Stoneham and Wakefield)" | L RTP 2026-30 | N/A | \$339,100,000 | 16.5 | N/A |
| Major Highway | Major Infrastructure | 87790 | Canton, Dedham, Norwood (MassDOT) | Interchange Improvements at I-95/I-93 (Non-Federal Funds) | L RTP 2016-2020 | N/A | \$177,414,000 | N/A | X |
| Major Highway | Major Infrastructure | 606146 | Canton, Norwood, Westwood (MassDOT) | Ramp Construction on I-95 (NB) and Improvements on Dedham Street/Canton Street (Non-Federal Funds) | L RTP 2013-2015 | N/A | \$51,000,000 | N/A | X |
| Transit | Transit Capacity | N/A | MPO | Green Line Extension Phase II from College Avenue to Mystic Valley Parkway/Route 16 | L RTP 2016-2025 | N/A | \$190,000,000 | N/A | X |

TABLE B.2
L RTP - Universe of Projects - Projects That Add Capacity to the System/Cost More than \$20 million

| Project Type | Investment Program | PROJIS | Proponent(s) | Project Name | TIP/L RTP Status | CTPS Study | Estimated Cost | Project Length | 2015-2018 TIP |
|---------------------------|---------------------------|--------|----------------------------------|---|------------------|------------|----------------|----------------|---------------|
| Arterial and Intersection | Bottleneck | N/A | Brookline, Newton | Route 9 Capacity Improvements | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | Bottleneck | 604619 | Lexington | Route 4/225 (Bedford Street) and Hartwell Avenue | Pre-TIP | N/A | \$23,221,000 | N/A | N/A |
| Arterial and Intersection | Interchange | N/A | Revere (MassDOT) | Mahoney Circle Grade Separation | Conceptual | N/A | \$60,000,000 | N/A | N/A |
| Arterial and Intersection | Interchange | N/A | Revere (MassDOT) | Route 1/Route 16 Connector | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | Interchange | N/A | Revere (MassDOT) | Route 1A/Route 16 Connector | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | MassPort, MassDOT, MBTA, Boston | South Boston Transportation Study - Cypher Street extension from D Street to E Street and reconstruct and extend E Street from Cypher Street to Summer Street | Conceptual | 2015 | \$9,700,000 | N/A | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | MassPort, MassDOT, MBTA, Boston | South Boston Transportation Study - New Summer Street north/south connector to Northern Avenue/Haul Road/Drydock Avenue | Conceptual | 2015 | N/A | N/A | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | MassDOT | Route 1 Intersection Signalization (Corridorwide) | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | Major Infrastructure | 602091 | Concord | Improvements & Upgrades to Concord Rotary (Routes 2/2A/119) | Pre-TIP | 1995 | \$98,900,000 | N/A | N/A |
| Arterial and Intersection | Major Infrastructure | 607981 | Somerville (MassDOT) | McGrath Boulevard Project | Pre-TIP | N/A | \$65,000,000 | N/A | N/A |
| Arterial and Intersection | Major Infrastructure | N/A | CTPS Study | Route 30 (Cochituate Road) in Framingham and Natick | Conceptual | 2013 | N/A | N/A | N/A |
| Arterial and Intersection | | N/A | Boston | Boardman Street at Route 1A | Conceptual | 1990 | \$13,686,000 | 0.1 | N/A |
| Arterial and Intersection | | N/A | Milford | Veteran's Memorial Drive/Alternate Route | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | | N/A | Rockland | Completion of the S. Weymouth Naval Air Station - Widening Reservoir Park Drive and Hingham Street | Conceptual | N/A | N/A | N/A | N/A |
| Freight | Freight Movement | N/A | Boston | Charlestown Haul Road | Conceptual | N/A | N/A | N/A | N/A |
| Freight | Freight Movement | N/A | Boston | Conley Rail Service | Conceptual | N/A | N/A | N/A | N/A |
| Major Highway | Bottleneck | N/A | CTPS Study | Extend I-93 High-Occupancy Vehicle Lane into the City (Somerville) | Conceptual | N/A | N/A | N/A | N/A |
| Major Highway | Bottleneck | N/A | CTPS Study | I-495 Capacity Improvements (Littleton to Wrentham) | Conceptual | N/A | N/A | N/A | N/A |
| Major Highway | Bottleneck | N/A | CTPS Study | I-93 Capacity Improvements (Boston to Braintree) | Conceptual | N/A | N/A | N/A | N/A |
| Major Highway | Bottleneck | N/A | CTPS Study | I-95 Capacity Improvements (Canton to Foxborough) | Conceptual | N/A | N/A | N/A | N/A |
| Major Highway | Bottleneck | N/A | CTPS Study | Route 128 Capacity Improvements (Lynnfield to Peabody) | Conceptual | N/A | N/A | N/A | N/A |
| Major Highway | Bottleneck | N/A | CTPS Study | Route 128 HOV (Wellesley to Woburn) | Conceptual | N/A | N/A | N/A | N/A |
| Major Highway | Bottleneck | N/A | CTPS Study | Route 2 Capacity Improvements (Acton to Lexington) | Conceptual | N/A | N/A | N/A | N/A |
| Major Highway | Bottleneck | N/A | CTPS Study | Route 24 Capacity Improvements (Taunton to Randolph) | Conceptual | N/A | N/A | N/A | N/A |
| Major Highway | Bottleneck | N/A | CTPS Study | Interstate 93 Capacity Improvements (Somerville to Woburn) | Conceptual | N/A | N/A | N/A | N/A |
| Major Highway | Bottleneck | 604638 | Danvers, Peabody (MassDOT) | Mainline Improvements on Route 128 (Phase II) | Pre-TIP | N/A | \$23,776,000 | 1.7 | N/A |
| Bridge | Interchange | 605313 | Natick | Bridge Replacement, Route 27 (North Main Street) over Route 9 (Worcester Street) and Interchange Improvements | Pre-TIP | N/A | \$25,793,370 | N/A | N/A |
| Major Highway | Interchange | 607977 | Hopkinton, Westborough (MassDOT) | Reconstruction of I-90/I-495 Interchange | Pre-TIP | N/A | \$220,000,000 | 2.0 | N/A |
| Major Highway | Interchange | N/A | Newton | New Route 128 Ramp to Riverside Station | Conceptual | N/A | N/A | N/A | N/A |
| Major Highway | Interchange | N/A | Wilmington | I-93/Route 125/Ballardvale Road | Conceptual | N/A | N/A | N/A | N/A |
| Major Highway | Interchange | 607727 | Beverly | Interchange Reconstruction at Route 128/Exit 19 at Brimbal Avenue (Phase II) | Pre-TIP | N/A | \$23,000,000 | N/A | N/A |
| Major Highway | Interchange | N/A | Boston | Massachusetts Turnpike Back Bay Exit | Conceptual | N/A | N/A | N/A | N/A |
| Major Highway | Interchange | 603345 | Hudson, Marlborough (MassDOT) | Reconstruction on Routes I-290 and 495 and Bridge Replacement | Pre-TIP | N/A | \$100,000,000 | 2.0 | N/A |
| Major Highway | Interchange | N/A | Randolph | I-93/Route 24 Interchange | Conceptual | N/A | N/A | N/A | N/A |

(cont.)

TABLE B.2 (Cont.)
L RTP - Universe of Projects - Projects That Add Capacity to the System/Cost More than \$20 million

| Project Type | Investment Program | PROJIS | Proponent(s) | Project Name | TIP/L RTP Status | CTPS Study | Estimated Cost | Project Length | 2015-2018 TIP |
|---------------|-----------------------|--------|-------------------------------------|--|------------------|------------|--|----------------|---------------|
| Major Highway | Interchange | 601513 | Saugus (MassDOT) | Interchange Reconstruction at Walnut Street & Route 1 (Phase II) | Pre-TIP | N/A | \$18,612,130 | 1.2 | N/A |
| Major Highway | Interchange | 607701 | Southborough, Westborough (MassDOT) | Improvements on Route 9 at I-495 Interchange, from Computer Drive/ Research Drive to Route 9/Crystal Road Intersection | Pre-TIP | N/A | \$25,000,000 | 4.4 | N/A |
| Major Highway | Interchange | | Boston (MassDOT) | Allston Interstate 90 Massachusetts Turnpike Interchange Improvement Program | Pre-TIP | | \$260,000,000 | | |
| Major Highway | Bridge | | Boston | South Boston Transportation Study - Northern Avenue Bridge reconstruction | Conceptual | | N/A | | |
| Major Highway | Major Infrastructure | 608128 | MassDOT | Boston-Southeast Expressway Modification (Southampton Interchange) | Conceptual | N/A | \$143,750,000 | | N/A |
| Major Highway | Major Infrastructure | N/A | MassDOT | Route 3 South Express Toll Lanes | Conceptual | N/A | \$800,000,000 | | N/A |
| Transit | Transit Capacity | N/A | CTPS Study | Build New Busways to Alewife Station (Cambridge) | Conceptual | N/A | N/A | N/A | N/A |
| Transit | Transit Capacity | N/A | CTPS Study | Construction of new commuter rail stations in Milford and/or Hopedale on the Franklin Line | Conceptual | 2012 | \$126-150 million (capital) \$3.1-4.3 (operating) | N/A | N/A |
| Transit | Transit Capacity | N/A | MassDOT/MBTA | South Station Expansion Project | Conceptual | N/A | N/A | N/A | N/A |
| Transit | Transit Capacity | N/A | MassDOT/MBTA | New Worcester Line Commuter Rail Station in Allston (West Station) | Conceptual | N/A | \$200,000,000 | N/A | N/A |
| Transit | Transit Capacity | N/A | MassPort, MassDOT, MBTA | T Under D (South Boston) | Conceptual | N/A | N/A | N/A | N/A |
| Transit | Transit Capacity | N/A | MassPort, MassDOT, MBTA, Boston | South Boston Transportation Study - Extension of Silver Line to Dudley Square | Conceptual | 2015 | N/A | N/A | |
| Transit | Transit Capacity | N/A | Private - New Balance | Brighton Landing Commuter Rail Station | Pre-TIP | | \$25,000,000 | N/A | |
| Transit | Transit Capacity | N/A | MassDOT/MBTA | Maintenance Facilities | Conceptual | N/A | N/A | N/A | N/A |
| Transit | Transit Capacity | N/A | MassDOT/MBTA | Orient Heights Maintenance Facility Renovation Phase III | Conceptual | N/A | N/A | N/A | N/A |
| Transit | Transit Capacity | N/A | Waltham | Fitchburg Commuter Rail - Multi-Modal Transit Center | | N/A | N/A | N/A | N/A |
| Transit | Transit Extension | N/A | MassDOT/MBTA | Urban Rail Service (DMU or EMU) "A" - Riverside to South Station via Worcester CR ROW | Conceptual | N/A | N/A | N/A | N/A |
| Transit | Transit Extension | N/A | MassDOT/MBTA | Urban Rail Service (DMU or EMU) "B" - Allston to North Station via Grand Junction ROW thru Cambridge | Conceptual | N/A | N/A | N/A | N/A |
| Transit | Transit Extension | N/A | MassDOT/MBTA | Urban Rail Service (DMU or EMU) "C" - Back Bay to the Convention Center (BCEC) via Worcester CR ROW | Conceptual | N/A | N/A | N/A | N/A |
| Transit | Transit Extension | N/A | MassDOT/MBTA | Urban Rail Service (DMU or EMU) "D" - Route 128 Station to South Station via Fairmount CR ROW | Conceptual | N/A | N/A | N/A | N/A |
| Transit | Transit Extension | N/A | MassDOT/MBTA | Urban Rail Service (DMU or EMU) "E" - Lynn to North Station via Newburyport/Rockport CR ROW | Conceptual | N/A | N/A | N/A | N/A |
| Transit | Transit Extension | N/A | MassDOT/MBTA | Urban Rail Service (DMU or EMU) "F" - Anderson/Woburn to North Station via Lowell CR ROW | Conceptual | N/A | N/A | N/A | N/A |
| Transit | Transit Extension | N/A | MassDOT/MBTA | Operate Weekday Commuter Rail Service to Foxboro | Conceptual | N/A | N/A | N/A | N/A |
| Transit | Transit Extension | N/A | MVPC | Bus on Shoulder | Conceptual | 2014 | N/A | | N/A |
| Transit | Transit Extension | N/A | Public Input | Improved Cross-Town or Circumferential Transit | Conceptual | N/A | N/A | N/A | N/A |
| Transit | Transit Extension | N/A | Public Input | Improved connections between North and South Station | Conceptual | N/A | N/A | N/A | N/A |
| Transit | Transit Modernization | N/A | Natick | Natick Center MBTA Commuter Rail Station Upgrades | Conceptual | N/A | N/A | N/A | N/A |
| Transit | Transit Modernization | N/A | Quincy | Quincy Center Multimodal MBTA Station | Conceptual | N/A | N/A | N/A | N/A |
| Transit | N/A | N/A | MassDOT/MBTA | Improved Inner Harbor Ferry | Conceptual | N/A | N/A | N/A | N/A |
| Transit | N/A | N/A | MassDOT/MBTA | Improved Ferry Service from South Shore Communities to Boston | Conceptual | N/A | N/A | N/A | N/A |
| Transit | Ferry Service | N/A | MassPort, MassDOT, MBTA, Boston | South Boston Transportation Study - New or expanded ferry service and water transportation infrastructure | Conceptual | 2015 | N/A | N/A | |
| Transit | Ferry Service | N/A | Winn Resort/ Revere | Water transportation vessels and dock facilities | Conceptual | | N/A | N/A | |

TABLE B.3
L RTP - Universe of Projects - Projects That Do Not Add Capacity to the System/Cost Under \$20 million

| Project Type | Investment Program | PROJIS | Proponent(s) | Project Name | TIP/L RTP Status | CTPS Study | Estimated Cost | Project Length | 2015-2018 TIP |
|---------------------------|--------------------|--------|-------------------|---|------------------|------------|----------------|----------------|---------------|
| Arterial and Intersection | Complete Streets | 604123 | Ashland | Reconstruction on Route 126 (Pond Street), from the Framingham T.L. to the Holliston T.L. | Pre-TIP | N/A | \$13,277,000 | 1.7 | N/A |
| Arterial and Intersection | Complete Streets | 606453 | Boston | Improvements on Boylston Street, from Intersection of Brookline Avenue & Park Drive to Ipswich Street | Pre-TIP | N/A | \$6,555,000 | 0.6 | N/A |
| Arterial and Intersection | Complete Streets | 601274 | Boston | Reconstruction of Tremont Street, from Court Street to Boylston Street | Pre-TIP | N/A | \$2,681,260 | 0.6 | N/A |
| Arterial and Intersection | Complete Streets | N/A | Chelsea | Reconstruction of Beacham and Williams Street, from Spruce Street to the Everett City Line | Conceptual | N/A | N/A | 0.5 | N/A |
| Arterial and Intersection | Complete Streets | 608007 | Cohasset | Corridor Improvements and Related Work on Justice Cushing Highway (Route 3A), from Beechwood Street to the Scituate Town Line | Pre-TIP | 2013 | \$4,000,200 | 0.8 | N/A |
| Arterial and Intersection | Complete Streets | 606896 | CTPS Study | Route 203 (Gallivan Street in Boston) | Conceptual | 2012 | \$11,500,000 | N/A | N/A |
| Arterial and Intersection | Complete Streets | 606897 | CTPS Study | Route 203 (Morton Street in Boston) | Conceptual | 2012 | \$11,500,000 | N/A | N/A |
| Arterial and Intersection | Complete Streets | N/A | CTPS Study | Route 114 in Danvers | Conceptual | 2012 | N/A | N/A | N/A |
| Arterial and Intersection | Complete Streets | N/A | CTPS Study | Reading - Main Street (Route 28) from South Street to Washington Street | Conceptual | 2013 | N/A | N/A | N/A |
| Arterial and Intersection | Complete Streets | 602310 | Danvers | Reconstruction on Collins Street, from Sylvan Street to Centre & Holten Streets | Pre-TIP | N/A | \$7,300,000 | 0.9 | N/A |
| Arterial and Intersection | Complete Streets | N/A | Everett | Beacham Street | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | Complete Streets | 607652 | Everett | Reconstruction of Ferry Street, South Ferry Street and a Portion of Elm Street | Pre-TIP | 2013 | \$6,440,000 | 1.6 | N/A |
| Arterial and Intersection | Complete Streets | 601359 | Franklin | Reconstruction of Pleasant Street, from Main Street to Chestnut Street | Pre-TIP | N/A | \$5,378,680 | 2.4 | N/A |
| Arterial and Intersection | Complete Streets | 604377 | Gloucester | Washington Street And Railroad Avenue | Pre-TIP | N/A | \$4,600,000 | 1.3 | N/A |
| Arterial and Intersection | Complete Streets | 607309 | Hingham | Reconstruction and Related Work on Derby Street from Pond Park Road to Cushing Street | Pre-TIP | N/A | \$3,840,661 | 0.8 | N/A |
| Arterial and Intersection | Complete Streets | 606501 | Holbrook | Reconstruction of Union Street (Route 139), from Linfield Street to Centre Street/ Water Street | Pre-TIP | N/A | \$2,471,136 | 0.9 | N/A |
| Arterial and Intersection | Complete Streets | 606043 | Hopkinton | Signal & Intersection Improvements on Route 135 | Pre-TIP | N/A | \$7,235,377 | 0.8 | N/A |
| Arterial and Intersection | Complete Streets | 601607 | Hull | Reconstruction of Atlantic Avenue and Related Work, from Nantasket Avenue to Cohasset Town Line | Pre-TIP | N/A | \$5,175,277 | 1.3 | N/A |
| Arterial and Intersection | Complete Streets | 607409 | Lexington | Reconstruction on Massachusetts Avenue, from Marrett Road to Pleasant Street | Pre-TIP | 2008 | \$4,899,166 | 0.7 | N/A |
| Arterial and Intersection | Complete Streets | 602077 | Lynn | Reconstruction on Route 129 (Lynnfield Street), from Great Woods Road to Wyoma Square | Pre-TIP | N/A | \$3,457,578 | 1.0 | N/A |
| Arterial and Intersection | Complete Streets | 604810 | Marlborough | Route 85 | TIP - 2016 | N/A | \$5,144,104 | 1.1 | X |
| Arterial and Intersection | Complete Streets | 607428 | Milford | Resurfacing & Intersection Improvements on Route 16 (Main Street), from Water Street to the Hopedale T.L. | Pre-TIP | N/A | \$5,417,832 | 0.6 | N/A |
| Arterial and Intersection | Complete Streets | 608045 | Milford | Rehabilitation on Route 16, from Route 109 to Beaver Street | Pre-TIP | N/A | \$2,700,000 | 0.6 | N/A |
| Arterial and Intersection | Complete Streets | 604206 | Milton | Rehabilitation of Central Avenue, from Brook Road to Eliot Street | Pre-TIP | N/A | \$2,535,886 | 0.9 | N/A |
| Arterial and Intersection | Complete Streets | 605034 | Natick | Reconstruction of Route 27 (North Main Street), from North Avenue to the Wayland Town Line | Pre-TIP | N/A | \$13,090,726 | 2.2 | N/A |
| Arterial and Intersection | Complete Streets | 601704 | Newton | Reconstruction & Signal Improvements on Walnut Street, from Homer Street to Route 9 | Pre-TIP | N/A | \$4,648,360 | 1.3 | N/A |
| Arterial and Intersection | Complete Streets | 600932 | Newton | Reconstruction on Route 30 (Commonwealth Avenue), from Weston Town Line to Auburn Street | Pre-TIP | N/A | \$2,208,000 | 1.2 | N/A |
| Arterial and Intersection | Complete Streets | N/A | CTPS Study | Washington Street - Chestnut Street to Church Street | Conceptual | 2015 | \$15,000,000 | 2.0 | N/A |
| Arterial and Intersection | Complete Streets | 605708 | Sharon | Signal and Intersection Improvements on South Main Street | Pre-TIP | N/A | \$2,984,345 | 0.8 | N/A |
| Arterial and Intersection | Complete Streets | 604989 | Southborough | Route 30 | TIP - 2017 | N/A | \$6,345,000 | N/A | N/A |
| Arterial and Intersection | Complete Streets | 602261 | Walpole (MassDOT) | Reconstruction of Route 1A (Main Street), from the Norwood Town Line to Route 27 | Pre-TIP | N/A | \$15,886,000 | 2.1 | N/A |
| Arterial and Intersection | Complete Streets | 600671 | Walpole (MassDOT) | Reconstruction of Route 1A, from Common Street to the Norfolk Town Line | Pre-TIP | N/A | \$15,000,000 | 1.9 | N/A |
| Arterial and Intersection | Complete Streets | 607777 | Watertown | Rehabilitation of Mount Auburn Street (Route 16) | Pre-TIP | N/A | \$12,233,125 | 1.8 | N/A |

TABLE B.3 (Cont.)
L RTP - Universe of Projects - Projects That Do Not Add Capacity to the System/Cost Under \$20 million

| Project Type | Investment Program | PROJIS | Proponent(s) | Project Name | TIP/L RTP Status | CTPS Study | Estimated Cost | Project Length | 2015-2018 TIP |
|---------------------------|---------------------------|--------|---------------------------|--|------------------|------------|--------------------------|----------------|---------------|
| Arterial and Intersection | Complete Streets | 608051 | Wilmington | Reconstruction on Route 38 (Main Street), from Route 62 to the Woburn City Line | Pre-TIP | N/A | \$9,108,000 | 2.1 | N/A |
| Arterial and Intersection | Complete Streets | 607244 | Winthrop | Reconstruction and Related Work along Winthrop Street and Revere Street Corridor | Pre-TIP | N/A | \$5,040,000 | 1.8 | N/A |
| Arterial and Intersection | Complete Streets | 607340 | Wellesley | Route 9 Corridor Enhancements | Pre-TIP | | \$16,462,400 | 4.8 | |
| Arterial and Intersection | Complete Streets | 604745 | Wrentham | Reconstruction of Taunton Street (Route 152) | Pre-TIP | N/A | \$3,945,871 | 0.9 | N/A |
| Arterial and Intersection | Intersection Improvements | 607748 | Acton | Intersection and Signal Improvements on State Route 2 and State Route 111 (Massachusetts Avenue) at Piper Road and Taylor Road | Pre-TIP | N/A | \$520,000 | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Ashland | Intersection Improvements at Frankland Road and West Union Street (Route 135) | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | 606117 | Boston | Traffic Signal Improvements at 11 Locations | Pre-TIP | N/A | \$3,036,200 | 0.6 | N/A |
| Arterial and Intersection | Intersection Improvements | 605110 | Brookline | Intersection and Signal Improvements at Route 9 & Village Square (Gateway East) | TIP | N/A | \$5,070,387 | | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Winn Resort/ Cambridge | Intersection Improvements at Land Boulevard/O'Brien Highway | Conceptual | | N/A | | |
| Arterial and Intersection | Intersection Improvements | N/A | CTPS Study | Franklin/West Street, Braintree Intersection improvements | Conceptual | 2013 | N/A | N/A | X |
| Arterial and Intersection | Intersection Improvements | N/A | CTPS Study | Marshfield - Careswell Street (Route 139) and Webster Street Intersection | Conceptual | 2012 | N/A | N/A | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | CTPS Study | Milford - Route 140 at South Main Street | Conceptual | 2013 | | N/A | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | CTPS Study | Reconstruct Intersection at Southern Artery (Route 3A) at Sea Street/Coddington Street and at McGrath Highway/Field Street, Quincy | Conceptual | 2012 | \$750,000- 1,0000,000 | N/A | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | CTPS Study | Revere - Crescent Avenue and Winthrop Avenue Intersection | Conceptual | 2012 | N/A | N/A | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | CTPS Study | Revere - Safety Improvements for Pedestrians at Park Avenue and Dale Street Intersection | Conceptual | 2013 | N/A | N/A | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | CTPS Study | Intersection Improvements Turnpike Road (Route 9) at Central Street/Oak Hill Road in Southborough | Conceptual | 2012 | N/A | N/A | N/A |
| Arterial and Intersection | Intersection Improvements | 606002 | Duxbury | Signal Installation at Route 3 (NB & SB) Ramps & Route 3A (Tremont St) | Pre-TIP | N/A | \$2,400,000 | 0.5 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Duxbury | Intersection Improvements at Route 3A and Route 139 | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | 605168 | Hingham | Intersection Improvements at Route 3A/Summer Street Rotary | Pre-TIP | N/A | \$1,780,644 | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | 600518 | Hingham (MassDOT) | Intersection Improvements at Derby Street, Whiting Street (Route 53) and Gardner Street | Pre-TIP | 2003 | \$2,827,048 | 0.4 | N/A |
| Arterial and Intersection | Intersection Improvements | 607255 | Holbrook | Intersection improvements and related work at Weymouth Street/Pine Street/ Sycamore Street | Pre-TIP | 2011 | \$1,016,544 | | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Holbrook | Intersection Improvements at South Franklin Street and King Road | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Hudson | Intersection Improvements at Lincoln Street and Cox Street and Packard Street | Conceptual | 2011 | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Hudson | Upgrades to the Route 85 and Route 62 Rotary | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Lynn | Intersection Improvements at Boston Street and Hamilton Street | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Lynn | Intersection Improvements at Route 1A Lynnway and Blossom Street | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Lynn | Intersection Improvements at Route 1A Lynnway and Market Street | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | 604231 | Marlborough | Intersection & Signal Improvements on Route 20 (East Main Street/Boston Post Road) at Concord Road | Pre-TIP | N/A | \$1,706,600 | 0.2 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | MassDOT | Route 1 Intersection Signalization (Corridorwide) | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Medfield | Intersection Improvements at Route 109 and Hartford Street | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Milton | Intersection Improvements at Blue Hills Parkway and Brook Road | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | 605857 | Norwood | Intersection Improvements at Route 1 & University Avenue/Everett Street | Pre-TIP | 1999 | \$3,780,000 | 0.2 | N/A |
| Arterial and Intersection | Intersection Improvements | 606130 | Norwood | Intersection Improvements at Route 1A & Upland Road/Washington Street & Prospect Street/Fulton Street | Pre-TIP | N/A | \$3,275,390 | 0.2 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Peabody | Signalize Intersection of Central Street and Tremont Street | Conceptual | N/A | N/A | 0.1 | N/A |

(cont.)

TABLE B.3 (cont.)
L RTP - Universe of Projects - Projects That Do Not Add Capacity to the System/Cost Under \$20 million

| Project Type | Investment Program | PROJIS | Proponent(s) | Project Name | TIP/L RTP Status | CTPS Study | Estimated Cost | Project Length | 2015-2018 TIP |
|---------------------------|---------------------------|--------|----------------------------|--|------------------|------------|----------------|----------------|---------------|
| Arterial and Intersection | Intersection Improvements | N/A | Randolph | Route 28 (N. Main Street) and Liberty Street Intersections | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Randolph | Route 28 (N. Main Street) and West Street Intersection | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Somerville | Intersection Improvements at Cross Street and Pearl Street | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Somerville | Intersection Improvements at Powderhouse Boulevard and Packard Avenue | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Winn Resort/ Somerville | Intersection Improvements at (1) I-93 SB Off-Ramp/I-93 NB On-Ramp/Mystic Avenue (2) I-93 Off-Ramp/McGrath Highway (3) Mystic Avenue/McGrath Highway (4) Mystic Avenue/I-93 SB On-Ramp (5) Broadway/McGrath Highway (6) Mystic Avenue/I-93 NB On-Ramp | Conceptual | | N/A | | |
| Arterial and Intersection | Intersection Improvements | 607249 | Sudbury | Intersection Improvements at Route 20 and Landham Road | Pre-TIP | 2010 | \$1,980,000 | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Sudbury | Intersection Improvements at Route 20 and Horsepond Road | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Sudbury | Intersection Improvements at Route 20 and Wayside Inn Road | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Waltham | Intersection Improvements at Lexington Street and Glen Meadow | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Waltham | Intersection Improvements at Moody Street and Maple Street and High Street | Conceptual | N/A | N/A | 0.2 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Waltham | Intersection Improvements at Totten Pond Road and Lexington Street and Bacon Street | Conceptual | N/A | N/A | 0.5 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Waltham | Intersection Improvements at Trapelo Road and Forest Street | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | 601579 | Wayland | Signal and intersection improvements at Route 27 (Main Street) and Route 30 (Commonwealth Road) | TIP | 2008 | \$2,479,451 | N/A | N/A |
| Arterial and Intersection | Intersection Improvements | 605721 | Weymouth | Intersection Improvements at Middle Street, Libbey Industrial Parkway and Tara Drive | Pre-TIP | 2003 | \$937,326 | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Wilmington | Intersection Improvements at Salem Street (Route 62) and Middlesex Avenue and High Street | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | Intersection Improvements | 608067 | Woburn | Intersection Reconstruction at Route 3 and Bedford Road and South Bedford Street | Pre-TIP | N/A | \$1,440,000 | N/A | N/A |
| Arterial and Intersection | N/A | N/A | Arlington | Reconstruct Massachusetts Avenue (Phase 2), from Pond Lane to Water Street | Conceptual | N/A | N/A | 0.3 | N/A |
| Arterial and Intersection | N/A | N/A | Bedford | Reconstruct South Road, from Washington Street (Elm Brook) to Summer Street | Conceptual | N/A | N/A | 0.9 | N/A |
| Arterial and Intersection | N/A | N/A | Bedford | Reconstruct Wiggins Avenue | Conceptual | N/A | N/A | 0.9 | N/A |
| Arterial and Intersection | N/A | N/A | Bellingham | Reconstruct Maple Street, from Route 126 to Route 140 | Conceptual | N/A | N/A | 2.8 | N/A |
| Arterial and Intersection | N/A | N/A | Bellingham | Reconstruct Pulaski Boulevard (Route 126), from South Main Street to the Blackstone Town Line | Conceptual | N/A | N/A | 0.7 | N/A |
| Arterial and Intersection | N/A | N/A | Bellingham | Reconstruct Route 126 (South Main Street), from Pulaski Boulevard to Route 140 | Conceptual | N/A | N/A | 4.6 | N/A |
| Arterial and Intersection | N/A | N/A | Bellingham | Reconstruct Hartford Avenue, from North Main Street (Route 126) to the Mendon Town Line | Conceptual | N/A | N/A | 1.6 | N/A |
| Arterial and Intersection | N/A | N/A | Bolton | Reconstruct Route 85 (Hudson Road) | Conceptual | N/A | N/A | 1.6 | N/A |
| Arterial and Intersection | N/A | 53001 | Boston | Northern Avenue Connector Roads (Phase 1) | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | Boston | South Huntington Avenue | Conceptual | N/A | N/A | 0.2 | N/A |
| Arterial and Intersection | N/A | N/A | Boston | Huntington Avenue | Conceptual | N/A | N/A | 1.3 | N/A |
| Arterial and Intersection | N/A | N/A | Boston | Huntington Avenue | Conceptual | N/A | N/A | 0.3 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Winn Resort/ Boston | Intersection Improvements at (1) Alford Street/Main Street/Sever Street/Cambridge Street (2) Cambridge Street/I-93 NB Off-Ramp (3) Dexter Street/Alford Street (4) Rutherford Avenue/Route 1 | Conceptual | | N/A | | |
| Arterial and Intersection | N/A | N/A | Burlington | Route 62 (Wilmington Road) | Conceptual | N/A | N/A | 1.6 | N/A |
| Arterial and Intersection | N/A | N/A | Burlington | Wheeler Road | Conceptual | N/A | N/A | 0.7 | N/A |
| Arterial and Intersection | N/A | N/A | Burlington | South Bedford Street | Conceptual | N/A | N/A | 0.6 | N/A |
| Arterial and Intersection | N/A | N/A | Chelsea | Reconstruct Spruce Street, from Everett Avenue and Sixth Street | Conceptual | N/A | N/A | 0.2 | N/A |

(cont.)

TABLE B.3 (cont.)
L RTP - Universe of Projects - Projects That Do Not Add Capacity to the System/Cost Under \$20 million

| Project Type | Investment Program | PROJIS | Proponent(s) | Project Name | TIP/L RTP Status | CTPS Study | Estimated Cost | Project Length | 2015-2018 TIP |
|---------------------------|---------------------------|--------|----------------------|---|------------------|------------|----------------|----------------|---------------|
| Arterial and Intersection | N/A | N/A | Chelsea | Reconstruct Broadway, from City Hall Ave to the Revere City Line | Conceptual | N/A | \$10,000,000 | 1.0 | N/A |
| Arterial and Intersection | N/A | N/A | Chelsea | Spruce Street/Second Street/Carter Street Improvements | Conceptual | N/A | \$8,000,000 | 1.2 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Winn Resort/ Chelsea | Intersection Improvements at (1) Route 16/Washington Avenue (2) Route 16/ Everett Avenue (3) Route 16/Webster Avenue | Conceptual | | N/A | | |
| Arterial and Intersection | N/A | N/A | Concord | Reconstruction of Route 117 (Fitchburg Turnpike) | Conceptual | N/A | N/A | 1.0 | N/A |
| Arterial and Intersection | N/A | N/A | Concord | Reconstruction of Route 62 (Main St), Phase 3 | Conceptual | N/A | N/A | 0.8 | N/A |
| Arterial and Intersection | N/A | N/A | Concord | Cambridge Turnpike | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | CTPS Study | Route 138 Corridor (Canton, Milton, Stoughton) | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | Danvers | Improve Railroad Crossing at the Intersection of Holten Street and Burroughs Street | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | N/A | N/A | Everett | Reconstruction of Main Street, from Sweetser Circle to the Malden City Line | Conceptual | N/A | N/A | 0.9 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Winn Resort/ Everett | Intersection Improvements at (1) Revere Beach Parkway/Mystic View Road/Santilli Highway/Route 99 Connector Improvements (2) Route 16/Broadway/Main Street (3) Broadway/Beacham Street (4) Broadway/Horizon Way (5) Broadway/Lynde Street (6) Broadway/Thorndike Street (7) Bow Street/Mystic Street (8) Bow Street/ Lynde Street (9) Bow Street/Thorndike Street (10) Beacham Street/Robin Street (11) Broadway/Bowdoin Street (12) Broadway/Norwood Street/Chelsea Street (13) Ferry Street/Broadway | Conceptual | | N/A | | |
| Arterial and Intersection | N/A | N/A | Framingham | Reconstruct Route 126 (Hollis Street), from Irving Street to the Ashland town line | Conceptual | N/A | N/A | 1.2 | N/A |
| Arterial and Intersection | N/A | N/A | Framingham | Reconstruction of Route 126, from Route 9 to Lincoln Street | Conceptual | 2000 | N/A | 1.2 | N/A |
| Arterial and Intersection | N/A | N/A | Framingham | Route 9/Route 126 Interchange | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | Franklin | Reconstruct Chestnut Street, from Route 140 to Pleasant Street | Conceptual | N/A | N/A | 2.1 | N/A |
| Arterial and Intersection | N/A | N/A | Franklin | Reconstruct Summer Street, from Route 140 to Wrentham Town Line | Conceptual | N/A | N/A | 2.5 | N/A |
| Arterial and Intersection | N/A | 607774 | Franklin | Resurfacing and Intersection Improvements on Route 140, from Beaver Street to I-495 Ramps | Conceptual | N/A | \$4,200,000 | N/A | N/A |
| Arterial and Intersection | N/A | N/A | Franklin | Reconstruct Washington Street, from Bellingham Town Line to Prospect Street | Conceptual | N/A | N/A | 1.7 | N/A |
| Arterial and Intersection | N/A | N/A | Gloucester | Gloucester Rotary | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | Hudson | South Street | Conceptual | N/A | N/A | 0.3 | N/A |
| Arterial and Intersection | N/A | N/A | Hull | Manomet Avenue | Conceptual | N/A | N/A | 1.0 | N/A |
| Arterial and Intersection | N/A | N/A | Hull | Samoset Avenue | Conceptual | N/A | N/A | 1.1 | N/A |
| Arterial and Intersection | N/A | 605743 | Ipswich | Resurfacing & Related Work on Central & South Main Streets | Pre-TIP | N/A | \$2,624,154 | 0.6 | N/A |
| Arterial and Intersection | N/A | N/A | Lexington | Waltham St | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | Lexington | Hayden Ave | Conceptual | N/A | N/A | 1.0 | N/A |
| Arterial and Intersection | N/A | N/A | Littleton | Harvard Street | Conceptual | N/A | N/A | 1.6 | N/A |
| Arterial and Intersection | N/A | N/A | Lynn | Broad Street/Lewis Street/Route 129 | Conceptual | N/A | N/A | 6.7 | N/A |
| Arterial and Intersection | N/A | N/A | Lynn | Route 129 (Boston St./Washington St.) | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | N/A | N/A | Lynn | Route 1A Lynn (GE Bridge Nahant Rotary) | Conceptual | N/A | N/A | 2.4 | N/A |
| Arterial and Intersection | N/A | N/A | Marlborough | Route 85 North (Bolton Street) | Conceptual | 2001 | N/A | 2.0 | N/A |
| Arterial and Intersection | N/A | 604811 | Marlborough | Reconstruction of Route 20 (East Main Street), from Main Street Easterly to Lincoln Street | Pre-TIP | N/A | \$2,252,930 | 0.3 | N/A |
| Arterial and Intersection | N/A | N/A | Medfield | South Street | Conceptual | N/A | N/A | 1.3 | N/A |
| Arterial and Intersection | N/A | N/A | Medford | Medford Square Phase 2 Improvements | Conceptual | N/A | N/A | 0.1 | N/A |

(cont.)

TABLE B.3 (cont.)
L RTP - Universe of Projects - Projects That Do Not Add Capacity to the System/Cost Under \$20 million

| Project Type | Investment Program | PROJIS | Proponent(s) | Project Name | TIP/L RTP Status | CTPS Study | Estimated Cost | Project Length | 2015-2018 TIP |
|---------------------------|---------------------------|--------|----------------------|--|------------------|------------|----------------|----------------|---------------|
| Arterial and Intersection | Intersection Improvements | N/A | Winn Resort/ Medford | Intersection Improvements at (1) Mystic Valley Parkway/Fellsway/Middlesex Avenue (2) Mystic Valley Parkway/Route 16 Connector (3) Mystic Valley Parkway/ Mystic Avenue | Conceptual | | N/A | | |
| Arterial and Intersection | N/A | N/A | Medway | Route 109 (Milford Street) | Conceptual | N/A | N/A | 2.4 | N/A |
| Arterial and Intersection | N/A | N/A | Melrose | Reconstruct Lebanon Street, from Main Street to the Malden City Line | Conceptual | N/A | N/A | 1.0 | N/A |
| Arterial and Intersection | N/A | N/A | Melrose | Reconstruct Swains Pond Avenue, from Maple Terrace to the Malden City Line | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | N/A | N/A | Melrose | Reconstruct Swains Pond Avenue, from Grove Street to Wheeler Avenue | Conceptual | N/A | N/A | 0.3 | N/A |
| Arterial and Intersection | N/A | N/A | Melrose | Wyoming Avenue | Conceptual | N/A | N/A | 0.7 | N/A |
| Arterial and Intersection | N/A | N/A | MPO Identified Need | Route 1A Salem to Revere | Conceptual | N/A | N/A | | N/A |
| Arterial and Intersection | N/A | N/A | MPO Identified Need | Route 107 Western Ave at | Conceptual | N/A | N/A | | N/A |
| Arterial and Intersection | N/A | N/A | MPO Identified Need | Route 114 Peabody, Salem | Conceptual | N/A | N/A | | N/A |
| Arterial and Intersection | N/A | N/A | MPO Identified Need | Route 16 Fresh Pond Parkway and Alewife Brook Parkway | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | MPO Identified Need | Memorial Drive Cambridge | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | MPO Identified Need | Route 3A Marshfield to Quincy | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | MPO Identified Need | Route 28 Milton to Randolph | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | MPO Identified Need | Route 138 Milton | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | MPO Identified Need | Route 9 Southborough to Newton | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | MPO Identified Need | Route 16 Holliston to Newton | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | MPO Identified Need | Route 20 Weston | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | MPO Identified Need | Route 60 Improvements Arlington | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | MPO Identified Need | Route 30 Framingham | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | MPO Identified Need | Route 99 Everett | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | MPO Identified Need | Route 129 Wilmington to Reading | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | MPO Identified Need | Route 135 Wellesley to Natick | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | Needham | Highland Avenue | Conceptual | N/A | N/A | 1.3 | N/A |
| Arterial and Intersection | N/A | N/A | Newton | Washington St., Phase 2 (Perkins Street to Commonwealth Avenue) | Conceptual | N/A | N/A | 0.5 | N/A |
| Arterial and Intersection | N/A | N/A | North Reading | Park Street Improvements | Conceptual | N/A | N/A | 0.7 | N/A |
| Arterial and Intersection | N/A | N/A | Randolph | Reconstruction of Oak Street, from Devine Road to North Street | Conceptual | N/A | N/A | 1.2 | N/A |
| Arterial and Intersection | N/A | N/A | Reading | Haverhill Street Reconstruction | Conceptual | N/A | N/A | 2.5 | N/A |
| Arterial and Intersection | N/A | N/A | Reading | Streetscape Improvements on Haven & High Streets | Conceptual | N/A | N/A | 0.7 | N/A |
| Arterial and Intersection | Intersection Improvements | N/A | Winn Resort/ Revere | Intersection Improvements at Route 16/Route 1A/Route 60 | Conceptual | | N/A | | |
| Arterial and Intersection | N/A | N/A | Rockland | VFW Drive, Weymouth Street, Hingham Street | Conceptual | N/A | N/A | 4.3 | N/A |
| Arterial and Intersection | N/A | N/A | Somerville | Broadway East Somerville CMAQ | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | N/A | N/A | Southborough | Cordaville Road/Route 85 Rehabilitation | Conceptual | N/A | N/A | 2.6 | N/A |
| Arterial and Intersection | N/A | N/A | Sudbury | Old Sudbury Road (Route 27) | Conceptual | N/A | N/A | 0.1 | N/A |
| Arterial and Intersection | N/A | N/A | Walpole | Walpole Central Business District | Conceptual | N/A | N/A | N/A | N/A |
| Arterial and Intersection | N/A | N/A | Walpole | Elm St Improvements | Conceptual | N/A | N/A | 1.5 | N/A |
| Arterial and Intersection | N/A | N/A | Waltham | Wyman Street | Conceptual | N/A | N/A | 1.0 | N/A |
| Arterial and Intersection | N/A | N/A | Woburn | Route 38 (Main St.) Traffic Lights | Conceptual | N/A | N/A | 0.9 | N/A |
| Arterial and Intersection | N/A | N/A | | Air Force Road Rehabilitation | Conceptual | N/A | N/A | 0.4 | N/A |
| Arterial and Intersection | N/A | N/A | | Main St Reconstruction and Pedestrian Improvement | Conceptual | N/A | N/A | 5.2 | N/A |

(cont.)

TABLE B.3 (cont.)
L RTP - Universe of Projects - Projects That Do Not Add Capacity to the System/Cost Under \$20 million

| Project Type | Investment Program | PROJIS | Proponent(s) | Project Name | TIP/L RTP Status | CTPS Study | Estimated Cost | Project Length | 2015-2018 TIP |
|------------------------|---------------------------|--------|---|---|------------------|------------|----------------|----------------|---------------|
| Bicycle and Pedestrian | Bike Network | 607738 | Bedford | Minuteman Bikeway Extension, from Loomis Street to the Concord T.L. | Pre-TIP | N/A | \$4,006,200 | 2.0 | N/A |
| Bicycle and Pedestrian | Bike Network | N/A | Berlin, Hudson, Sudbury, Waltham, Wayland, Weston | Mass Central Trail "Wayside Trail" from Waltham to Berlin | Conceptual | 1997 | N/A | 24.4 | N/A |
| Bicycle and Pedestrian | Bike Network | N/A | Boston | Linking the Corridors | Conceptual | N/A | N/A | 2.0 | N/A |
| Bicycle and Pedestrian | Bike Network | 607888 | Boston | Multi-use Path Construction on New Fenway | Pre-TIP | N/A | \$1,702,618 | 0.4 | N/A |
| Bicycle and Pedestrian | Bike Network | N/A | Boxborough | Route 111 Trail | Conceptual | N/A | N/A | 0.1 | N/A |
| Bicycle and Pedestrian | Bike Network | 606316 | Brookline | Pedestrian bridge rehabilitation over MBTA off Carlton Street | TIP | N/A | \$1,776,396 | | N/A |
| Bicycle and Pedestrian | Bike Network | N/A | Brookline | Emerald Necklace Bicycle and Pedestrian Crossings at Route 9 | Conceptual | N/A | \$1,680,000 | 0.2 | N/A |
| Bicycle and Pedestrian | Bike Network | N/A | Lexington | West Lexington Greenway | Conceptual | N/A | N/A | 4.4 | N/A |
| Bicycle and Pedestrian | Bike Network | N/A | Lynn, Malden, Revere & Saugus | Bike to the Sea (Northern Strand) | Conceptual | 1996 | N/A | 8.4 | N/A |
| Bicycle and Pedestrian | Bike Network | N/A | Medford | Mystic River Linear Park | Conceptual | N/A | N/A | 1.6 | N/A |
| Bicycle and Pedestrian | Bike Network | 607732 | Natick | Cochituate Rail Trail, Phase Two | Pre-TIP | 2000 | \$5,417,832 | 2.4 | N/A |
| Bicycle and Pedestrian | Bike Network | N/A | Peabody and Salem | Riverwalk/Greenway, Peabody Square to Salem Train Depot | Conceptual | N/A | N/A | N/A | N/A |
| Bicycle and Pedestrian | Bike Network | N/A | Salem | Canal Street Bikeway | Conceptual | N/A | \$2,368,000 | 1.5 | N/A |
| Bicycle and Pedestrian | Bike Network | N/A | Scituate | Scituate Greenway | Conceptual | N/A | N/A | 2.6 | N/A |
| Bicycle and Pedestrian | Bike Network | N/A | Scituate | Pathway for all of Scituate and linking Commuter Rail | Conceptual | N/A | N/A | 17.1 | N/A |
| Bicycle and Pedestrian | Bike Network | N/A | Sudbury | Bruce Freeman Rail Trail, Phase 2D | Conceptual | N/A | N/A | 4.4 | N/A |
| Bicycle and Pedestrian | Bike Network | N/A | Sudbury | Bruce Freeman Rail Trail, Phase 2E | Conceptual | N/A | N/A | 1.3 | N/A |
| Bicycle and Pedestrian | Bike Network | N/A | Woburn | Woburn Loop Bikeway Project | Conceptual | N/A | N/A | 0.8 | N/A |
| Bicycle and Pedestrian | Clean Air and Mobility | N/A | Inner Core | Hubway Expansion | Conceptual | N/A | N/A | N/A | N/A |
| Bicycle and Pedestrian | Pedestrian Connections | 604993 | Cambridge | Innovation Boulevard Streetscape & Pedestrian Improvements, Between Main Street & Binney Street (Phase I) | Pre-TIP | N/A | \$1,500,000 | 0.3 | N/A |
| Bicycle and Pedestrian | Pedestrian Connections | 607901 | Dedham | Pedestrian Improvements along Elm Street & Rustcraft Road Corridors | Pre-TIP | N/A | \$3,312,000 | N/A | N/A |
| Bicycle and Pedestrian | Pedestrian Connections | 607899 | Dedham | Pedestrian Improvements along Bussey Street | Pre-TIP | N/A | \$2,592,000 | 1.5 | N/A |
| Bicycle and Pedestrian | Pedestrian Connections | 608006 | Framingham | Pedestrian Hybrid Beacon Installation at Route 9 and Maynard Road | Pre-TIP | N/A | \$886,228 | N/A | N/A |
| Enhancement | N/A | N/A | Boston | Harbor Islands National Park Access | Conceptual | N/A | N/A | N/A | N/A |
| Enhancement | N/A | N/A | Boston | Harbor Islands National Park and Long Island Pier Reconstruction | Conceptual | N/A | N/A | 0.3 | N/A |
| Enhancement | N/A | N/A | Boston | Long Island Pier Reconstruction | Conceptual | N/A | N/A | 0.1 | N/A |
| Enhancement | N/A | N/A | Boston | Long Island Pier | Conceptual | N/A | N/A | 0.2 | N/A |
| Enhancement | N/A | N/A | Medford | Medford Square Parking | Conceptual | N/A | N/A | 0.4 | N/A |
| Enhancement | N/A | N/A | Medford | Medford Square Water Taxi Landing and Related Park Improvements | Conceptual | N/A | N/A | N/A | N/A |
| Freight | Arterial and Intersection | N/A | Winn Resort/ Everett | Lower Broadway Truck Route | Conceptual | | N/A | | |
| Major Highway | Interchange | 604862 | Bellingham | Ramp Construction and Relocation, I-495 at Route 126 | Pre-TIP | N/A | \$15,000,000 | 0.6 | N/A |
| Major Highway | Interchange | N/A | MassDOT | Coney Street Interchange with Route 95 | Conceptual | N/A | N/A | 0.6 | N/A |
| Major Highway | Interchange | N/A | Newton | I-90/Interchange 17 | Conceptual | N/A | N/A | N/A | N/A |
| Major Highway | Interchange | 607940 | Newton | Improvements of Route 128/I-95 & Grove Street | Pre-TIP | N/A | \$10,000,055 | N/A | N/A |
| Major Highway | Interchange | N/A | Rockland | Route 3/Union St. | Conceptual | N/A | N/A | N/A | N/A |
| Major Highway | Interchange | N/A | Weston | Route 30/I-90 Interchange | Conceptual | N/A | N/A | N/A | N/A |
| Major Highway | Interchange | 603739 | Wrentham | Construction of I-495/Route 1A Ramps | Pre-TIP | N/A | \$4,002,192 | 0.1 | N/A |

(end)



C APPENDIX PROJECT EVALUATION

INTRODUCTION

The MPO applied its goals and objectives as criteria to qualitatively evaluate the major infrastructure and capacity-adding highway projects that are in the Universe of Projects and Programs list (which had been sufficiently well defined to allow for analysis). Assessing how well projects would address the MPO's goals and objectives helped the MPO identify priority projects for its major infrastructure program. Table C.1 shows the evaluated major infrastructure projects and Table C.2 provides a summary of the evaluated projects. A memorandum documenting the evaluation process also is included.



BOSTON REGION METROPOLITAN PLANNING ORGANIZATION

Stephanie Pollack, MassDOT Secretary and CEO and MPO Chairman
Karl H. Quackenbush, Executive Director, MPO Staff

TECHNICAL MEMORANDUM

DATE: April 15, 2015
TO: Boston Region MPO
FROM: Sean Pfalzer and William Kuttner
RE: Long-Range Transportation Plan Evaluation Criteria

1 OVERALL SCORING SYSTEM

For the 2040 LRTP, 38 projects classed as “major infrastructure” were evaluated by MPO staff. Based on these evaluations, MPO staff recommended inclusion of 13 of these projects in the LRTP, four of which were already programmed in the current TIP. Each of these 38 projects was given a numerical score, and this score to a large extent determined which projects were recommended for inclusion in the LRTP.

Each project was given a “high,” “medium,” or “low” rating in each of six rating categories. Expressing these ratings as numerical values of three, two, or one point respectively, the scores were summed resulting in a single numerical score for each project. While the scores could range from 18 points (six “high” scores) down to only 6 points, the 38 Major infrastructure projects ranged between 14 and 7 points.

Of the 13 projects recommended for inclusion in the LRTP, all had 11 or more points. Five projects had scores of at least 11 but were not recommended for inclusion because their costs were beyond the funding capabilities of the MPO regardless of their high scores.

1.1 Six Rating Categories

The rating categories were established based on the MPO’s adopted goals and focused on the primary goals addressed by Major Infrastructure projects:

- Safety
- System Preservation
- Capacity Management and Mobility (3 sub-categories include impacts to automobiles, buses, and pedestrian/bicyclists)
- Economic Vitality

The value of a project for each of these six areas was in turn characterized by a number of different factors. The evaluation criteria were grouped into the appropriate rating areas. MPO staff also identified or developed appropriate quantitative data and indices to help inform the scoring. As far as practicable, these criteria and indices had to be applied to all projects so that comparisons could be made between fundamentally dissimilar projects. More information on the evaluation criteria is presented below.

1.2 Role of Judgment in Determining a Score

Even with a reasonably complete set of planning-level evaluation data, the use of judgment is unavoidable in deciding which of the three scores to give projects for each of the six rating categories. There is, however, a structure within which judgment is applied. This process can be seen as a balancing of three factors:

- The needs in the proposed project area
- The criteria the proposed project addresses
- The impact a project can have in addressing the identified needs and advancing MPO goals

Of these three factors, the needs are perhaps best understood because they are derived from existing conditions. The configurations of proposed improvements are at this point conceptual and the extent and intensity of anticipated improvements can only be surmised.

Costs are not mentioned explicitly in these three factors. As a general rule, however, more costly projects will often have a larger impact. For instance, the safety and capacity of an obsolete intersection can be improved by rebuilding it to modern standards. In some instances constructing some kind of grade separation might be warranted. The costs will inevitably be greater but the benefits should also be greater. MPO staff accounted for cost to inform the safety rating for projects in order to compare projects across purpose and scale.

2 DEVELOPING SCORES IN EACH CATEGORY

One of the difficulties of scoring projects is choosing a scoring convention that will allow a valid comparison of dissimilar projects. Furthermore, fair and usable scoring conventions need to be developed separately for each of the six rating categories.

In developing a score it is important to consider the amount of improvement a project might be expected to achieve. This kind of project impact has been represented in this analysis by characterizing candidate projects by a very general “project concept.” The six project concepts used here are:

- Adding new grade separation
- Reconstructing of a major interchange
- Reconstructing of a minor interchange
- Significant widening of a road
- Minor widening of a road
- Reducing roadway capacity

The amount of improvement to safety and capacity in and near the project area will to some degree depend on the project concept.

The balance of this memo considers the rating categories individually. The indices, factors, and judgments that could result in a high, medium, or low score being assigned to a particular project are described and discussed for each of the six rating categories.

2.1 Safety

MPO staff maintains extensive databases of regional crash history, and these were used to assess the safety improvement needs for interchanges, express highways, and regional arterials. Crash history is measured using the “equivalent property damage only” index, abbreviated as EPDO. Crashes resulting in a fatality are given ten points, crashes resulting in injury five points, and property-damage-only crashes are given only one point. Given the relative infrequency of accidents, using the most recent three years of EPDO data in the candidate project areas gives a reasonable idea of the safety needs at that location.

Using the project-area EPDO values, staff developed indices that relate the crash history to project costs and projected users. Regional safety “hot spots” are identified by EPDO and may be addressed by candidate projects. EPDO related to specific modes and vehicle classes are also calculated and reviewed. These EPDO-based metrics include:

- Cost per EPDO (“cost effectiveness”): Estimated project cost divided by the EPDO value
- Average annual EPDO per 100,000,000 vehicles (“crash rate” or “risk”): Average annual EPDO value divided by average annual traffic volumes per 100,000,000 vehicles: $((EPDO/3)/(AADT*330))*100,000,000$
- EPDO concentrations
 - Top 200 Crash Cluster Locations (Total EPDO)

- Highway Safety Improvement Program (HSIP) Cluster (Total EPDO)
- MPO-identified Truck Cluster (Truck-involved EPDO)
- HSIP Bicycle Cluster (bicycle-involved EPDO)
- HSIP Pedestrian Cluster (pedestrian-involved EPDO)

Choosing a score in the safety category requires comparing the severity of the safety problem with the improvement impact of the candidate project. As a general rule, the lower score of the two factors was the final score:

Low: Either the need or the project benefit is low. Other factor may be higher

Medium: Either the need or the project benefit is medium. Other factor may be higher

High: Both the safety need and project benefit is high

In assessing the project impact the project concept offers some general guidance:

- | | |
|---|----------------|
| • Adding new grade separation | Low to medium |
| • Reconstructing of a major interchange | Medium to high |
| • Reconstructing of a minor interchange | Low to high |
| • Significant widening of a road | Low to high |
| • Minor widening of a road | Low to high |
| • Reducing roadway capacity | Medium |

An example of an improvement with a high safety benefit would be one that eliminates peak-period use of breakdown lanes on express highways or eliminates dangerous weaving movements at major interchanges.

2.2 System Preservation

MPO staff was able to use the state Road Inventory File and other sources to develop quantitative data for most candidate projects. The measured criteria include:

- **Improves substandard pavement**
 - Pavement Condition (“fair” or “poor” pavement merit improvement)
 - Number of lane-miles improved
- **Improves substandard bridge**

- Bridge Condition (structurally deficient or functionally obsolete merit improvement)
- Number of substandard bridges addressed
- **Improves sidewalk infrastructure**
 - Number of sidewalk miles improved
- **Improves bicycle facilities**
 - Number of bicycle lane-miles improved
- **Improves emergency response or ability to respond to extreme conditions**
 - Improves access to an emergency support location
 - Implements climate change adaptation strategies

The system preservation score was a judgment based on reviewing all the measured factors. An index that collapsed all the above factors into a single number was not used.

2.3 Capacity Management/Mobility: Autos

As part of the LRTP Needs Assessment, MPO staff analyzed several congestion measurements for both current and future conditions based on travel time, travel speed, and volume/capacity ratios to identify the worst bottleneck locations in the region. These MPO-identified bottleneck locations from the Needs Assessment were used to assess mobility-related needs of both express highways and regional arterials. Staff then assessed the impact of the project on managing capacity and improving mobility. The category scoring generally followed this pattern:

Low: Project is not at an MPO-identified bottleneck location
MPO-identified bottleneck would receive limited or no benefit

Medium: MPO-identified bottleneck will be addressed to a medium degree
Non-bottleneck location is substantially improved

High: MPO-identified bottleneck location is substantially improved
New connection will improve mobility to a high degree

As in the safety category, levels of need and project benefit will vary across candidate projects, and judgment must be used to arrive at a score. A few examples can help illustrate this process.

Three projects that rated low, the I-290/I-495 interchange in Hudson, the Routes 126/135 junction in Framingham, and Middlesex Turnpike in Bedford were not MPO-identified bottleneck locations simply because other locations were significantly worse. Highland Avenue in Newton and Montvale Avenue in Woburn were also not MPO-designated bottlenecks. However, in these instances the improvements were considered great enough that the projects were given the score of “medium.” Complete reconstructions of old interchanges can also earn the medium ranking in the same way.

The heavily used I-93/I-95 interchange in Woburn is near the top of the list of regional bottlenecks. The improvements to the interchange and nearby roadways proposed as part of project reconstruction will result in a major improvement to regional traffic flow. At the other extreme is rebuilding the Boston Street overpass over the Lowell commuter rail line near the Wilmington-Woburn city line creates a completely new access corridor to an industrial area thereby earning a “high” rating.

2.4 Capacity Management/Mobility: Buses

To determine the bus mobility rating for congestion management, MPO staff considered the level of bus service (MBTA and other local bus services) within the project area based on the number of routes and number of scheduled weekday bus trips. Then, using the auto mobility rating as the baseline, MPO staff assessed whether the bus service within area derived the same level of improvement as automobiles. The general scoring pattern for this category was:

- Low: No bus service within the project area or bus service will not be improved
 Limited bus service and small to medium improvement for bus service
 Some bus service within the project area but little bus service improvement
- Medium: Some bus service within the project area; and moderate service improvement
 Significant bus service within the project area and smaller service improvement
- High: Significant project area bus service and significant service improvement

Judgment was required where projects seemed to fall between scoring levels. An example is the proposed Boardman Street grade separation. This is a severe

arterial bottleneck causing delay to a large number of buses on some of the MBTA's longest bus routes. However, because speeding traffic on this part of Route 1A would only shorten the bus travel times by a small percentage, a "medium" score for bus mobility has been assigned to the project.

The Route 3 widening would be a major improvement in a corridor that is considered to only have moderate congestion, as compared with its connecting highway, the Southeast Expressway. Few MBTA buses would benefit from the Route 3 widening, so the bus mobility score is "low." Closer to downtown Boston, the Southampton Street interchange improvements would make a moderate impact at a location with severe congestion. Because more bus services would benefit, both auto and bus mobility improvements are rated "medium."

2.5 Capacity Management/Mobility: Pedestrians and Bicycles

For the two non-motorized modes, the mobility issues relate primarily to the completeness and ease-of-use of the system of paths, sidewalks, and roads available for non-motorized travel. In evaluating candidate projects, MPO staff evaluates to what degree, if any, a project:

- **Expands bicycle network, especially closing gaps in the system:**
 - Number of bicycle lane-miles added to the network
 - Bay State Greenway Priority 100 project element
 - High Priority Gap (flagged in the MPO's Network Evaluation Study)
- **Expands sidewalk network**
 - Number of sidewalks miles added to the network
- **Improves transit access and intermodal connections**
 - Access to transit stations are improved for bicyclists and/or pedestrians

The project scores for this category reflect these benefit judgments:

- Low: Bicycle and pedestrian facilities are not applicable to the project
Bike/pedestrian facilities will be expanded to a low degree
- Medium: Bike/pedestrian facilities will be expanded to a moderate degree
Project meets healthy transportation policy directive standards
- High: Bike/pedestrian facilities will be expanded to a high degree
Project exceeds healthy transportation policy directive standards

2.6 Economic Vitality

While any major transportation improvement can be expected to contribute to economic vitality, the ratings in this category reflect to what degree the improvements support the land use objectives embraced by the MPO. A candidate project can support these objectives if it:

- **Provides access to target development area**
 - Vehicle, transit, bicycle, or pedestrian access improvements
- **Serves existing area of concentrated development**
 - High population and employment density for type of community
- **Facilitates new development**
 - Transportation project is tied to new development proposals

The project scores for this category reflect these benefit judgments:

Low: Project does not provide access to a targeted development area or area of concentrated development.

Medium: Project provides access to a targeted development area or area of concentrated development to a moderate degree or facilitates economic development

High: Project provides access to a targeted development area or area of concentrated development to at least a moderate degree, and it facilitates new development.

SP/WK/wk

TABLE C.1
Evaluated Major Infrastructure Projects for the LRTP

| Abbreviated Project Name | Project Cost | AADT | Safety | | | | | | | | System Preservation | | | | | Capacity Management/Mobility (Autos) | | | Capacity Management/Mobility (Buses) | | | Capacity Management/Mobility (Peds/Bikes) | | | Economic Vitality | | | | | | | | | | | | | | | |
|---|---------------|---------|--------|---------------|-------------------------------|------|-------------------------------------|---------------------------|-------------------------------------|---|---|---------------------|-------------------------------|-----------------------------|----------------------------------|--------------------------------------|---|--------------------------------------|--|---|--------------------------------------|---|------------------------------|---|-------------------------|---------------------------------|--|--------------------------|-------------------------|-------------------|--|--|--|---|---|---|-----------------------------|---|---|---|
| | | | Safety | Cost per EPDO | EPDO per 100,000,000 vehicles | EPDO | Top 200 Crash Location (Total EPDO) | HSIP Cluster (Total EPDO) | Truck Polygon (Truck-involved EPDO) | HSIP Bicycle Cluster (Bike-involved EPDO) | HSIP Pedestrian Cluster (Ped-involved EPDO) | System Preservation | Improves substandard pavement | Improves substandard bridge | Improves sidewalk infrastructure | Improves bicycle facilities | Improves emergency response/Improves response to extreme conditions | Capacity Management/Mobility (Autos) | MPO-identified express highway bottleneck location | MPO-identified arterial bottleneck location | Capacity Management/Mobility (Buses) | Number of Bus Routes Served | Total Bus Trips Served Daily | Capacity Management/Mobility (Peds/Bikes) | Expands bicycle network | Bay State Greenway Priority 100 | High Priority Gap (Network Evaluation Study) | Expands sidewalk network | Improves transit access | Economic Vitality | Provides vehicle access to target development area | Provides transit access to target development area | Provides bicycle access to target development area | Provides pedestrian access to target development area | Mostly serves existing area of concentrated development | Partly serves existing area of concentrated development | Facilitates new development | | | |
| Allston Viaduct Realignment (Boston) | \$460,000,000 | 174,000 | medium | \$1,133,005 | 236 | 406 | 3 | | | high | 7 | | • | medium | | | | medium | 9 | 421 | high | • | | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | |
| Route 18 Widening (Weymouth) | \$58,822,115 | 29,600 | high | \$43,252 | 4641 | 1360 | 6 | 10 | 4 | high | 8 | 1 | 8 | • | medium | moderate | | low | 1 | 127 | medium | 8 | | | | | | | high | • | • | • | • | • | • | • | • | • | | |
| Highland Ave (Newton) | \$14,297,606 | 35,000 | high | \$24,233 | 1703 | 590 | 3 | 1 | | high | 9 | 1 | 6 | • | medium | | | low | 2 | 86 | medium | 6 | | | | • | high | • | • | • | • | • | • | • | • | • | • | • | • | |
| Route 4/225 (Lexington) | \$23,221,000 | 40,200 | high | \$44,400 | 1314 | 523 | 2 | | | medium | 8 | | | • | medium | moderate | | medium | 3 | 104 | high | 8 | | 8 | • | medium | | | | | | | | | | | | • | • | |
| Rutherford Ave (Boston) | \$109,967,000 | 48,200 | medium | \$561,056 | 411 | 196 | 1 | 1 | | high | 9 | 3 | 6 | • | low | | | low | 8 | 897 | high | 6 | | | | • | high | • | • | • | • | • | • | • | • | • | • | • | • | |
| McGrath (Somerville) | \$56,563,000 | 38,000 | medium | \$425,286 | 354 | 133 | 2 | | 1 | high | 3 | 2 | 1.5 | | low | | | low | 7 | 558 | high | 1.5 | | | | • | high | • | • | • | • | • | • | • | • | • | • | • | • | |
| Extend I-93 HOV Lane (Somerville to Woburn) | \$550,000,000 | 202,000 | low | \$239,234 | 1150 | 2299 | 17 | 7 | | high | 6 | | | • | high | severe | | high | 8 | 492 | low | | | | | | medium | • | | | | | | | | • | • | • | • | |
| I-93/I-95 (Woburn) | \$294,000,000 | 373,000 | high | \$207,774 | 383 | 1415 | 7 | 5 | | medium | 1 | | | • | high | severe | | medium | 3 | 92 | low | | | | | medium | • | | | | | | | | | • | • | • | • | |
| Route 27/9 (Natick) | \$25,793,370 | 80,000 | high | \$55,709 | 585 | 463 | 1 | 2 | | high | 1 | 1 | 1 | • | medium | | | medium | 4 | | medium | 1 | | | | • | low | | | | | | | | | | • | • | • | |
| New Boston St (Woburn) | \$9,706,549 | 14,000 | low | \$9,706,549 | 7 | 1 | | | | low | | | | | high | | | low | 0 | | high | 0.5 | | 0.5 | • | high | • | • | • | • | • | • | • | • | • | • | • | • | • | |
| Route 1 Widening (Malden, Revere, Saugus) | \$236,078,161 | 115,000 | medium | \$666,887 | 311 | 354 | 5 | 2 | | low | 1 | | | • | high | severe | | high | 6 | 250 | low | | | | | medium | • | | | | | | | | | • | • | • | • | • |
| Braintree Split | \$53,288,794 | 282,000 | high | \$32,612.48 | 585 | 1634 | 4 | 1 | | medium | 3 | | | • | high | severe | | medium | 5 | 283 | low | | | | | low | | | | | | | | | | | | | • | • |
| Montvale Ave (Woburn) | \$4,225,256 | 31,000 | high | \$15,534 | 886 | 272 | 1 | 1 | | high | 1 | | 0.5 | • | medium | | | low | 1 | 38 | medium | 0.5 | | | | • | low | | | | | | | | | | | • | • | |
| Southampton Interchange (Boston) | \$143,750,000 | 225,000 | medium | \$123,709 | 522 | 1162 | 1 | | | medium | 1 | | | • | medium | severe | | medium | 8 | 705 | medium | | | | | medium | | | | | | | | | | | | • | • | |
| I-93/I-95 (Canton) | \$186,700,000 | 240,000 | medium | \$470,277 | 167 | 397 | 4 | 2 | | medium | 2 | | | • | medium | | | low | 0 | | medium | • | | | | • | high | • | | | | | | | | | | • | • | • |
| Route 128 Add-a-Lane (Needham, Wellesley) | \$150,000,000 | 188,000 | medium | \$208,333 | 387 | 720 | 4 | 1 | | high | 4 | | | • | high | severe | | low | 1 | 50 | low | | | | | low | | | | | | | | | | | | | • | • |
| Concord Rotary | \$104,000,000 | 48,000 | medium | \$594,286 | 368 | 175 | 2 | 1 | | high | 6 | 1 | | • | high | severe | | low | 0 | | low | | | | | low | | | | | | | | | | | | | • | • |
| Dedham St Ramp (Canton, Norwood, Westwood) | \$50,961,567 | 5,000 | low | \$1,456,045 | 707 | 35 | | | | low | 1 | | | • | high | | | low | 0 | | medium | 1 | | 1 | • | high | • | | | | | | | | | | | • | • | • |
| Route 3 Widening | \$800,000,000 | 159,000 | high | \$365,297 | 1391 | 2190 | 15 | 3 | | high | 9 | | | • | medium | moderate | | low | 5 | 361 | low | | | | | low | | | | | | | | | | | | | • | • |
| I-90/I-495 (Hopkinton) | \$220,000,000 | 209,000 | medium | \$660,661 | 161 | 333 | 3 | 4 | | high | 4 | | | • | medium | | | low | 0 | | low | | | | | medium | • | | | | | | | | | | | | • | • |
| Middlesex, Phase III (Bedford, Burlington) | \$26,935,171 | 14,300 | medium | \$402,017 | 473 | 67 | | | | high | 3 | 1 | | • | low | | | low | 3 | 8 | medium | 3 | | 3 | • | medium | • | | | | | | | | | | | | • | • |
| Route 126/135 (Framingham) | \$115,000,000 | 35,400 | medium | \$542,453 | 605 | 212 | 1 | 1 | 1 | low | 0.5 | | 0.5 | • | low | | | medium | 7 | | medium | 0.5 | | | • | high | • | • | • | • | • | • | • | • | • | • | • | • | • | • |
| I-95 Add-a-Lane (Woburn) | \$32,900,000 | 164,000 | medium | \$109,667 | 185 | 300 | 2 | 1 | | medium | 2 | | | • | medium | severe | | low | 2 | 75 | low | | | | | medium | • | | | | | | | | | | | | • | • |
| Cypher St Extension (Boston) | \$9,700,000 | 1,000 | low | N/A | N/A | N/A | | | | low | 1 | | | • | medium | | | low | | | low | | | | | medium | | | | | | | | | | | | | • | • |
| Mahoney Circle (Revere) | \$60,000,000 | 56,000 | low | \$588,235 | 184 | 102 | 2 | 1 | | low | 1 | | | • | medium | moderate | | high | 10 | 451 | low | | | | | medium | • | • | | | | | | | | | | | • | • |
| Route 9/I-495 (Southborough) | \$25,000,000 | 135,000 | low | \$342,466 | 55 | 73 | 1 | | | high | 2 | | | • | medium | | | low | 0 | | low | | | | | medium | • | | | | | | | | | | | | • | • |
| Route 128, Phase II (Danvers, Peabody) | \$23,776,000 | 102,000 | medium | \$65,319 | 360 | 364 | 3 | 1 | | high | 7 | 2 | | • | medium | | | low | 3 | 57 | low | | | | | low | | | | | | | | | | | | | • | • |

**TABLE C.1 (Cont.)
Evaluated Major Infrastructure Projects for the LRTP**

| Abbreviated Project Name | Project Cost | AADT | Safety | Cost per EPDO | EPDO per 100,000,000 vehicles | EPDO | Top 200 Crash Location (Total EPDO) | HSIP Cluster (Total EPDO) | Truck Polygon (Truck-involved EPDO) | HSIP Bicycle Cluster (Bike-involved EPDO) | HSIP Pedestrian Cluster (Ped-involved EPDO) | System Preservation | Improves substandard pavement | Improves substandard bridge | Improves sidewalk infrastructure | Improves bicycle facilities | Improves emergency response/improves response to extreme conditions | Capacity Management/Mobility (Autos) | MPO-identified express highway bottleneck location | MPO-identified arterial bottleneck location | Capacity Management/Mobility (Buses) | Number of Bus Routes Served | Total Bus Trips Served Daily | Capacity Management/Mobility (Peds/Bikes) | Expands bicycle network | Bay State Greenway Priority 100 | High Priority Gap (Network Evaluation Study) | Expands sidewalk network | Improves transit access | Economic Vitality | Provides vehicle access to target development area | Provides transit access to target development area | Provides bicycle access to target development area | Provides pedestrian access to target development area | Mostly serves existing area of concentrated development | Partly serves existing area of concentrated development | Facilitates new development |
|---|---------------|---------|--------|---------------|-------------------------------|------|-------------------------------------|---------------------------|-------------------------------------|---|---|---------------------|-------------------------------|-----------------------------|----------------------------------|-----------------------------|---|--------------------------------------|--|---|--------------------------------------|-----------------------------|------------------------------|---|-------------------------|---------------------------------|--|--------------------------|-------------------------|-------------------|--|--|--|---|---|---|-----------------------------|
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Walnut Street Interchange (Saugus) | \$19,500,000 | 136,000 | medium | \$103,723 | 140 | 188 | 1 | | | | | low | | 0.5 | | | • | medium | | | low | 1 | 51 | medium | 1 | | 0.5 | • | low | | | | | | • | | |
| Bridge St (Salem) | \$16,613,152 | 17,800 | medium | \$117,824 | 800 | 141 | 1 | | | | | medium | 1 | 0.5 | | | | low | | | low | 5 | 133 | low | | | | • | medium | • | | | • | • | | | |
| Route 1/16 (Chelsea, Revere) | N/A | 40,200 | low | N/A | 193 | 77 | 1 | 2 | 1 | | | high | 5.25 | 1 | | | • | low | moderate | low | 2 | 75 | low | | | | | • | medium | • | • | | | • | | | |
| I-95 Capacity Improvements (Lynnfield, Reading) | \$198,443,000 | 157,000 | low | \$187,742 | 680 | 1057 | 6 | 1 | | | | low | | | | | • | high | severe | low | 0 | | low | | | | | • | medium | • | | | | • | • | | |
| I-290/495 (Hudson, Marlborough) | \$100,000,000 | 162,500 | medium | \$334,448 | 186 | 299 | 2 | 1 | | | | high | 2 | 1 | | | | low | | | low | 0 | | low | | | | | low | | | | | | | | |
| Route 1A/16 (Revere) | N/A | 36,700 | low | N/A | 39 | 14 | 1 | 3 | 1 | | | medium | 1.5 | | | | • | low | severe | low | 9 | 416 | low | | | | | • | medium | • | | | • | | | | |
| Brimbal Ave, Phase II (Beverly) | \$23,000,000 | 73,500 | low | \$383,333 | 82 | 60 | 1 | | | | | medium | | 1 | | | • | low | | low | 1 | | low | | | | | • | medium | • | | | | • | • | | |
| I-90/Interchange 17 (Newton) | \$4,000,000 | 141,000 | medium | \$8,677 | 330 | 461 | 4 | 1 | 1 | | | low | | 3 | 0.5 | | • | medium | severe | low | 12 | 528 | low | | | | | • | low | | | | | • | | | |
| 128 Capacity Improvements (Peabody) | \$24,634,000 | 110,000 | low | \$98,536 | 230 | 250 | 2 | | | | | low | | 1 | | | • | high | severe | low | 1 | 36 | low | | | | | • | low | | | | | • | | | |
| Riverside Ramp (Newton) | N/A | 23,500 | low | N/A | 4 | 1 | 2 | | | | | low | | | | | | low | moderate | low | 1 | 20 | low | | | | • | medium | • | | | | • | • | | | |
| Washington Street Bridge (Woburn) | \$12,200,000 | 38,800 | low | \$98,387 | 323 | 124 | 1 | | | | | low | | 0.1 | | | • | low | | low | 0 | | medium | 0.1 | | | • | low | | | | | • | | | | |

TABLE C.2
Summary of Evaluated Major Infrastructure Projects for the LRTP

| Proponent(s) | Project Name | Project Cost | AADT | Safety | System Preservation | Capacity Management/Mobility (Autos) | Capacity Management/Mobility (Buses) | Capacity Management/Mobility (Peds/Bikes) | Economic Vitality | Total Rating | 5 or more low ratings | 4 or more low ratings | 3 or more low ratings | 2 or more low ratings | 2 or more high ratings |
|--------------------------------------|---|---------------|---------|--------|---------------------|--------------------------------------|--------------------------------------|---|-------------------|--------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|
| Boston | Replacement of Allston I-90 Elevated Viaduct | \$460,000,000 | 174,000 | 2 | 3 | 2 | 2 | 3 | 3 | 15 | | | | | • |
| Weymouth | Reconstruction & Widening on Route 18 (Main Street), from Highland Place to Route 139 | \$58,822,115 | 29,600 | 3 | 3 | 2 | 1 | 2 | 3 | 14 | | | | | • |
| Newton & Needham | Reconstruction of Highland Avenue, Needham Street & Charles River Bridge | \$14,297,606 | 35,000 | 3 | 3 | 2 | 1 | 2 | 3 | 14 | | | | | • |
| Lexington | Route 4/225 (Bedford Street) and Hartwell Avenue | \$23,221,000 | 40,200 | 3 | 2 | 2 | 2 | 3 | 2 | 14 | | | | | • |
| Boston | Reconstruction of Rutherford Avenue, from City Square to Sullivan Square | \$109,967,000 | 48,200 | 2 | 3 | 1 | 1 | 3 | 3 | 13 | | | | • | • |
| Somerville | McGrath Boulevard Project | \$56,563,000 | 38,000 | 2 | 3 | 1 | 1 | 3 | 3 | 13 | | | | • | • |
| Somerville & Woburn | Extend I-93 HOV Lane into Somerville and/or Capacity Improvements to Route 128, Woburn | \$550,000,000 | 202,000 | 1 | 3 | 3 | 3 | 1 | 2 | 13 | | | • | • | • |
| Reading, Stoneham, Wakefield, Woburn | Interchange Improvements to I-93/I-95 (Bridge Replacement and Related Work) | \$294,000,000 | 373,000 | 3 | 2 | 3 | 2 | 1 | 2 | 13 | | | | • | |
| Natick | Bridge Replacement, Route 27 (North Main St.) over Route 9 (Worcester St.) | \$25,793,370 | 80,000 | 3 | 3 | 2 | 2 | 2 | 1 | 13 | | | | | • |
| Woburn | Bridge Replacement, New Boston Street over MBTA | \$9,706,549 | 14,000 | 1 | 1 | 3 | 1 | 3 | 3 | 12 | | | • | • | • |
| Malden, Revere, Saugus | Reconstruction & Widening on Route 1, from Route 60 to Route 99 | \$236,078,161 | 115,000 | 2 | 1 | 3 | 3 | 1 | 2 | 12 | | | | • | • |
| Braintree | I-93/Route 3 Interchange (Braintree Split) | \$53,288,794 | 282,000 | 3 | 2 | 3 | 2 | 1 | 1 | 12 | | | | • | • |
| Woburn | Reconstruction of Montvale Avenue, from I-93 Interchange to Central Street | \$4,225,256 | 31,000 | 3 | 3 | 2 | 1 | 2 | 1 | 12 | | | | • | • |
| MassDOT | Southeast Expressway Modification (Southampton Interchange) | \$143,750,000 | 225,000 | 2 | 2 | 2 | 2 | 2 | 2 | 12 | | | | • | |
| Canton, Dedham, Norwood | Interchange Improvements at I-95/I-93/University Avenue/I-95 Widening | \$186,700,000 | 240,000 | 2 | 2 | 2 | 1 | 2 | 3 | 12 | | | | | |
| Needham & Wellesley | Rehab/Replacement of 6 Bridges on I-95/Route 128 (Add-a-Lane Contract 5) | \$150,000,000 | 188,000 | 2 | 3 | 3 | 1 | 1 | 1 | 11 | | | • | • | • |
| Concord | Improvements & Upgrades to Concord Rotary (Routes 2/2A/119) | \$104,000,000 | 48,000 | 2 | 3 | 3 | 1 | 1 | 1 | 11 | | | • | • | • |
| Canton, Norwood & Westwood | Ramp Construction on I-95 (NB) & Improvements on Dedham Street | \$50,961,567 | 5,000 | 1 | 1 | 3 | 1 | 2 | 3 | 11 | | | • | • | • |
| MassDOT | Route 3 South Express Toll Lanes | \$800,000,000 | 159,000 | 3 | 3 | 2 | 1 | 1 | 1 | 11 | | • | • | • | • |
| Hopkinton, Westborough | Reconstruction of I-90/I-495 Interchange | \$220,000,000 | 209,000 | 2 | 3 | 2 | 1 | 1 | 2 | 11 | | | • | • | |
| Bedford, Billerica, & Burlington | Middlesex Turnpike Improvements, from Crosby Drive North to Manning Road (Phase III) | \$26,935,171 | 14,300 | 2 | 3 | 1 | 1 | 2 | 2 | 11 | | | • | • | |
| Framingham | Intersection Improvements at Route 126/135/MBTA & CSX Railroad | \$115,000,000 | 35,400 | 2 | 1 | 1 | 2 | 2 | 3 | 11 | | | | | |
| Reading, Stoneham, Wakefield | Improvements along Route 128/95, from North of Interchange of Interchange 37 to 40 | \$32,900,000 | 164,000 | 2 | 2 | 2 | 1 | 1 | 2 | 10 | | | | • | |
| Boston | Cypher Street Extension | \$9,700,000 | 1,000 | 1 | 3 | 2 | 1 | 1 | 2 | 10 | | | • | • | |
| Revere | Mahoney Circle Grade Separation | \$60,000,000 | 56,000 | 1 | 1 | 2 | 3 | 1 | 2 | 10 | | | • | • | |
| Southborough, Westborough | Improvements on Route 9 at I-495 Interchange, from Computer Drive/Research Drive to Route 9 | \$25,000,000 | 135,000 | 1 | 3 | 2 | 1 | 1 | 2 | 10 | | | • | • | |
| Danvers & Peabody | Mainline Improvements on Route 128 (Phase II) | \$23,776,000 | 102,000 | 2 | 3 | 2 | 1 | 1 | 1 | 10 | | | • | • | |
| Boston | Boardman Street at Route 1A | \$13,686,000 | 59,500 | 1 | 1 | 3 | 2 | 1 | 2 | 10 | | | • | • | |
| Saugus | Interchange Reconstruction at Walnut Street & Route 1 (Phase II) | \$19,500,000 | 136,000 | 2 | 1 | 2 | 1 | 2 | 1 | 9 | | | • | • | |
| Salem | Reconstruction of Bridge Street, from Flint Street to Washington Street | \$16,613,152 | 17,800 | 2 | 2 | 1 | 1 | 1 | 2 | 9 | | | • | • | |
| Chelsea & Revere | Route 1/Route 16 Connector | N/A | 40,200 | 1 | 3 | 1 | 1 | 1 | 2 | 9 | | • | • | • | |
| Lynnfield & Reading | I-95 Capacity Improvements, Lynnfield to Reading (used old LRTP project Beverly to Peabody) | \$198,443,000 | 157,000 | 1 | 1 | 3 | 1 | 1 | 2 | 9 | | • | • | • | |
| Hudson & Marlborough | Reconstruction on Routes I-290 & 495 and Bridge Replacement | \$100,000,000 | 162,500 | 2 | 3 | 1 | 1 | 1 | 1 | 9 | | • | • | • | |
| Revere | Route 1A/Route 16 Connector | N/A | 36,700 | 1 | 2 | 1 | 1 | 1 | 2 | 8 | | • | • | • | |
| Beverly | Interchange Reconstruction at Route 128/Exit 19 at Brimbal Avenue (Phase II) | \$23,000,000 | 73,500 | 1 | 2 | 1 | 1 | 1 | 2 | 8 | | • | • | • | |
| Newton | I-90/Interchange 17 | \$4,000,000 | 141,000 | 2 | 1 | 2 | 1 | 1 | 1 | 8 | | • | • | • | |
| Peabody | Route 128 Capacity Improvements: Exit 26 to Exit 28 | \$24,634,000 | 110,000 | 1 | 1 | 3 | 1 | 1 | 1 | 8 | • | • | • | • | |
| Newton | New Route 128 Ramp to Riverside Station | N/A | 23,500 | 1 | 1 | 1 | 1 | 1 | 2 | 7 | • | • | • | • | |
| Woburn | Bridge Replacement & Related Work, W-43-028, Washington Street over I-95 | \$12,200,000 | 38,800 | 1 | 1 | 1 | 1 | 2 | 1 | 7 | • | • | • | • | |



D APPENDIX PUBLIC COMMENTS

OVERVIEW OF CONTENTS

As a result of its extensive outreach activities while developing the LRTP, *Charting Progress to 2040*, the MPO received a substantial number of written and spoken comments, which are summarized in this appendix. Additional comments on the draft document received during the formal 30-day public review and comment period, which began on June 25, 2015 and closed on July 24, 2015 are summarized in Table D.1.

COMMENTS RECEIVED DURING DEVELOPMENT OF THE LRTP

Chapter 2—Process for Developing *Charting Progress to 2040* provides an overview of the public outreach methods used in developing this LRTP. This section provides additional information from the public outreach venues as noted in Chapter 2.

Metropolitan Area Planning Council Subregional Outreach Meetings

MPO staff attended meetings for all eight MAPC subregions, first in September through November 2014, then again in May and June 2015. In the first round of meetings, attendees commented on the vision, goals, and objectives, which are summarized below. Comments received in writing during this outreach period are also included in the summaries. In the second round of meetings, staff presented information about the ongoing LRTP development including scenario planning and project selection. The subregions submitted their written comments as part of the formal comment period.

COMMENTS LEADING TO REVISIONS ON THE VISION, GOALS, AND OBJECTIVES

Comments leading to revisions noted in blue (commenter noted if known)

MPO staff responses to comments noted in purple

Vision - revised vision

- The vision must be more transformative, holistic, and reflect new technologies. Creative thinking should be used to find new solutions that address how technology like driverless cars and buses will play a role in future travel decisions
- Supports including transportation technologies – Arthur Strang of Cambridge
- Re-write the central vision statement so that it's central purpose, transportation, supports and is compatible with neighborhoods of work and the residential neighborhoods that make up cities and towns: “a transportation system that *supports the neighborhoods--work, residential and mixed-- of the Boston region. Transportation must be safe, provide equitable access, excellent mobility, and varied transportation options-- in support of sustainable, healthy, livable, and economically vibrant neighborhoods in the cities and towns of the region.*” Support for other elements of the Draft Central Vision Statement. Fresh Pond Residents Alliance (*suggested re-write of vision in italics*)
- Incorporate the 8-80 philosophy when talking about accommodating a range of users. The 8-80 philosophy: if you create a city that's good for an 8-year old and an 80 year old, you will create a successful city for everyone. City of Cambridge

Congestion Reduction - revised goal

- Communities are concerned about how the Congestion Reduction goal affects the need for more and better transit. There is fear that congestion reduction for all modes emphasizes highway-centric solutions. Rather than reduce delay for all modes, pedestrian and transit modes should be prioritized.

Transportation Options/Healthy Modes - revised goal and objectives

- The mode-shift goal should be more aggressive and focus on mass transit to result in desirable changes in person miles traveled. The goal should promote autonomous, cheap, safe travel.
- The first three objectives are redundant and could be addressed by expanding the goal. Suggested re-wording of the 4th bullet to emphasize creation of a regional network – City of Cambridge
- Communities want increased transit choices, improved reliability, and transit that go beyond the needs of commuters.
 - Suburban communities want the MPO to support non-traditional transit, and expand the definition of transit to include carpooling and park and ride. There should also be support for last mile connections and reverse commute options.
 - Include private providers of public transportation. Public policy barely

acknowledges the impact or presence of motor coach companies when considering planning options.

- The elderly population should be included in equity; they have specific transportation needs.

SUMMARY OF COMMENTS GENERATED AT SUBREGIONAL MEETINGS

Most frequent comments (heard 2 or more times)

- The vision, goals, and objectives are very general and redundant.
Addressed as part of performance measure development
- The goals and objectives should be tied to measurable outcomes, such as miles of new sidewalks or number of new bike facilities.
Addressed with performance measures
- Regional equity should be part of the goals and objectives.
Addressed in project selection process
- The goals and objectives favor the built-up urban core and do not address the needs of suburban communities.
Addressed in project selection process, as part of considering regional equity
- Interest in weighting the goals – economic vitality and freight movement appears least important since it is the last goal listed.
Addressed if MPO prioritizes goals

Other comments

- Some goals, such as congestion reduction, can generate cost savings, if achieved by open-road tolling. There could be increased revenue and less use of the roads.
Potential UPWP study
- Reducing freight delay conflicts with other goals. How does the MPO deal with conflicts of interest?
Addressed if MPO prioritizes goals, programs could allow funding for projects not listed in the L RTP
- The economic development goal should direct economic development to downtowns. Consider value capture and ways to incentivize development around transit.
L RTP is coordinated with Metrofuture, the regional land use plan
- Cost-effectiveness should be a goal. Project selection should consider how many people the project serves and the project's functional necessity.
Can be considered as part of performance based planning

- Include the relation to housing development goals and Smart Growth.
L RTP is coordinated with Metrofuture, the regional land use plan
- Goals and objectives should provide incentives for relieving bottlenecks.
Addressed through investment strategies for L RTP

Public Priorities

- Transportation Options/Healthy Modes is the most widely-supported priority goal.
- System preservation, safety, congestion reduction, and economic vitality/freight are all high priorities.
- Important objectives include planning for climate change and hazard mitigation.

SUMMARY OF WRITTEN SUBMITTED COMMENTS

1. Pat Brown, Sudbury Resident

- Add cost-effectiveness as a goal
Can be considered as part of performance based planning
- Economic Vitality should exchange places with transportation options/healthy modes if goals are listed in order of importance
Addressed if MPO prioritizes goals
- The objectives should be measureable
Addressed with performance measures
- Objective measurement is difficult for some of the objectives
Addressed with performance measures

2. Arthur Strang, Cambridge Resident

- How does the Olympics transportation plan factor into the L RTP
Item for consideration
- Add time and standard-time deviation-of-time to destination rather than only congestion
Addressed with performance measures
- Congestion on Alewife Brook Parkway and Fresh Pond Parkway is a result of the end of Route 2 - this also delays a number of bus routes
Identified need

3. City of Cambridge

(Many suggestions are addressed as part of the performance-based planning and process, through a PM, an MPO action, or investment strategy)

- Objectives are very high level and could use further definition with specific targets
Addressed with performance measures
- Why do objectives touching on transit oriented development not explicitly state it?
Addressed with performance measures and coordination with Metrofuture, the regional land use plan
- Congestion reduction goal may have direct conflict with other goals; example: reducing congestion delay for all modes does not contribute to achieving mode shift. Place priority on pedestrian, bike, transit facilities to decrease single-occupant vehicle trips.
Addressed if MPO prioritizes goals
- Emphasize that funding should target more sustainable and healthier modes of transportation, particularly for low-income and minority populations.
MPO action through project selection

4. Fresh Pond Residents Alliance

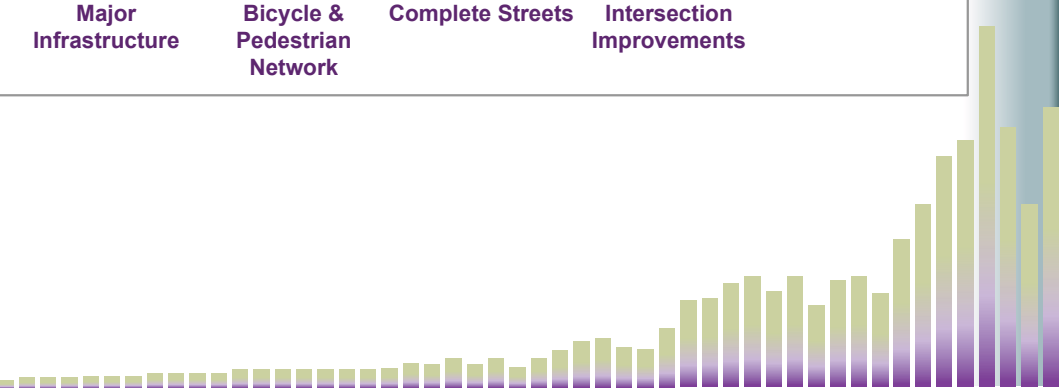
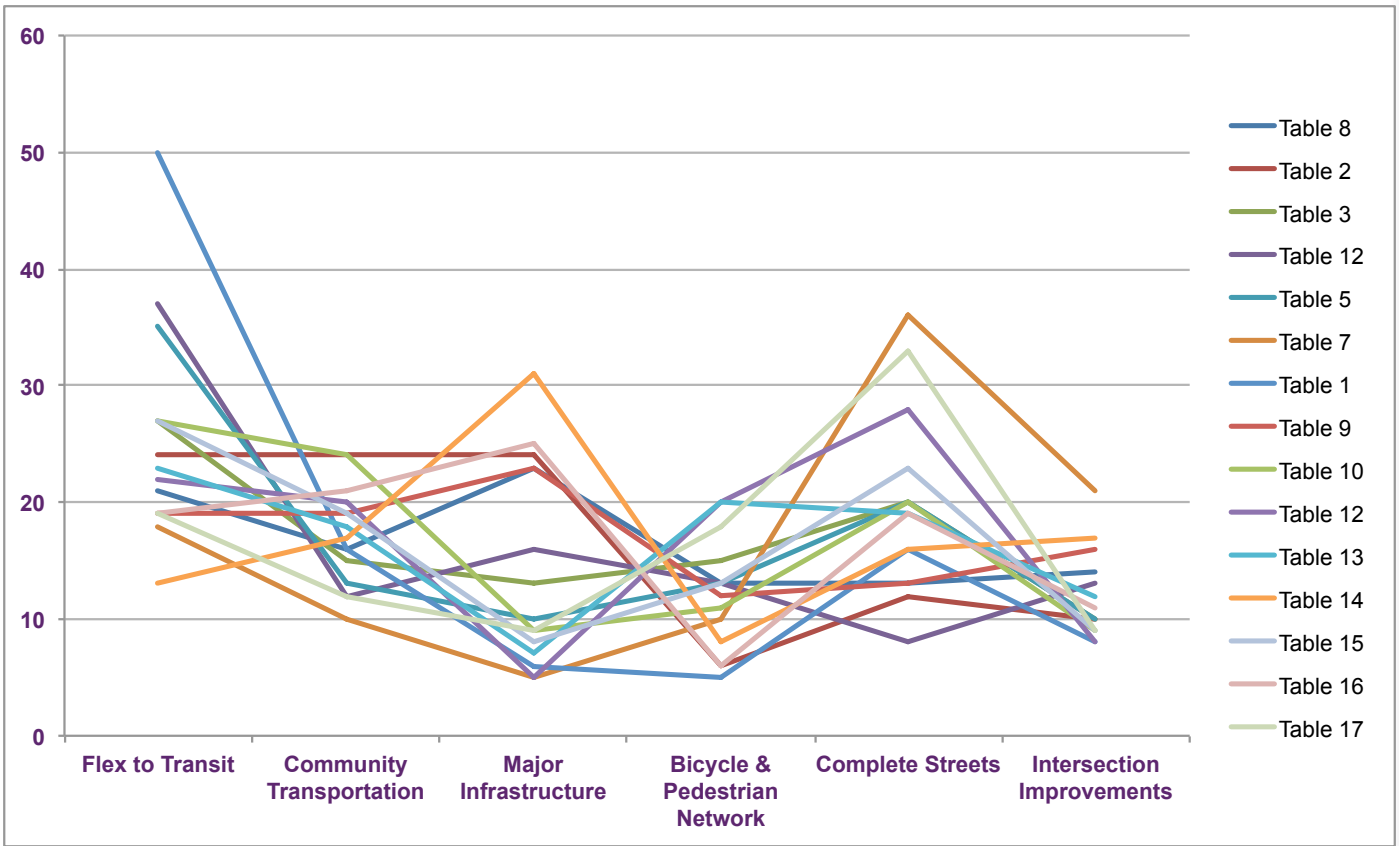
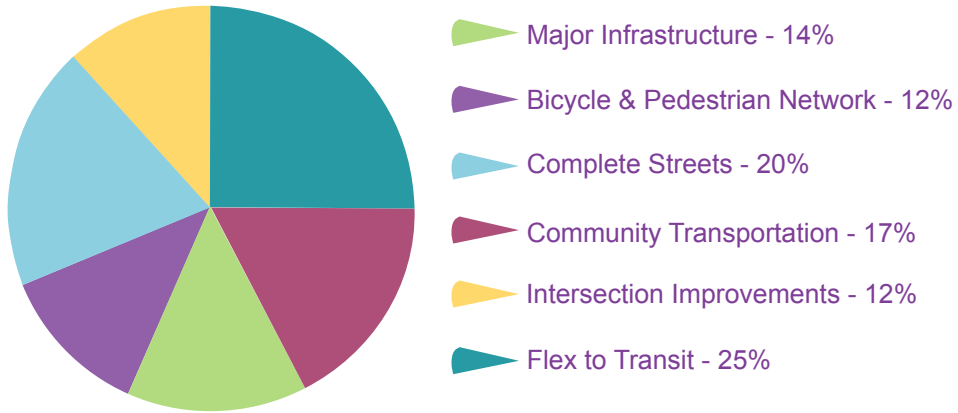
- Priority Goals: “transportation options/healthy modes” and “congestion reduction.” Need for improved local and metropolitan connectivity

Metropolitan Area Planning Council Winter Council Meeting

The MAPC Winter Council Meeting was devoted to discussing the LRTP, with a focus on prioritizing investments. Attendees were divided into 15 tables to participate in a budgeting activity, allocating the MPO’s \$2 billion among six investment programs. Figure D.1 illustrates the average allocation among all tables.



FIGURE D.1
MAPC Winter Council Meeting:
Overview of Budgeting Activity Results



Online Surveys

COMMENTS ON VISION, GOALS, AND OBJECTIVES

A survey was released between October and November 2014 to collect feedback on the MPO's draft vision, goals, and objectives. Respondents were asked their views about the vision, to rank the goals, and provide additional feedback on the objectives. A summary of survey results is provided below.

MPO staff responses to comments are noted in purple.

FIGURE D.2
Public Ranking of Goals
(Raw scores in parentheses; a lower score indicates a higher priority.)

-
1. **Transportation Options/Healthy Modes (132)**
 2. **Safety (175)**
 3. **Greenhouse Gas (GHG)/Air Pollution/Environment (253)**
 4. **System Preservation (263)**
 5. **Transit Equity (265)**
 6. **Congestion Reduction (267)**
 7. **Economic Vitality and Freight Movement (317)**
-

When asked the following question:

How well does the MPO's proposed vision for transportation in the region align with your own vision?

Members of the public on average felt the MPO's vision match their vision as well (3.9 out of 5).

(through November 18, 2014 with 66 respondents)



Source: Central Transportation Planning Staff.

Safety

- Vehicular safety: reconfigure interchanges; construct medians or barriers along principle arterials and interstates; construct turn lanes at intersections. Better enforcement of speed limits.
Addressed in investment strategies, specific projects, UPWP activities, or by MassDOT and/or municipalities
- Pedestrian and Bike safety: Pedestrian safety is a concern. Improve the sense of safety for walking and biking. Assist towns to more proactively promote bike lanes and safety improvements.
Addressed through investment strategies, specific projects, or UPWP activities, such as the Community Transportation Technical Assistance Program
- Recognize that vehicular safety would improve with mode shift to transit.
Item for MPO consideration
- Knowledge of and adherence to the laws by all travelers.
Item for MPO consideration

Transportation Options/Healthy Modes

- Restripe roadway shoulders where feasible to better accommodate bicycles.
Addressed through investment strategies, specific projects
- Consider equity between motorized and human powered transportation.
Addressed with performance measures
- Private providers of transit often provide greater levels of efficiency than publicly managed agencies. If there is truly a meaningful desire to provide the greatest level of passenger transportation at the lowest cost, motor-coach companies are here to assist.
Added objective to Transportation Options and Healthy Modes

System Preservation

- Improve cooperation among all governments and departments to improve maintenance.
Item for consideration in MPO processes and decision making
- “Maintain and modernize capital assets” is vague. Transit capital assets are very old and need modernization.
Addressed with performance measures

Congestion Reduction

- Road focus: Construct additional travel lanes to congested corridors to alleviate bottlenecks; reconfigure interchanges to alleviate congestion and improve mobility. More traffic lights could be “No right turn on red between 7am-9pm” or similar, and have an allowance at night.
Can be addressed through investment strategies, specific project, UPWP activities, or by MassDOT and/or municipalities
- Multi-modal focus: Prioritize projects with opportunity for multi-modal interconnectivity. Reduce the standard deviation of travel time to destination for all forms of transportation. Recognize methods already provided by private motor-coach companies.
Can be addressed through investment strategies, specific project, UPWP activities, or by MassDOT and/or municipalities
- Mode-shift should be the first bullet, not the second. Reducing delays on roadways may increase auto-use and undermine mode shift.
Addressed if MPO prioritizes goals
- Add credits for multi-passenger vehicles and tax rebates for bike commuters.
Item for MPO/MassDOT/Legislative consideration
- Increasing congestion to “force” mode-shift is an elitist and false assumption. The MPO should vigorously fight this and explicitly argue against it. Not everyone can bike to work!
Item for MPO consideration
- Reducing the number of trucks on the road will significantly reduce congestion, particularly on main highways. Consider listing this in this section.
Trucks cannot be banned from roadways that receive federal funding

Economic Vitality and Freight Movement

- Economic Vitality: Include more ties between transportation investment and the region’s and state’s land use, housing and economic development goals. Partial high-speed commuter rail to knit urban jobs with rural towns.
Addressed with performance measures, also LRTP is coordinated with Metrofuture, the regional land use plan
- Freight Movement: The goals mostly ignore freight transportation. It really bothers me that the Boston MPO will not take freight movement seriously as it is done in the rest of the MPOs in Mass. Improve the role of freight rail in the movement of freight. Coordinate with transportation firms to identify and promote new opportunities for intermodal movements of freight by rail and truck.
Specific goal for freight movement, freight is considered in other goals – system preservation, safety, congestion reduction. Item for ongoing MPO consideration

- Separate Economic Vitality and Freight Movement as two separate goals: Economic vitality and freight movement are related and possibly have an impact on each other, but they are not the same thing. They should be separate and economic vitality should be first on the list with an emphasis on quality of life. Congress, DOT have made it clear that freight movement is a critical item for our nation; Boston MPO ignores this. Freight movement may have an impact on economic vitality; however economic vitality is a MUCH larger subject than just freight movement. Linking them together like this is over valuing freight movement and under valuing economic vitality. Economic vitality and quality of life should be listed before safety. Freight movement should have its own section.

Item for MPO consideration

- Heavy trucks do not mix with bikes.

Item for MPO consideration

Greenhouse Gas (GHG)/Air Pollution/Environment

- Place higher taxes on vehicles that are not up to date in pollution decreasing.

Item for MPO/MassDOT/Legislature consideration

- There is a significant reduction in GHG by reducing the number of truck movements-probably more than bicycle usage.

Item for MPO consideration

- Buses must be monitored for pollution and noise reduction. Pedestrians' and bicyclists' ears are assaulted by overly loud hissing of air brakes-probably over allowed decibels. Just follow one on your bicycle.

Items for MPO/MassDOT/MBTA consideration

Transportation Equity

- Some could argue that we have equitable access to jobs when the RTA runs one bus an hour to an employment center. This is not equitable because one bus/hour is not real transit that allows some flexibility. The equity goal and objectives need to be fleshed out to specifically identify this need.

Increased transit frequency is included in the Transportation Options goal

- Ensure transportation projects are distributed in a geographically equitable manner across the region based upon need.

Addressed in project selection process

- Consider what equity is between motorized versus human powered transportation.

Addressed with performance measures

General comments

- Transportation is about making human connections. Transportation must be built and modified to reduce the barriers of walking to make these connections, and not allowed to divide communities and neighborhoods.

Item for MPO/MassDOT/MBTA/municipality consideration

- Congestion and delays will be reduced for all modes... The MPO must continue to be a leader in promoting a multi-modal system while taking an aggressive stand for transportation equity. It must stand up against the “fad of the year” approach and keep people focused on keeping livable neighborhoods while promoting mobility and access to jobs for all. Boulevards and parks built by transportation projects are great, but if we are screwing up access for those passing through, we have degraded mobility for all.

Item for MPO consideration

- Means to these ends are not apparent. More biking and walking needs safety education.

Addressed with performance measures, item for MPO/MassDOT/MBTA/ municipal/ other entity consideration

- There is no goal relating to highway system expansion and modernization within suburban and urban areas, e.g. adding travel lanes to congested corridors to alleviate bottlenecks and improve mobility; reconfiguring interchanges to alleviate congestion, improve mobility and safety.

Addressed through investment strategy

- To ensure responsible and predictable (safe) travel, include the TROMP message in all travel related material. www.TROMPcambridge.org (Travel Responsibility Outreach & Mentoring Project)

Item for MPO consideration; could be supported through UPWP activities, such as the Community Transportation Technical Assistance Program

- Citizen working groups might work on specific topics like issues at Alewife Brook Parkway and Fresh Pond Parkway, or walking and biking initiatives. These, from your MPO (ICC booklet)

Identified need, action item under public outreach or through the Community Transportation Technical Assistance Program

- The Boston MPO staff has done a nice job of identifying goals and objectives. However, I feel too much emphasis is given to mode shift versus addressing existing highway safety and congestion issues, which burden commuters with opportunity costs such as lost productivity, etc.

Addressed if MPO prioritizes goals

COMMENTS ON REGIONAL NEEDS BY GOAL

Congestion Reduction (needs prioritized by frequency heard)

1. Congestion on regional arterials (commuter and non-commuter). Examples are Route 1, 1A, 2, 3, 16, 30, 62, 97, 126, 128, 133, 135, Middlesex Turnpike
 - At peak hours, Randolph's main street is congested with traffic from other towns
 - Commuting on a game day in Foxborough is difficult for a number of towns.
2. Use alternative means to reduce congestion, not highway expansion, such as more transit.
3. Increase quantity and quality of parking at transit stations. Examples are Alewife and Braintree stations.
4. Expanding housing, shopping centers, and population growth are contributing factors to increasing congestion.
5. Congestion on highways, I-90, 95, 495, and specifically the I-93/95 interchange.
6. Congestion on neighborhood roads makes them unsafe for pedestrians

Economic Vitality/Freight (all heard once)

1. Desire for economic growth within the subregions so that people do not have to travel to Boston for work.
2. Proactive action in terms of connections between projects that affect multiple communities.
3. Truck traffic on arterials and also it will spill over onto other routes, for example if Routes 126 and 135 are upgraded.
4. A master vision that addresses transportation holistically, looking at both trucks and people, for example Route 16 in Natick.
5. Truck traffic poses safety issues at I-290/I-495.
6. Framingham would be a logical DMU hub for the western reaches of the MBTA including opening several north-south low density freight routes to passenger service as was done many years ago by the B&M and New Haven RRs.

Greenhouse Gas/Air Quality

1. Mounting traffic congestion at Fresh Pond Parkway and Alewife Brook Parkway. This idling leads to more emissions.
2. We all know that GreenDOT is a comprehensive environmental responsibility and sustainability initiative that will make MassDOT a "green" state transportation

system. (Reduce greenhouse gas (GHG) emissions; Promote the healthy transportation options of walking, bicycling, and public transit; Support smart growth development.) There is a challenge to coordinate GreenDOT across state agencies.

Safety (needs prioritized by frequency heard)

1. Pedestrian safety at the intersections of Route 16/Mount Auburn and Coolidge Hill and Coolidge Ave and Brattle Street and Fresh Pond Parkway. This is especially problematic for children crossing to access the nearby school. Traffic congestion leads to less safety because cars get backed up and tend to run lights and speed through intersections.
2. Pedestrian safety on Fresh Pond Parkway, Alewife Brook Parkway, Brattle Street, Huron and Route 16, especially since the area connects shopping centers and Alewife Station.
3. Concord Ave is a narrow street that causes safety problems for bicycles when trucks pass by. It should be eliminated as an “unrestricted arterial” street.
4. Safety on interstates. Examples are I-290/I-495 and I-90/I-495.

System Preservation

1. Desire for more and better transit within existing system: improved service hours and frequency, expanded intra/inter-suburban transit, bus only lanes, point to point bus service.
2. Roads need to be fixed to accommodate transit, for example, Route 1 in Milton has no bus stop area and hardly a curb making it unsafe for riders.
3. Improvements are needed to pedestrian/cycling infrastructure. There are too many places where they end suddenly or go over “no man’s land” before continuing, are unsafe (exposed, beside heavy traffic), there is not room for both bikes and cars, or the “bike lane” is full of ruts, potholes, glass, etc.
4. Improvements are needed to Annisquam Bridge.
5. Improvements to Rockport Commuter Rail Station, including the parking lot.
6. The streets are a mess

Transportation Options

1. More investment in bike/pedestrian infrastructure.
Specific Needs include:
 - A new rail/bike network in a circumferential route around the Inner Core.
 - Expanded regional bike network, but not necessarily along rails, as these could be used in the future for transit.

- A bike network between Acton and Concord.
 - Connections between regional trail systems and multi-use trails.
 - Connections between Upper Charles Trail to SNETT to the south and Bruce Freeman Trail to the north. Connection from Bruce Freeman to the east and west trails.
 - Increased walkability, and support to communities to promote walkability.
 - Promoting interconnectedness in the system and neighborhood connectivity. Train tracks and parkways impeded neighborhood connectivity necessary for north-south connections (in Cambridge area). The Hub and spoke transit system impedes connectivity.
 - Complete streets may be a problem and not a solution if we just mandate bike lanes and sidewalks on every roadway -- some of which are small and scenic.
2. Increase train and bus transit options, such as improved service hours and frequency, less expensive commuter rail and subway, bus only lanes, point to point bus service. Specific areas of need include:

Bus


- MBTA bus routes in Cambridge that are slowing by traffic coming off of Route 2 and onto Alewife Brook Parkway and Fresh Pond Parkway.
- A lane solely reserved for Bus Rapid Transit and freight on I-495 and freight traffic.

Railroad

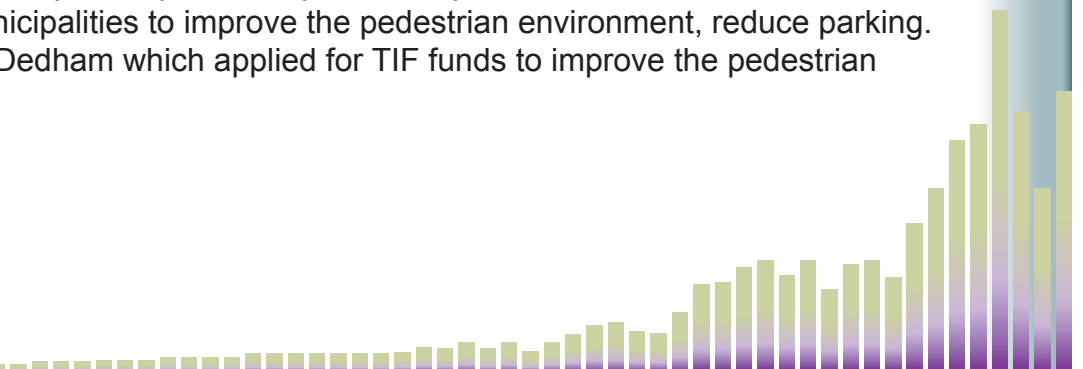
- DMU hub in Framingham for the western reaches of the MBTA. Open several north-south low density freight routes to passenger service as was done many years ago by the B&M and New Haven rail roads.

Commuter Rail / Subway

- A new North/South Rail Link between Clinton and Mansfield to bring commuter rail connections to those commuting in the I-495 corridor. Address demand for Marlborough and Foxboro rail service.
- More commuter rail service for reverse commuting, particularly on the Fitchburg Line.
- More reverse commute options in MetroWest, particularly Framingham and Natick.

- 
- Expand commuter rail and subway infrastructure from the South Shore into Boston. Services are inadequate, too expensive and discourage regular use by commuters. Schedules should have more frequent trains in both directions.
 - A subway extension of the Blue Line to Lynn.
 - The MBTA needs to better publicize its schedule changes.
 - More capacity on the red line and at Alewife.
 - The red line should be extended further than Braintree.
 - Commuter rail should be more like subway service. Need for more DMU.
 - Most towns have no transportation and the MBTA is very far away. For example, there is no way to get from Stoughton to Randolph.
 - More evening and weekend service from the Council on Aging.
 - More transit on Cape Ann.
3. More ferry service in coastal cities/towns.
4. Better links to existing transit is a dominant need in the region. There are train stations, but it is hard for people to get to them. Many bus routes run parallel to transit rather than to transit. There needs to be more local connections to transit that are convenient for people and that people know how to use. Specific needs include:
- A first mile/last mile program.
 - Better connections to suburban commuter rail stops.
 - Investment in technology like Uber to help with connections.
5. Alternative transit for suburban environments.
- Suburban para-transit buses must be better labeled with clear signage so people can more easily use the service. An example is the Neponset Valley TMA shuttle. People do not know how to use it and visibility should be part of transit plans.
 - MWRTA needs additional support.
 - Suburbs need help providing shuttles and para-transit. Particularly Concord, which has little MBTA service, but is part of the region.
 - Suburban transit is needed beyond the commute to Boston and beyond borders of RTAs. For example, facilities in the area between Central Mass and Boston Region MPOs.

- The region would prioritize a suburban mobility program over fixing the Concord Rotary. Fixing bad roads will not be as effective as creating a better more integrated system. This will also make the system more equitable for people not traveling into Boston.
 - Think of youth with suburban transit. CrossTownConnect was successful with youth going to school activities.
 - More coordination is needed between RTAs - there are frequently schedule mismatches between various shuttle services. They would like to eventually use the Charlie Card System. Services that can accommodate teenagers, as well as millennials and seniors, are also needed.
 - Westwood shuttle and bus service stops at Westwood municipal borders.
 - The Neponset Valley really needs and deserves access to transit. In particular, they need transit to accommodate an aging population and millennials. Transit should accommodate the suburban landscape. There are many transit gaps among the Three Rivers communities.
6. More parking at transit stations, specifically at Alewife, Quincy Adams, Braintree, Littleton, Medway, Norfolk, Littleton, Fitchburg, Kingston, and Plymouth.
 - Some park-and-ride lots are always full, some are not fully utilized - prices will impact a customer who is seeking all day parking.
 7. Transit for an aging population, including door to door service for elderly.
 8. Roads need to be fixed to accommodate transit, for example, Route 1 in Milton has no bus stop area and hardly a curb making it unsafe for riders
 - More and more people want to walk to the train or bus station.
 - There needs to be safe conditions for pedestrians entering and exiting the transit services - street furniture, waiting space.
 9. Airport service is needed, specifically in the Fitchburg area.
 10. More coordination is needed between commercial/industrial retailers and transportation options. They look for sites that suit business needs, but not about how people will get to and from work.
 - Need for public-private partnerships. Developers and businesses should work with the municipalities to improve the pedestrian environment, reduce parking. Example is Dedham which applied for TIF funds to improve the pedestrian realm.



- More connections to existing transit in Neponset Valley, especially to and from major employment centers like Patriot Place/Gillette Stadium, Kraft, and Schneider Electric. Specifically coordinated service to Walpole Station.
 - Include developers in finding first-mile last-mile solutions
 - Legacy Place ownership says that the facility cannot accept MBTA buses on their property because the buses are too big so no buses go there. Retail and service workers cross busy streets to get to Legacy Place from the places where MBTA buses will stop. While this seems preposterous--it is not clear if state or municipal leadership has demanded change from Legacy Place.
11. More coordination is needed between RTAs - there are frequently schedule mismatches between various shuttle services. They would like to eventually use the Charlie Card System. Services that can accommodate teenagers, as well as millennials and seniors, are also needed.
- Funding for TMAs is a challenge. The Clean Air & Mobility Program helped fund the first three years of a TMA, but many shuttle programs fail when funding is ended and only a limited ridership has been found for the service.
 - Managing both efficiency and equity in shuttle service is a problem. If we serve all who require service (equity) that means too many stops (efficiency).
 - Regional collaboration for transit services along Route 1
 - Information technology for transportation coordination for local services

COMMENTS ON INVESTMENT STRATEGIES

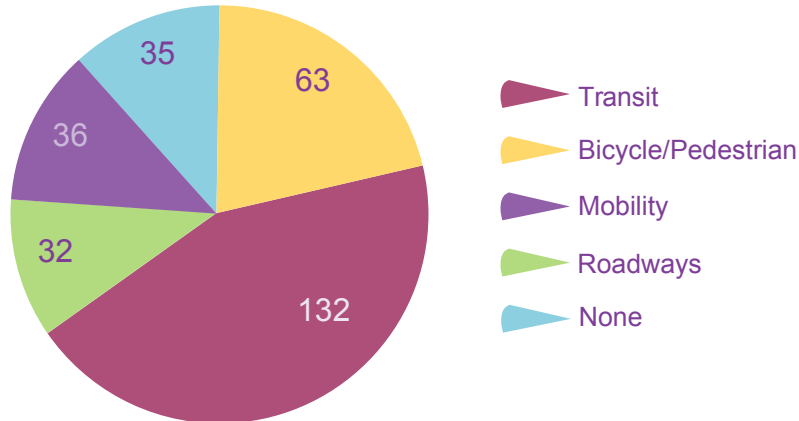
A series of mini-surveys was released between May 15 and July 15, 2015 to collect input on investment strategies for the LRTP. Seven different surveys were released; these surveys asked for the respondents' views on

- Transportation needs in the region
- Investment priorities
- Expanding and funding public transportation
- Expanding the bicycle network

The surveys were publicized through MPOInfo, Twitter, and the release of an MPO NewsFlash. Each survey had either one or two questions. The MPO received a total of 1,100 responses from the seven surveys. A summary of the responses is shown below.

Survey 1: Transportation Needs

Question 1 – What personal need of yours is not being met by the regional transportation system? (212 respondents)



Transit had the most responses; the issues included:

- The need for expanded transit service
- Frequency and reliability
- Circumferential transit
- Transit Connections
- Off-peak service

Bicycle/Pedestrian had the second highest number of responses; the issues included:

- An expanded network
- Safer facilities
- More maintenance and law enforcement

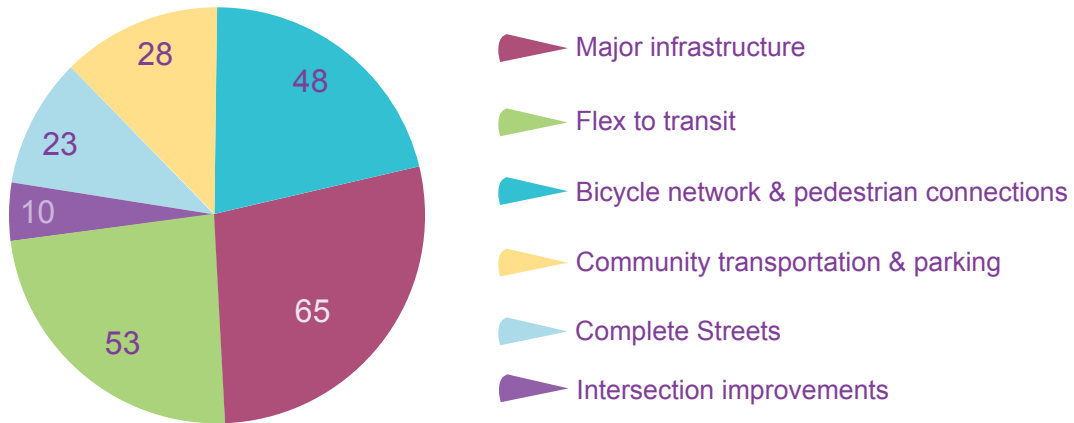
Mobility had the third highest number of responses; the issues included:

- Access to Boston
- Access to rail
- Transportation equity
- Complete Streets

Roadways had the fourth highest number of responses; the issues included:

- Congestion and capacity
- Major highway interchange Improvements
- Maintenance
- Safety

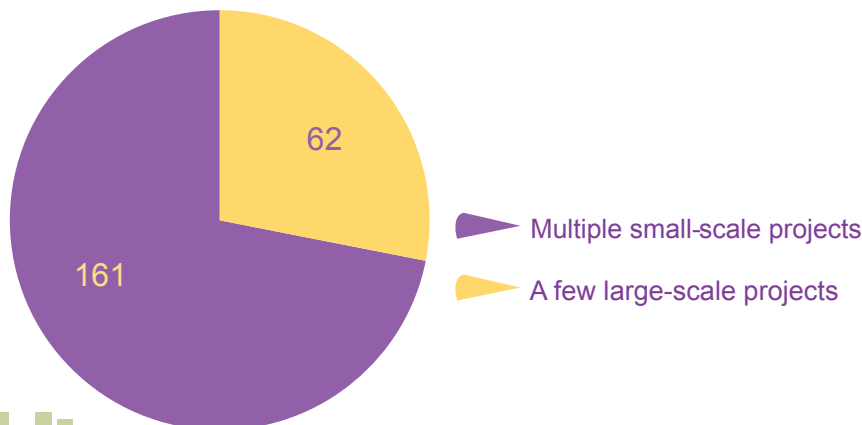
Question 2 – Which of the following investment programs include projects that would best address this need? (227 respondents)



Major infrastructure had the most responses. This includes both transit and highway infrastructure; transit received two-thirds of the responses and highway received one-third of the responses.

Survey 2: Types of Projects to Serve Your Needs

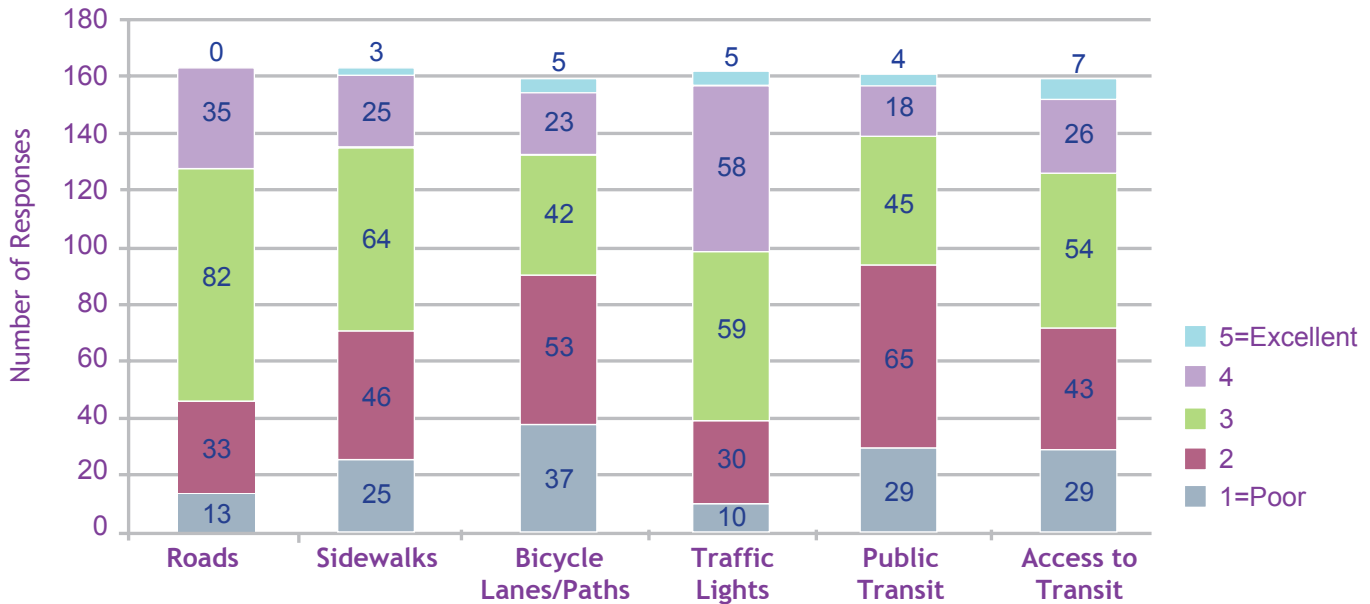
Question 1 – During the next 25 years, would you focus funding on a few large-scale projects or multiple small-scale projects? (223 respondents)



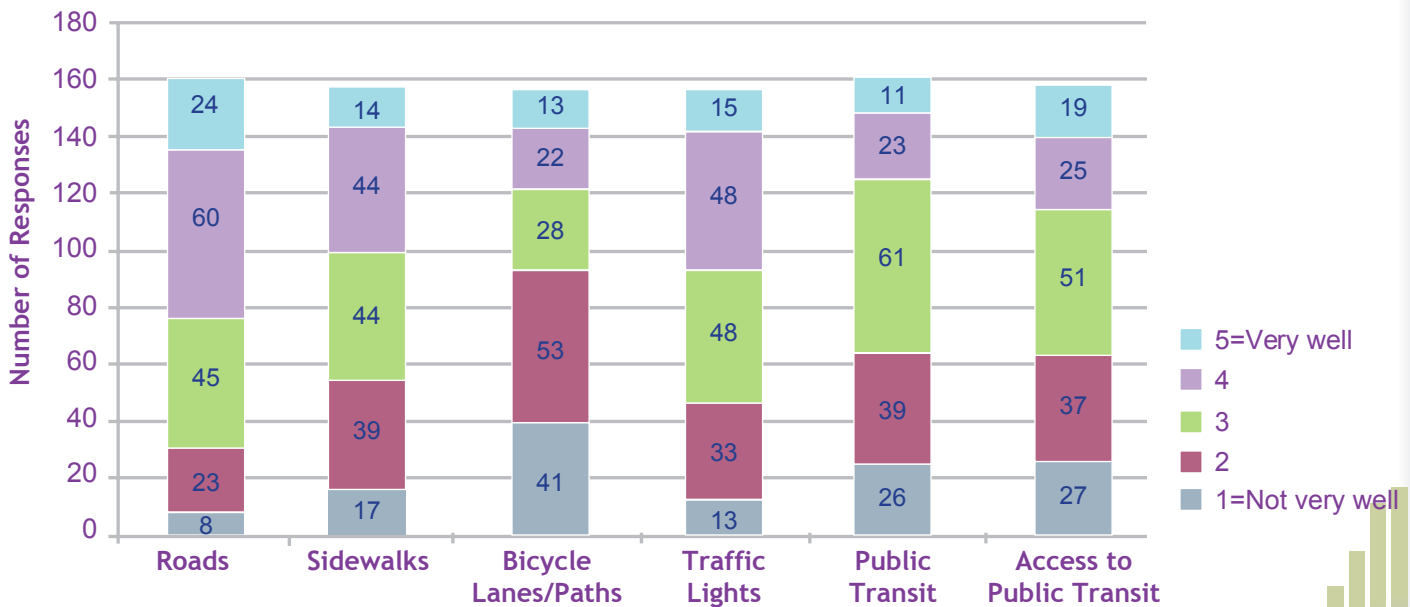
The majority of respondents wanted multiple small-scale projects. This coincides with the MPO's new Operations and Management (O&M) approach to funding projects.

Survey 3: Condition of the Transportation Infrastructure

Question 1 – Rate the physical condition of the following facilities or services (1 = poor and 5 = excellent). (160 respondents)

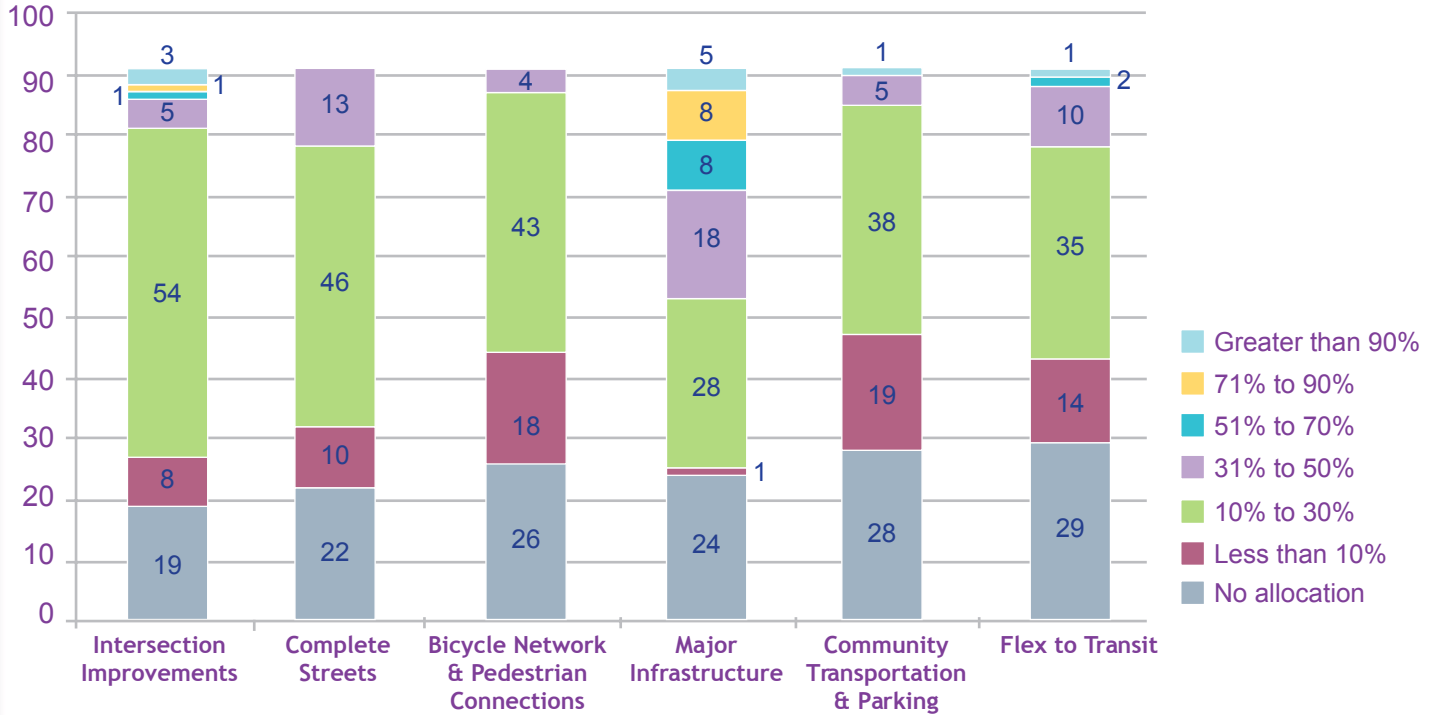


Question 2 – Rate how well the regional transportation facilities or services meet your travel needs for these same categories (1 = not very well and 5 = very well). (160 respondents)



Survey 4: Investment Priorities

Question 1 – How do you think the MPO should allocate its funds among the following six investment programs to best meet the region’s needs? (91 respondents)

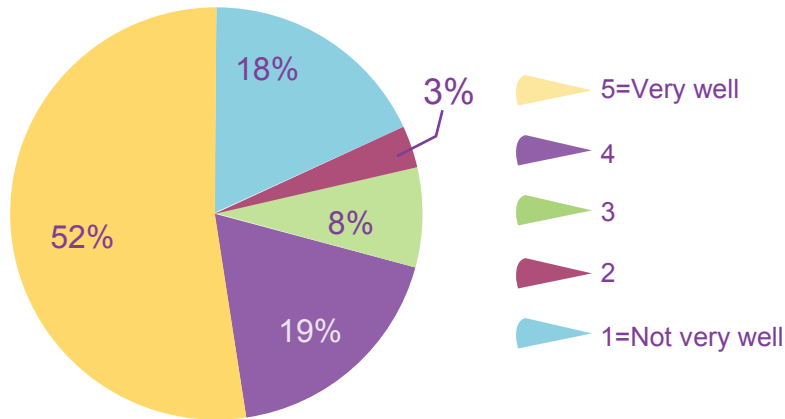


This question asked about the six different investment programs that the MPO considered in programming the LRTP. It shows how the respondents would allocate funding to each of these programs. For example, for the Complete Streets Program, 46 of 91 people think that 10% to 30% of the funds should be allocated to this program.

For all programs, some felt that there should be no allocation to that particular program, but many felt that there should be some allocation across all of the programs. This reinforces the MPO’s O&M approach across the various programs.

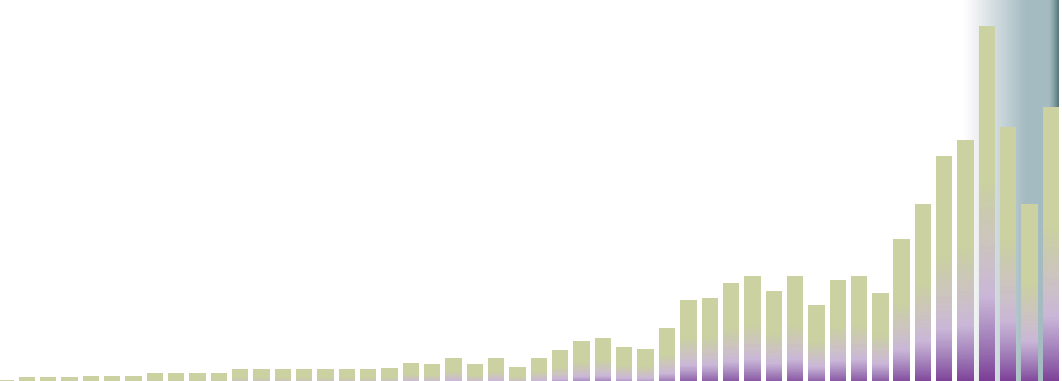
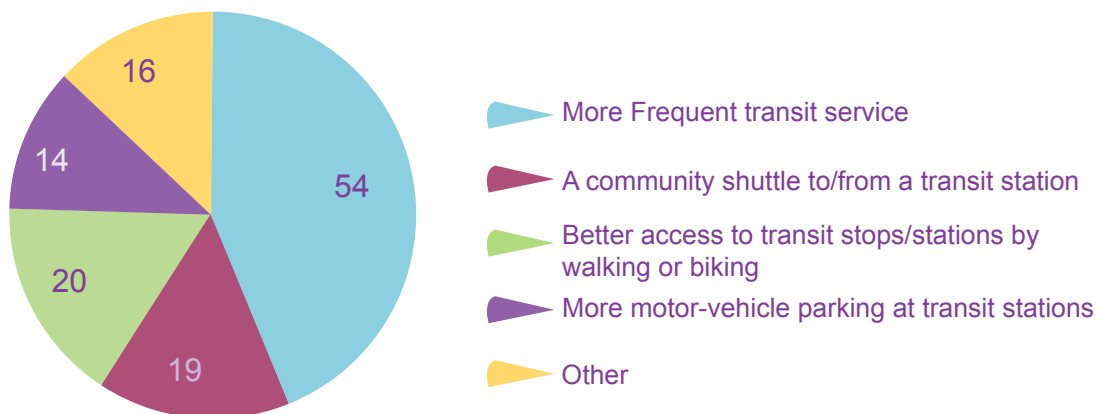
Survey 5: Expanding the Region's Bike Network

Question 1 – How well would expanding the off-road bike-path network improve your ability to travel around the region (1 = not very well and 5 = very well)? (182 respondents)



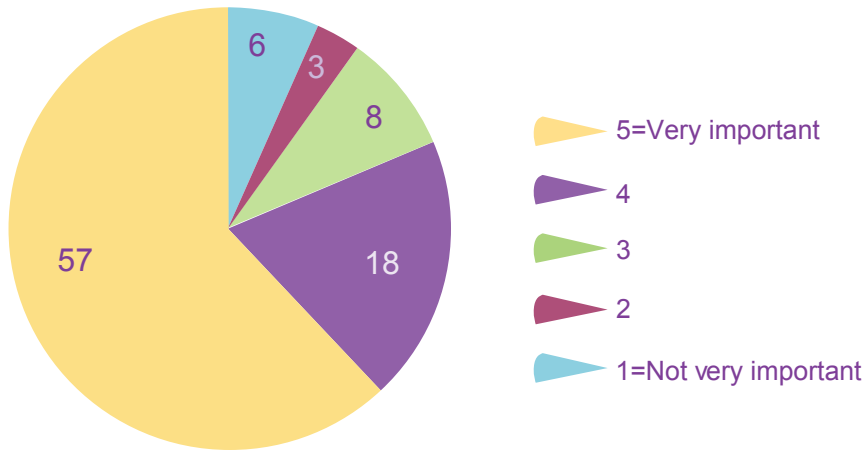
Survey 6: Expanding Public Transportation

Question 1 – What types of transit improvements likely would increase your use of public transportation? (123 respondents)

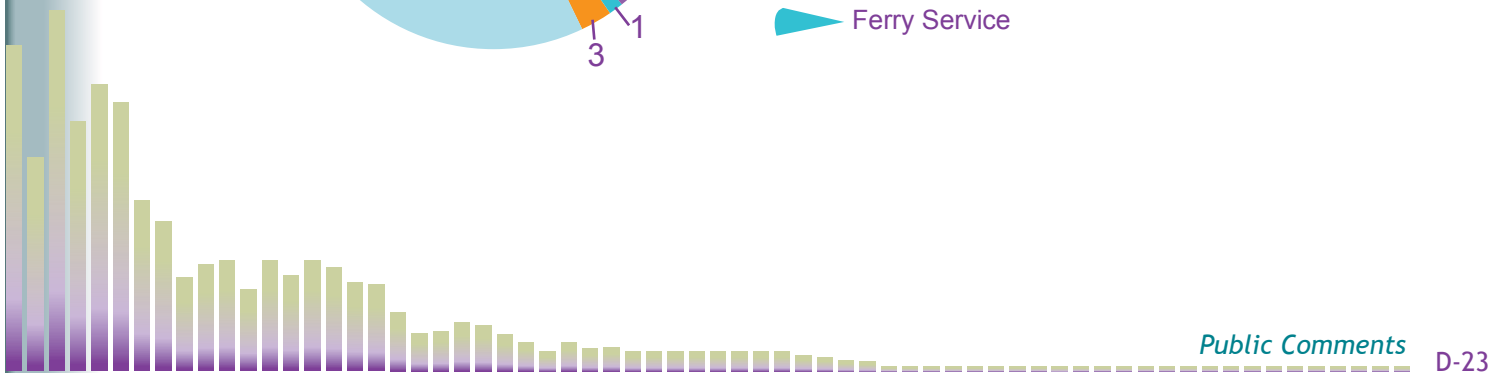
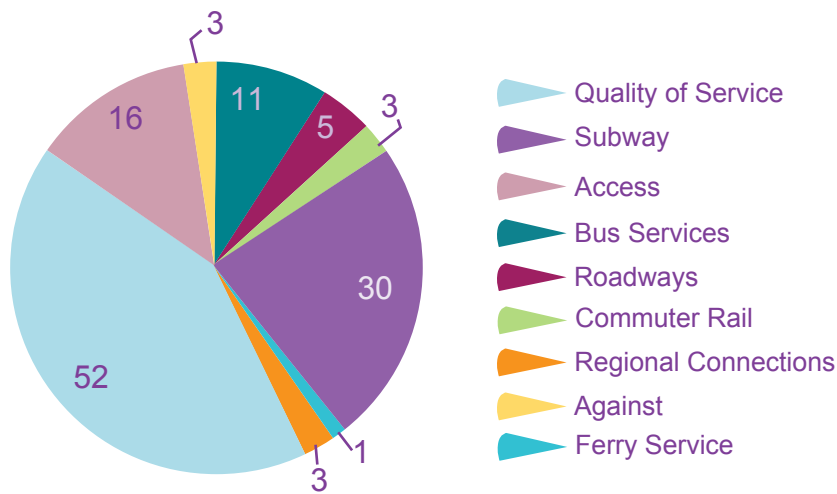


Survey 7: Funding Public Transportation

Question 1 – In addition to keeping the existing system well maintained, how important is it to expand the public transportation system (1 = not very important and 5 = very important)? (92 respondents)



Question 2 – If the MPO spends a portion of its highway funding for transit improvements or expansion, what projects do you think it should fund? (92 respondents)



The majority of the responses requested an improvement to the quality of service; the issues included:

- System expansion
- Frequency and reliability
- Equipment and station improvements

Expansion of the subway system had the second highest number of responses.

Access to transit had the third highest number of responses; the issues included:

- Bicycle and pedestrian access
- More parking

Bus service had the fourth highest number of responses; the issues included:

- More buses
- More bus rapid transit
- More bus shelters

Even though the question asked specifically about transit, roadway is another category. The responses to this category requested:

- Improved roadways so that buses could operate more efficiently
- HOV facilities for buses and high-occupancy travel

COMMENTS RECEIVED DURING THE FORMAL PUBLIC COMMENT PERIOD

Table D.1 summarizes the comments received during the 30-day public review and comment period for the LRTP Charting Progress to 2040. This formal public review and comment period began on June 25, 2015 and closed on July 24, 2015.

TABLE D.1
Summary of Written Public Comments Received During the Official Comment Period:
June 25 to July 24, 2015

| Project(s) / Issue(s) | Affiliation | Name | Comment | MPO Response (to be added) |
|--|------------------------------------|--|---|----------------------------|
| Bridge Replacement, Route 27 Over Route 9 and Interchange Improvements | Town of Natick, Board of Selectmen | Charles M. Hughes, Chair | Supports inclusion of the Bridge Replacement, Route 27 (North Main Street) over Route 9 in the FFYs 2021-2025 time band of the LRTP. The project will support economic development and quality of life initiatives. The ability to safely move people through Natick is essential to the Town and Region's continued success. The project will benefit both Natick residents and those who visit the region. | |
| I-90/I-495 Interchange & I-495/I-290/Route 85 Interchange | 495/MetroWest Partnership | Paul Matthews & Jessica Strunkin | The 495/MetroWest region has a diverse economic base and high quality of life, however transportation challenges remain. They are concerned how the MPO's new Operations and Management (O&M) approach will meet the needs of the regionally significant projects such as the I-90/I-495 Interchange in Hopkinton, Southborough, and Westborough and the I-495/I-290/Route 85 Interchange in Hudson and Marlborough. They understand the funding constraints but are disappointed by the inability to fund and plan these critical projects. Both projects have completed the ENF process and are high on the list of priorities for MassDOT District 3. These are long-standing priorities of the Partnership. The I-90/I-495 project was included in MassDOT's 2016 CIP as one of the "five projects of particular note." Partnership urges the MPO to include both projects in the LRTP. | |
| Operations & Management Programs | 495/MetroWest Partnership | Paul Matthews & Jessica Strunkin (cont.) | The Partnership hopes that the 495/ MetroWest region benefits from the several nationwide funding and project categories such as Complete Streets (for example Reconstruction of Taunton Street in Wrentham and Reconstruction of Pleasant Street in Franklin), Bike/Ped (for example the Route 111 Trail in Boxborough and the Bruce Freeman Rail Trail Phases 2D and 2E in Sudbury), Intersection Improvements (for example Route 20/Landham Road in Sudbury and Route 9/Central Street/ Oak Hill Road in Southborough), and Community Transportation/Parking/Clean Air and Mobility. The Partnership expects equitable distribution of such resources across the Boston region. They hope their region's rural and suburban communities are not at a disadvantage compared to their fellow urban MPO municipalities when project selection moves forward. | |

TABLE D.1 (Cont.)

| Project(s) / Issue(s) | Affiliation | Name | Comment | MPO Response (to be added) |
|---|--|--|---|----------------------------|
| Bridge Replacement, Route 27 Over Route 9 and Interchange Improvements & Route 126/ Route135/ MBTA & CSX Railroad | 495/MetroWest Partnership | Paul Matthews & Jessica Strunkin (cont.) | Offer strong support for the Route 126/ Route135/MBTA & CSX Railroad and the Bridge Replacement at Route 27 (North Main Street) over Route 9 (Worcester Street) Interchange Improvements projects included in the LRTP. | |
| I-90/I-495 Interchange | Southwest Advisory Planning Committee (SWAP) | Gino Carlucci, Chair | The subregion's top priority project is the I-90/I-495 Interchange in Hopkinton. This project is not listed due to financial constraints, and SWAP believes it should be. Request that the project be listed with a notation that there is no funding currently identified for these critical improvements. SWAP understands that planned modifications will include open road tolling which is part of the delay and expense. However, there may be additional federal programs developed in the future that could result in the MPO receiving unanticipated funding. This project needs to be on a list of priorities should funding become available. | |
| Operations & Management Programs/ Scenario Planning/ Prioritizing Major Investment projects | Regional Transportation Advisory Council | Mike Gowing, Chairman | <p>Supports the adoption of the Operations and Management (O&M) scenario, rather than the High-Capital Investment Congestion Management scenario or the Current LRTP scenario.</p> <p>Supports designating funding for general types of small projects, with specific projects beyond the current TIP period to be selected at a later date.</p> <p>Requests that the MPO conduct further analysis of scenarios with additional funding beyond the projected LRTP levels, to illustrate the regional benefits that could be achieved through expanded investment in transportation.</p> <p>Requests that the MPO collaborate more closely with MassDOT and the contiguous MPOs (including the MBTA and regional transit authorities) to develop a process where priorities for major investments in the Boston region can be jointly determined.</p> <p>Requests that the Regional Transportation Advisory Council continue to provide input as the MPO develops and implements guidelines for funding decisions in the 2021 and beyond timeframes.</p> | |

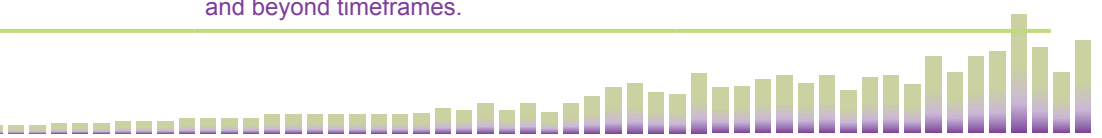


TABLE D.1 (Cont.)

| Project(s) / Issue(s) | Affiliation | Name | Comment | MPO Response (to be added) |
|--|---|---|---|-----------------------------------|
| Last Mile Connections | CrossTown Connect Transportation Management Association (TMA) | Scott Zadakis, Executive Director | <p>This TMA is on the periphery of the MPO boundaries and has limited transportation choices. They are regionalizing some of their services and urge the MPO to do the same. The MPO should consider connectivity and cross-boundary connections to other RTAs and systems in its planning process so as to be as inclusive as possible to communities that lie between RTAs. Supports the decision to focus on operations and management projects, especially the "last mile" shuttle connections, but is concerned that the allocation is too small. The MPO should consider a more robust allocation before adoption of the LRTP.</p> <p>The Fitchburg Commuter Rail schedule should be adjusted to allow for more reverse commuting. They believe that adding an earlier train would encourage people to use commuter rail instead of driving. Reduced fares for reverse commute would also incentivize the use of commuter rail. This could actually increase revenue because trains would not be empty.</p> <p>They support weighing various options and scenarios for increased parking at commuter rail stations. More parking and more peak-period outbound trains will create viable reverse commute for talented workers from the Boston area.</p> | |
| North and South Station Link/ Concord Rotary improvements/ intersection and signal improvements in Sudbury/ Hudson Rotary improvements/ Bike & Ped | CrossTown Connect Transportation Management Association (TMA) | Scott Zadakis, Executive Director (cont.) | <p>Supports the future link between North and South Station. Also supports Concord Rotary improvements, intersection and signal improvements in Sudbury, and improvements to the Hudson Rotary. Thanks the MPO for funding the Assabet River Rail Trail and the Bruce Freeman Rail Trails. Continue to fund these types of projects with an eye toward connecting them to the Fitchburg Commuter Rail line.</p> | |
| Bruce Freeman Rail Trail, Phase 2D (Sudbury) | | Dick Williamson | <p>Requests an update of the LRTP to reflect that the Bruce Freeman Rail Trail, Phase 2D is no longer "conceptual." Notes that VHB has been contracted for the 25% design plans, and that the project could be considered for the FFY 2019 TIP.</p> | |

TABLE D.1 (Cont.)

| Project(s) / Issue(s) | Affiliation | Name | Comment | MPO Response (to be added) |
|---|-------------------------------------|--------------------|---|-----------------------------------|
| Bruce Freeman Rail Trail, Phase 2D (Sudbury) | Town of Sudbury, Board of Selectmen | Leonard Simon | Requests an update of the LRTP to reflect that the Bruce Freeman Rail Trail, Phase 2D is no longer "conceptual." Notes that the 25% design study began in November 2014, and should be completed by February 2016. | |
| Bruce Freeman Rail Trail, Phase 2B (Acton and Concord) and Phase 2D (Sudbury) | | Louis Hills | More support for Bruce Freeman Rail Trail is needed. Requests that Phase 2B be moved back to 2017 and that the Sudbury Bruce Freeman Rail Trail phase of design and construction be programmed at the earliest possible dates. | |
| Bruce Freeman Rail Trail | | Anne Anderson | Keep the Bruce Freeman Rail Trail on schedule. This a major bicycle and pedestrian corridor. | |
| Circumferential Transit | | Schuyler Larrabee | Requests that the MPO support the development of circumferential lines for the MBTA. States that there has been planning for a line that would use the right-of-way through MIT and then through Longwood Medical Area, with extensions on either end. Suggests that the MPO consider a line from Union Square, through Harvard to Harvard Street in Allston, to Brookline Village, and ultimately to the Red Line in the south of the region. | |
| Route 9 / Massachusetts Turnpike (Framingham, Natick, & Wellesley) | Resident, City of Somerville | Joel Weber | Suggests diverting Route 9 traffic in Framingham, Natick, and Wellesley to the Massachusetts Turnpike, which could be achieved through removing the financial incentive in the Pike's toll structure, adding a lane in each direction to the Pike, and a road diet on Route 9. Reducing traffic on Route 9 could make the Route 27 over Route 9 bridge replacement unnecessary, and diverting traffic from signalized intersections on Route 9 could reduce collisions and address safety needs identified in the LRTP. A road diet on Route 9 could be an opportunity to make bus service on Route 9 more appealing. Removing the toll from the Pike's interchange with Route 9 in Framingham may be more appropriate depending on the shift in traffic. | |
| Park & Ride | Resident, City of Somerville | Joel Weber (cont.) | Asks if MassDOT, the MBTA, and the MPO have explored opportunities to adjust pricing to better distribute vehicles to adjacent parking facilities with available capacity. The LRTP doesn't have a map highlighting underutilized parking facilities. | |



TABLE D.1 (Cont.)

| Project(s) / Issue(s) | Affiliation | Name | Comment | MPO Response (to be added) |
|--------------------------------|------------------------------|--------------------|---|-----------------------------------|
| Bicycle Parking | Resident, City of Somerville | Joel Weber (cont.) | The LRTP discusses the Community Transportation/Parking and Clean Air and Mobility program but does not have a clear commitment to add bicycle parking at MBTA stations that have a high utilization rate of bike parking. This bicycle parking should be constructed as soon as possible. Additionally new multi-use path connections (Tri-Community Bikeway connected Alewife Brook bike path, Wayside Trail to the Fitchburg Cutoff Path) should be considered at Alewife Station when determining future demand for bike parking. | |
| Bike Racks on MBTA Buses | Resident, City of Somerville | Joel Weber (cont.) | Suggests the installation of bike racks on all MBTA buses. | |
| Expanding Green Line Capacity | Resident, City of Somerville | Joel Weber (cont.) | MassDOT, the MBTA, and the MPO should explore possibilities for improving capacity in the Green Line's central subway tunnel. The organizations should look at the possibility of a grade separated Copley Junction, lengthening platforms to support making 225 foot trains the norm during peak travel times. Future Green Line cars should be 225 foot cars with smart readers at each door. Questions why the Green Line is at capacity. The possibility of building a flyover between Copley and Arlington Stations should be explored. Platforms at Park, Copley, Boylston, and Arlington stations should be lengthened, as well as existing surface Green Line stations. Discusses the possibilities of taking the existing outbound E branch track from Boylston Street to Huntington Avenue out of revenue service make it available as a storage track allowing parking for a disabled trains or for overnight storage. | |
| McGrath Boulevard (Somerville) | Resident, City of Somerville | Chris Gunadi | Supports inclusion of the McGrath Boulevard project in the LRTP. States that the project will make the area more accessible and pedestrian-friendly, and improve quality of life. | |
| McGrath Boulevard (Somerville) | Resident, City of Medford | Kevin Cuddeback | Supports inclusion of the McGrath Boulevard project in the LRTP. | |
| McGrath Boulevard (Somerville) | Resident, City of Medford | Patrick Bibbins | Supports inclusion of the McGrath Boulevard project in the LRTP. | |

TABLE D.1 (Cont.)

| Project(s) / Issue(s) | Affiliation | Name | Comment | MPO Response (to be added) |
|---|-------------------------------|----------------------------|--|-----------------------------------|
| McGrath Boulevard (Somerville) | Resident, City of Somerville | Karen Molloy | Supports inclusion of the McGrath Boulevard project in the LRTP. | |
| Green Line, Bruce Freeman Rail Trail, Montvale Avenue Reconstruction, and McGrath Boulevard | Resident, City of Medford | Ken Krause | Supports inclusion of the Green Line Extension, Phases I & II, in the FFYs 2016-20 TIP. States that the project will improve regional mobility, air quality and transportation equity, and generate an estimated \$4 billion in related economic development activity. Notes that Medford has already seen a tremendous amount of associated economic development and is benefiting from the nearly completed rail bridge reconstruction over Harvard Street. Supports funding to extend the Bruce Freeman Rail Trail (Phases 2B and 2C) as part of the 200-mile Bay Circuit Trail and Greenway. Supports funding to reconstruct and widen Montvale Avenue in Woburn from the I-93 interchange to Central Street, including new sidewalks and wheelchair ramps. Supports inclusion of the McGrath Boulevard project in the LRTP. States that the project will improve conditions for bicycling and walking, and provide safer and more convenient access to Union Square and Washington Street Green Line stations. | |
| McGrath Boulevard and Bicycle & Pedestrian Projects | Friends of the Community Path | Lynn Weissman & Alan Moore | Supports inclusion of the McGrath Boulevard project in the LRTP. States that the project will make the area more accessible and pedestrian-friendly, and improve quality of life. Urges the MPO to: (1) Continue funding of multi-use paths (2) Shift funding away from highway expansion (3) Prioritize bicycle and pedestrian projects when programming the Clean Air and Mobility funds | |
| Green Line/McGrath Boulevard (Somerville) | Resident, City of Somerville | Alan Moore | Supports inclusion of the Green Line to Route 16 and the McGrath Boulevard projects in the LRTP. Other necessary projects include continued funding to support multi-use paths, shifting funding away from highway expansion, and prioritizing bicycle and pedestrian projects with future Clean Air/Mobility funds. | |

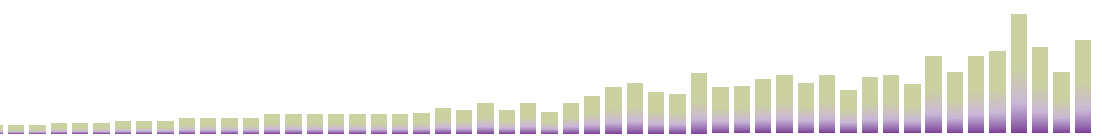


TABLE D.1 (Cont.)

| Project(s) / Issue(s) | Affiliation | Name | Comment | MPO Response (to be added) |
|--|--|--|---|-----------------------------------|
| Green Line/McGrath Boulevard | Members of the Massachusetts State Legislature | Senator Jehlin, Representative Barber, Representative Garballey, Representative Provost, Representative Toomey | Support the MPO's commitment to both phases of the Green Line Extension which is important to their constituents. Also supports the inclusion of the McGrath Boulevard project in the 2026-2030 time band of the LRTP. | |
| Green Line Phase 1, Community Path, Green Line Phase 2, Rutherford Avenue, and McGrath Boulevard | STEP & MVTF | Wig Zamore | Appreciates the work of the Boston MPO and finds the meetings, staff presentations, Board discussion, and public outreach to be exemplary. The certification documents represent appropriate prioritization of sustainable transit and complete streets, with growing regional walk and bike facility emphasis. Applauds the MPO's decision to fund community-based projects at the expense of some larger highway projects. Grateful to see Green Line Phase 1 and Community Path supported by the state. Also grateful to see Green Line Phase 2, Rutherford Avenue, and McGrath Boulevard supported by the MPO. | |
| Air Quality | STEP & MVTF | Wig Zamore (cont.) | Regarding environmental impacts of transportation, hopes that the MPO will soon be able to fully recognize the serious impacts of transportation air pollution and noise on nearby residents, workers, and students. Regarding climate, states that it would be helpful to include black carbon from diesel in our climate pollutant inventories and in transportation conformity. With regard to equity, states that it would be beneficial to more fully use disaggregated TAZ level data to really investigate the disparities in transportation neighborhood facilities and transportation exposures. | |

TABLE D.1 (Cont.)

| Project(s) / Issue(s) | Affiliation | Name | Comment | MPO Response (to be added) |
|---------------------------------------|-----------------------------------|--------------|---|----------------------------|
| Green Line and Air Quality Conformity | Conservation Law Foundation (CLF) | Rafael Mares | <p>Supports the Green Line Extension project in the TIP.</p> <p>Requests that the MPO return to its previous practice of conducting a conformity analysis for ozone. A recent court action affirmed the requirement for the MPO to conduct an ozone conformity analysis. CLF understands that the MPO did not plan to continue to abandon this tool but did so on the advice of US EPA. Normally after a region achieves attainment, it moves into a maintenance process. When the 2008 ozone standard was established, the 1997 standard was revoked and Eastern Massachusetts became an "orphan area" where conformity was not required. A court decision determined that this revocation violates the Clean Air Act.</p> <p>Pursuant to this ruling, the MPO would be required to conduct a conformity determination, however, EPA issued a new rule revoking the entire 1997 air quality standard which was presumably the agency's basis for advising MassDOT and the MPO that no conformity analysis was required. This revocation is being challenged again.</p> <p>Since the MPO intends to conduct a greenhouse gas analysis, adding the conformity analysis for ozone will not be an arduous additional step. This will allow the MPO to assure its members and the public that the proposed plan remains consistent with the goal of protecting the region from serious public health threats associated with ozone.</p> | |
| Grand Junction Multi-Use Path | Resident, City of Cambridge | Mark Jaquith | <p>Requests inclusion of the Grand Junction Multi-Use Path in the LRTP. States that connecting East Somerville, North Point, East Cambridge, Kendall Square, MIT/ Cambridgeport, and Allston Landing to the existing Minuteman, Charles River, and Harborwalk path systems will make bicycle commuting a safer, more accessible alternative for thousands of individuals.</p> | |

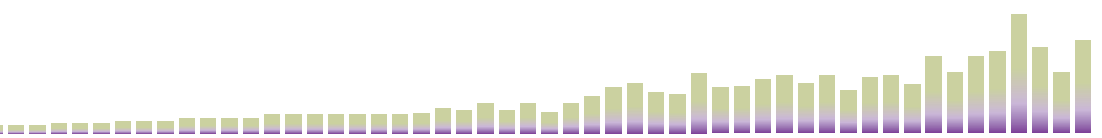


TABLE D.1 (Cont.)

| Project(s) / Issue(s) | Affiliation | Name | Comment | MPO Response (to be added) |
|--|--|-----------------|--|----------------------------|
| Planning Process/ Evacuation Planning/ Bicycle and Pedestrian Design | Framingham Bicycle and Pedestrian Advisory Committee | Tom Branham | <p>The overall emphasis and connotation of Boston as the core demotes every other region to insignificance. There is a need to establish permanent regional cooperative intergovernmental forums (for example the MetroWest open space forums). Having open lines of communication could encourage a plethora of new ideas. Serious consideration should be held to define new standards for a low speed electric personal transportation (wheelchairs, e-assist bikes, Segway's, etc.). Global warming-planning should be done to allow for potential evacuation needs, including the potential for temporary storage of essential transit, rescue and repair vehicles. Seeing more bike and pedestrian awareness in design and overall conceptual design is very encouraging. Provided grammatical and formatting notes and suggestions throughout the document.</p> | |
| Bicycle & Pedestrian Projects | Resident, Town of Framingham | William Hanson | <p>Delighted to see the commitment to infrastructure improvements benefitting pedestrian and bicyclists. As a resident of Framingham, supports projects in his community such as the Bruce Freeman Rail Trail and the Cochituate Trail. Also supports additional pedestrian crossings across Route 9.</p> <p>States that it would be convenient to be able to download the entire document in one file and to create full document automation with active intra-document links.</p> | |
| Bicycle Projects | | David Hutcheson | <p>The LRTP should strongly include rail trails and bicycle and pedestrian access. The Bruce Freeman Rail Trail, Mass Central Rail Trail, Assabet River Rail Trail, and Bay Colony Rail Trail allow for good health.</p> | |

TABLE D.1 (Cont.)

| Project(s) / Issue(s) | Affiliation | Name | Comment | MPO Response (to be added) |
|---|---|--|--|-----------------------------------|
| Malden/ Revere/ Saugus Route 1 Transportation Improvement Project | North Shore Alliance for Economic Development | Chief Elected Officials from Danvers, Essex, Georgetown, Hamilton, Ipswich, Lynnfield, Middleton, Newbury, Salem, Salisbury, Saugus, Revere, Swampscott, Wenham, Winthrop, Gloucester, Beverly, Newburyport, Rockport, Peabody, Marblehead, Lynn, Manchester, Nahant | Concerned that the Route 1 Transportation Improvement Project has been removed from the Draft LRTP. Route 1 commuters have been forced to contend with these worsening and intolerable conditions along Route 1 for too long. The chief elected officials are requesting that MassDOT and the MPO (1) Reevaluate the Route 1 Improvement project to identify “specific phases” of the project that will address some of the immediate traffic, safety and environmental concerns that affect communities all along the Route 1 North corridor and (2) Include an identified and appropriate phase of the Route 1 Improvement Project as eligible for funding in the Final LRTP and FFY2016-2019 TIP respectively. By phasing the project and funding a portion of the improvements, some progress can be realized. | |
| Malden/Revere/ Saugus Route 1 Transportation Improvement Project | North Shore Alliance for Economic Development (cont.) | Chief Elected Officials from Danvers, Essex, Georgetown, Hamilton, Ipswich, Lynnfield, Middleton, Newbury, Salem, Salisbury, Saugus, Revere, Swampscott, Wenham, Winthrop, Gloucester, Beverly, Newburyport, Rockport, Peabody, Marblehead, Lynn, Manchester, Nahant (cont.) | This stretch of highway creates negative effects and disincentives for private investment, job creation, and economic development on the North Shore. This is a “highway nightmare” on a daily basis. Despite exhaustive efforts and participation by the Alliance, the Commonwealth has not advanced this project. They collectively request that MassDOT and the Boston Region MPO revisit the decision to remove the Route 1 Improvement project from the current Draft LRTP and the FFY 2016-2019 TIP and to identify “specific phases” of the project that will address some of the immediate traffic, safety, and environmental concerns that affect communities all along the Route 1 North corridor. | |

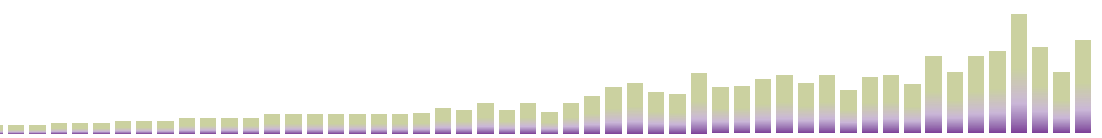


TABLE D.1 (Cont.)

| Project(s) / Issue(s) | Affiliation | Name | Comment | MPO Response (to be added) |
|---|--|--|--|-----------------------------------|
| Malden/Revere/Saugus Route 1 Transportation Improvement Project | Cities of Malden, and Revere, and Town of Saugus | Gary Christenson, Mayor of Malden Daniel Rizzo, Mayor of Revere Scott Crabtree, Town Manager of Saugus | Dismayed to learn that the Malden/Revere/Saugus Route 1 Transportation Improvement project is not included in the TIP and LRTP. Communities are negatively impacted in terms of commute time and wasted economic opportunity; constitutes an incredible waste of energy, time, and human potential. The three communities propose a three-phase plan over a multi-year period (plan attached to comment letter). The project segments have within them certain actions that could be approached sequentially over a defined time period. There was a \$10 million authorization in the 2013 Bond Bill but was not prioritized in the 2015-2018 TIP. The Commonwealth must take steps that can aid the hundreds of thousands of long suffering Route 1 commuters and hundreds of businesses forced to contend these deplorable conditions. They ask that the Project Selection Advisory Committee meet with the chief executives of the three communities to discuss a path to resolving the issue. Would like this to happen before the final 2016-2020 STIP is approved. | |
| Route 4/225(Bedford Street) and Hartwell Avenue Project (Lexington) | Town of Lexington, Planning Board | Aaron Henry, Planning Director | Supports inclusion of the Route 4/225(Bedford Street) and Hartwell Avenue Project in the LRTP. This corridor is a significant link in the regional transportation and economic development network. The Town supports and recognizes that the existing transportation infrastructure needs to be upgraded to support future development. Inclusion of this project is an important step to improve conditions along this corridor. | |
| Climate Change | Resident, City of Cambridge | John MacDougall | Concerned about MassDOT's slow progress in meeting the requirements of the 2008 Global Warming Solutions Act. | |

TABLE D.1 (Cont.)

| Project(s) / Issue(s) | Affiliation | Name | Comment | MPO Response (to be added) |
|--|--|-----------------|--|----------------------------|
| Canton Interchange Project | Three Rivers Interlocal Council (TRIC) | Sarah Raposa | <p>Between 2007 and 2015, TRIC has been consistent in supporting the full completion of the Canton Interchange project to alleviate public safety and traffic congestion issues at this location. It is a continuing detriment to quality of life and viability and prosperity of business interests that depend on a functional roadway system capable of handling employee commutes, truck deliveries, and customer access. Full completion has been promised repeatedly over the years. Information on this project has been sparse and this jeopardizes good faith efforts between communities and private developers. Complete funding must be found to move this project forward.</p> | |
| I-93/I-95 Interchange in Woburn, Reading, Stoneham, and Wakefield/ Increased Transit | North Suburban Planning Council | Kristin Kassner | <p>Supports the MPO's decision to shift the majority of funding away from larger projects to fund smaller local projects. They also feel that some portion of the I-93/I-95 Interchange in Woburn, Reading, Stoneham, and Wakefield (or at least some feasible transit improvements in the area) should be funded. This interchange is central to vehicular circulation in the region. There are significant safety problems and it is a high crash location. The safety and congestion issues are highly concerning.</p> <p>The significant amount of drivers in the subregion is a result of a lack of public transportation. Many communities are providing alternative transportation options but more is needed. Alternative options must be available and if the interchange is not remedied, the economy of the subregion will be threatened.</p> <p>Requests that a small portion of funding be dedicated to continuing to advance the interchange project and studies should be pursued to identify feasible alternatives for public transportation to serve the subregion.</p> | |

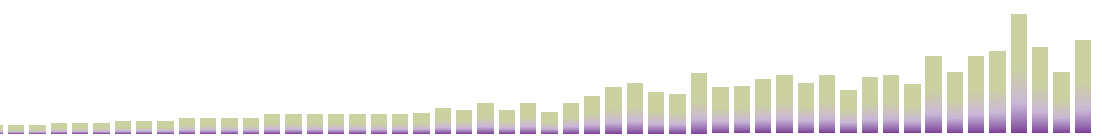


TABLE D.1 (Cont.)

| Project(s) / Issue(s) | Affiliation | Name | Comment | MPO Response (to be added) |
|-----------------------|---------------------------|-----------------------------|---|----------------------------|
| Climate Change | Massachusetts Sierra Club | Cathy Ann Buckley, Chairman | <p>The statement in Chapter 8 that addresses global warming should read "The largest threat the MPO and humanity face is the need to reduce GHG emissions that contribute to climate change, which if unchecked, will impair our transportation system and way of life on an unparalleled scale." This statement should appear at the beginning of Chapter 8, and Chapter 8 should be Chapter 1 of the LRTP because many worthwhile things are included in this chapter. Many of the people that approved the list of projects in the LRTP either did not read or do not believe what is in this chapter.</p> <p>The climate impacts that we are experiencing today are based on the carbon dioxide emissions from the last 100 years. By 2040, the emissions of 1915 to 1940 will fall out and be replaced by the emissions we generate now through 2040. To include significant funds to deal with what we are inviting by our inaction on climate would be intelligent and courageous. To ignore them is politically expedient. With each passing year of inaction we become less able to change this trajectory. The LRTP states that the project mix is expected to show a neutral shift toward meeting the GHG reduction goal. What would someone reading this plan in 2040 think? Perhaps - "what were we thinking, we still had a chance in 2015."</p> <p>Please educate people to the real and present threat of climate change. Publicize that a gallon of gasoline creates twenty pounds of carbon dioxide. Tell us why Massachusetts has made idling illegal. Educate us as to why raising transit fares is bad for our financially neediest residents today and for all of us tomorrow, that a healthy transit system is good for motorists, too. Please lead.</p> <p>Those who study climate know that we are approaching - at an accelerating rate - a point of no return. Accumulating evidence indicates that this may well be the last Plan where we still have a chance to make a positive impact.</p> | |

TABLE D.1 (Cont.)

| Project(s) / Issue(s) | Affiliation | Name | Comment | MPO Response (to be added) |
|---|-----------------------------------|---------------|---|----------------------------|
| Planning Process/Alewife/Fresh Pond area in Cambridge | The Fresh Pond Residents Alliance | Arthur Strang | <p>The Alliance is confounded by the complexity, multilayer, independent government offices, each of which has a distinct responsibility quasi-insulated from the other by the structure of management of transportation in Massachusetts, which is not responsible or responsive to the commuter. Each day, the commuter tests the maximum capacity of our roads and our transit systems. We find this daily test inimical to urban neighborhoods and unresponsive to the demands of the urban commuter. Although good, skilled, knowledgeable, and dedicated people are operating the commuter system, their efforts are hindered by the lack of money for maintenance and the lack of clear management from the top. Clarity of strategy and a redirection of intent are required for mobility in the neighborhoods of rising density in Urban Metropolitan Boston.</p> <p>Specific comments are in regard to the Alewife/Fresh Pond area in Cambridge, where development is adding to congestion, commuting hours are lengthening, speeds are falling, and the Red Line is near capacity. The roads are full, especially during peak periods, and it is unlikely that more lane miles will be built in Urban Metropolitan Boston and Complete Streets will reduce vehicle lane miles.</p> <p>Transportation funding is tight and uncertain. Low cost pedestrian improvements facilitate high density transit in areas like Alewife and Kendall Square. High occupant vehicles—buses operated privately, by TMAs, or RTAs are a relatively low-cost way to increase road capacity and commuting speeds.</p> <p>The strategic statement of Charting Progress 2040 should be walk, bike, bus, and rail. The strategy requires well planned investment in paths that are direct, safe, and attractive, and significantly better management of the operations of buses, subway, and rail, and better management and more money for maintenance of transit.</p> | |

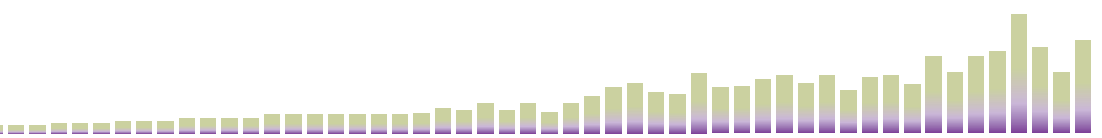


TABLE D.1 (Cont.)

| Project(s) / Issue(s) | Affiliation | Name | Comment | MPO Response (to be added) |
|--------------------------------------|-----------------------------------|-----------------------|--|----------------------------|
| Alewife/Fresh Pond area in Cambridge | The Fresh Pond Residents Alliance | Arthur Strang (cont.) | <p>A clear strategy is critical for the rising development around transit centers, for the technology growth centers in Urban Metropolitan, and for older close-in neighborhoods for which more attractive and safer walking paths can make transportation more neighborhood friendly. Some communities will need more proactive guidance and support to implement strategy.</p> <p>Given fixed, even declining lane space, the only way to accommodate growth is to increase the ‘density’ of commuters, not the density of vehicles and cars. To do this, government at all levels must act to support transit that will attract more riders.</p> <p>The MPO’s Operations and Management strategy is a good beginning for solving our problems, but it needs to go further. A more neighborhood-centric approach is needed for urban mobility in the future, which would support a combination of walk, bike, bus, applications, transit, rail, and “walk the last mile.” Alewife could be an example of this approach.</p> <p>There is only one major transit infrastructure investment listed in the LRTP, the Green Line Extension, yet other major transit investments are needed to tackle the problem of urban traffic congestion and the current lack of efficient mobility. These include a Red-Blue Line connection, other subway line extensions, and major commuter rail improvements. A new commuter station at Alewife on the Fitchburg Line would also be helpful.</p> <p>The Alliance also made specific comments regarding possible corrections to some of the maps in Chapter 3</p> | |



E

APPENDIX METHODOLOGY FOR LAND USE PROJECTIONS IN THE BOSTON REGION

INTRODUCTION

The Metropolitan Area Planning Council (MAPC), the region's land use planning agency, is responsible for preparing detailed transportation analysis zone (TAZ)-level socioeconomic and land use projections out to the year 2040 to support the Long-Range Transportation Plan (LRTP) travel-demand model process. MAPC began this process with the development of regional and municipal population and household projections for the entire Metro Boston model region. Because the model region includes an additional 63 municipalities in adjacent regional planning agencies (RPAs), MAPC convened an advisory team with representatives from neighboring RPAs, along with academic experts, staff from Boston and Cambridge, and state agencies.¹

MAPC reviewed reports from other regions nationwide to assess the current state of practice and also reviewed prior projections for the Boston region to assess their accuracy and identify opportunities for improvement. Data sources for the demographic projections included decennial census data from 1990, 2000, and 2010; American Community Survey (ACS) data from 2005 to 2011; fertility and mortality information from the Massachusetts Community Health Information Profile; housing production information from the Census Building Permit Survey database; and MAPC's Development Database. For the employment projections, MAPC referred to historic employment data from the US Bureau of Labor Statistics (BLS) and the Executive Office of Labor and Workforce Development, as well as labor force participation data from the US Census Bureau.

Because the future cannot be predicted with certainty, identifying a range of possible futures may prove more useful than a single forecast. Consequently, MAPC prepared two scenarios for regional growth. Each scenario reflects different assumptions about key trends. The "Status Quo" scenario is based on the continuation of existing rates of births, deaths, migration, and housing occupancy. Alternatively, the "Stronger Region" scenario explores how changing trends could result in higher population growth, greater housing demand, and a substantially larger workforce. Specifically, the Stronger Region scenario assumes that in the coming years:

¹ A full report, technical documentation, and data downloads are available at www.mapc.org/projections.

- The region will attract and retain more people, especially young adults, than it does today.
- Younger householders (born after 1980) will be more inclined toward urban living than were their predecessors, and they will be less likely to seek out single-family homes.
- An increasing share of senior-headed households will choose to downsize from single-family homes to apartments or condominiums.

Of the two scenarios, the Stronger Region is more consistent with the housing, land use, and workforce development goals of MetroFuture, MAPC’s regional plan for sustainable and equitable growth and development in the region. This scenario has been adopted by MAPC for future planning purposes and, as a result, the LRTP socioeconomic data is based on the Stronger Region scenario.

METHODOLOGY

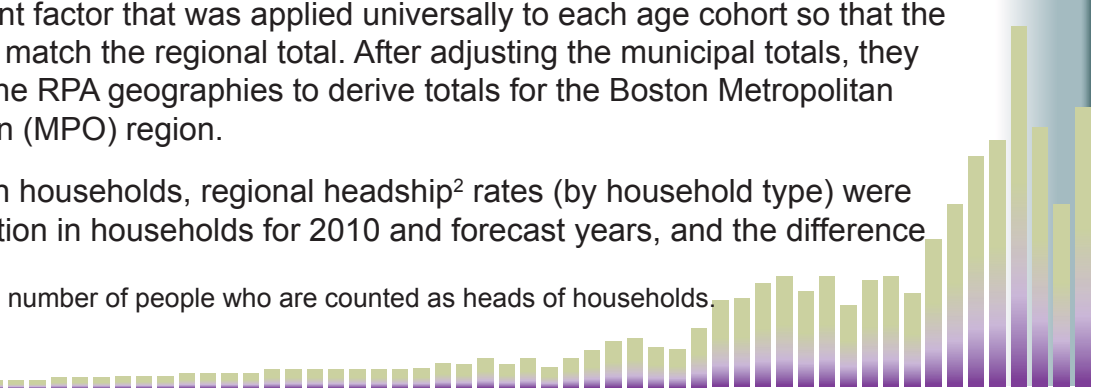
Municipal Population and Household Projections

MAPC first developed regional projections of population by age, gender, and race, utilizing a standard cohort survival methodology with age- and race-specific fertility and mortality rates based on information from the Massachusetts Department of Public Health (DPH). Disaggregated and adjusted age- and race-specific migration rates to and from the region were used, based on migration data available from the US Census Bureau’s ACS and Public Use Microdata Sample (PUMS). Household estimates are produced using region-wide age-specific headship rates derived from the decennial census, and they are disaggregated into households by type (family versus nonfamily) and size.

Municipal population projections were initially developed using age- and municipal-specific fertility and mortality rates from the DPH. Net migration by age for each municipality was calculated using the vital statistics method, which compares the actual population in 2010 to the “expected” population, which was derived from Census 2000 counts and recorded deaths during the subsequent ten-year period. Any difference between the observed and expected population is assumed to be the result of migration in or out of the municipality. The independently projected population for each of the 164 cities and towns was calculated and compared to the regional control total in order to produce an adjustment factor that was applied universally to each age cohort so that the municipal sum would match the regional total. After adjusting the municipal totals, they were aggregated to the RPA geographies to derive totals for the Boston Metropolitan Planning Organization (MPO) region.

To estimate change in households, regional headship² rates (by household type) were applied to the population in households for 2010 and forecast years, and the difference

² Headship rates are the number of people who are counted as heads of households.



was calculated. This change in households was added to the actual household counts by age from Census 2010 to produce future-year household estimates by householder age. These households were then disaggregated by household type (family versus nonfamily), income (relative to the area median income defined by the US Department of Housing and Urban Development), and size, based on the distributions observed using decennial census data and ACS microdata. Municipal household projections were allocated to TAZs using the land use model described below.

Employment Projections

MAPC collaborated extensively with the Massachusetts Department of Transportation (MassDOT) to develop employment projections for Massachusetts' MPO regions. An analysis found that as the baby boom generation ages past the age of 65 in the coming decades, a massive wave of retirement is likely to dramatically alter the Massachusetts workforce, making labor availability a major constraint on economic growth. Meanwhile, the state's slow pace of housing construction will make it difficult for younger workers to move into Massachusetts to fill those vacancies. As a result, statewide employment was projected as a function of the available labor force based on demographic projections. In consultation with expert advisors, MAPC also assumed a gradual decrease in the average unemployment rate over the next few decades. Age-specific labor force participation rate was developed for each RPA and applied to the projected population to estimate the number of employed residents. The Stronger Region scenario assumes a gradual decrease in the unemployment rate, from a peak of 8.8 percent in 2010 to 6.0 percent in 2020, 5.8 percent in 2030, and 5.6 percent in 2040.³ This scenario is more consistent with long-term unemployment averages (about 5.75 percent from 1990 to 2015 and from 2000 to 2015), and it also reflects the fact that with likely labor shortages in the coming decades as baby boomers retire, workers will find it easier to get a job. The rate of change in employed residents was then used to estimate total future employment in Massachusetts, assuming that in/out commuting will remain a constant share of total employment. The sectoral distribution of employment in future decades was based on a shift-share analysis⁴ of Massachusetts sectoral growth versus the rest of the nation, utilizing BLS forecasts to the year 2020, and then continuing an attenuated rate of change for each sector out to the year 2040.

³ Estimates of a “non-accelerating inflation rate unemployment” (NAIRU) measure of the “natural” unemployment is in the vicinity of 5.0 percent to 5.25 percent. However, this figure is the structural “floor” on unemployment, and any long-term average will also have to account for recessionary periods with higher unemployment.

⁴ A shift-share analysis is an economic forecasting technique that projects future employment change for a specified area (such as a state or region) as a function of three key factors: a *general growth effect*, reflecting change in employment for a larger reference area (such as the nation); an *industry mix effect*, reflecting differential growth rates for specific sectors; and a *local share effect*, based on the specified area's performance in each sector relative to the reference area.

MAPC then used shift-share methods to analyze how the economic trends of the 164 municipalities in Metro Boston compare to the state. Metro Boston jobs grew an average of 0.66 percent faster than Massachusetts overall over the last decade. As a result, future employment share for the region was derived based on the total employment projection for the state. Shifts in employment sectors in the region (by the 2-digit North American Industry Classification System [NAICS] sectors) were analyzed to get a composite share of employment for 2020. The logarithmic extrapolation using the shift in share from 2001, 2010, and 2020 was used to determine the respective sectoral shares for 2030 and 2040. Municipal and TAZ allocation of employment was done using the land use model described below.

TAZ Allocation

MAPC worked collaboratively with MPO staff to procure and develop a regional Land Use Model, which distributes households and employment to TAZs based on a variety of zonal attributes, including access to employment and labor, development capacity, and new real estate development already “in the pipeline.” After reviewing the wide variety of land use modeling software tools currently available, MAPC and CTPS procured Citilabs “Cube Land” software. Based on the bid-rent model at the core of the software, the model “agents” (households or employers) compete for available real estate. The agent’s location is a result of interaction with other agents, the agent’s ability to afford a location, the attractiveness of a location based on neighborhood characteristics, transportation connectivity and other attributes, and other factors. MAPC defined the agents to be consistent with the previously developed population and household projections as well as employment projections.

A total of 24 model agents were defined, composed of 13 household agents and 11 employment agents. The household agents are defined in terms of the age of the householder, the household type, the household size, and income level. Table E-1 summarizes the 13 household agent types by their characteristics.

TABLE E.1
Land Use Model Household Agent Description

| HH Agent Code | Age Range | HH Type | HH Size | Income | Agent Description |
|---------------|-----------|---------------------------|--------------|-------------------|--|
| 1 | 15-34 | Nonfamily | 2-4+ Persons | All income levels | 15-34 Nonfamily 2-4+ persons HH all income levels |
| 2 | 15-34 | Nonfamily | 1 Person | All income levels | 15-34 Nonfamily single person HH all income levels |
| 3 | 15-44 | Family | 2-4+ Persons | Above 80% AMI | 15-44 Family 2-4+ persons HH high income |
| 4 | 15-44 | Family | 2-4+ Persons | Below 80% AMI | 15-44 Family 2-4+ persons HH low income |
| 5 | 35-64 | Nonfamily | 2-4+ Persons | All income levels | 35-64 Nonfamily 2-4+ persons HH all income levels |
| 6 | 35-64 | Nonfamily | 1 Person | Above 80% AMI | 35-64 Nonfamily single person HH high income |
| 7 | 35-64 | Nonfamily | 1 Person | Below 80% AMI | 35-64 Nonfamily single person HH low income |
| 8 | 45-64 | Family | 2-4+ Persons | Above 80% AMI | 45-64 Family 2-4+ persons HH high income |
| 9 | 45-64 | Family | 2-4+ Persons | Below 80% AMI | 45-64 Family 2-4+ persons HH low income |
| 10 | 65+ | Both family and nonfamily | 2-4+ Persons | Above 80% AMI | 65+ Family and nonfamily 2-4+ persons HH high income |
| 11 | 65+ | Both family and nonfamily | 2-4+ Persons | Below 80% AMI | 65+ Family and nonfamily 2-4+ persons HH low income |
| 12 | 65+ | Nonfamily | 1 Person | Above 80% AMI | 65+ Nonfamily single person HH high income |
| 13 | 65+ | Nonfamily | 1 Person | Below 80% AMI | 65+ Nonfamily single person HH low income |

AMI = average median income. HH = household

MAPC created a residential location choice model based on responses from the Massachusetts Travel Survey.⁵ Travel survey responses were assigned to an agent category based on household type, householder age, household size, and reported income, and they were geocoded to individual parcels based on the reported home address. These observations of actual households formed the basis for estimating location choice preferences used in the bid-rent model.

⁵ <http://www.massdot.state.ma.us/planning/Main/MapsDataandReports/Reports/TravelSurvey.aspx>

While the Cube Land software is most commonly used to allocate regional totals to zones, MAPC chose to set up the model in such a way that the previously developed municipal population and household totals would be maintained, so as to preserve LRTP consistency with the Regional Housing Plan and other policy documents. Therefore, the model's primary role was to determine the distribution of household agents to TAZs *within* each municipality, not to forecast regional-scale population movement.

The regional travel-model land use inputs are more detailed than the 13 agents reflected in Table E-1. The regional model inputs include:

- Households by four income groups
- Households by household size (one-person households, two-person households, three-person households, and households with four or more persons)
- Households by workers (zero-worker households, one-worker households, two-worker households, and households with three or more workers)

In addition, the regional travel model requires information on households by auto availability (zero-auto households, one-auto households, two-auto households, and households with three or more autos).

MAPC and the MPO staff have jointly developed a methodology to convert the zonal Cube Land output to the needed regional model input. This methodology makes extensive use of the existing census data and uses a methodology known as iterative proportional fitting. Simply stated, the households by income, size, and workers are proportionally scaled to match MAPC-predicted community control totals for population, households, and workers. Once completed, the results of the proportional fitting were manually checked so that all community control totals established by MAPC were precisely matched.

For the auto-owner projections, the MPO staff had developed an auto ownership model. This auto ownership model was estimated from the 2011 Massachusetts Travel Survey data. The model was then calibrated to known Massachusetts Registry of Motor Vehicle data. The auto ownership model uses households by income, households by size, and households by worker as the basis for predicting auto ownership.

The 11 employment agents were defined based on the 2-digit NAICS sector, with an adjustment to move retail employment firms from the Trade, Transportation, and Utilities sectors as grouped in NAICS; the Retail sector was grouped with the Leisure and Hospitality sector. This was done because the location choice of retail jobs and firms more closely follows that of jobs in the Leisure and Hospitality sectors than those in the Wholesale and Transportation sectors. Table E-2 summarizes the grouping of employment by NAICS sector to the 11 employment firms.

Table E.2
Land Use Model Employment Agent Description

| NAICS 2-Digit Sector | NAICS Description | Model Firm Number | Model Firm Description |
|-----------------------------|--|--------------------------|--------------------------------------|
| 11 | Agriculture, Forestry, Fishing and Hunting | 8 | Natural Resources and Mining |
| 21 | Mining, Quarrying, and Oil and Gas Extraction | 8 | Natural Resources and Mining |
| 22 | Utilities | 11 | Trade, Transportation, and Utilities |
| 23 | Construction | 1 | Construction |
| 31 | Manufacturing | 7 | Manufacturing |
| 32 | Manufacturing | 7 | Manufacturing |
| 33 | Manufacturing | 7 | Manufacturing |
| 42 | Wholesale Trade | 11 | Trade, Transportation, and Utilities |
| 44 | Retail Trade | 6 | Retail, Leisure and Hospitality |
| 45 | Retail Trade | 6 | Retail, Leisure and Hospitality |
| 48 | Transportation and Warehousing | 11 | Trade, Transportation, and Utilities |
| 49 | Transportation and Warehousing | 11 | Trade, Transportation, and Utilities |
| 51 | Information | 5 | Information |
| 52 | Finance and Insurance | 3 | Financial Activities |
| 53 | Real Estate Rental and Leasing | 3 | Financial Activities |
| 54 | Professional, Scientific, and Technical Services | 10 | Professional and Business Services |
| 55 | Management of Companies and Enterprises | 10 | Professional and Business Services |
| 56 | Administrative and Support and Waste Management and Remediation Services | 10 | Professional and Business Services |
| 61 | Educational Services | 2 | Education and Health Services |
| 62 | Health Care and Social Assistance | 2 | Education and Health Services |
| 71 | Arts, Entertainment, and Recreation | 6 | Retail, Leisure and Hospitality |
| 72 | Accommodation and Food Services | 6 | Retail, Leisure and Hospitality |
| 81 | Other Services (except Public Administration) | 9 | Other Services |
| 92 | Public Administration | 4 | Public Administration |
| 99 | Not Applicable | 9 | Other Services |

NAICS = North American Industry Classification System

MAPC created an employment location choice model by geocoding establishment data from InfoGroup to land parcels, with information about land use, density, and

accessibility. These observations of actual establishment formed the basis for estimating the location choice preferences used in the bid-rent model.

The 13 household agents and the 11 employment agents compete to occupy different types of real estate. The model has a total of 12 real estate types, including single family and multifamily for residential agents, as well as various commercial real estate types, including high- and low-density retail office, warehouse, and institutional real estate. Mixed-use real estate is occupied by both residential and employment agents. In the case of employment, the model also accounted for commercial real estate built since 2000 or proposed for construction. This information was derived from MAPC's Development Database,⁶ an online inventory of 3,000 recently completed or anticipated residential and commercial development projects that was compiled based on inputs from municipal planning staff in MAPC's 101 cities and towns, information provided by neighboring RPAs, and MAPC research. The database provided the supply side of real estate that is likely to be available for employment firms to occupy in the future.

The zonal employment data needed by the regional travel model is not as detailed as the 11 employment agents forecast by Cube Land. The regional travel model requires zonal employment for three categories (basic employment, retail employment, and other employment). However, as seen in Table E-2, components of these three categories are parsed throughout the 11 categories used by Cube Land. Consequently, MAPC and the MPO staff developed a methodology for distributing the 11 Cube Land categories across the three categories needed for model input.

Based on the allocation of households from the land use model, additional household attributes that were needed for the travel model were estimated. These included school-age population, workers, and total household population. MAPC provided municipal control totals for these inputs, which were a part of the demographic projections work that had been done previously. PUMS data was used to estimate the population younger than 20 years old in households and was controlled at the municipal level for consistency with the projections. Labor force participation rate and the share of employed residents (both for current and future years) in the municipalities were used to estimate the change in workers.

6 dd.mapc.org



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APPENDIX GLOSSARY OF ACRONYMS

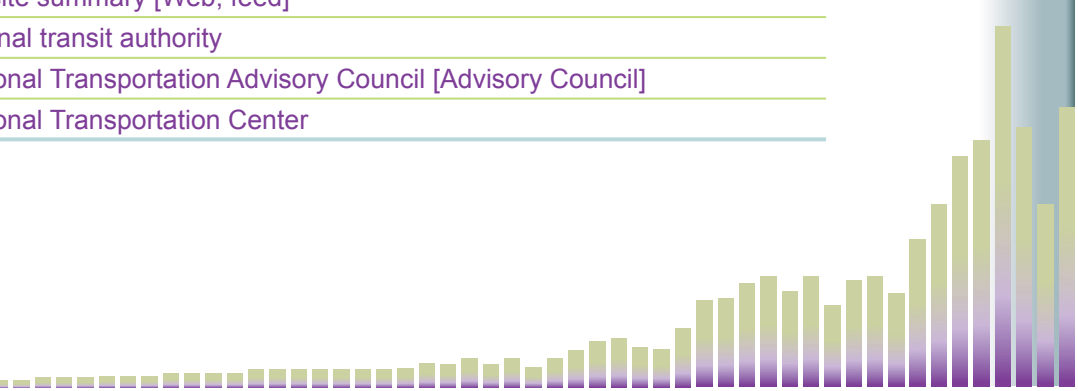
| Acronym | Definition |
|-----------------|--|
| 3C | continuous, comprehensive, cooperative [planning process] |
| A&F | administration and finance |
| AACT | Access Advisory Committee to the MBTA |
| ABP | Accelerated Bridge Program |
| ADA | Americans with Disabilities Act of 1990 |
| ADT | average daily traffic |
| AFC | automated fare collection |
| AMPO | Association of Metropolitan Planning Organizations |
| APC | automatic passenger counter |
| APTA | American Public Transportation Association |
| ARAN | automatic road analyzer |
| ARRA | The American Recovery and Reinvestment Act of 2009 |
| ASL | American sign language |
| ATR | automatic traffic recorder |
| AVL | automatic vehicle location |
| AWDT | average weekday daily traffic |
| BCIL | Boston Center for Independent Living |
| BRA | Boston Redevelopment Authority |
| BRT | bus rapid transit |
| BTD | Boston Transportation Department |
| CA/T | Central Artery/Tunnel [project] |
| CAA | Clean Air Act of 1970 |
| CAAA | Clean Air Act Amendments of 1990 |
| CATA | Cape Ann Transportation Authority |
| CBD | central business district |
| CFR | Code of Federal Regulation |
| CHSTP | Coordinated Public Transit Human Services Transportation Plan |
| CIC | Community Innovation Challenge |
| CIP | Capital Investment Program |
| CMAQ | Congestion Mitigation and Air Quality |
| CMP | Congestion Management Process |
| CNG | compressed natural gas |
| CO | carbon monoxide |
| CO ₂ | carbon dioxide |
| CTPS | Central Transportation Planning Staff [to the Boston Region MPO] |
| CTTAP | Community Transportation Technical Assistance Program |

| Acronym | Definition |
|-----------|---|
| DBMS | Database Management System |
| DCAMM | Division of Capital Asset Management and Maintenance |
| DCR | Department of Conservation and Recreation |
| DEIR | draft environmental impact report [MA] |
| DEIS | draft environmental impact statement [federal] |
| DEP | Department of Environmental Protection [MA] |
| DMU | diesel multiple unit |
| DTA | dynamic traffic assignment |
| EERPAT | Energy and Emissions Reduction Policy Analysis Tool |
| EIR | environmental impact report [MA] |
| EIS | environmental impact statement [federal] |
| EJ | environmental justice |
| EOEEA | Executive Office of Energy and Environmental Affairs [MA] |
| EOHED | Executive Office of Housing and Economic Development [MA] |
| EOHHS | Executive Office of Health and Human Services [MA] |
| EPA | Environmental Protection Agency [federal] |
| EPDO | equivalent property damage only [index] |
| ETC | electronic toll collection |
| FDR | functional design report |
| FEIR | final environmental impact report [MA] |
| FEIR | final environmental impact statement [federal] |
| FFGA | full funding grant agreement |
| FFY, FFYs | federal fiscal year, federal fiscal years |
| FHEA | Fair Housing Equity Assessment |
| FHWA | Federal Highway Administration |
| FONSI | finding of no significant impact |
| FTA | Federal Transit Administration |
| GANS | grant anticipation notes [municipal bond financing] |
| GHG | greenhouse gas [as in greenhouse gas emissions] |
| GIS | geographic information system |
| GLX | Green Line Extension [Green Line Extension project] |
| GPS | global positioning system |
| GWI | global warming index |
| GWSA | Global Warming Solutions Act of 2008 [MA] |
| HOV | high-occupancy vehicle |
| HPP | high-priority projects |
| HSIP | Highway Safety Improvement Program |
| HTC | Healthy Transportation Compact |
| ICC | Inner Core Committee [MAPC subregion] |



| Acronym | Definition |
|-----------|--|
| IMS | intermodal management system |
| INVEST | Infrastructure Voluntary Evaluation Sustainability Tool [FHWA] |
| IPCC | Intergovernmental Panel on Climate Change |
| ISTEA | Intermodal Surface Transportation Efficiency Act [federal] |
| IT&S | Information Technology and Systems [CTPS group] |
| ITDP | Institute for Transportation and Development Policy |
| ITE | Institute of Transportation Engineers |
| ITS | intelligent transportation systems |
| JARC | Job Access and Reverse Commute [program] |
| LAP | language access plan |
| LCW | Livable Community Workshop |
| LEP | limited English proficiency |
| LNG | liquefied natural gas |
| LOS | level of service |
| LRTA | Lowell Regional Transit Authority |
| L RTP | Long-Range Transportation Plan |
| MAGIC | Minuteman Advisory Group on Interlocal Coordination |
| MAP-21 | Moving Ahead for Progress in the 21st Century Act [federal] |
| MAPC | Metropolitan Area Planning Council |
| MARPA | Massachusetts Association of Regional Planning Agencies |
| MassDOT | Massachusetts Department of Transportation |
| MassGIS | Massachusetts Office of Geographic Information |
| Massport | Massachusetts Port Authority |
| MassRIDES | MassDOT's statewide travel options program |
| MBCR | Massachusetts Bay Commuter Railroad |
| MBTA | Massachusetts Bay Transportation Authority |
| MCAD | Massachusetts Commission Against Discrimination |
| MEMA | Massachusetts Emergency Management Agency |
| MEPA | Massachusetts Environmental Policy Act |
| MGL | Massachusetts general laws |
| MHS | metropolitan highway system |
| MAGIC | Minuteman Advisory Group on Interlocal Coordination [MAPC subregion] |
| MOU | memorandum of understanding |
| MOVES | Motor Vehicle Emissions Simulator [EPA] |
| MPO | metropolitan planning organization [Boston Region MPO] |
| MPOinfo | Boston Region MPO's email contact list |
| MWGMC | MetroWest Growth Management Committee |
| MWRC | MetroWest Regional Collaborative [MAPC subregion] |
| MWRTA | MetroWest Regional Transit Authority |

| Acronym | Definition |
|---------|--|
| NAAQS | National Ambient Air Quality Standards |
| NBPD | National Bicycle and Pedestrian Documentation Project |
| NEPA | National Environmental Policy Act |
| NHPP | National Highway Performance Program |
| NMHC | non-methane hydrocarbons |
| NSTF | North Shore Task Force [MAPC subregion] |
| NSPC | North Suburban Planning Council [MAPC subregion] |
| NOx | nitrogen oxides |
| NTD | National Transit Database |
| NTP | notice to proceed |
| O&M | operations and management |
| ODCR | Office of Diversity and Civil Rights [MassDOT] |
| OE | operating expenses |
| OTA | Office for Transportation Access [MBTA] |
| OTP | Office of Transportation Planning [MassDOT] |
| P3 [1] | Public Participation Plan |
| P3 [2] | public private partnership |
| PBPP | performance-based planning and programming |
| PDM | Pre-Disaster Mitigation Program [federal] |
| PEV | pedestrian environmental variable |
| PL | public law [PL] funds, or metropolitan planning funds [FHWA] |
| PM2.5 | particulate matter smaller than 2.5 micrometers in size |
| PM10 | particulate matter up to 10 micrometers in size |
| PMT | Program for Mass Transportation [MBTA] |
| ppm | parts per million |
| PSA | Project Selection Advisory Council |
| RCCs | Regional Coordinating Councils |
| RIF | roadway inventory file |
| RMV | Registry of Motor Vehicles |
| ROC | Rider Oversight Committee [MBTA] |
| ROW | right-of-way |
| RPA | regional planning agency |
| RSA | Roadway Safety Audit [FHWA] |
| RSS | rich site summary [Web, feed] |
| RTA | regional transit authority |
| RTAC | Regional Transportation Advisory Council [Advisory Council] |
| RTC | Regional Transportation Center |



| Acronym | Definition |
|----------------|---|
| SAFE | service and fare equity [analysis] |
| SAFETEA-LU | Safe, Accountable, Flexible, Efficient Transportation Equity Act—A Legacy for Users |
| SCCCT | Statewide Coordinating Council on Community Transportation |
| SCI | sustainable communities initiative |
| SDO | supplier diversity office |
| SFY | state fiscal year |
| SGR | state-of-good repair |
| SHRP | Strategic Highway Research Program |
| SHSP | Strategic Highway Safety Plan |
| SIP | State Implementation Plan |
| SNAC | special needs advisory committee |
| SNLA | Small Necessities Leave Act |
| SORE | statement of revenue and expenses |
| SOV | single-occupancy vehicle |
| SPR | Statewide Planning and Research |
| SRTS | Safe Routes to School |
| STB | State Transportation Building [Boston] |
| STIP | State Transportation Improvement Program |
| STP | Surface Transportation Program |
| SWAP | South West Advisory Committee [MAPC subregion] |
| TAM | transit asset management |
| TAP | Transportation Alternatives Program |
| TAZ | transportation analysis zone |
| TCMs | transportation control measures |
| TCRP | Transit Cooperative Research Program |
| TDM | travel-demand management, or transportation-demand management |
| TE | transportation equity |
| TEAMS | Travel Efficiency Assessment Method |
| TEA-21 | Transportation Equity Act for the 21st Century [federal] |
| TIGER | Transportation Investment Generating Economic Recovery [TIGER Discretionary Grant program, federal] |
| TIGGER | Transit Investments for Greenhouse Gas and Energy Reduction [FTA grant program] |
| TIP | Transportation Improvement Program [MPO] |
| Title VI | Title VI of the Civil Rights Act of 1964 |
| TMA [1] | transportation management area [FTA, FHWA] |
| TMA [2] | Transportation Management Association |

| Acronym | Definition |
|------------|---|
| TMC | turning movement counts |
| TOD | transit-oriented development |
| TRB | Transportation Research Board |
| TREDIS | Transportation Economic Development Impact System [software] |
| TRIC | Three Rivers Interlocal Council [MAPC subregion] |
| TSIMS | Transportation Safety Information Management System |
| TSM | transportation systems management [FHWA] |
| UFP | ultrafine particles |
| UPWP | Unified Planning Work Program |
| US | The United States of America |
| USDOT | United States Department of Transportation |
| USGS | US Geological Survey |
| UZA | urbanized area |
| V/C | volume-to-capacity ratio |
| VHT | vehicle-hours traveled |
| VMS | variable message signs |
| VMT | vehicle-miles traveled |
| VOCs | volatile organic compounds [pollutants] |
| VRH | vehicle revenue-hours |
| VRM | vehicle revenue-miles |
| WalkBoston | pedestrian advocacy group [Boston area] |
| WAT | walk-access transit |
| WMM | weMove Massachusetts [MassDOT long-range transportation plan] |
| WTS | Women in Transportation Seminar |
| YMM | youMove Massachusetts [MassDOT planning initiative] |

