weMOVE MASSACHUSETTS

planning for performance

massDOT
Massachusetts Department of Transportation

December 2013

Acknowledgments

This project was funded by the United States Department of Transportation (U.S. DOT), Federal Highway Administration (FHWA).

TITLE VI NOTICE

The Massachusetts Department of Transportation (MassDOT) fully complies with Title VI of the Civil Rights Act of 1964 and related state laws. MassDOT offers a variety of resources/services in Spanish, Portuguese, Haitian Creole, Khmer, Chinese, and Vietnamese, among others, free of charge. Services include, but are not limited to, the following: oral interpreters, written language services, and translations of vital documents.

If you believe that you or anyone in a specific class of persons has been subjected to discrimination prohibited by Title VI and other nondiscrimination laws based on race, color, national origin, sex, age, disability, or gender, you or your representative may file a complaint with MassDOT, which can help you to complete the form. A complaint must be filed no later than 180 days after the date of the alleged discrimination.

If you need help understanding this document because you do not speak English, have a disability which impacts your ability to read the text, or wish to file a complaint, please contact MassDOT's Office for Diversity and Civil Rights at (857) 368-8580 or (617) 368-7306 (TTY), or via our web site at http://www.massdot.state.ma.us.

AVISO DE TÍTULO VI

El Departamento de Transporte de Massachusetts (MassDOT) cumple plenamente con el Título VI de la Ley de Derechos Civiles de 1964 y las leyes estatales relacionadas al mismo. MassDOT ofrece una variedad de recursos/servicios en español, portugués, criollo haitiano, camboyano, chino y vietnamita, entre otros, libre de costo. Entre varios servicios se encuentran los siguientes: intérpretes orales, servicios de lengua escrita y traducción de documentos vitales. Si usted necesita ayuda para entender este documento ya que no habla inglés o tiene una incapacidad que afecta su habilidad de leer el texto, por favor contacte a la Oficina para la Diversidad y Derechos Civiles de MassDOT al (857) 368-8580 o el (617) 368-7306 (TTY) o a través de nuestro sitio web en http://www.massdot.state.ma.us.

Si cree que usted o cualquier otro individuo perteneciente a una clase específica de personas ha sufrido discriminación prohibida por el Título VI y otras leyes antidiscriminatorias basada en raza, color, origen nacional, sexo, edad, incapacidad o género, usted o su representante puede presentar una queja a MassDOT, la cual podemos ayudarle a llenar. Se debe presentar la queja a más tardar 180 días después de la fecha de la discriminación alegada. Si necesita más información, por favor contacte a la Oficina para la Diversidad y Derechos Civiles de MassDOT al (857) 368-8580 o (857)-266-0603 (TTY) o a través de nuestro sitio web en http://www.massdot.state.ma.us.

如果需要使用其它语言了解信息，请联系马萨诸塞州交通部（MassDOT）《民权法》第六章专职人员，电话（857）368-8580

如果需要使用其它語言了解信息，請聯系馬薩諸塞州交通部（MassDOT）《民權法》第六章專職人員，電話（857）368-8580

Caso esta informação seja necessária em outro idioma, favor contar o Especialista em Título VI do MassDOT pelo fone (857) 368-8580.

Si necesita información en otro lenguaje, favor contactar al especialista de MassDOT del Título VI al (857) 368-8580.

TABLE OF CONTENTS

1.0 OVERVIEW 1

Why Invest in Transportation 2

Transportation Reform 3

Provide Services in the Face of New Demands 3

How This Plan and Prioritization Will Be Used Going Forward 4

2.0 TRANSPORTATION TODAY 5

Listening to Our Customers 5

Serving Our Customers 7

3.0 TRANSPORTATION TOMORROW 15

Using Policy Priorities to Shape the Transportation System 15

Scenario Planning and Performance Measurement 17

Analytical Methodology Applied to Current Funding Levels 19

Scenarios 20

Performance Outcomes 20

4.0 CONCLUSIONS 31

A. METHODOLOGY 33

Roadways 33

Transit 36

Letter from Secretary of Transportation Richard A. Davey

weMove Massachusetts: Planning for Performance (WMM) represents a significant change in practice at the Massachusetts Department of Transportation (MassDOT). For the first time, MassDOT has developed a single, multimodal Long-Range Transportation Plan (LRTP) as a unified statewide agency. In the past, each division – such as the MBTA and Highway Division – developed its own plans and there was little or no assessment of needs and priorities across modes of travel. WMM sets MassDOT firmly on the path to multimodal capital planning and the use of scenario planning for the first time. Incorporating performance management into investment decision-making realizes one of the primary goals and requirements of the 2009 Transportation Reform legislation. It also gives MassDOT a head start in meeting the performance measurement requirements of the 2012 Federal transportation authorization legislation, *MAP-21: Moving Ahead for Progress in the 21st Century Act.*

The WMM Planning for Performance scenario tool was built and used to calculate the differences in performance outcomes resulting from different funding levels available to MassDOT. In developing the WMM tool, we also are working to incorporate more directly our important policy initiatives, such as mode shift and sustainability into the capital planning process. In the future, MassDOT will use the tool to update and refine investment priorities. The performance tool also allows our customers and stakeholders to understand the impacts of investment or disinvestment in our transportation system.

WMM is built on extensive customer outreach that MassDOT started in the *you*Move Massachusetts (YMM) project. MassDOT conducted wider outreach to Environmental Justice and Title VI communities through the WMM process and this outreach complemented the conversations MassDOT was conducting concurrently as part of the Administration's transportation revenue proposals. All of this outreach confirmed the essential connection between transportation and growth.

We welcome input from the customers of our transportation services and all of the citizens of Massachusetts. We hope you will participate in further development and refinement of the priorities identified in WMM.

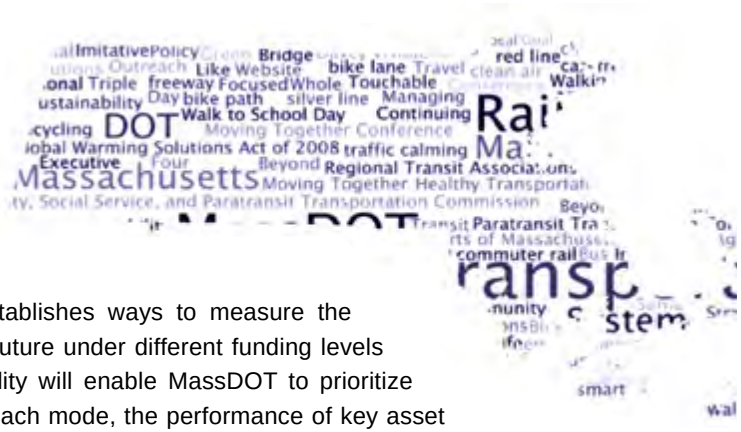
Sincerely,

Richard A. Davey
Secretary and Chief Executive Officer
Massachusetts Department of Transportation

1.0 OVERVIEW

The Massachusetts Department of Transportation (MassDOT) provides services that transport or assist millions of customers each day. Our customers travel by auto, bus, rail, boat, bicycle, plane, and on foot. They are served on-line or in person at a Registry of Motor Vehicles office. Many use smartphone applications to plan travel on the T or purchase commuter rail tickets. They use real-time information from highway signs to plan their routes and estimate travel times. They ride a bus in Worcester to a college class and take the Silver Line to Logan Airport. They travel to home and work, to school, to medical appointments, and to meet personal needs.

*we*Move Massachusetts (WMM) incorporates the needs and wishes of MassDOT's customers into a long-term strategy for investments, policies, and programs. As part of a multiyear MassDOT-led process, WMM will improve how MassDOT does business, responds to customers, and provides transportation services to the Commonwealth.



WMM's Planning for Performance analytical tool establishes ways to measure the performance of transportation assets now and in the future under different funding levels based on the agency's policy priorities. This capability will enable MassDOT to prioritize transportation investments across all modes. Within each mode, the performance of key asset categories can be analyzed, including bridges, roadways, buses and trains, railroad tracks and signals, and bike paths. The WMM process and tool are innovative, flexible, and permit MassDOT and its customers to envision a variety of ways to distribute current and new revenues to transportation.

WMM analyzes system performance if historical state and Federal funding levels had continued into the future. It also evaluates the current funding situation that includes new revenues also projected into the future. WMM documents the significant improvements in system performance that could be achieved with additional revenue. WMM outlines potential future spending priorities for MassDOT, focusing on the years 2023 and 2040, WMM and the Planning for Performance tool can be used by MassDOT to forecast performance outcomes under any policy and funding scenario now and in the future.

This WMM report serves as the Long-Range Transportation Plan (LRTP) for the Commonwealth of Massachusetts. It meets a legal requirement to develop a Commonwealth transportation plan, outlined in the 2009 transportation reform legislation, and the Federal requirement for each state to develop, maintain, and update a Statewide Transportation Plan (SWTP). The new Federal transportation legislation, ***Moving Ahead for Progress in the 21st Century Act (MAP-21),*** *requires states to develop performance-based LRTPs. The requirements of MAP-21 are described more fully in Chapter 3.*

WMM is fiscally constrained, looking at system performance based on specific funding levels that might be available in the future. WMM represents the first fully multimodal LRTP for the Commonwealth.

The Massachusetts Statewide Airport Economic Impact Study, a recent analysis by the MassDOT Aeronautics Division, estimates that the 39 airports of the Commonwealth generate $11.9 billion in total annual economic activity and $4.9 billion in total annual payroll from the 124,369 jobs that can be traced to the aviation industry.

Why Invest in Transportation

MassDOT developed WMM to address the Commonwealth's existing and anticipated transportation challenges and opportunities. These challenges include specific MassDOT responsibilities, such as constructing, maintaining, and operating transportation assets, as well as important policy areas where transportation can play a crucial role, such as economic development and environmental sustainability.

Meeting these challenges requires more resources than are currently available to MassDOT, and because of past underinvestment, assets have deteriorated, making it increasingly difficult to meet the economic and personal travel needs of our customers and businesses. Key industries that drive our economy, such as health care, research, education, and tourism, depend on a well-functioning and reliable transportation system. Underinvestment can have real costs, affecting our ability to travel to our jobs, make shopping trips, seek medical care, take vacations, and maintain active social lives. Access to good transportation and a well-maintained infrastructure is important to Massachusetts' residents, business owners, and visitors.

While the long-term effects of underinvestment may remain hidden for some time, the inability to maintain facilities in good condition can impact millions of travelers on a daily basis by increasing travel time and decreasing reliability. Consider congestion as an example: jobs and population growth bring important economic activity and cause congestion when roads and highways are jammed and buses and trains are filled to capacity. A healthy economy means more trips of all kinds are being made. Fewer trips likely mean fewer jobs. While travel increased to support the economy in the years prior to the Great Recession, the Commonwealth's investments in roads and transit slowed in recent decades with the exception of the Central Artery/Tunnel project, which consumed much of the Commonwealth's transportation funding. The Patrick Administration began to reverse these years of disinvestment with the Accelerated Bridge Program, and with a major roadway repaving effort and other investments funded by the Federal American Recovery and Reinvestment Act (ARRA).

Local and national studies have shown that a well-funded transportation system produces tangible and meaningful economic benefits. According to the American Public Transportation Association, every dollar invested in transportation produces four dollars in economic return. For example, commuter rail service to the South Coast is projected to create 3,800 new jobs and generate nearly $500 million in new statewide economic activity every year. The American Road and Transportation Builders Association has estimated that more than 1.5 million full-time jobs in the Commonwealth in key industries like tourism, retail sales, agriculture, and manufacturing are in some way dependent on or benefit from the State's transportation network. These jobs and the economic benefits and quality of life that accrue from a strong economy will be jeopardized without responsible, forward-looking investment in our transportation system.

The Urban Land Institute recently noted in its 2012 report *Hub and Spoke: Core Transit Congestion and the Future of Transit and Development in Greater Boston,* that increasing ridership on the MBTA – without an accompanying increase in investment – leads to delays and congestion that inhibit productivity. All of this research points to inconveniences and lost opportunities for job growth. For example, at historical rates of investment the percentage of MBTA trains and buses in acceptable condition will decline from today's 58 percent to only 46 percent in 2023. Without the new funding recently enacted by the Legislature, MassDOT's customers would see even more dramatic deterioration of roads, bridges, and transit services, facing congestion, delays, and unreliable services on a regular basis.

Transportation Reform

WMM is the latest in a series of steps the Commonwealth has taken on the road to transportation reform. The creation of MassDOT on November 1, 2009 began a new era in transportation for the Commonwealth. For the first time in Massachusetts, one transportation agency is responsible for planning, investing in, maintaining, and operating the statewide transportation system.

Transportation reform combined a collection of independent agencies and authorities into one unified Department of Transportation and changed the way MassDOT does business. The agency continues to find new and efficient ways of providing and improving customer service across modes of travel. Other elements of the reform program include:

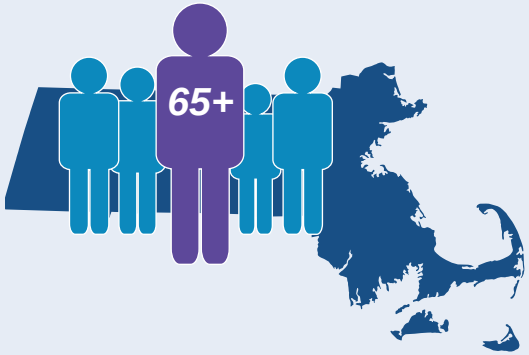
- Renewing our focus on customer service and better understanding their goals and wants;
- Making public and employee safety the top priority for all programs and services;
- Making decisions that balance the needs of all users and support stronger, healthier communities, as exemplified by MassDOT's Healthy Transportation Policy Directive issued in September 2013; and
- Establishing a culture of innovation and accountability – MassDOT's leadership is encouraging new ideas and approaches to problem solving and customer service.

MassDOT continues to reach out to its customers, most recently with a series of 17 listening sessions around the state. "Your Vision, Our Future" asked MassDOT's customers to help determine, now and in the future, how we should pay for the roads, bridges, transit infrastructure, bikeways, and more that residents of the Commonwealth want.

Provide Services in the Face of New Demands

As an agency, MassDOT is adapting its transportation planning, programs, and services to the needs of different populations and geographic and economic patterns. Through interviews within MassDOT, from other state agencies, and members of the public, MassDOT is developing an understanding of new challenges to provide services and adapt to new demands on the transportation system.

The rate of overall population growth in Massachusetts is slowing but our population is becoming more economically, socially, and ethnically diverse. Massachusetts is also getting older. People aged 65 and over now represent approximately one-fifth of Massachusetts' population,[1] primarily due to the aging of the Baby Boom generation. Meanwhile, younger people are looking for new ways to move about the Commonwealth other than by automobile. Changing land use patterns, including new population centers, are requiring transit providers to reassess their routes, service hours, and frequency of service. Since its creation, MassDOT has increasingly embraced its role as an important steward of natural resources, and this focus will be critical in helping minimize the impacts of climate change on the transportation system.



One-fifth of all Massachusetts residents is aged 65 or older.

[1] Gerontology Institute at the University of Massachusetts Boston, data released from the 2010 Census.

How This Plan and Prioritization Will Be Used Going Forward

MassDOT has limited resources for maintaining, operating, and improving the Commonwealth's transportation system. By developing a single plan for choosing transportation priorities, MassDOT can ensure that investment decisions are based on transportation goals and policies and a thorough analysis of needs and priorities in a transparent manner. MassDOT will be able to manage assets and allocate resources in the most efficient and cost-effective way across the entire transportation system, and customers and stakeholders will be able to review how these decisions are made.

At historical funding levels, our assets – such as roadways, bridges, trains and buses, and track and signal systems for rail services – would have continued to deteriorate at a dramatic rate. At the same time, customer needs and expectations are for increased services and facilities, adding to MassDOT's responsibilities. MassDOT must address these urgent needs in the transportation system to prevent further degradation of the functioning, safety, and long-term viability of the transportation infrastructure that supports our economy, our daily activities, and our quality of life.

Current funding, which includes the new revenues established by the Legislature, will help to meet these needs. The alternatives outlined in this report highlight the critical needs of the entire system. Regardless of what sources of funds or the level of those funds are going forward, WMM and the Planning for Performance tool will be a key part of MassDOT's toolbox for analyzing how to allocate dollars to achieve the best possible performance for the money available.

2.0 TRANSPORTATION TODAY

Listening to Our Customers

MassDOT is committed to meaningful community participation and leadership in our transportation planning across all modes. MassDOT listens to what our customers have to say and we want to provide the services communities need. As an agency, we rely on a variety of perspectives in our planning and decision making, including groups that have not been historically engaged in planning efforts. This chapter summarizes what we've learned from our customers and how MassDOT is responding.

youMove Massachusetts Outreach

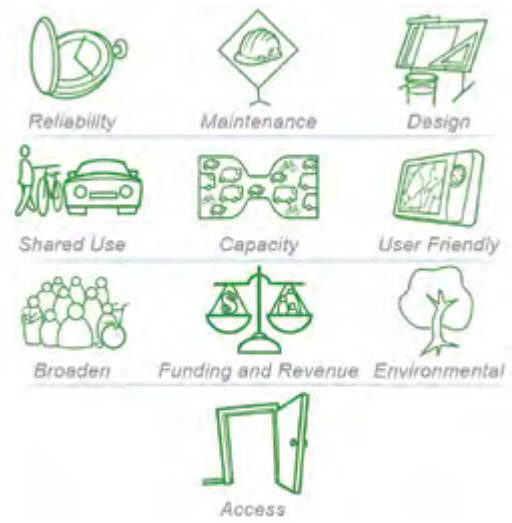
The *you*Move Massachusetts (YMM) strategic outreach initiative represented a coordinated effort to better understand the needs of our customers and has informed this and other planning efforts. Public comments were solicited through public workshops – held in Boston, Natick, Barnstable, Lawrence, North Adams, Taunton, Braintree, Worcester, Malden, and Chicopee – as well as a project web site and comment letters, e-mails, and telephone calls. The web site offered users an interactive map that allowed comments to be linked to specific locations, to trace routes or commutes, and to encompass whole regions. All told, we received more than 700 individual comments – termed "mobility gaps and challenges" – together articulating a universe from which we could recognize themes and begin to identify potential solutions. Using the 700 mobility gaps and challenges, we developed a list of 184 problem statements, which attempted to expand upon the gaps and challenges so that they have wider geographic and topical applicability. These conversations led to the publication of a list of 10 core themes – statements of fundamental importance that articulate the concerns, needs, and aspirations of Massachusetts' customers for their transportation network. MassDOT took these themes forward into the next step, developing ways to implement our customers' ideas and meet their needs.

weMove Massachusetts Outreach

As part of WMM, MassDOT continued to ask our customers to help set transportation investment priorities. The WMM outreach sought to learn more about the transportation experiences and needs of a focused set of stakeholders – Environmental Justice and Title VI populations. MassDOT developed an outreach approach to target potentially underserved populations, emphasizing:

> *"Transportation is a barrier to pulling people out of poverty," according to community leaders we interviewed during WMM. This reinforces the importance of transportation to economic development and quality of life in the Commonwealth.*
>
> *– WMM Interview, February 2012*

YMM Themes



Major On-Line Survey Findings (nearly 1,900 responses were received)

- *Update transit service to reflect demographic and employment changes.*
- *Expand the hours of regional transit service.*
- *Maintain and improve walking and bicycling infrastructure.*
- *Ensure that transportation funding is sufficient to avoid annual increases of user fees, which fall more heavily on low-income and transit-dependent populations.*
- *Better maintain existing roadway infrastructure without building new roads.*

- Residence in or representation in a Gateway community as designated by MassDOT; these are communities with large Environmental Justice populations, including low-income and minority residents; and
- Title VI stakeholder groups, including those with a low level of English proficiency; elderly or elder services groups; rural residents; low income, minority, community action, or economic development groups; disabled groups; Latino, African-American, or other minority groups; or a transit-focused group.

Based on the goal of reaching more members of Title VI population groups, MassDOT developed a multi-element outreach approach. This engagement included:

- Reaching out (by phone and/or e-mail communication) to more than 100 representatives of stakeholder groups in communities around the Commonwealth. The groups included councils on aging, neighborhood and family alliances, economic development agencies, community action councils, planning commissions, community health centers, homeless programs, and low-income and minority groups.
- Development of a questionnaire in five languages for wide circulation on-line and in print versions.
- Wide circulation of the questionnaire through community groups, participants in *you*Move Massachusetts meetings, Metropolitan Planning Organizations (MPO), and many other organizations.
- Invitations to the respondents and interview participants to a series of meetings around the Commonwealth to comment on MassDOT's sustainability program.

The interview participants outlined a wide range of transportation concerns, but the most powerful was a feeling of isolation prompted by the lack of access to public transportation among the Title VI groups. Throughout 19 interviews, the conversations repeatedly focused on the lack of sensible and reliable access to transportation in communities facing high poverty and unemployment rates, and limited education and English proficiency.

The 26-item questionnaire was prepared in five languages: English, Spanish, Portuguese, Haitian Creole, and Vietnamese (on-line only). MassDOT provided print copies of the questionnaire to community leaders for distribution, developed a contact database for reaching out to the Title VI population and residents of Gateway Communities, and sent an e-mail to all of the contacts announcing the availability of the questionnaire. MassDOT also distributed a press release promoting the questionnaire (in five languages) to all English and non-English media outlets in the Commonwealth. A reminder e-mail was sent to the project database at the same time as the release. The goal of this outreach was to gather information from groups whom MassDOT felt were not well represented in the YMM phase of outreach and who are hard to reach.[2] Nearly 1,900 responses were received.

Data from the interviews and questionnaire responses affirmed the themes developed in the YMM process while providing more specific recommendations for serving targeted stakeholders in Title VI and Environmental Justice communities. The most striking comment in the interview process – transportation is a barrier to pulling people out of poverty – was affirmed by many of the leaders and reinforces the importance of transportation to economic development, health, and quality of life in the Commonwealth.

In general, feedback from the outreach effort provided valuable themes and topics that MassDOT integrated into its priorities for responding to transportation challenges in the Commonwealth. Outreach results indicated the importance of an accessible and reliable transit system:

[2] *Stakeholder Summary Report: Report on Questionnaire and Interview Outreach for the MA Multimodal Project,* August 13, 2012.

- Transit service should reflect demographic and employment changes, and hours of regional transit service need expansion (outside of the MBTA's service area). Currently, night and weekend service is the exception and limits economic and social opportunities. Strengthening the dependability and reliability of regional transit service will ensure that customers can reach jobs, appointments, and schools; and remain mobile. This need translates to a scenario where RTAs around the State receive additional funding to expand services.
- Feedback also supported maintaining and improving the walking and bicycling infrastructure around the Commonwealth. These efforts include vigorous implementation of MassDOT's Complete Streets policy and improving lighting and crosswalk conditions.
- Customers also recommended that the existing transportation system be better maintained, including public transportation vehicles, stations, and existing roadways.

Other Outreach

WMM has been informed by three additional outreach initiatives:

- WMM conducted over 100 interviews with key MassDOT staff and planning partners and stakeholders, such as MPOs. The findings of these interviews helped to identify the strengths and weaknesses of current planning processes and ways they could be improved. The program prioritization focus of this plan is one such outcome.
- MassDOT hosted four open houses on its draft GreenDOT Implementation Plan and invited participants to comment on its proposals for sustainability, greening its services, and improving multimodal opportunities.
- MassDOT conducted *Your Vision, Our Future, a Transportation Conversation,* a series of public meetings in 17 locations from September to December 2012. The focus of the meetings was on what Massachusetts can afford – both now and in the future – and how we pay for the roads, bridges, transit services, bikeways, and sidewalks that residents of the Commonwealth want and need.

The 50 billion vehicle miles traveled annually by Massachusetts drivers on Highway Division roads would be enough to circle the earth 2 million times!

Serving Our Customers

The following discussion explains the functions and customers of each of MassDOT's four divisions, and how the divisions have been innovating to improve customer services.

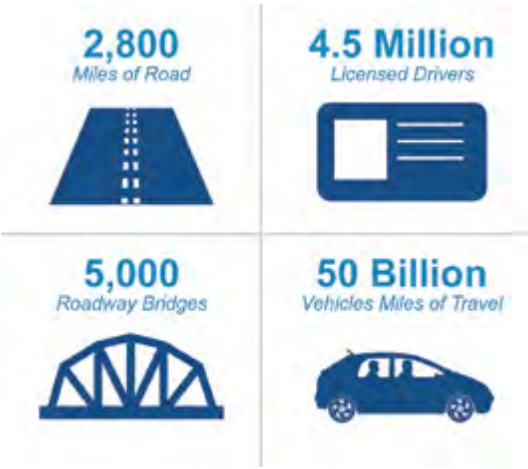
The Highway Division

Customers who travel by automobile, truck, or bus are likely to travel on one of the 2,800 miles of roads maintained by the Highway Division. More than 2.3 million licensed drivers, and their passengers, drove nearly 50 billion vehicle miles of travel (VMT) in 2010 on Highway Division roads, accounting for 85 percent of all VMT in Massachusetts.

This 2,800-mile network from the Berkshires to Boston to Cape Cod, known as the Federal-aid Highway System, is the main focus of WMM. MassDOT oversees this roadway system in close collaboration with local, regional, state, and Federal

MassDOT's Highway Division

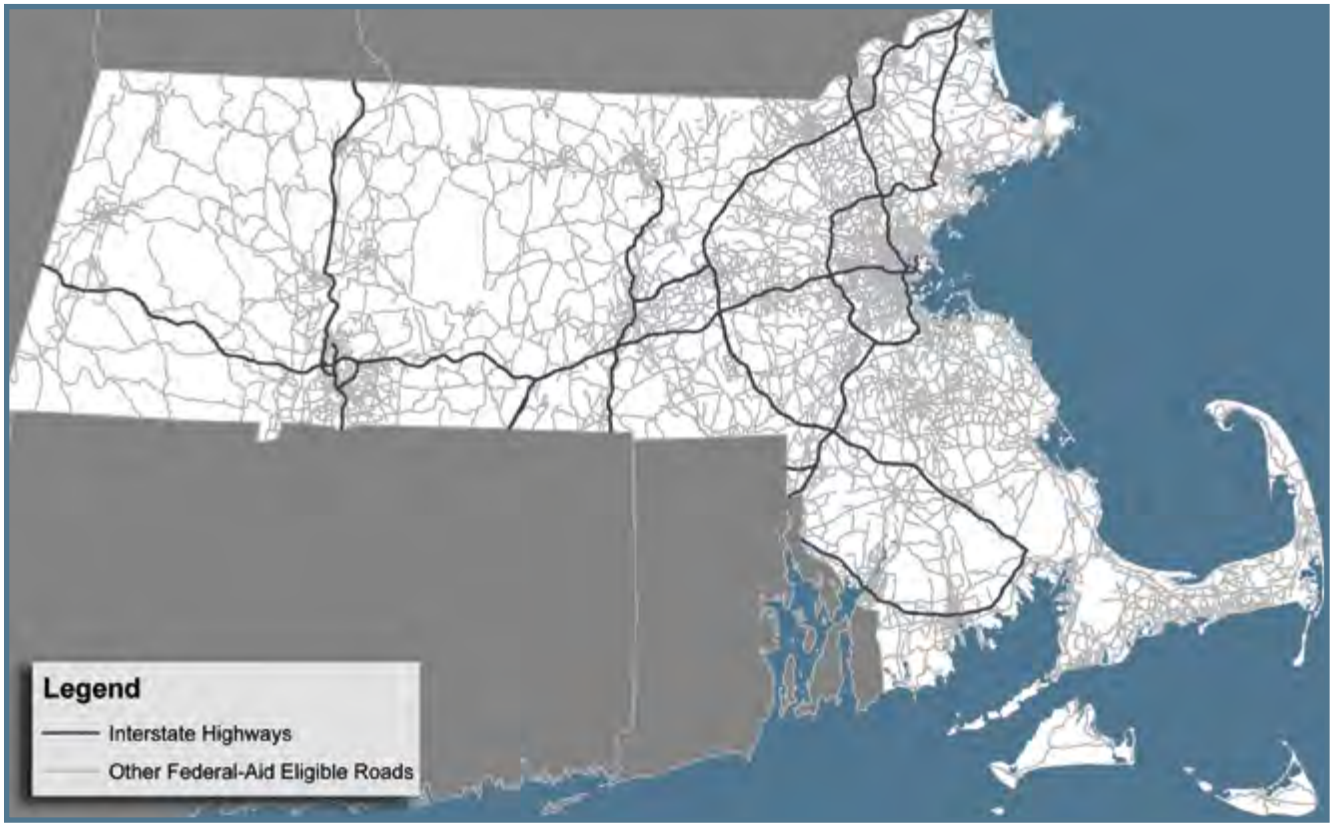
- *Keeps your roads clear of snow and ice and other debris.*
- *Monitors highways for accidents and other incidents at our Highway Operations Center to keep traffic moving and respond to public safety emergencies.*
- *Collects and analyzes traffic data and shares it with software developers and others to improve travel information for our customers, such as providing real-time travel information on some of our major highways like I-93.*
- *Conducts safety and other technology research.*
- *Has won awards for its project development process, environmental stewardship, and its Accelerated Bridge Program (see text box on next page).*
- *Provides technical assistance to communities looking to improve their roads in the project development process and delivers the Complete Streets program, which designs roadway improvements that integrate all modes of travel and fit into a community's landscape.*



partners. The Highway Division is responsible for the maintenance of 3,481 state-owned roadway bridges and for the inspection of another 1,570 bridges owned by other agencies. The Highway Division also is responsible for shared use and off-road bike paths.

The Highway Division also implements construction projects using Federal highway funds on almost 8,400 miles of roads owned by others, primarily cities and towns. In addition, the Highway Division disperses the Massachusetts Chapter 90 funds that provide capital assistance used by municipalities on the over 24,000 miles of roads owned by cities and towns.

Federal-Aid Highway System in Massachusetts



In 2007, the Transportation Finance Commission asserted that over the next 20 years the cost just to maintain the highway system would exceed anticipated funding by $10 billion, or by an annual average of $500 million. Since 2007, MassDOT has been able to keep this gap from widening, in part due to additional Federal funds from the ARRA, but primarily due to the Commonwealth's Accelerated Bridge Program (ABP). The ABP is a prime example of the Highway Division's willingness to implement projects differently than in the past – to better meet safety, customer service, and engineering goals.

The ABP represents a major investment in Massachusetts's bridges and has greatly reduced the number of structurally deficient bridges in the state system, while creating thousands of construction jobs on bridge projects. The ABP is a model for a targeted investment strategy that could be applied to all modes and transportation assets. To complete the ABP, MassDOT and our partner agency, the Department of Conservation and Recreation, used innovative and accelerated project development and construction techniques. As a result, projects have been completed on time, on budget, and with minimum disruption to people and to commerce. Since 2008, the number of structurally deficient bridges has dropped from 543 to 437, a decline of 19.5 percent. As of September 1, 2012, the ABP had completed 102 bridge projects, with another 67 projects currently in construction, and an additional 19 projects scheduled to start construction within the next year. Over the course of the eight-year program, more than 200 bridges are planned to be replaced or repaired. Lessons in cost-effective and efficient planning and project delivery from this program are being applied across the Highway Division.

The Highway Division is not just about roadways. It plans and implements improvements to support bicycling and walking projects across the Commonwealth through several important policies and programs:

- **Complete Streets Education.** Complete Streets is a design concept that emphasizes planning for all users of the road, including pedestrians, bicyclists, transit riders, motorists, and persons with disabilities. Complete Streets represents the comprehensive multimodal philosophy in MassDOT's Project Development and Design Guide that requires safe and appropriate accommodation for all roadway users. In 2012, MassDOT conducted over 80 Complete Streets workshops across the State for municipal officials, local leaders, decision-makers, and consultants in order to increase the understanding of Complete Streets at the local level. MassDOT is implementing the Complete Streets philosophy on its own projects. For example, restoration of the B.U. Bridge in Boston incorporated bike lanes into the project design. Restoration of Boston's historic Longfellow Bridge will include a new, fully accessible route connecting Charles Circle and Beacon Hill to the Esplanade parkland. In addition, the Whittier Bridge replacement project on I-95 will include the first shared use path on an interstate highway in Massachusetts. All of these efforts are the result of extensive collaboration with stakeholders and customers.

- **The Bay State Greenway (BSG).** One of MassDOT's commitments to bicycle transportation is implementation of the BSG. The BSG is a seven-corridor, 777-mile network of bicycle routes that comprise both off-road and on-road facilities. MassDOT has been working on implementing the BSG 100, a list of priority shared use paths that would add 100 miles to the network.

- **Hubway Bikeshare system.** MassDOT provided funding for the highly successful Hubway Bikeshare program, which was launched with a $3 million Federal Transit Administration livability grant awarded to the MBTA, along with nearly $2.5 million in Congestion Mitigation and Air Quality funds from MassDOT. MassDOT's partnership with Hubway demonstrates our commitment to providing customers with mode-shift options as part of a healthy transportation network.

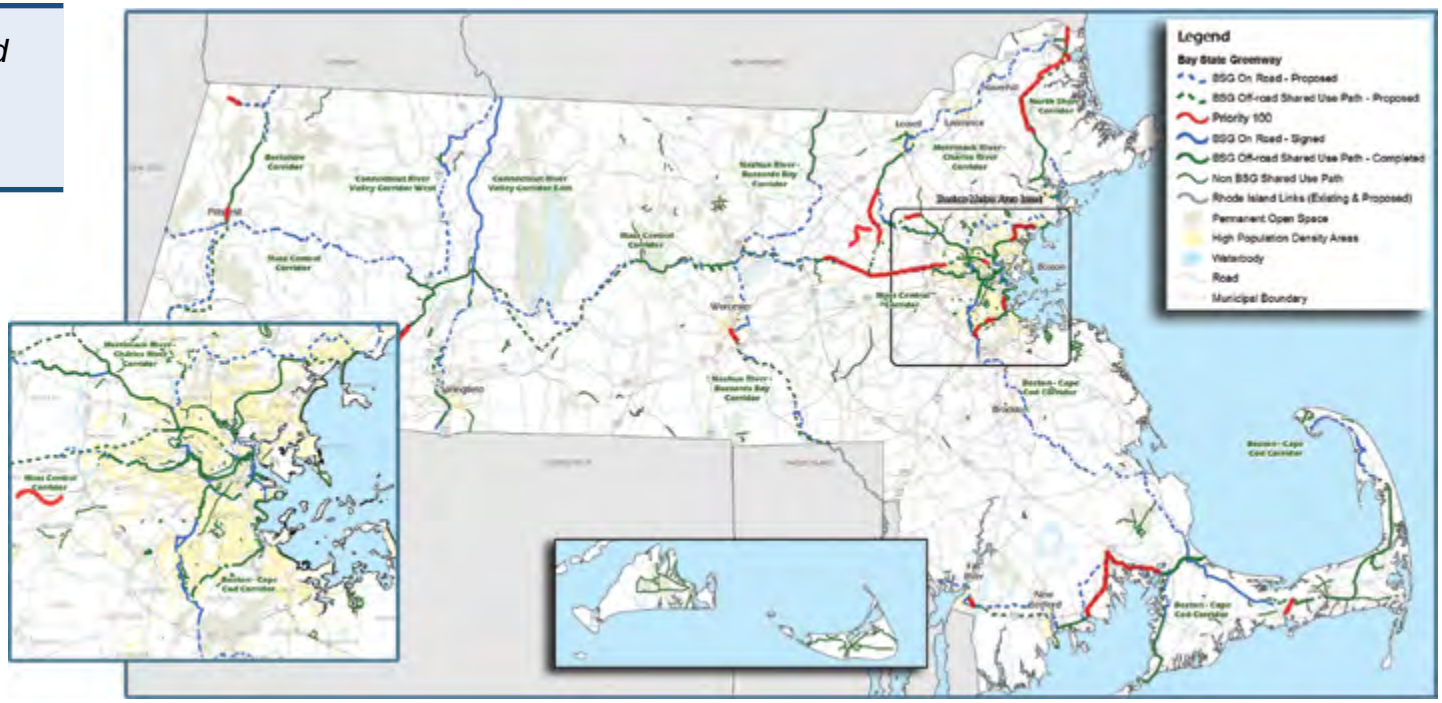
Award-Winning 93FAST14 Rapid Bridge Replacement Project

Over 10 summer weekends in 2011, using a state-of-the-art approach to construction, MassDOT replaced 14 highway bridges on I-93 north of Boston. Typically, this type of bridge replacement would take at least five years. This ABP project has won numerous national awards, recognized for its efficiency and innovation. Most recently, Environmental News Record (ENR) chose MassDOT's Fast 14 as the Best Project of 2012 from among 104 entries.

http://www.mass.gov/massdot/93fast14

Boston's daily bicycle riders would just about fill Fenway Park on the average commuting day.

Bay State Greenway



Improving MBTA Customer Service

Next-train arrival information is now available on many subway platforms and plans are underway to expand this service to more stations.

Rail and Transit Division

Public transportation services in Massachusetts are provided by several types of vehicles and services, including the MBTA's buses, trains, and ferries; Regional Transit Authority (RTA) buses; privately operated commuter buses; and paratransit services like The Ride for the elderly and disabled. This section describes how the MBTA and RTAs provide transit services and highlights ways in which needs are being addressed.

Massachusetts Bay Transportation Authority (MBTA)

Each weekday, more than 1.3 million customers in Greater Boston depend on the MBTA's subway, bus, commuter rail, and ferry services. As the fifth largest transit agency in the country, the MBTA operates a fleet of 2,500 buses and trains, 885 miles of track, almost 500 bridges, 20 miles of tunnel, and subsidizes four water transportation routes. Despite recent fare increases, ridership on the MBTA is at its highest point in recent years. Daily ridership in November 2012 increased by 1.3 percent compared with November 2011. Because of its vital role in supporting the regional economy and despite constrained financial resources, the MBTA continues to focus on improving the reliability of its services and customer information.

MBTA Commuter Rail/Rapid Transit Map

MBTA Time Scale Subway Map

Used with permission of Stonebrown Design.

RTAs Are Adapting to Customer Needs

The Southeastern Regional Transit Authority (SRTA), which includes the Greater Fall River and New Bedford regions, began to implement customer suggestions that arose from the Beyond Boston study, such as accepting the Charlie Card to make payment easier for its customers and initiating a pilot study to meet passengers' needs for Sunday travel.

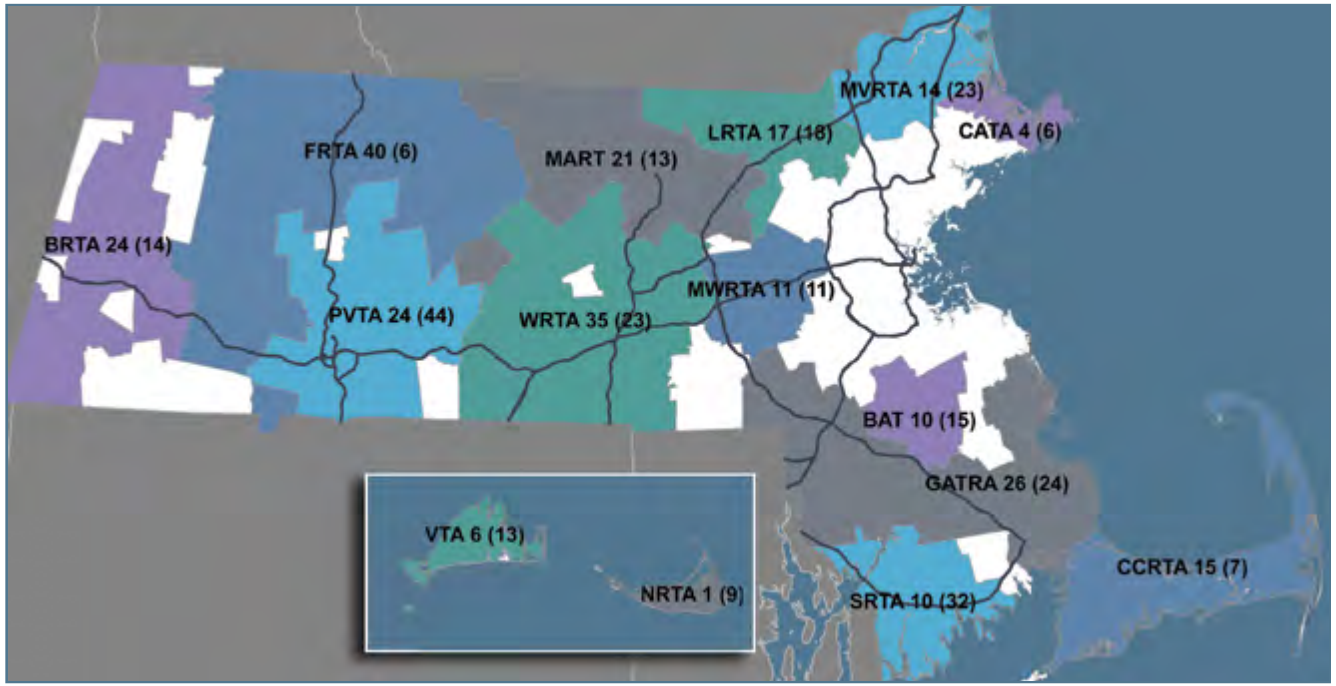
Regional Transit Authorities

The 15 RTAs provide critical transportation services outside of Greater Boston. They provide approximately 26 million passenger trips annually on 258 routes in 258 communities.[3] The RTAs serve MBTA and Amtrak stations, medical facilities, and make intermodal connections with airports, buses, and ferryboats. The RTA service districts are shown below.

Recent public outreach has shown that customers outside of Greater Boston want more hours of service to help them make better connections to employment and meet other economic and educational needs. These findings are supported by the surveys and interviews conducted as part of MassDOT's WMM outreach process.

In 2012, MassDOT's *Beyond Boston Transit Study*[4] inventoried the strengths and weaknesses of how MassDOT and the RTAs deliver public transportation services in Massachusetts and identified efficiencies and other opportunities that would support a more robust transit network to better meet the needs of the Commonwealth's residents, workers, and visitors. The study led to a series of recommendations and strategies for MassDOT and the RTAs to address major issues. These recommendations are being implemented through the RTA Council process, which is an established body for coordination between the RTAs and MassDOT. The Council has been the forum for advancing *Beyond Boston* recommendations, including the introduction of a new and rational distribution mechanism for state operating funds, agreement on a set of RTA performance measures, and a process for conducting comprehensive service analyses for all 15 RTAs.

RTA Service Areas



[3] Calculated from RTA Profiles in *Beyond Boston Transit Study,* MassDOT, 2012.

[4] http://www.massdot.state.ma.us/planning/Main/CurrentStudies/BeyondBostonTransitStudy/StudyDocuments.aspx.

The Aeronautics Division

The Aeronautics Division oversees 36 airports in the Commonwealth, as well as private-use landing areas, seaplane bases, and heliports. Twenty-five of the airports are publicly used, while 11 are privately used. In addition, Logan International Airport in Boston, Hanscom Field Airport in Bedford, and Worcester Regional Airport are operated by the Massachusetts Port Authority (Massport). The Secretary of MassDOT serves as Chairman of the Massport Board of Directors and ensures coordination between MassDOT and Massport. The Federal Aviation Administration (FAA) currently classifies eight of the 39 total airports as commercial service airports, meaning that scheduled flights are operated.

Massachusetts Airports

Overall, Massachusetts' public-use airports generate $11.9 billion in total annual economic activity, including $4.9 billion in total annual payroll for 124,369 jobs that can be traced to the aviation industry.[5] Airports in Massachusetts also provide health, welfare, and safety benefits. These services include medical transport and evacuation, flight training, law enforcement flights, wildlife management, military exercises, and search and rescue operations. Many airports also serve as regional community centers.

The Aeronautics Division's focus is to plan and implement programs to maintain the economic linkages to the airports throughout the Commonwealth. This plan includes expanding runways to meet minimum lengths (3,200 feet) required by the FAA to be eligible for new instrument approach technology. Twenty-one airports meet this runway length standard.

MassDOT's priority goal is that all airports eligible for Airport Transportation Improvement Funding meet Runway Safety Area standards. RSAs protect aircraft which land short or overshoot the runway. Currently, seven airports do not meet these standards. In most cases, wetlands, rivers, severe grade changes, or property lines affect the airport's ability to meet standards. The New Bedford and Pittsfield airports are actively pursuing RSA compliance.

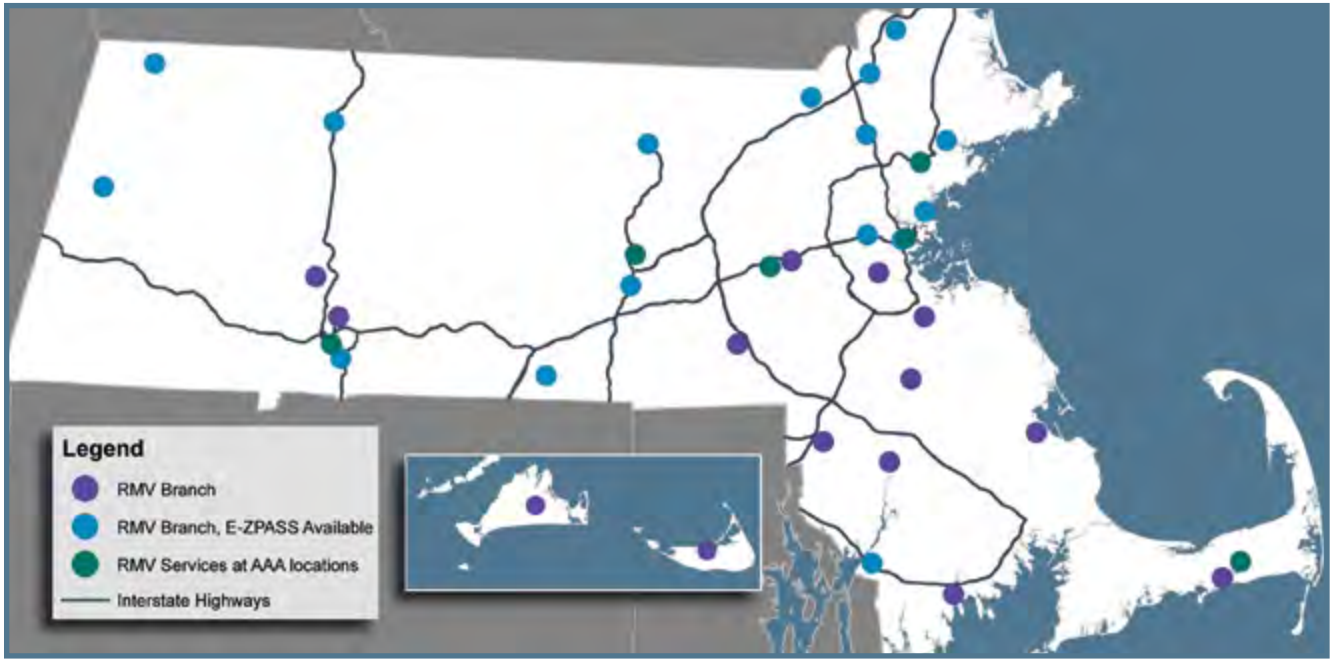
[5] Including Logan International Airport.

Registry of Motor Vehicles Division

Although 4.5 million licensed drivers spend a great deal of time on Highway Division roads, most only interact with MassDOT employees when they visit an office of the Registry of Motor Vehicles (RMV) Division. As such, the RMV Division is in many respects the face of MassDOT, effectively the customer service department. The RMV operates over 40 customer service offices across the state. The RMV has dramatically expanded access to on-line transactions through its web site. The RMV has primary responsibility for issuing and maintaining records related to motor vehicle and aircraft registration and motor vehicle operators' licenses. The RMV Division enforces the motor vehicle laws to promote highway safety, supports the Safe Driver Insurance Plan through the Merit Rating Board, and maintains crash records. The RMV Division also plays an important environmental role through its oversight of the vehicle inspection program, including emissions testing for air quality.

To improve its customer service, the RMV Division's focus is on modernization of the Automated License and Registration System, an ongoing project to better integrate data within the systems used for licensing, registrations, and crash reporting.

RMV Offices



3.0 TRANSPORTATION TOMORROW

During the Patrick Administration, MassDOT has focused on several key priorities: infrastructure maintenance; access to jobs and opportunities; quality of life; and sustainability. These high-level policy priorities have helped to shape decisions about how to best allocate the available transportation funding.

Using Policy Priorities to Shape the Transportation System

Infrastructure Maintenance and Preservation

Underinvestment in maintenance has clear long-term consequences – over time, without care and attention, assets will deteriorate to the point where they have diminished capacity or are no longer viable. Further, deferring maintenance ultimately leads to far higher costs. This is particularly true for new or reconstructed infrastructure for which early maintenance is relatively inexpensive compared to the cost for reconstruction or replacement. In addition, deteriorating assets can stifle economic activity as they reduce access, increase congestion, and threaten reliability. Potentially more damaging is the effect of lost confidence in our transportation network by our residents, businesses, and visitors as they make their own visual assessments of the reliability and safety of our infrastructure. Maintaining "state of good repair" as a system standard reinforces the perception that Massachusetts is an attractive place to live and to do business, and it demonstrates to taxpayers that their taxes are being well spent. The Federal government, through the Moving Ahead for Progress in the 21st Century Act (MAP-21) transportation reauthorization bill, also recognized the importance of maintenance and preservation of the existing system through the use of asset management tools.

Maintaining and preserving the highway and transit system has been a priority of MassDOT for over a decade. The MBTA began work on a State of Good Repair Study in 1999, which led to the creation of a State of Good Repair Database. The MBTA defines state of good repair as the standard whereby all capital assets are functioning at their ideal capacity within their design life. Starting in 2004, the MBTA began to issue rolling five year Capital Investment Programs on an annual basis. Projects to be included in the capital program were scored based on five factors: 1) Safety, Health, Environment; 2) State of Good Repair; 3) Operations Impact; 4) Cost/Benefit; and 5) Legal Commitments.

MassDOT's Mission

Deliver excellent customer service to people who travel in the Commonwealth, and provide our nation's safest and most reliable transportation system in a way that strengthens our economy and quality of life. We are one transportation organization focused on customer service and safety.

State of Good Repair

All agencies have their own definitions of state of good repair. In general, the term means that all capital assets are functioning at their ideal capacity within their design life. In other words, bridges, pavement, buses, trains, and tracks are replaced before the end of their design life and are able to function at full capacity, so there is not an excessive number of breakdowns in the case of buses and trains; or in the case of roadways, bridges, and tracks, there are no speed or operating restrictions.

Source: U.S. Department of Commerce, Bureau of Economic Analysis.

The Highway Division has also prioritized preservation projects over expansion ones. Key projects funded through the American Recovery and Reinvestment Act (ARRA) were to fix broken roads and bridges. Massachusetts received authority under ARRA to spend $437.9 million over two years on road and bridge projects. Another key aspect of this maintenance and preservation program is the state-financed Accelerated Bridge Program (ABP). This $3 billion program has greatly reduced the number of structurally deficient bridges in the state system.

Access to Jobs and Opportunities

When people are unable to use Massachusetts' transportation system efficiently, they cannot fully benefit from past investments. In many cases, this lack of service results in diminished educational and employment opportunities and other losses due to reduced mobility. The costs of isolation can be acute for seniors, persons with disabilities, teenagers, low-income residents, and those living in rural areas. For residents with access to an automobile, the decision to use public transportation can be difficult if services do not run late enough or if routes do not adequately serve all desired destinations.

The Patrick Administration has identified high-priority projects for both roads and transit. These project involve the expansion of service to new markets, such as the MBTA's South Coast Rail project, to connect historically underserved neighborhoods with new employment opportunities, as in the Silver Line Gateway extension to Chelsea; increases in system capacity to reduce congestion, such as the South Station Expansion project; and bottleneck removal, such as improvements to the Allston/Brighton interchange on the Mass Pike.

Sustainability

GreenDOT is MassDOT's comprehensive initiative that will make the agency a national leader in "greening" the state transportation system by reducing greenhouse gas (GHG) emissions; promoting the healthy transportation options of walking, bicycling, and public transit; and supporting smart growth development. It is a commitment to act as responsible stewards and careful consumers of natural resources.

MassDOT is implementing the GreenDOT and accompanying mode shift and healthy transportation goals in many ways. The scenario development process described in this section tracks whether investments in transit, bike, and pedestrian improvements will help to achieve GreenDOT goals, which include:

- Design a multimodal transportation system, including increases in bicycle facilities and improved transit performance;
- Develop healthy transportation options and livable communities; and
- Triple the mode share of walk, bike, and transit.

To facilitate the GreenDOT goals, Secretary Davey issued the Healthy Transportation Policy Directive in September 2013. This directive requires all state transportation projects to increase bicycling, transit, and walking options, thereby promoting multimodal access for all transportation customers. To implement this Policy Directive, MassDOT Divisions will review all projects currently in design to ensure they are consistent with Directive goals. Other elements of the Directive include:

- All MassDOT facilities will consider adjacent land uses and be designed to include wider sidewalks, landscaping, crossing opportunities, and other features to enhance healthy transportation options.
- Reviews will be conducted of cluster sites where incidents have occurred with healthy transportation users.
- MassDOT will develop a guide to assist communities proposing Shared Use Paths on or along rail beds to accelerate the path design process.

In addition to incorporating policy priorities and feedback from customers, the essence of WMM is implementing performance-based planning and decision-making within MassDOT. In support of this goal, WMM includes an analytical tool called ***Planning for Performance*** for prioritizing transportation investments. The next section explains how the tool works and how it has been applied to different funding scenarios and investment priorities. Further detail is provided in Appendix A.

Scenario Planning and Performance Measurement

The Commonwealth's 2009 transportation reform legislation required MassDOT to develop a performance-based planning process which is reflected in the WMM and other initiatives, such as the creation of an Office of Performance Management and Innovation described below. As noted earlier, the Federal transportation legislation, MAP-21, was enacted in July 2012. MAP-21 contains specific performance-measurement requirements for state DOTs. In particular, MAP-21 requires that long-range transportation plans (LRTPs) like WMM incorporate performance measures and targets. MassDOT is ahead of many other states in looking at performance in a truly multimodal fashion.

Introduction to Prioritization and Performance Measurement

The process of prioritizing investment decisions can take place at several different stages in the planning process, as shown in the funnel diagram. At the top of the funnel, individual projects come into the prioritization process and are prioritized using the policies and strategic priorities developed by MassDOT in consultation with customers and stakeholders. For example, projects that advance MassDOT's GreenDOT and mode shift goals would receive higher priority than projects that do not.

The middle step of programmatic tradeoffs is typically the least well formulated step in the process. Historically, most states, including Massachusetts, have allocated resources across programs by mode and funding categories based on historic patterns and arcane funding rules and regulations. For example, a state receives a certain amount of bridge maintenance money via the Federal Highway Administration (FHWA), which it must match with state and/or local dollars. These amounts of money come to define the bridge program year after year. The fact that other Commonwealth transportation agencies also own bridges, such as the MBTA and the Department of Conservation and Recreation, would not factor into the definition of the official Highway Bridge program. This rigid approach to programmatic prioritization made a certain amount of sense when funding categories were equally rigid at both the Federal and state levels, and responsibility for different types of assets was defused across numerous agencies. Neither of these conditions is true any longer. MAP-21 has significantly increased funding flexibility at the Federal level. The consolidation of all transportation services and assets under one agency – MassDOT – makes it easier to flex money across programmatic and modal categories in order to make the most of limited state and Federal resources.

WMM, therefore, focuses on the programmatic tradeoff level to enable MassDOT to most cost-effectively target funding across programs and modes. MassDOT will select and implement priorities in close coordination with its key planning partners, such as FHWA, Federal Transit Administration (FTA), and Federal Aviation Administration (FAA); MPOs; RTAs; and Massport.

Programmatic prioritization is not a new process. MassDOT has long-established processes for prioritizing some roadway assets, such as bridge repair and replacement or repaving roadways. However, these processes often exist in isolation from other agency priorities. Meanwhile, less rigorous processes typically exist for prioritizing other types of investments, such as roadway capacity improvements or bottleneck removal; or for train and bus purchases, track and signal infrastructure, and accessibility of rail stations and vehicles. WMM does not attempt to prioritize which bridges should be the next to be repaired or replaced, which roads should be the next to be repaved, or which type of MBTA or RTA buses to buy, but it does enable MassDOT (and its regional planning partners) to prioritize how much money should be spent on bridges and pavement versus other system priorities, such as purchasing new buses and trains or expanding capacity over a long-range, capital planning view.

MAP-21 Requirements for Performance Measurement

The enactment of MAP-21 ended several years of uncertainty in national transportation policy. With the passage of MAP-21, states can again count on a predictable level of Federal funding for the immediate future, and these funding levels are assumed as the base case in the analysis contained in WMM. MAP-21 also contains performance measurement requirements that will transform the Federal-aid Highway and Transit programs by refocusing on national transportation goals, increasing accountability and transparency, and improving project decision-making through performance-based planning and programming.

States must now develop LRTPs that incorporate performance measures and targets. By incorporating performance measurement and targets into WMM (MassDOT's LRTP), MassDOT will meet the new requirements of MAP-21 and ensure the continued flow of Federal transportation dollars. Most importantly, MassDOT is fundamentally changing the way it does business by quantifying the relationship between transportation investment and performance. MassDOT's approach is further addressed in stand-alone statewide documents, including the Highway Safety Plan, Freight Plan, Bicycle Plan, Rail Plan, Intelligent Transportation System (ITS) Plan, State Transportation Improvement Programs (STIP), the MBTA's Capital Investment Plan, and the State Implementation Plan for Air Quality.

National and State Trends in Performance Measurement

At its core, performance-based planning helps an organization make the hard choices necessary to ensure that it will achieve its goals efficiently. Successful implementation of performance-based planning requires that an agency successfully conduct three primary activities:

- Establish clear goals;
- Specify performance metrics that measure progress toward the attainment of these goals; and
- Set quantitative targets for each metric.

MassDOT has created an Office of Performance Management and Innovation to expand performance management and innovative strategies across all of MassDOT's divisions and departments. Monthly Performance Management Accountability meetings are used to review data on critical performance indicators. The data will allow MassDOT managers to evaluate progress against specific goals and targets, and to improve overall performance. It will provide a greater ability to monitor performance, manage operations, and adopt best practices. WMM builds on the work of the Office of Performance Management and Innovation by developing the Planning for Performance tool which can be used to forecast future performance levels under different funding scenarios.

The sidebar highlights five states which are also leaders in the development of performance-based planning systems. MassDOT is doing most of these activities in WMM, and doing so in a fully multimodal way.

Analytical Methodology Applied to Current Funding Levels

The Planning for Performance Tool was used to forecast performance and condition of the various transportation assets under different funding scenarios. This document highlights the forecasts for years 2023 (the target year for the Administration's *The Way Forward* investment plan) and 2040 (MassDOT's long-term planning horizon year). The funding scenarios presented are based on the pre-2013 finance bill funding levels and the current funding levels afforded by the 2013 revenue bill.

The approach taken to forecast performance for roadways is consistent with established procedures at the national level. MassDOT applied national performance management tools to MassDOT-supplied, nationally consistent datasets in the areas of bridge, pavement, and mobility performance. MassDOT uses the same datasets to analyze system performance that FHWA uses nationally to develop its biennial Condition and Performance Reports to Congress. These reports provide Congress with the rationale for requested Federal-aid Highway System funding levels, and these datasets and tools have therefore been put through rigorous quality review. MassDOT is relying on these national datasets and tools (including the tool's default values for project costs, asset deterioration rate, and asset improvement thresholds) with some adjustments to meet the needs of WMM.

There is not a comparably tested and applied set of national performance measures and forecasting tools for the transit mode, although such tools will be developed as part of the implementation of MAP-21. MassDOT developed its own performance measurement approach using MBTA and RTA data, and MBTA and FTA standards for useful life of individual asset classes. The MBTA's datasets were derived from a variety of sources, such as fleet information from the MBTA's 2013 to 2017 Capital Investment Program (CIP), bridge condition data from the MBTA's inspection and rating list, and the MBTA Scorecard for subway minutes of delay. MassDOT benefited from the MBTA being a recognized industry leader in scoring system performance. For the RTAs, MassDOT used fleet information from the National Transit Database. To the extent possible, MassDOT's analytical approach was consistent across the modes.

Minnesota's Strategic Plan led to policies and performance measures that are defined in the Statewide Transportation Plan. Detailed objectives were formulated through the identification of system deficiencies and improvements in supporting local, interregional, and modal plans.

Florida has five long-range goals that provide the policy direction and desired outcomes for Florida's transportation system over 20 years. The goals are supported by 29 specific long-range objectives.

Maryland defines goals related to six key performance areas: highway safety, mobility, system preservation, environmental stewardship, organizational effectiveness, and customer service and satisfaction.

Texas has criteria for project selection and budgeting which address the goals of reducing congestion, enhancing safety, expanding economic opportunity, improving air quality, and increasing the value of transportation assets.

California has five goals (safety, mobility, delivery, stewardship, and service) and 26 objectives.

Scenarios

MassDOT analyzed performance against two potential funding scenarios – *Historical Funding* and *Current Funding:*

"Historical Funding." *Assumes state and Federal funding levels and allocation priorities and rules projected into the future, prior to the Legislature's passing of the transportation funding bill in July 2013.*

The Commonwealth was projected to spend approximately $786.4 million annually in Federal and state matching funds and toll revenue on the Federal Aid Highway system[6] (including bicycle and pedestrian projects). This base funding level, plus the remaining ABP money ($400 million in state bond proceeds on bridge repair) prorated out through the planning horizon year for WMM of 2040, constitutes the Historical Funding scenario for roadways. The Commonwealth spends another $200 million annually on Chapter 90 assistance to cities and towns. Most of this funding goes to roads not on the Federal-aid System, and so both Chapter 90 funding and the local roadways that the program supports are excluded from this analysis.

The MBTA's current CIP includes $491 million in available funding, including some carryover Federal funds from earlier years. However, the MBTA only has $406 million in annual Federal and state matching funds available going forward. The $406 million available to the MBTA, once the current carryover Federal funds are spent, was used to establish the MBTA funding baseline in the Historical Funding scenario. The RTA annual capital budget from state and Federal sources is $17 million.

"Current Funding." *Reflects the new transportation funding recently enacted by the Massachusetts state legislature, with dollars allocated among asset categories to reflect the Administration's policy priorities.*

This scenario adds about $900 million annually in additional capital funding to the Commonwealth's prior funding levels for transportation for a total of almost $2.5 billion. The majority of new funding goes to transit, both MBTA and RTAs, to bring existing services closer to a state of good repair, and in particular to replace the aging bus and train fleets. Funding is provided to maintain our roadways and bridges close to a state of good repair.[7]

Performance Outcomes

This section provides a brief description of each of the asset categories whose performance is measured by the Planning for Performance tool – how performance is measured and the impact that varying funding support for this asset can have on the customer. Certain categories of funding are not analyzed, such as General Facilities like power plants. Aeronautics and Registry of Motor Vehicle (RMV) facilities were not analyzed. Appropriate performance metrics still need to be developed for these assets. The Planning for Performance tool is intended to be dynamic, with additional performance measures to be developed over time; in particular more work must be done to incorporate the capital needs of the Aeronautics Division and the RMV which primarily relies on operating funds.

[6] The universe of roadways considered in this analysis is the Federal-aid Highway System, which constitutes 37 percent of all roads in the Commonwealth, but 85 percent of all vehicle miles traveled (VMT). The WMM analysis includes roads that are owned by MassDOT and by other entities such as cities and towns.

[7] An additional $100 million is provided annually for Chapter 90 roadways not included in this analysis.

Another important area for improving the tool will focus on better tying our policy goals related to achieving mode shift; reducing GHG emissions; and tackling the Commonwealth's congestion to the outputs of the model. Over the next year, MassDOT will work to develop and further refine quantifiable metrics for these goals that can then be estimated under different funding scenarios. With this change to our capital planning process, MassDOT will be able to determine what the best funding scenario is to advance these goals. For the first time, MassDOT will be able to employ performance-based budgeting to our transportation system.

For this plan, the tables on pages 26-27 show the performance outcomes for each funding scenario for the two forecast years – 2023 and 2040.

Funding levels in the current five-year MassDOT and MBTA CIPs are assumed to continue over time and are thus extended out through the above milestone years. The accompanying graphic arrows show the percentage difference in performance between the Current Funding scenario and the Historic Funding scenario.

Pavement condition is measured by the Present Serviceability Rating (PSR), which ranks pavement on a five point scale from very poor to excellent, with recently resurfaced roads generally having the highest ratings. MassDOT considers PSR of 2.0 or above as meeting a state of good repair. Currently, as a result of the major reinvestment which took place with the one-time infusion of funding from ARRA, roadway pavement is in good shape, with 88 percent in a state of good repair.[8] As shown in the subsequent tables, pavement conditions will slowly degrade in the post-ARRA era under either funding scenario, but under Current Funding performance will be 4 percent better in 2023 than under Historical Funding, and 100 percent better in 2040.

2023	2040
4%	100%

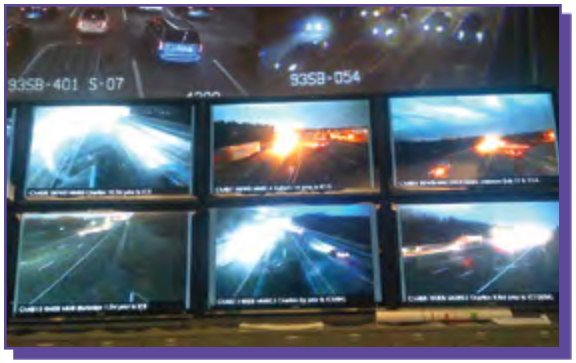
Customer Impact: Route 213 in Methuen is an example of a facility with PSR below MassDOT's state of good repair threshold that does not yet have funding dedicated for a resurfacing. This results in less comfortable driving conditions for users of Route 213, and an elevated risk of crashes and property damage.

Bridge condition is measured by the Health Index (HI). HI is the ratio of the current condition of each element to its perfect condition (expressed as a score from 0 to 100). Currently, as a result of the major reinvestment which took place under the Accelerated Bridge Program (ABP), Highway Division bridges have a high average HI of 89 percent. Under Historical Funding levels, these hard-won gains would be lost gradually, with the HI declining to 72 percent in 2023 and 61 percent in 2040. Under the Current Funding scenario, bridges will have a good HI index of 76 percent in 2023, declining to 69 percent in 2040. This represents a 6 percent improvement under Current Funding versus Historical Funding in 2023, and 13 percent in 2040. Lower HI scores in future years, while a clear indication that bridge conditions will worsen, do not mean that bridge safety is compromised. Lower scores do indicate a greater likelihood of weight and speed restrictions being posted on bridges.

2023	2040
6%	13%

Customer Impact: The structurally deficient bridge carrying Routes 202 and 10 over the Little River in Westfield is posted with very low weight restrictions, particularly for two and three axle trucks. This results in heavier loads traveling along city streets for an additional four miles round trip to the next suitable crossing of the Little River.

[8] Only Federal Aid roadways are included in this analysis, most of which are owned and operated by MassDOT but some of which are owned by municipalities or other agencies. These roadways tend to be major facilities which carry high volumes of traffic.



Mobility is measured by the number of hours of delay experienced by the average driver for every 1,000 VMT. Currently, the average driver experiences 4.8 hours of delay/1,000 VMT. Under Historical Funding,[9] delay would increase to 6.3 hours in 2023 and 8.9 hours in 2040, an increase which most drivers would find unacceptable. Under Current Funding, delay will increase to 5.4 hours in 2023, and will increase to 6.9 hours by 2040. This represents a 14 percent improvement under Current Funding versus Historical Funding in 2023, and a 22 percent improvement in 2040.

14% 2023 | 22% 2040

Customer Impact: The intersection of Route 27 and Route 30 in Wayland operates at a level of service F for peak periods, during which time motorists can experience a daily delay of 7 minutes or more in getting through the intersection.

Safety is measured by the number of accidents which occur at intersections and interchanges.[10] Performance is measured by the number of intersections which can be improved for a specific level of funding. Safety improvement has been a priority of MassDOT's for the past decade. Therefore, under the historical funding scenario, 528 intersections can be improved by 2023, and 1,426 by 2040. Under the current funding scenario, 1,304 intersections can be improved by 2023, and 3,521 by 2040. This represents a 147 percent improvement under Current Funding versus Historical Funding in 2023 and 2040.

147% 2023 | 147% 2040

Customer Impact: In recent years, motorists traveling through the junction of Route 28 and 139 in downtown Randolph have contended with design issues that have translated into crashes resulting in an average of five personal injuries and 17 incidents of property damage per year.

Bicycle performance is measured by the percentage (by mileage) of the Bay State Greenway (BSG) which can be completed under different funding scenarios. Currently, 31 percent of the entire BSG is completed. Under both funding scenarios, the BSG would be substantially completed by 2023 and fully completed by 2040.

0% 2023 | 0% 2040

Customer Impact: The un-built and currently unfunded sections of the BSG's Columbia Greenway in Southampton and Westfield represent the missing link between the Amherst/Northampton trail network and the Farmington River Trail in Connecticut, which extends as far south as New Britain and will ultimately terminate in New Haven.

[9] Funding for mobility projects includes any projects that will increase roadway system capacity such as additional lanes, bottleneck removal, intersection improvements, etc.

[10] Using currently available tools, it is not easy to accurately project these numbers into the future based on given levels of investment, although research is on-going on this topic, and this methodology could be updated in the future. Current data on crash rates is very useful in targeting locations for improvement and investment.

MBTA Bridge condition is evaluated through regular MBTA bridge inspections generating a Condition Rating (on a scale of 0 to 100). Bridges with a rating of 56 or above are considered to be in a state of good repair. Currently, 65 percent of MBTA bridges are in a state of good repair. As with Highway Bridges, being below the threshold for state of good repair does not mean that a bridge's safety is compromised, but it can result in speed or weight restrictions. Since the MBTA was not included in the ABP, under both scenarios MBTA bridge condition will decline to 47 percent in a state of good repair in 2023 and 19 percent in 2040.

0% 2023 | 0% 2040

Customer Impact: The Merrimack River Bridge on the Haverhill Line has had speed restrictions for years that result in an increase of travel time of about one minute per trip. For a daily Haverhill commuter using this line, this translates into 4.5 hours of lost time annually.

MBTA Subway Elevators/Escalators were evaluated using a five point scoring system based on asset age and condition. The performance of this asset class was measured by the percentage in a state of good repair (defined as elevators/escalators with a condition rating of 2.8 or greater). Currently, 60 percent are in a state of good repair. Under both funding scenarios, 56 percent of facilities will be in a state of good repair in 2023 and 49 percent in 2040.

0% 2023 | 0% 2040

Customer Impact: Frequent problems with Porter Square elevators/escalators have created significant burdens to access MBTA service, particularly given that the station is the deepest underground in the system.

MBTA Station Accessibility. The MBTA has already made a major commitment to improve accessibility at all key rapid transit and commuter rail stations (such as Government Center) and when other stations are modernized. Currently, 72 percent of stations are accessible. Under both funding scenarios, 79 percent will be accessible in 2023 and 89 percent in 2040.

0% 2023 | 0% 2040

Customer Impact: The lack of accessibility at the Government Center station, a major system transfer point between the Green and Blue Lines, means that disabled customers must travel to other nearby stations such as Park Street to access the system.

MBTA Bus and Train performance is measured by the percentage of MBTA vehicles (bus, subway, and commuter rail) in a state of good repair. For the WMM process, rolling stock state of good repair was determined using the 5 point score system identified in the elevator/escalators description, with vehicles scoring 2.8 or greater considered in a state of good repair. Today, only 58 percent of all vehicles are in a state of good repair, a performance level which many customers find wanting in terms of reliability. Under Historical Funding levels, performance would decline to 46 percent in a state of good repair in 2023 and 42 percent in 2040. Under Current Funding, performance will improve to 61 percent in a state of good repair in 2023 and 70 percent in 2040.[11] This represents a 33 percent improvement under Current Funding versus Historical Funding in 2023, and 67 percent in 2040.

33% 2023 | 67% 2040

[11] Because the funding allocation by vehicle type is different for the various funding scenarios, and because of the MBTA's cycle of vehicle rehabilitation before replacement, this statistic can move up and down over a long period of time, rather than following the general downward trajectory of other metrics over time.

Customer Impact: The 2003 vintage compressed natural gas 60-foot articulated buses in use on the Washington Street Silver Line and on the Jamaica Plain Bus Route 39 experience frequent engine and transmission issues. These mechanical issues often result in lower capacity 40-foot vehicles being deployed on the 39 bus route with associated on-vehicle crowding, and in Silver Line Waterfront dual mode articulated vehicles being shifted to Washington Street (which in turn reduces the capacity of that specialized fleet to serve growing demand in South Boston).

MBTA Track performance is measured by the daily hours of delay. Currently, the system experiences 16 hours of daily delay. Under Historical Funding, performance would worsen to 23.7 hours of delay in 2023, and an intolerable 57.7 hours of delay in 2040. Under Current Funding, hours of delay will increase to 21 hours in 2023 and 35.2 hours in 2040. This represents an 11 percent improvement under Current Funding versus Historical Funding in 2023, and 40 percent in 2040.

11% 2023 | 40% 2040

Customer Impact: A 500 foot stretch of the westbound Green Line between Newton Highlands and Eliot stations has resulted in a 10 m.p.h. zone in what is typically a 40 m.p.h. zone. This results in delays of 45 seconds per trip, or an added three hours of commuting time for a daily rider over the course of a year.

MBTA Signal performance is measured by the number of annual signal failures. Currently, the MBTA experiences an average of 1,900 annual signal failures. Under Historical Funding, this would have increased to 2,485 in 2023 and to 3,880 (double today's number) in 2040. Under Current Funding, there will be a small increase to 2,025 failures in 2023 and 2,207 failures in 2040. This represents a 19 percent improvement under Current Funding versus Historical Funding in 2023, and 43 percent in 2040.

19% 2023 | 43% 2040

Customer Impact: Red Line customers using Alewife Station contend with slow trips leaving/entering the station, as signal issues at the track crossover have required the implementation of a 10 m.p.h. speed restriction.

RTA Bus performance is measured by the percentage of vehicles in a state of good repair (which is defined similarly for RTA vehicles as for MBTA rolling stock). Today, 62 percent of RTA buses are in a state of good repair. Under Historical Funding, there would be no change in 2023 and performance would decline to only 50 percent in a state of good repair in 2040. Under Current Funding, there will be significant improvement with 81 percent in a state of good repair in 2023 and in 2040. This represents a 31 percent improvement under Current Funding versus Historical Funding in 2023, and 62 percent in 2040. In addition, there will be some funding left over to increase fleet size and provide more service.

31% 2023 | 62% 2040

Customer Impact: The Southeastern Regional Transit Authority (SRTA) still operates more than a dozen RTS buses which are well beyond their useful life, requiring additional maintenance resources to keep them in service. Given the funding challenges faced by SRTA in adding new service (such as new evening service), it is clear that reducing RTS maintenance costs would help SRTA continue to provide and potentially add the new service its customers are requesting.

MBTA Additional Rapid Transit Access. As part of the Current Funding scenario, MassDOT is planning to move forward with several system expansion projects, including the Green Line Extension to Somerville and Medford, South Coast Rail to New Bedford and Fall River, the Silver Line Gateway to Chelsea, and South Station Expansion. It would not be possible to significantly advance these projects under Historical Funding levels. These projects will increase the number of households within one-half mile of a rapid transit station by 88,867 households compared to Historical Funding.

Customer Impact: Residents in Somerville will have access to rapid transit service compared to bus service on crowded city streets today, and residents in Fall River and New Bedford will have access to commuter rail service to Boston instead of having to drive or ride buses on congested Route 24.

MBTA Added Rapid Transit Carrying Capacity. Under the Current Funding Scenario, the replacement of parts of the Red, Orange, and Green Line fleets will involve the purchase of new train sets beyond a one-to-one replacement, and accompanying improvement to track and signal systems. These steps will enable the MBTA to carry 13,638 more passengers/hour on these lines, thereby easing chronic overcrowding during peak periods.

Customer Impact: Riders on the Red Line from Braintree and Quincy will experience more frequent and reliable train service which will reduce peak period overcrowding.

The spreadsheets underlying these figures are interactive and can be used to vary funding levels and allocations across spending categories and immediately see the impact on asset performance. The methodology is described in more detail in Appendix A, which shows the full set of underlying performance curves.

Funding Scenarios and Performance Outcomes (2023)

	2012		Historical Funding		Current Funding	
	Division Funding (Annual $ in Millions)	Today's Performance	Scenario Funding (Annual $ in Millions)	2023 Performance	Scenario Funding Annual $ (millions)	2023 Performance
Highway Division						
Pavement (% state of good repair)[a]	$137	88%	$267	71%	$544	79%
Bridges (average health index)[b]	$620	89%	$353	72%	$447	76%
Mobility (delay hours/1000 VMT)[c]	$147	4.8	$65	6.3	$386	5.4
Safety (intersections or segments improved)	$49	TBD[e]	$26	528	$65	1,304
Bicycle Facilities (% of Bay State Greenway completed)	$25	31%	$26	87%	$26	86%
Highway Subtotal	***$977***		***$738***		***$1,468***	
Rail and Transit Division						
MBTA Bridges (% state of good repair)	$41	65%	$34	47%	$34	47%
MBTA Subway Elevators/Escalators (% state of good repair)	$13	60%	$11	56%	$11	56%
MBTA Accessibility	$22	72%	$18	79%	$18	79%
MBTA Rolling Stock (% state of good repair)	$209	58%	$173	46%	$341	61%
MBTA Track (daily hours of delay)	$18	16.0	$15	23.7	$40	21.0
MBTA Signal (signal failures)	$22	1,900	$18	2,485	$43	2,025
MBTA Add Rapid Transit Access (households walking distance to station)[d]	$0	0	$0	0	$319	88,867
MBTA Add Carrying Capacity (peak hour passenger capacity)	$0	0	$0	0	$28	13,638
MBTA Subtotal	***$325***		***$269***		***$487***	
RTA Rolling Stock (% state of good repair)	$17	62%	$17	62%	$37	81%
RTA Subtotal	***$17***		***$17***		***$37***	
Rail and Transit Subtotal	***$342***		***$286***		***$524***	
Other MassDOT Functions						
Highway General Facilities	$71	TBD[e]	$76	TBD[e]	$288	TBD[e]
MBTA General Facilities (includes power, stations, commuter rail accessibility, etc.)	$166	TBD[e]	$137	TBD[e]	$177	TBD[e]
RTA Facilities and Systems	$5	TBD[e]	$5	TBD[e]	$5	TBD[e]
Other MassDOT Subtotal	***$242***		***$218***		***$470***	
MassDOT Total	**$1,561**		**$1,241**		**$2,462**	

[a] The Current Funding scenario includes an additional $243 million dollars in operating expenses recaptured from the capital program.

[b] Historical Funding includes $400 million annually in Accelerated Bridge Program (ABP). The Current Funding scenario includes $1,580 million in ABP through FY 17 prorated over the 27 years of the Plan through 2040.

[c] The Current Funding scenario includes an additional $287 million dollars in currently unused bond cap.

[d] Additional rapid transit access includes Green Line Extension, South Coast Rail, and Silver Line Gateway.

[e] Additional measures may be developed in the future.

Funding Scenarios and Performance Outcomes (2040)

	2012		Historical Funding		Current Funding	
	Division Funding (Annual $ in Millions)	Today's Performance	Scenario Funding (Annual $ in Millions)	2040 Performance	Scenario Funding Annual $ (millions)	2040 Performance
Highway Division						
Pavement (% state of good repair)[a]	$137	88%	$267	30%	$544	60%
Bridges (average health index)[b]	$620	89%	$353	61%	$447	69%
Mobility (delay hours/1000 VMT)[c]	$147	4.8	$65	8.9	$386	6.9
Safety (intersections or segments improved)	$49	TBD[e]	$26	1,426	$65	3,524
Bicycle Facilities (% of Bay State Greenway completed)	$25	31%	$26	100%	$26	100%
Highway Subtotal	***$977***		***$738***		***$1,468***	
Rail and Transit Division						
MBTA Bridges (% state of good repair)	$41	65%	$34	19%	$34	19%
MBTA Subway Elevators/Escalators (% state of good repair)	$13	60%	$11	49%	$11	49%
MBTA Accessibility	$22	72%	$18	89%	$18	89%
MBTA Rolling Stock (% state of good repair)	$209	58%	$173	42%	$341	70%
MBTA Track (daily hours of delay)	$18	16.0	$15	57.7	$40	35.2
MBTA Signal (signal failures)	$22	1,900	$18	3,880	$43	2,207
MBTA Add Rapid Transit Access (households walking distance to station)[d]	$0	0	$0	0	$319	88,867
MBTA Add Carrying Capacity (peak hour passenger capacity)	$0	0	$0	0	$28	13,638
MBTA Subtotal	***$325***		***$269***		***$487***	
RTA Rolling Stock (% state of good repair)	$17	62%	$17	50%	$37	81%
RTA Subtotal	***$17***		***$17***		***$37***	
Rail and Transit Subtotal	***$342***		***$286***		***$524***	
Other MassDOT Functions						
Highway General Facilities	$71	TBD[e]	$76	TBD[e]	$288	TBD[e]
MBTA General Facilities (includes power, stations, commuter rail accessibility, etc.)	$166	TBD[e]	$137	TBD[e]	$177	TBD[e]
RTA Facilities and Systems	$5	TBD[e]	$5	TBD[e]	$5	TBD[e]
Other MassDOT Subtotal	***$242***		***$218***		***$470***	
MassDOT Total	**$1,561**		**$1,241**		**$2,462**	

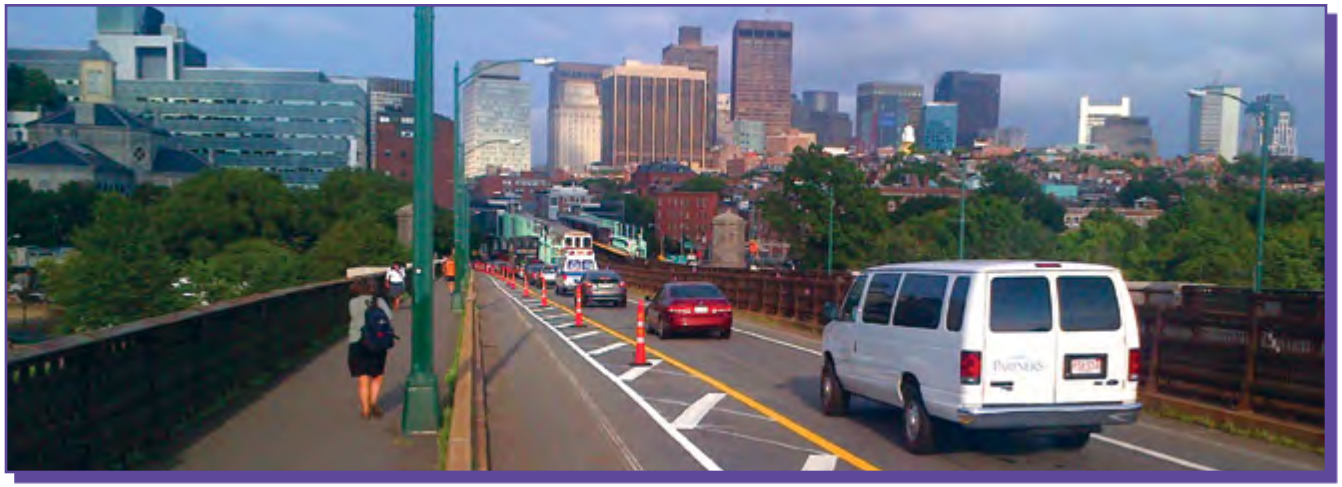
[a] The Current Funding scenario includes an additional $243 million dollars in operating expenses recaptured from the capital program.

[b] Historical Funding includes $400 million annually in Accelerated Bridge Program (ABP). The Current Funding scenario includes $1,580 million in ABP through FY 17 prorated over the 27 years of the Plan through 2040.

[c] The Current Funding scenario includes an additional $287 million dollars in currently unused bond cap.

[d] Additional rapid transit access includes Green Line Extension, South Coast Rail, and Silver Line Gateway.

[e] Additional measures may be developed in the future.



youMove Massachusetts Strategic Outreach Project

*you*Move Massachusetts Public Workshops
*you*Move Massachusetts Web Site Mapping Input Obtained
*you*Move Massachusetts Report Issued

massDOT Becomes Official

GreenDOT Launched

2008 | 2009 | 2010

Transportation Reform Establishes Massachusetts Department of Transportation

PRE-2008

Separate Transportation Agencies/ Departments in Operation

Executive Office of Transportation and Public Works (EOT)
Massachusetts Turnpike Authority (MTA)
Massachusetts Highway Department (MassHighway)
Registry of Motor Vehicles (RMV)
Massachusetts Aeronautics Commission (MAC)
Massachusetts Bay Transportation Authority (MBTA)
15 Regional Transportation Authorities (RTAs)

Healthy Transportation Compact Incorporated into Legislation Establishing MassDOT

MassDOT Mission and Values Published

Mission

Deliver excellent customer service to people who travel in the Commonwealth, and provide our nation's safest and most reliable transportation system in a way that strengthens our economy and quality of life. We are one transportation organization focused on customer service and safety.

Values

Dedication: We will provide service around the clock and under all circumstances.

Respect: We will treat the public as our valued customer, and treat one another as we would like to be treated.

Innovation: We will improve and integrate transportation services using creative thinking and best available practices and technology, while minimizing disruption to the public.

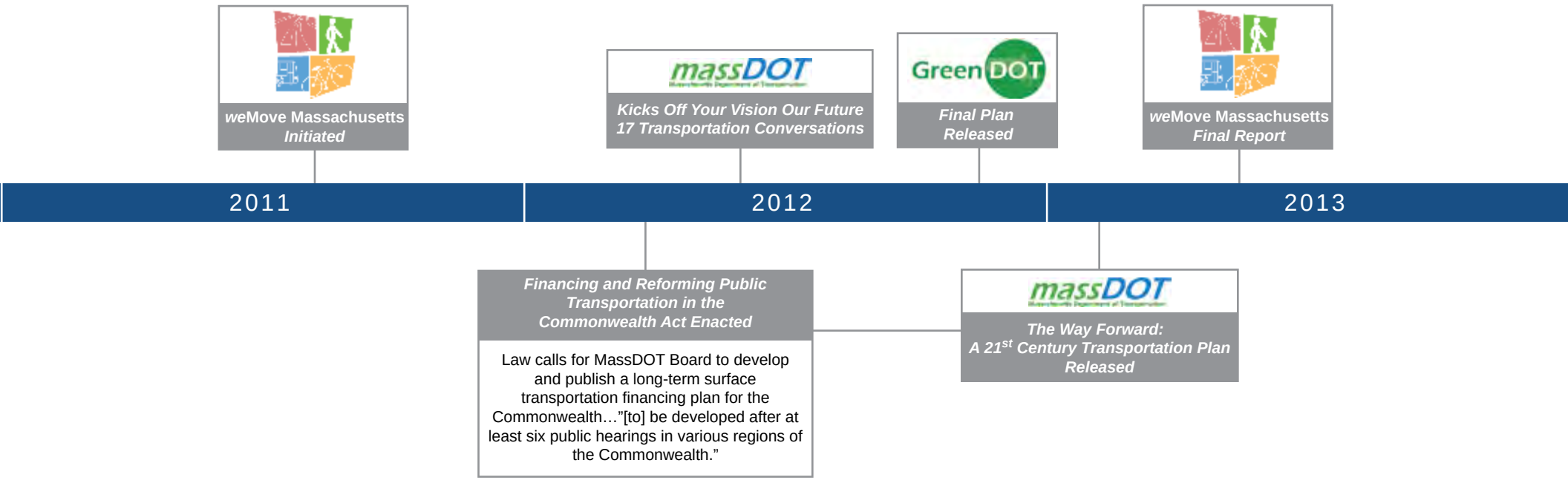
Diversity: We will promote an inclusive workforce and a culture that serves employees and customers fairly.

Honesty: We will provide the public accurate information that is understandable and accessible.

The key findings of the scenario analysis are the following:

*Under the **"Historical Funding"** scenario, performance of all assets would deteriorate with the most significant declines occurring in roadway pavement, bridges, and delay; and all MBTA assets except accessibility.*

***"Current Funding"** improves performance relative to the Historical Funding scenario. MassDOT will be able to maintain roadway performance at close to Current Funding levels through at least 2023, while performance of MBTA and RTA buses and trains will be improved.*

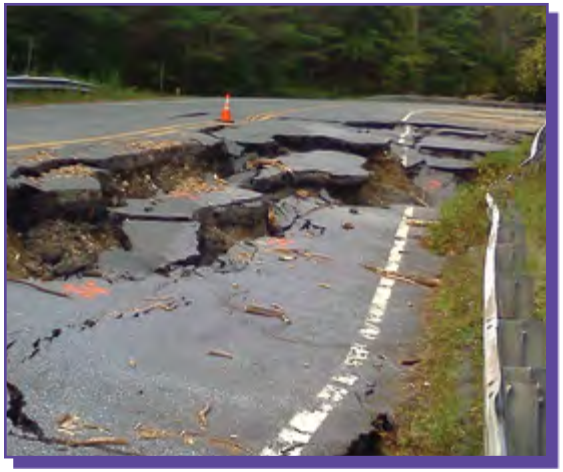


4.0 CONCLUSIONS

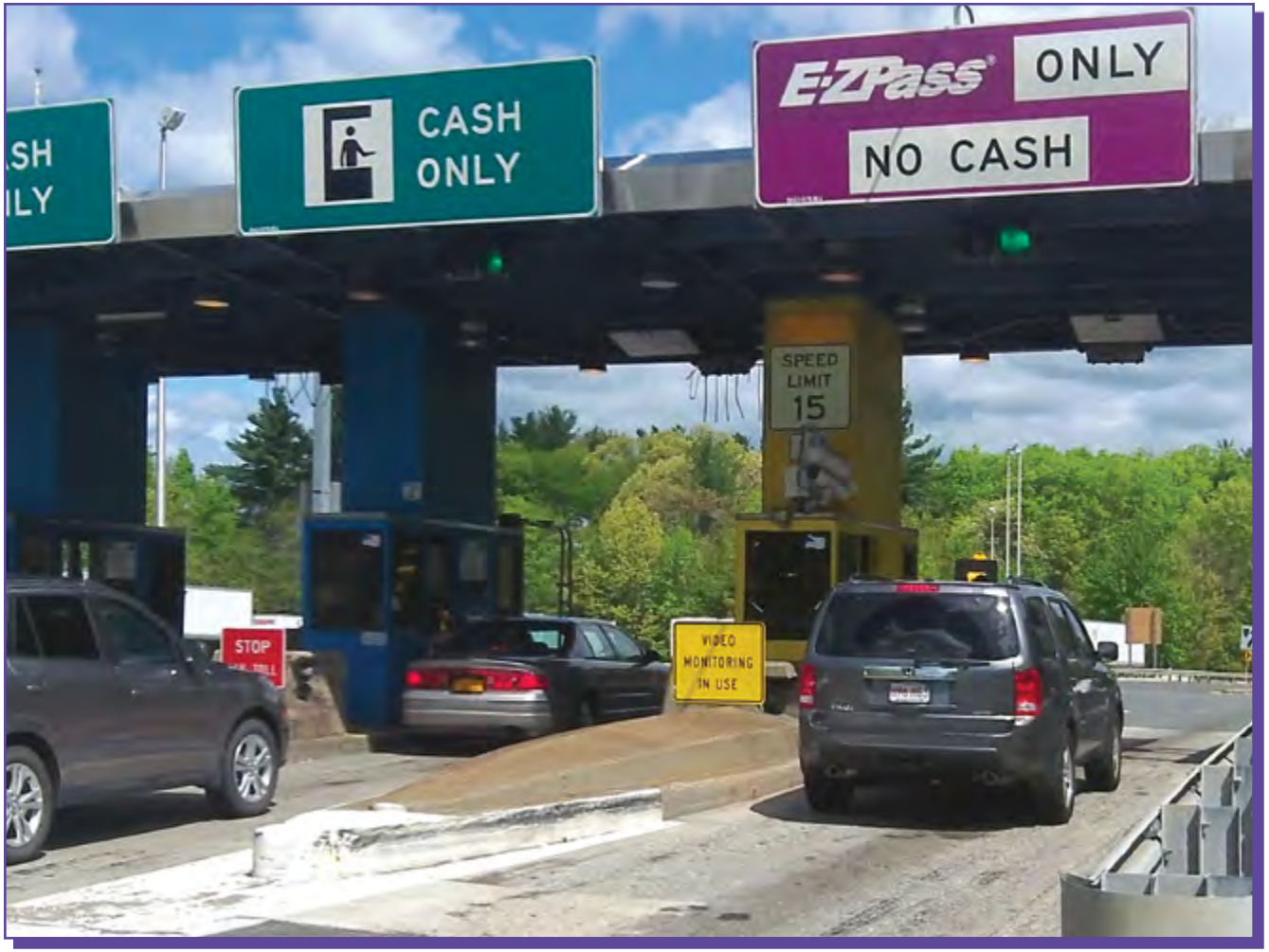
MassDOT has focused on several key transportation and customer priorities in the process of implementing transportation reform. First, through *you*Move Massachusetts (YMM) and now through *we*Move Massachusetts (WMM), MassDOT has developed a multimodal transportation plan that sets an investment framework for establishing priorities for Massachusetts over the next 10 years and beyond. WMM's analytical tool, Planning for Performance, calculates how funding levels affect performance. Through this tool, MassDOT will make funding choices and tradeoffs that reflect performance goals for highway, transit, and bicycle/pedestrian services. The resulting investment decisions are based on a thorough analysis of needs and priorities, are transparent, and reflect the most efficient and cost-effective distribution of funding across the entire transportation system. The application of this tool as part of a larger approach to performance management is a key element of MassDOT's mission of change and innovation.

WMM describes current and future performance across all modes of transportation and tests performance using different funding scenarios. These scenarios incorporate customer wants and needs. They also reflect MassDOT's policies to encourage multimodal investment in support of mode shift and healthier transportation. As described earlier, MassDOT has undertaken an extensive public outreach effort over the last several years, including YMM, WMM, and the *Your Vision, Our Future, A Transportation Conversation*. Our customers have identified the type of high-functioning transportation system they want across all modes of transportation. WMM highlights the critical needs of the entire transportation system and shows that current funding levels are not sufficient to sustain this high-performing system. The outreach confirmed the connection between a robust transportation system and economic development. WMM examined the current age and condition of each asset using national and MassDOT data and measures. Simply put, we were not investing enough and our system was in decline. Without additional funding, we were projected to lose the gains achieved in bridge quality by the Accelerated Bridge Program, and in roadway quality through the American Recovery and Reinvestment Act investments, and see continued deterioration in the condition of our buses, trains, and track/signal systems.

To make tangible improvements in quality, safety, reliability, and to expand MassDOT's networks, the Current Funding includes new revenue across all modes of transportation, resulting in improved performance compared to the Historical Funding levels. The results are based on performance curves developed for WMM using state-of-the-art methods for each transportation asset (described in Appendix A). However, this new level of funding does not solve all of MassDOT's challenges or the needs of our customers. Even with additional funding some asset categories may not improve.



MassDOT is embracing performance measurement and funding scenario planning methods to develop the most efficient and cost-effective solutions that are multimodal, protect our environment and communities, and create the type of 21st century transportation system that our customers want. MassDOT seeks to spend enough to improve performance significantly, while spending in a prudent manner. WMM connects MassDOT's policies, investments, and funding with our customers' needs and wants to create a safer and more effective transportation system that meets state and Federal guidance and performance standards.

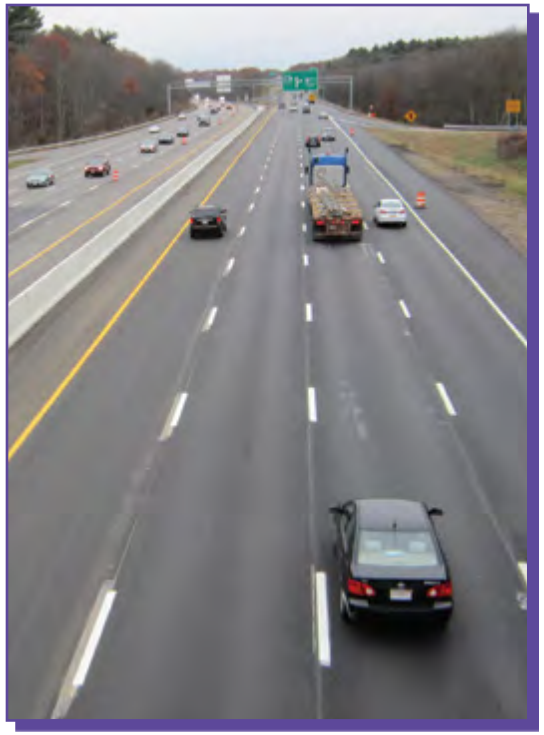


A. METHODOLOGY

The performance results contained in this report were produced using a combination of national and state methodologies and data. Results may, therefore, differ slightly from MassDOT's internally produced results because the national methodology may vary in some cases from the State's methodology. Note that the definition of state of good repair varies by asset class depending on the definition used by each MassDOT Division.

Roadways

For bridges, the Highway Division's PONTIS® bridge database was applied to FHWA's National Bridge Investment Analysis System (NBIAS) using MassDOT's most recent submittal of the National Bridge Inventory to assess bridge performance under different annual budget levels. NBIAS was used to forecast bridge condition in 2023 and 2040 as measured by the Health Index (HI) for the Federal-aid Highway System. NBIAS generates an optimal set of preservation actions for bridge elements based on lifecycle user and agency costs, and engineering standards of bridge maintenance needs. The tool is designed to minimize lifecycle cost rather than to maintain or achieve a specified level of performance. NBIAS outputs several different performance measures, but upon review the HI was selected for this analysis. NBIAS creates a synthetic version of the Highway Division's PONTIS database, and so the results may differ from the direct application of the actual database. For a more complete description of the technical approach used by NBIAS, refer to the *NBIAS Technical Manual.*[12]



Another commonly used output of NBIAS is the percentage of bridges that are Structurally Deficient (SD). The national average for SD bridges is 11 percent, while in Massachusetts about 10 percent of bridges are rated SD. This level of SD bridges is consistent with a high HI. It is important to note that SD bridges are not unsafe for travel. MassDOT would not allow an unsafe bridge to remain open. However, an SD bridge is likely to require more maintenance funds to keep it in operation in the short-term, and it may have to operate with load or lane restrictions until it can be replaced or rehabilitated. Like home repair, it is not economically efficient to fix or replace all problem bridges at the same time. Homeowners routinely live with and patch up problems that do not represent a safety hazard until they can afford to replace them.

In all performance graphics, better conditions are at the top and worse conditions are on the bottom. The horizontal axis shows funding increments and the vertical axis shows the performance level for whichever measure is being used for the specific asset class. For each asset category, one graphic shows the performance levels in 2023 and the other shows 2040. In each case, the red vertical dotted line shows where Historical Funding intersects the performance curve, and the green vertical dotted line shows where Current Funding intersects the performance curve.

[12] Cambridge Systematics, Inc., *NBIAS 3.4 Technical Manual,* prepared for the FHWA, April 2010.

Appendix Figures Key:

Historical Funding

Current Funding

Figure A.1 Bridge Condition

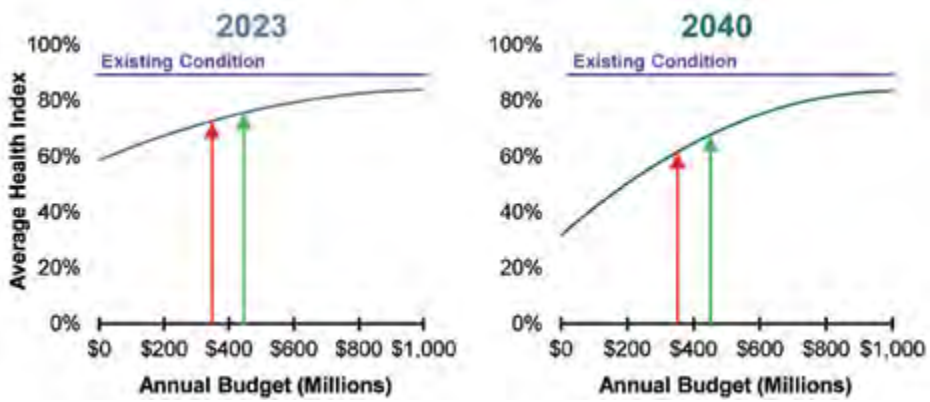
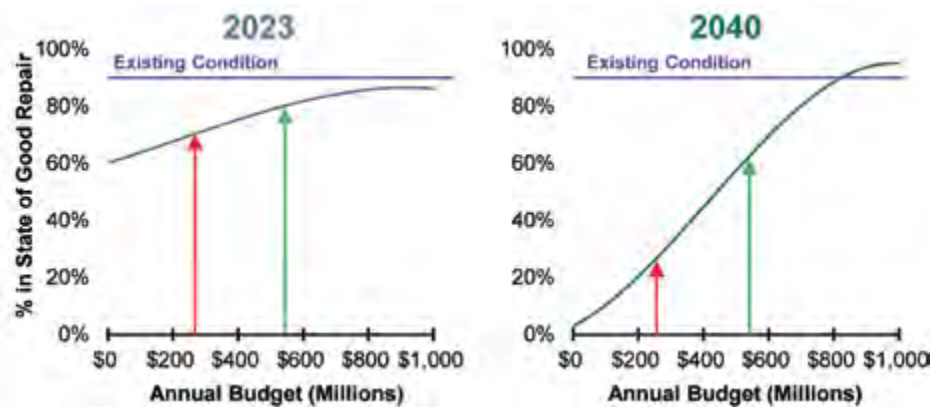


Figure A.2 Pavement Condition



The graphics in Figure A.1 shows the performance curves for projected bridge HI under Historical Funding and Current Funding levels in 2023 and 2040. Due to the success of the Governor's Accelerated Bridge Program (ABP), bridges today have an HI of 89 percent. Based on this analysis, it will take almost one billion dollars per year to maintain bridges in close to their current condition, but notice how the curve flattens out at the high end of the performance curve. A slightly lower, but still acceptable, level of performance (HI of 76 percent) could be achieved through 2023 for $447 million per year, which the Commonwealth would spend under the Current Funding scenario. This curve reflects the types of performance tradeoffs that this analysis is designed to support. Under the Historical Funding level of $353 million, bridge condition would have deteriorated to an HI of 72 percent in 2023.

For analyzing pavement condition under different budget levels, the FHWA's state version of the Highway Economic Requirements System (HERS-ST) was used with MassDOT's most recent submittal of the Highway Performance Monitoring System (HPMS).[13] HERS-ST generates an optimal pavement preservation work program based on engineering standards and economic analysis to minimize pavement preservation deficiencies. Pavement condition is analyzed using the standard Present Serviceability Rating (PSR), which ranks pavement on a five point scale from very poor to excellent. For a more complete description of the technical approach used in HERS-ST, refer to the *HERS-ST Technical Report.*[14]

Figure A.2 shows the resulting performance curves for pavement condition. Over 80 percent of the Commonwealth's pavement currently is in a state of good repair. Like bridges, this is a high rating and reflects a large amount of repaving that took place using funds from the Federal American Recovery and Reinvestment Act (ARRA). The Commonwealth's Historical Funding for repaving of about $267 million per year will result in only 71 percent of pavement being in a state of good repair in 2023. Under Current Funding Scenario, 79 percent of pavement will be in a state of good repair.

For analyzing mobility and congestion under different budget levels, MassDOT also used HERS-ST in combination with MassDOT's most recent submittal of the HPMS.[15] HERS-ST generates an optimal capacity expansion work program based on engineering standards and economic analysis to minimize mobility deficiencies.

[13] HERS-ST was applied to an older HPMS file (2008) because FHWA has moved to an updated, geographic-based HPMS file, but has not yet updated HERS-ST to accept this new format.

[14] Cambridge Systematics, Inc., *HER-ST Technical Report,* prepared for the FHWA, August 2005. http://www.fhwa.dot.gov/asset/hersst/pubs/tech/tech00.cfm.

[15] HERS-ST was applied to an older HPMS file (2008) because FHWA has moved to an updated, geographic-based HPMS file, but has not yet updated HERS-ST to accept this new format.

Figure A.3 shows the performance curves for roadway delay or congestion. Delay and congestion measure the extent to which the capacity of the current roadway system meets demand. Currently, the average Massachusetts driver experiences 4.8 hours of delay for every 1,000 vehicle miles of travel (VMT). Of course, this average performance varies greatly across different regions, roadways, and time of day. The average motorist in Massachusetts drives about 12,000 miles per year; therefore he or she would experience 58 hours of delay. Commuting to work full-time or an average of 250 days per year, he or she would experience a little over 15 minutes of delay per trip. The Commonwealth has been investing little funding, $65 million annually, on relieving roadway congestion under the Historical Funding Scenario. Under the Historical Funding Scenario, delay would have increased significantly to an average of 6.3 hours per 1,000 VMT by 2023. Under the Current Funding Scenario of $386 million, delay will be 5.4 hours.

Roadway safety is typically measured by the number of crashes. Crash rates cannot be easily projected into the future using the types of performance curves applied to other highway metrics. Therefore, safety performance was measured by the number of high-crash locations that can be improved over time for an average cost of $500,000/intersection. Under the Historical Funding scenario of $26 million, the State would have improved 528 intersections through 2023, or close to 50 per year. Many of these intersections would be among the Commonwealth's top 100 crash locations. Under the Current Funding Scenario, 1,304 intersections will be improved. Safety is a priority of MassDOT's. Many other highway projects also include safety improvement elements that are harder to quantify.

Similarly, bicycle performance does not lend itself to performance curve modeling. Bicycle performance was measured by the percentage of the Bay State Greenway (BSG) that could be completed for a specified level of funding. The BSG is a seven-corridor 777-mile network of bicycle routes that comprise both off-road and on-road facilities. An average cost to complete of $25,000/mile was used reflecting a blend from expensive urban bike lanes to improving signage and markings where bicycle facilities already exist. Under either funding scenario of $26 million, the percent of miles completed will increase from 31 percent to 87 percent in 2023 and to 100 percent in 2040.

Figure A.3 Mobility Condition

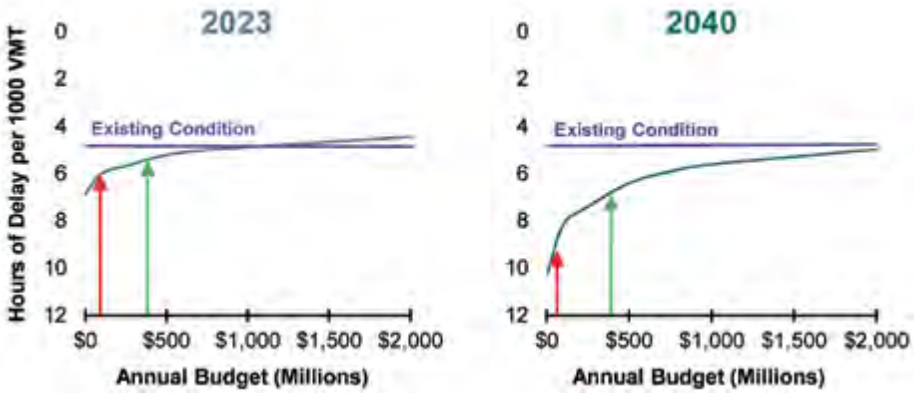
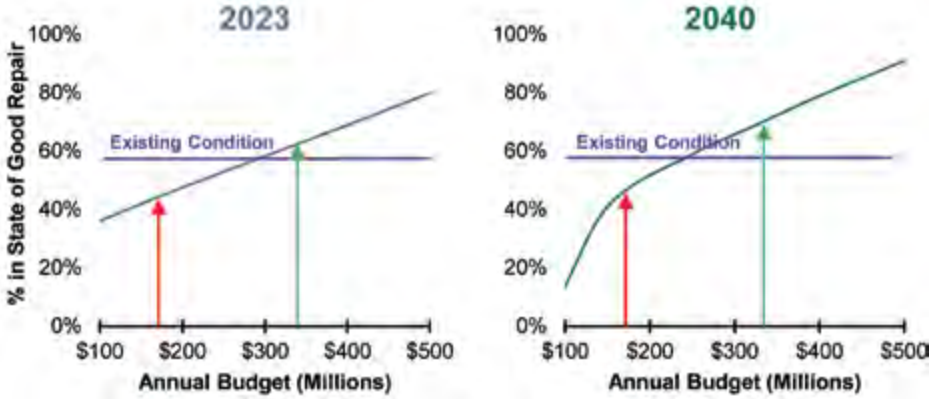
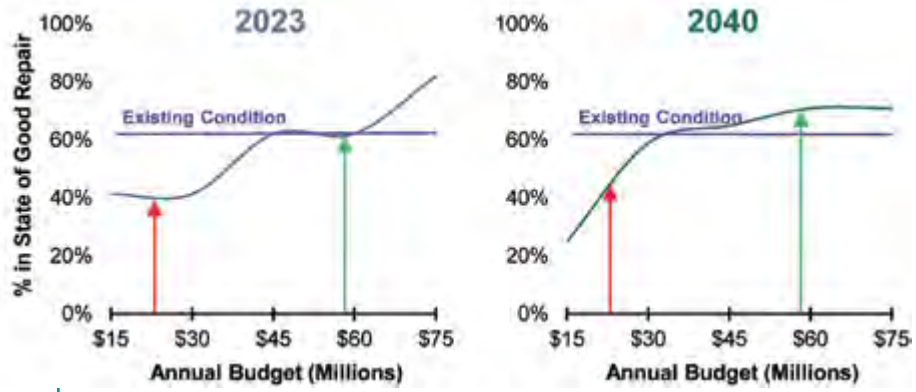


Figure A.4 MBTA Rolling Stock Condition



Note that this curve shows a weighted average of bus, subway, and commuter rail conditions based on the number of vehicles in each fleet.

Figure A.5 MBTA Bus Condition



Transit

Three vehicle types were analyzed: buses, subway cars, and commuter rail locomotive/coaches. Data were prepared separately for each category and then combined. Each asset category has 8 to 10 vehicle types (i.e., the MBTA owns different types of buses and trains depending on when they were acquired and the subway lines on which they operate). In assessing conditions for MBTA buses and trains, a condition scoring system (Table A.1) was applied that is based on asset age and condition. Projections of investment levels, midlife overhauls, and vehicle replacement were made consistent with MBTA useful life assumptions contained in its state-of-good-repair database. The use of MBTA assumptions is an important distinction as the MBTA assumes a longer life for buses and trains than FTA recommends. A threshold condition factor from 2.8 to 4.0 was applied to calculate the percent of assets in a state of good repair, per MBTA practice, as shown in shading in Table A.1 on the next page.

Figure A.4 shows the performance curves for all MBTA buses, rapid transit vehicles, and commuter rail trains combined. Currently, 58 percent of vehicles are rated as being in a state of good repair. The Historical Funding level of $173 million would have resulted in a decline from 58 percent in state of good repair to 46 percent in 2023. This forecast assumes that under actual historical funding levels the MBTA would not have been able to fully afford the currently programmed investments in subway cars.[16] Under the Current Funding Scenario, performance will improve to 61 percent in a state of good repair in 2023 and 70 percent in 2040.

Figures A.5 through A.7 show the performance curves separately for each of the MBTA's three main types of vehicles – buses, subway cars, and commuter rail cars and locomotives. As shown in Figure A.5, 62 percent of MBTA buses currently are in state of good repair, and the MBTA's Historical Funding level would have resulted in a gradual decline in performance and loss of the gains in bus performance from the major reinvestment during the last decade. As shown in Figure A.6, only about 46 percent of subway cars exist in good/fair condition. Under the Historical Funding scenario, this performance would decline significantly since the MBTA could not afford the currently programmed new cars for the Orange and Red Lines. As shown in Figure A.7, 59 percent of commuter rail vehicles exist in a state of good repair. This condition would have improved dramatically under the Historical Funding scenario of $95 million, which included a major fleet upgrade currently in procurement.

[16] This analysis does not include the possible need for additional vehicles to accommodate ridership growth in future years.

Figure A.6 MBTA Subway Condition

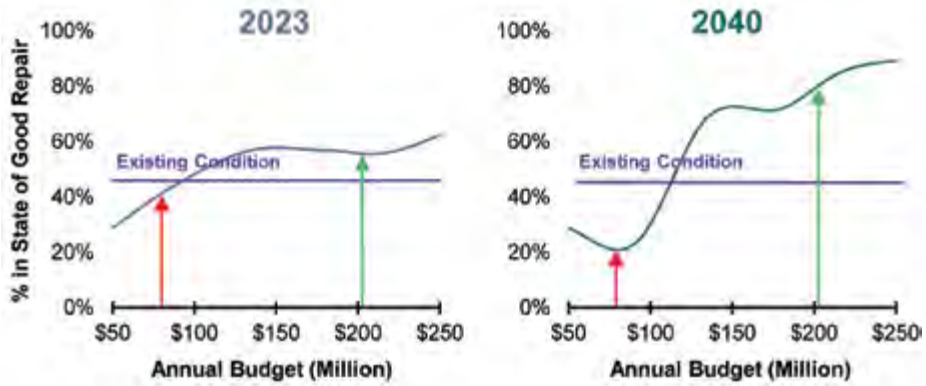


Figure A.7 MBTA Commuter Rail Condition

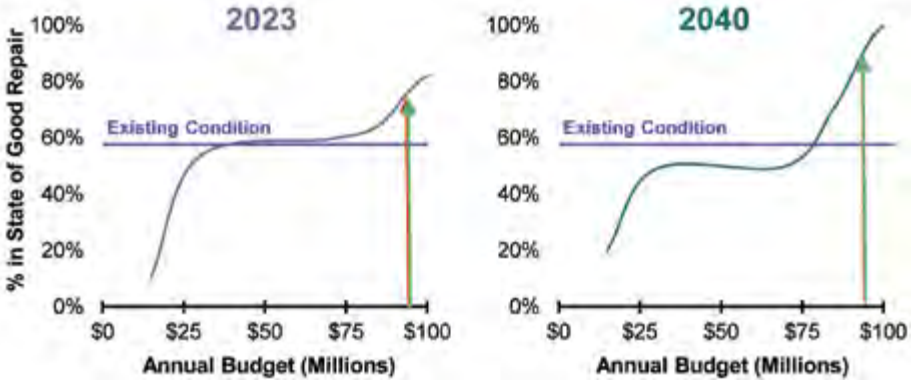


Figure A.8 RTA Rolling Stock Condition

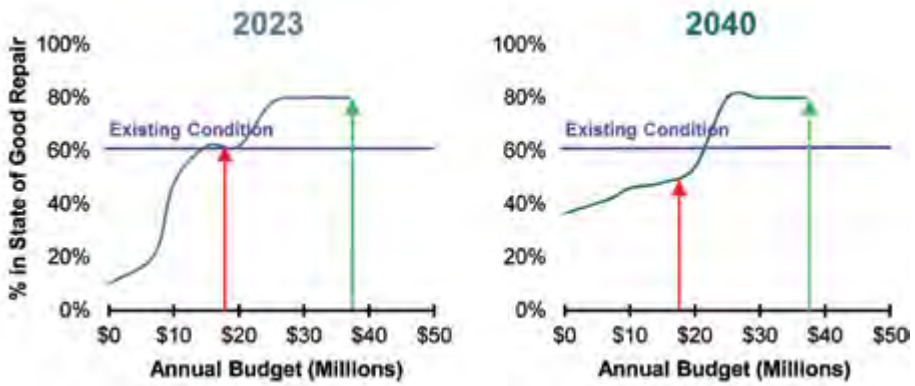


Figure A.9 MBTA Mean Time between Failures

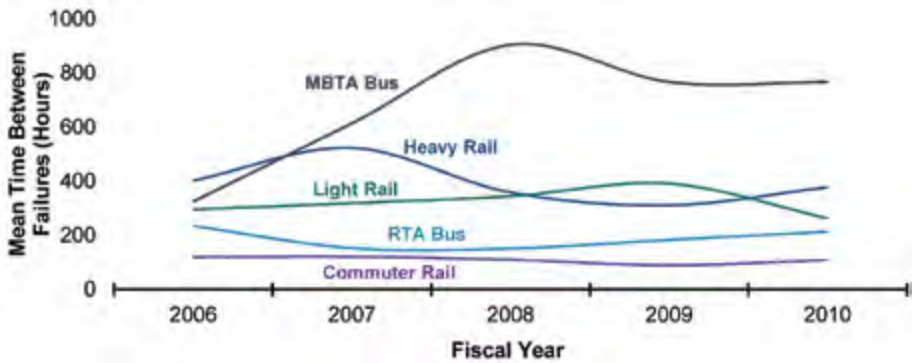


Figure A.10 MBTA Rolling Stock Failure

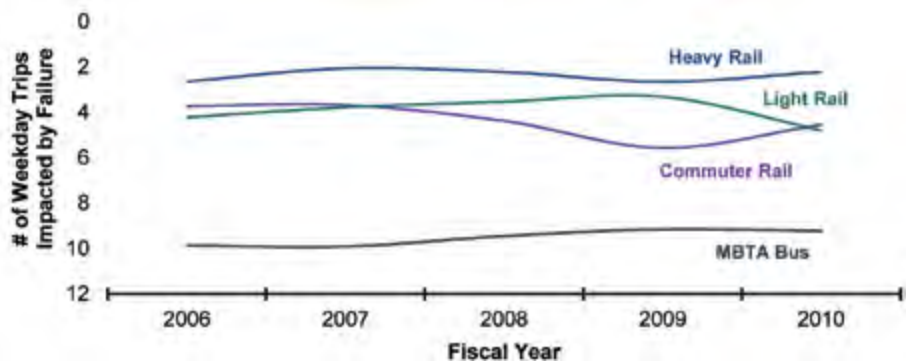


Figure A.8 shows the performance curve for RTA buses. Analysis of RTA bus fleets used data from the National Transit Database. The FTA's useful life requirements of 12 years was combined with the MBTA's condition scoring system, which is based on asset age and condition. Sixty-two percent of RTA buses currently are in state of good repair (slightly above the MBTA vehicle average). This performance would have remained the same in 2023 under the Historical Funding level of $17 million. Performance will improve to 81 percent in state of good repair under the Current Funding Scenario with $37 million of spending.

Table A.1 MBTA Condition Scoring System

Rating Description	Scoring Range	Asset Age (Percent of Useful Life Remaining)	Asset Condition (Quality, Level of Required Maintenance)
Excellent	4.4 to 5.0	Asset new or nearly new (0-25% of useful life)	Asset new or like new; no visible defects
Good	3.4 to 4.3	Asset nearing or at its mid-life point (26-50% of useful life)	Asset showing minimal signs of wear, some slight defects or deterioration
Adequate/Fair	2.8 to 3.3	Asset has passed its mid-life point; still within useful life (51-100% of useful life)	Some moderately defective or deteriorated components; expected maintenance needs
Adequate	2.5 to 2.7	Asset has passed its mid-life point; still within useful life (51-100% of useful life)	Some moderately defective or deteriorated components; expected maintenance needs
Marginal	1.8 to 2.4	Asset just beyond its useful life (101-125% of useful life)	Increasing number of defects, deteriorating components; growing maintenance needs
Poor	1.0 to 1.7	Asset is considered beyond its useful life (126%+ of useful life)	Asset in need of replacement or restoration; may have critically damaged components
Nonoperable	0	Asset nonoperable	Asset nonoperable

Figures A.9 and A.10 show the current mean time between failures and the number of vehicle trips impacted by failure for the primary vehicle types operated by the MBTA and by the RTAs respectively. Performance by vehicle type varies widely. Commuter rail vehicles have the worst performance record with a failure occurring slightly more than once every 100 hours (about every five days or once a week). Under existing conditions,

commuter rail riders should expect a vehicle failure once per week somewhere on the system. Conversely, buses travel the longest time between failures, about 780 hours. The other vehicle categories fall in between. This variation in performance reflects major investments made by the MBTA in upgrading the bus fleet in the 2000s, and the current need to make a similar investment in the commuter rail fleet.

The MBTA also uses the bridge rating program PONTIS. The MBTA supplied its current list of bridges for a calculation of each bridge's overall condition. As shown in Figure A.11, only 65 percent of MBTA bridges currently are in state of good repair, far below the performance level of roadway bridges. There has been no ABP for the MBTA's bridges as there was for highway bridges. At the Historical or Current Funding levels of $34 million, the percentage of bridges in state of good repair would decline to 47 percent in 2023.

For MBTA Elevators/Escalators, the analysis focused on rehabilitation and replacement of elevators and escalators based on age of the asset, consistent with the MBTA's state of good repair requirements. As shown in Figure A.12, 60 percent of elevators/escalators currently are in a state of good repair. In 2023, this performance will decline to 56 percent in state of good repair under either funding scenario.

For MBTA Accessibility, the analysis focused on the number of rapid transit and commuter rail stations which will provide full accessibility for the disabled. As shown in Figure A.13, under either funding scenario, 79 percent will meet this standard by 2023.

Figure A.11 MBTA Bridge Condition

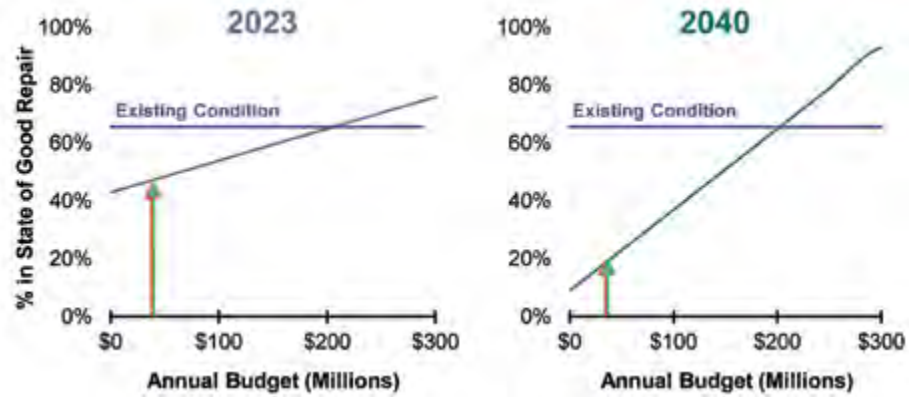


Figure A.12 MBTA Elevators and Escalators

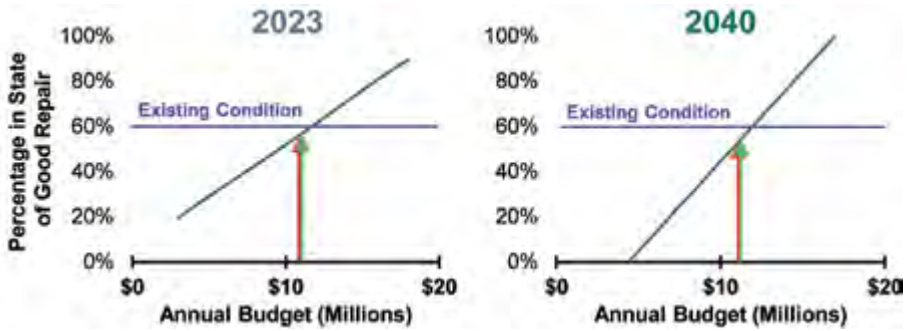


Figure A.13 MBTA Accessibility

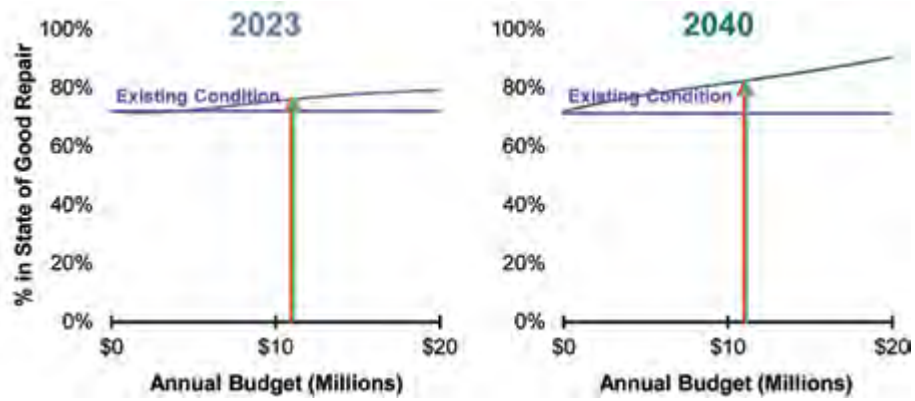


Figure A.14 MBTA Track Delay

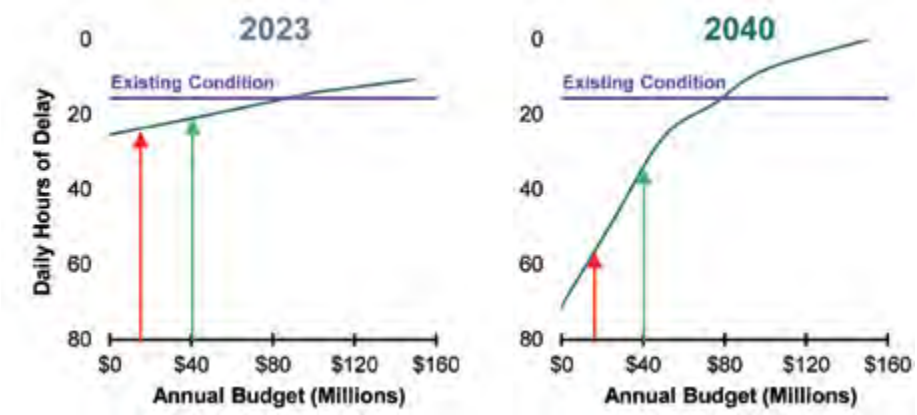
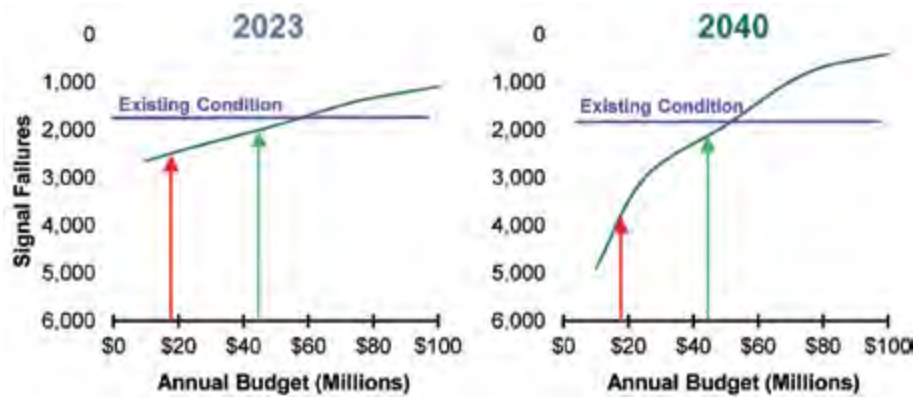


Figure A.15 MBTA Signal Failure



For MBTA Subway Track, the daily hours of delay were calculated for each subway line based on the MBTA Scorecard for FY 12 and scheduled service from the 2010 Blue Book. In order to maintain the track in its current condition, the MBTA needs to replace four percent of track annually as the track has a 25-year useful life. As shown in Figure A.14, the MBTA subway system currently experiences about 16 daily hours of delay due to substandard track conditions. At the Historical Funding level of $15 million annually, track hours of delay would have increased to almost 24 hours in 2023 as the additional number of speed restrictions necessary to maintain safe operation will hamper the ability of train operators to make up time delays. Under the Current Funding Scenario of $40 million, the MBTA will experience an average of 21 hours of delay.

As shown in Figure A.15, the MBTA currently experiences about 1,900 signal failures annually. Under the Historical Funding level of $18 million, the number of annual failures would have increased to almost 2,500 by 2023. Under the Current Funding Scenario ($43 million in funding), the MBTA will experience 2,025 failures, slightly more than today.

For transit expansion projects, the number of households was calculated which would be within a one-half mile walking distance of a rapid transit station when the project is completed. This data was provided by the Central Transportation Planning Staff (CTPS) based on their modeling work for MassDOT and the MBTA. The numbers are 33,195 for the Green Line Extension, 42,958 for South Coast Rail, and 12,714 for the Silver Line Gateway project for a total of 88,867 households.

The MBTA rapid transit carrying capacity measure includes capital costs associated with increasing the carrying capacity to the MBTA's existing system. Capital costs include expansion of existing fleets, upgrades to power systems, and system signal improvements which will allow for shorter headways during peak service. As an example, the procurement of new Orange Line cars, in addition to improving the state of good repair of the fleet as accounted for in the rolling stock category above, will also allow the MBTA to operate three more six-car trains during the peak service hour. Each Orange Line car has a capacity of 131 riders per train, which means the MBTA can carry an additional 786 riders per train. With the addition of three trains in the peak hour, the Orange Line can move an additional 2,358 customers. Similarly, the Red Line will be able to move an additional 4,008 riders between Alewife and JFK station, and the four Green Line branches will be able to carry an additional 7,272 riders.

VOLVO
VOLVO
VOLVO
EW230C
BARLETTA
CAT

86

weMOVE MASSACHUSETTS

planning for performance

massDOT

Massachusetts Department of Transportation