Performance and Asset Management Advisory Council

ANNUAL REPORT

December 2018

massDOT
Massachusetts Department of Transportation

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December 13, 2018

The Honorable Joan B. Lovely
Vice Chair
Senate Committee on Ways and Means
State House, Room 413-A
Boston, MA 02133

The Honorable Jeffrey Sánchez
Chair
House Committee on Ways and Means
State House, Room 243
Boston, MA, 02133

The Honorable Joseph A. Boncore
Senate Chair
Joint Committee on Transportation
State House, Room 112
Boston, MA 02133

The Honorable William M. Straus
House Chair
Joint Committee on Transportation
State House, Room 134
Boston, MA 02133

Members of the General Court:

On behalf of the Performance and Asset Management Advisory Council, I am pleased to submit this report in compliance with Chapter 46, Section 12 of the Acts of 2013 and as referenced in Chapter 6C, which requires the Council to report annually on progress by the Massachusetts Department of Transportation (MassDOT) to develop a mature asset management system.

Transportation Asset Management (TAM), according to the American Association of State Highway and Transportation Officials (AASHTO), "is a strategic and systematic process of operating, maintaining, upgrading and expanding physical assets effectively throughout their lifecycle." Asset management supports "better decision making based upon quality information and well-defined objectives."

Spurred on by regulatory framework established at the State and Federal levels, MassDOT has steadily expanded the breadth of its TAM practice, improving in-turn the information available for operations, maintenance and capital planning of infrastructure. This progress has been documented in the PAMAC Annual Report since 2015.

For **the Highway Division,** this report discusses the submission to the Federal Highway Administration (FHWA) of an Initial Transportation Asset Management Plan (TAMP), which has already begun to guide state reliability investments on the National High System (NHS). The TAMP will be finalized in 2019. Also included are discussions of bridge and pavement condition, tunnel system inspection and condition assessment, drainage and resiliency work, and business intelligence system development.

In October **the MBTA** filed an asset management plan with the Federal Transit Administration. It continues to focus on implementing TAM in all areas of the Agency. This report summarizes MBTA asset inventory and performance and includes plans for internal process and technology improvements.

This report also summarizes **MassDOT Rail and Transit and Aeronautics Division** activities and discusses asset management topics at the municipal level.

MassDOT is charged with maintaining existing infrastructure, adapting to climate change and extreme weather, and anticipating the mobility needs of a future Commonwealth. Accurate information on asset condition and performance are critical to make the right long-term investment decisions. The Council can once again report significant progress by the operating divisions of MassDOT and the MBTA toward the employment of sound TAM practices to inform these decisions.

The Council looks forward to remaining a resource for MassDOT, local governments, and the Legislature in the upcoming year.

Respectfully Submitted,

Patricia Leavenworth, P.E., Chair

Performance and Asset Management Advisory Council

Pat Ciaramella, Old Colony Planning Council

Karen Sawyer Conard, Merrimack Valley Planning Commission

Christopher Hennessey, Cohen Kinne Valicenti & Cook LLP

David Knowlton, City of Salem MA

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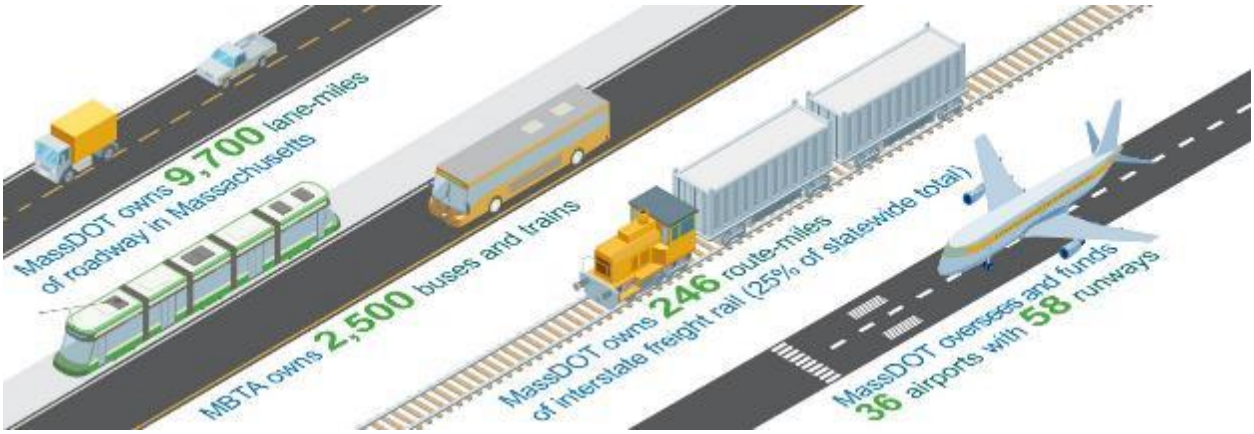
857-368-8580 الـ ساد سة الـ ف قرة بـ أخ صائ ي الاتـ صال يُرجى أخرى، بـ لـغة الـ مع لومات هذه إلـ ى بـ حاجة كـ نت إن الـ هاتـ ف ع لى

1. 0 Introduction

The purpose of this document is to summarize progress toward implementing an integrated transportation asset management (TAM) system in MassDOT's Divisions: Highway, Rail and Transit, Aeronautics, and the MBTA. The report also addresses asset management for pavement and bridges owned by cities and towns (i.e., municipalities). MassDOT assets form the core of the Massachusetts transportation system, as shown in Figure 1.1.

Figure 1.1 Examples of MassDOT Assets



1.1 Legislation: A Mandate for Progress

The Performance and Asset Management Advisory Council (the Council) was created by Chapter 46 of the Massachusetts General Law Acts of 2013, which charges:

> *"The council shall provide an annual progress report on the performance and asset management system to the House and Senate committees on Ways and Means and the Joint Committee on Transportation."*

Since 2013, this legislation has been a critical catalyst for MassDOT's ongoing effort to pursue a forward-looking investment policy across all of its functions. The efforts of the Council would not have been possible without the mandate.

1.2 Context for this Report

MassDOT has made significant strides since its creation in 2009 to incorporate performance-based, data-driven planning principles and to keep pace with innovative methods in the maintenance and operation of transportation systems. Internal and external championing of asset management practices has underpinned this progress.

MassDOT's progress in implementing asset management is keeping Massachusetts apace with Federal requirements. Congress introduced the requirement for Transportation Performance Management (TPM) in 2012 with the Moving Ahead for Progress in the 21st Century Act (MAP-21). MAP-21 priorities have been carried forward in the Fixing America's Surface Transportation Act (FAST Act) of 2015. The Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) have implemented final TAM rules in 2017 that are discussed in the related sections of this report. **These rules establish performance measures, and in some cases set minimum thresholds for statewide asset condition and require MassDOT to set performance targets.**

This report is designed to align with the *MassDOT Tracker FY2018*. That document summarizes additional performance metrics for each of MassDOT's divisions. While this document focuses on asset management and system condition, the *Tracker* includes measures of customer experience, budget and capital performance, safety, and health and sustainable transportation.

1.3 Structure of This Report

This report summarizes the TAM practice of the MassDOT Highway Division, the MassDOT Rail and Transit Division, the MassDOT Aeronautics Division, MBTA, and Municipalities. For each of these groups, the report (Sections 2-5) presents a list of assets; investment levels; past and future performance; and progress since last year's report and next steps for the coming year(s).

1.4 What's New

This report is intended to build on the reports from prior years and call out notable advances in asset management throughout MassDOT and the MBTA. This year's report highlights the following:

For the Highway Division

- A summary of the Division's initial Transportation Asset Management Plan (TAMP).
- Update on Bridge and Pavement Condition
- A discussion of several efforts involving drainage and resiliency.

For the MBTA

- A discussion of the MBTA's organizational commitment to asset management.
- An update on the development of MBTA asset management data systems.

- A summary of the agency's Transportation Asset Management Plan (TAM Plan).

For the Rail and Transit Division

- A discussion of MassDOT's rail asset management support project.

For the Aeronautics Division

- A discussion of the goals and approach of the upcoming Massachusetts State Aviation System Plan (MSASP).

Related to Municipal Infrastructure

- A summary of inventory and condition for municipally-owned small bridges.

2. 0 Highway Division

The Highway Division submitted an initial Transportation Asset Management Plan (TAMP) to the Federal Highway Administration (FHWA) on April 30, 2018. The TAMP is a key component of the Federal Transportation Performance Management regulatory framework, and the document describes the asset management processes which State Departments of Transportation employ for improvements to and preservation of the National Highway System (NHS). The final TAMP will be submitted in June of 2019 following the completion of remaining plan elements and incorporation of FHWA feedback.

2.1 Submission of the Initial Transportation Asset Management Plan to FHWA

The filing of the initial TAMP represents a significant milestone in development of performance-based capital planning at MassDOT. The processes described within the Highway Division's Initial TAMP have grown from mandates within Massachusetts General Law and have been promoted by MassDOT leadership past and present. While the TAMP is focused on the NHS, the asset management processes described in the plan are universally applied to MassDOT assets, and are the underlying framework for all reliability investments within the MassDOT CIP.

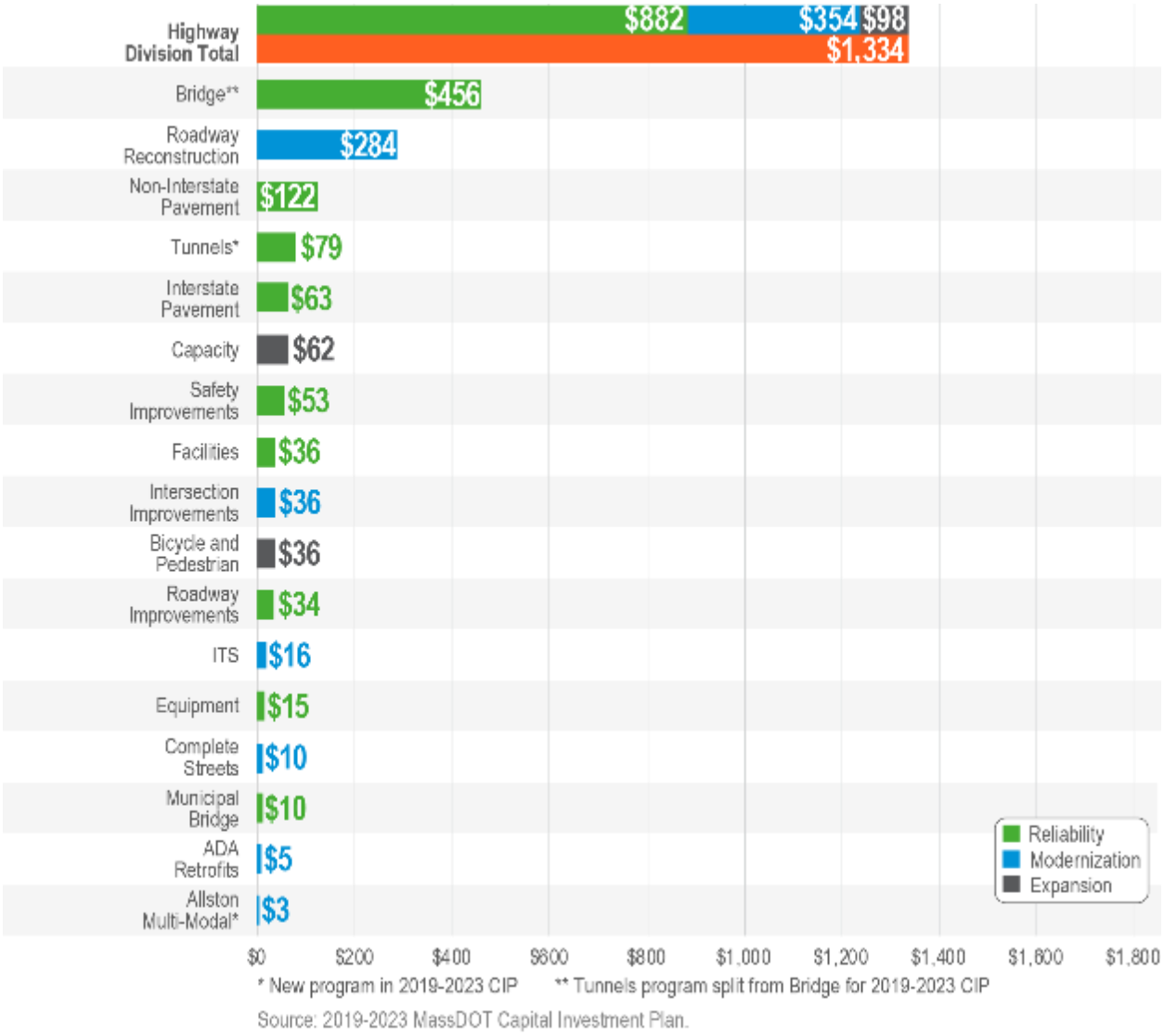
The TAMP outlines the MassDOT Asset Management approach as follows:

- Regular update of Inventory and condition data.
- Deliberate approach to the lifecycle management of infrastructure with the objective of minimizing overall cost of ownership.
- Forecasting of condition and performance outcomes at various investment levels.
- Consideration and mitigation of risks which could impact desired performance outcomes.

2.2 Investment in the Highway Division

Annual average investment in each Highway Division capital program in the 2019-2023 CIP is shown in Figure 2.1.

Figure 2.1 Average Annual Investment in Highway Division Programs, 2019-2023



2.3 Highway Division Assets

The Highway Division owns a large variety of assets. Some of these – but not all – are included in the TAMP and are subject to performance reporting to FHWA. Note that capital programs do not perfectly align with asset classes. Assets discussed in detail in this report include:

- **Pavement |** MassDOT owns 9,600 lane-miles of roadway in Massachusetts, including all interstates and limited-access freeways as well as many major arterials.
- **Bridges |** The National Bridge Inventory Standards (NBIS) define a bridge as a structure with a span length of over twenty feet. More than 5,000 structures in the Commonwealth are thus defined as "NBI Bridges." MassDOT

has capital responsibility for bridges owned by the Highway Division and by municipalities. Municipalities are responsible for preservation of their bridges.

- **Tunnels |** Tunnels include the structure, overhead elements (e.g., ceiling panels & lighting), and life safety and ventilation equipment. MassDOT owns 7 tunnels which are comprised of 44 individual tunnel subsections. All Highway Division tunnels reside within the Metropolitan Highway System (MHS).
- **Drainage Culverts |** Culverts are structures with a span less than 10 feet and a diameter greater than four feet (i.e., not pipes). To date, MassDOT has identified approximately 5,000 culverts.

Other MassDOT Assets not discussed in this report include:

- **Ancillary Structures |** Ancillary structures are vertical or overhanging and would impede the roadway if they fell. These include full and cantilever-span support structures for static and variable message signs, electronic tolling gantries, traffic signal supports, and lighting structures.
- **Signs and Signals |** MassDOT owns more than 250,000 signs and signposts and 1,531 traffic signals.
- **Pedestrian Ramps |** MassDOT owns more than 26,000 pedestrian ramps.
- **Bicycle and Sidewalk Accommodations |** MassDOT owns sidewalks and bicycle lanes on many roadways.

2.4 Asset Performance and Forecasts for the Highway Division

2.4.1 Pavement

MassDOT measures pavement condition using Pavement Serviceability Index (PSI), as illustrated in Figure 2.2. PSI is a composite index which combines data on ride quality, rutting, cracking, raveling, and flushing to rate a given road segment on a scale from 0 (unpassable) to 5 (pristine). Within the five-point scale are ranges that translate to the condition states of excellent, good, fair and poor.

Figure 2.2 Pavement Condition Ratings in 2017

Condition State	Interstates		Non-Interstate	
	PSI Range	*% of Lane-Miles*	*PSI Range*	*% of Lane-Miles*
Good/Excellent	3.0 – 5.0	**93%**	2.8 – 5.0	**63%**
Fair	2.5 – 3.0	**6%**	2.3 – 2.8	**24%**
Poor	0.0 – 2.5	**1%**	0.0 – 2.3	**13%**

Non-interstate pavement condition remains a long-term challenge for the Highway Division. Performance models predict a downward condition trend at the level investment proposed by the 2019-2023 CIP.

To maximize the effectiveness of available funding, MassDOT is increasing the use of pavement preservation on good and fair roadways to delay further degradation and extend pavement useful life at comparatively lower cost than rehabilitation (e.g. sealing of a residential driveway). Consistent preservation investments, coupled with rehabilitation projects, will result in a lower cost of ownership than found from rehabilitation alone. Preservation will not however replace the need for investment in conventional pavement resurfacing projects.

Project scope is a major factor in the outcome of pavement investments. Segments are selected for investment through the MassDOT Pavement Management System and are then fully developed into projects based on an in-depth engineering assessment of corridor conditions. In many cases, needs exist beyond the pavement, and can include bridge deficiencies, safety hardware upgrades, drainage repairs or upgrades, and improvements to bicycle/pedestrian accommodation. Once a project is fully designed, it is not uncommon to find significant portions of the project budget allocated to work outside of the pavement. Outwardly this appears to be an increased cost of ownership for pavement but is reflective of investments toward other assets.

2.4.2 Bridges

The National Bridge Inventory Standards (NBIS) define a bridge as a structure with a span length of over twenty feet. More than 5,000 structures in the Commonwealth are thus defined as "NBI Bridges," of which 1,569 are owned by municipalities and most of the remainder are owned by MassDOT.

The NHS consists of Interstates and roadways which serve major transportation, commercial and other strategic transport facilities. 2,270 bridges in Massachusetts are on the NHS. Of these, 73 are owned by municipalities and the remainder – 2,167 NHS bridges – are owned by MassDOT. Approximately 44% of Massachusetts bridges are on the NHS; however, over 70% of bridge deck area is on the NHS. Because of the multi-lane facilities which the structures carry, NHS bridges are on average three times the size of non-NHS structures.

Current Condition of NHS and Non-NHS Bridges

FHWA's final rule on bridge performance measures has defined two condition metrics for bridges: **percentage of NHS deck area on bridges that are in good and poor condition**. FHWA defines bridge condition using the nine-point National Bridge Inspection Standards (NBIS) scale, where higher values indicate better condition. "Good" condition begins at a rating of 7, and "Poor" is defined as "structurally deficient" (SD), a rating of 4 or lower. MassDOT has adopted the FHWA performance measure. The distribution of bridge deck area among condition states for NHS and Non-NHS structures is shown in Figure 2.3.

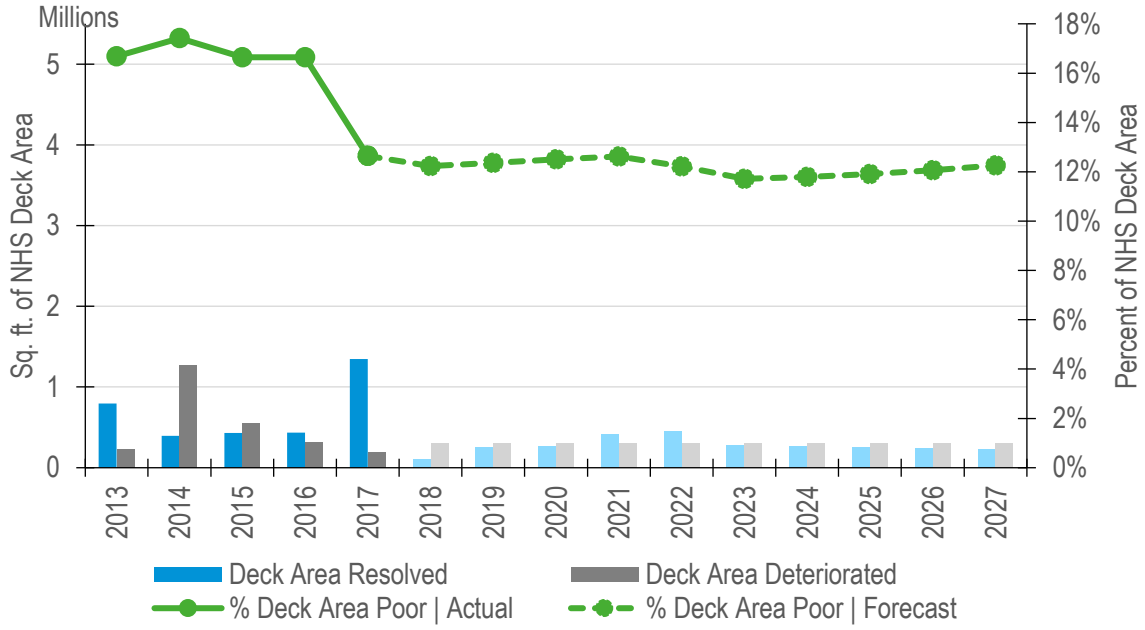
Figure 2.3 Bridge Condition in 2018

Condition State	NHS		Non-NHS	
	NBI Score Range	*% of Deck Area*	*NBI Score Range*	*% of Deck Area*
Good	7 – 10	16%	7 – 10	25%
Fair	5 – 6	71%	5 – 6	67%

Poor	0 – 4	13%	0 – 4	8%

As of November 2018, 12.7% of the NHS bridge area in Massachusetts is rated poor, which exceeds the maximum threshold of 10% identified by FHWA. Exceeding the Federal threshold requires MassDOT to make a minimum investment in bridges – MassDOT has invested above this level since 2008. **At the rate of bridge investment proposed by the 19-23 CIP, MassDOT does not expect to achieve the 10% condition threshold within the next five years, as shown in Figure 2.4.**

Figure 2.4 NHS Bridge Deck Area in Poor Condition | 2013-2027



2.4.3 Tunnels

MassDOT tracks seven structures that are classified as tunnels or that are comprised of tunnels – the Sumner and Callahan Tunnels, the Prudential Tunnel, the CANA Tunnel (City Square in Charlestown), and on the Central Artery: the Ted Williams, I-90 Connector, and Tip O'Neill (I-93) Tunnels.

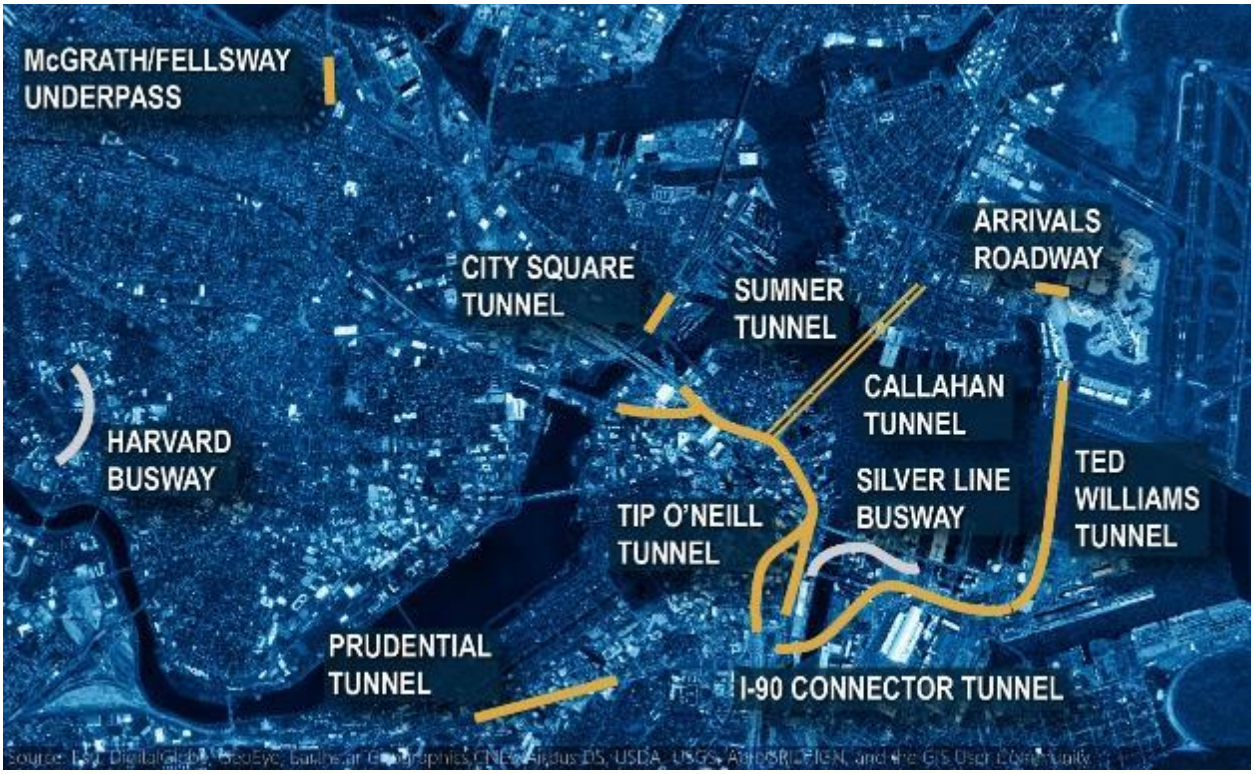
Tunnel assets are identified with "Tunnel Identification Numbers" (TINs). MassDOT tracks TINs owned by several entities, including MassDOT, Massport, MBTA, Boston Properties, the Massachusetts Convention Center Authority (MCCA), and Simon/Copley. Two TINs are "highway transit" tunnels – Silver Line and Harvard Square – both owned and overseen by the MBTA. While the MBTA manages the maintenance and inspection of these tunnels, the inspection data is passed on to FHWA by MassDOT.

Tunnel assets include not only the structural elements of a tunnel (roof, walls, floor, and columns), but also roadway assets (pavement, fencing), and safety/operations assets (ventilation ducts, struts, hanging panels, lighting, pumps,

fire suppression, etc.). Tunnel-related assets also include vent buildings and equipment within them (electrical gear, ventilation fans, and pump stations).

The location of MassDOT's tunnels is shown in Figure 2.5.

Figure 2.5 Tunnels Inspected by MassDOT



Note: Highway tunnels are in gold, "highway transit" tunnels are in silver.

Current Condition of Tunnels

FHWA created National Tunnel Inspection Standards (NTIS) in July, 2015. The NTIS requires biannual inspections and an updated inventory with condition data for all structural and non-structural assets. MassDOT maintains a stricter inspection protocol for overhead elements (annual) and lights (semi-annual). MassDOT has developed a Tunnel Inspection Handbook over the past year that provides an exact location and diagrams for each of MassDOT's tunnels as well as the inspection program's purpose, structure, procedures, inventory management practice, and quality assurance practice.

MassDOT made its first element-level tunnel inspection data submission to FHWA on March 15, 2018. The dataset includes 44 TINs and 65 assets spread across eight more general "elements": structural; civil; mechanical; electrical; fire/life safety/security; and protective systems (against deterioration, not danger). Each asset was assigned a scale unit (feet, square feet, or each). **For each asset and location, inspectors recorded the number of units in each of four condition states, with condition state 1 (CS1) best and CS4 worst and in need of attention.**

Per the requirements of the Metropolitan Highway System (MHS) Trust Agreement, MassDOT has retained a third-party consultant to conduct a Triennial Inspection of the MHS. The MHS consists of the Boston Extension of the Massachusetts Turnpike (I-90), the facilities built by the Central Artery and Tunnel project, the Sumner and Callahan tunnels, and the Tobin Bridge. The triennial inspection will provide an independent determination of the state of good repair of the MHS, including the Tunnels, and make recommendations for capital investments. The report will be filed in the fall of 2018, and the recommendations will be considered in future Capital Programming.

2.5 Highway Division Progress in 2018 and Next Steps

2.5.1 Drainage and Resiliency

Culvert Inventory

The Highway Division began to inventory highway drainage culverts in the spring of 2016 through an innovative process based on record construction plans. Using desktop GIS tools, Highway Staff overlaid aerial photography, roadway centerline, and wetland resource data with scanned construction plans to identify the location, type and size of State-owned culverts. Each Highway District has prioritized the inventory work in descending order of roadway functional classification, beginning with the Interstate system. These data will be used to identify needs for culvert inspection, and ultimately maintenance or replacement.

Going into summer 2018, MassDOT has confirmed 4,957 culverts, estimated at 83% of the statewide inventory of 6,000 (as compared to 70% at this time last year). This inventory is illustrated in Figure 2.7 (next page).

Figure 2.6 MassDOT Culvert Inventory as of Spring 2018

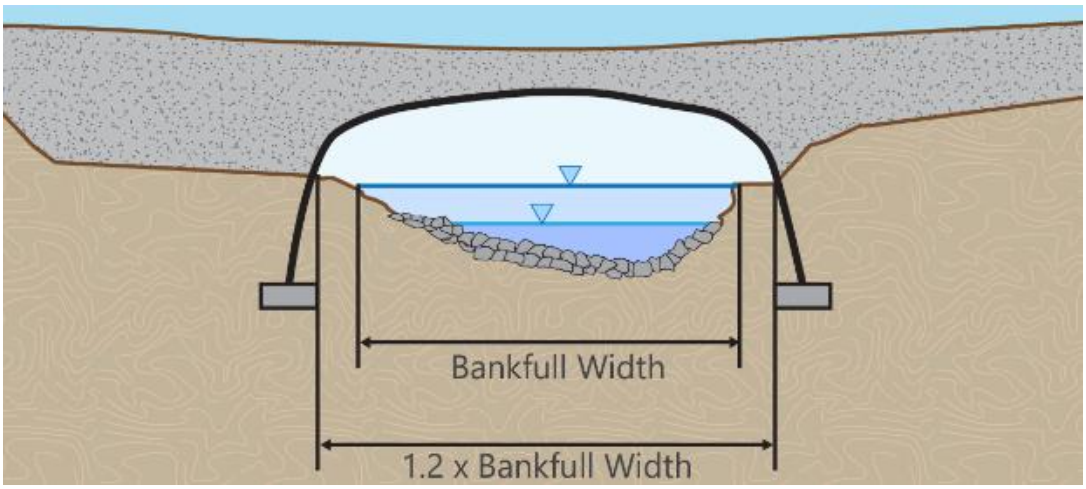
To record the condition of the identified culverts, as well as that of catch basins and manholes, MassDOT has developed a mobile inspection platform: the "Drainage and Utility Collector". Using this tool, inspections can be logged directly from the field. MassDOT is initiating inspections of culverts by first focusing within the limits of upcoming resurfacing projects, making the most of field staff while facilitating the future coupling of culvert and pavement repairs. Figure 2.7 shows a sample of the culvert replacement work MassDOT can accomplish with this information.

Figure 2.7 Example of Culvert Replacement

Statewide Drainage Study

To facilitate the culvert inventory, the Highway Division applied for and was awarded a grant from FHWA to pursue a pilot project for the integration of asset management and extreme weather vulnerability. The FHWA study builds on MassDOT's pilot project in the Deerfield River Watershed and the culvert inspection by incorporating measures of risk under severe weather conditions – the culverts most likely to wash out under riverine flooding. These measures are specific stream power (SSP) and percent bankfull width – the percentage of the stream's 1.5-year maximum width that falls between the culvert's walls (the Massachusetts standard is 120%), as shown in Figure 2.8.

Figure 2.8 MassDOT Standards for Stream Crossing Design



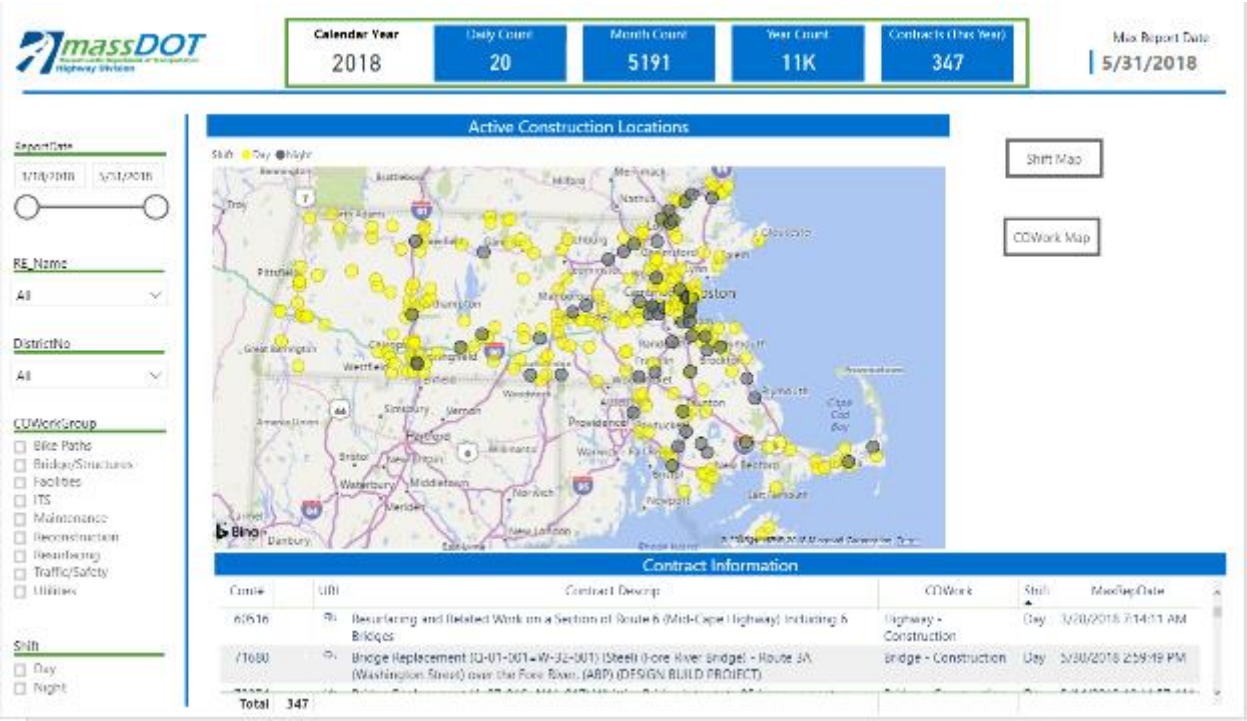
As with the culvert inventory, data from the FHWA study will be integrated into MassDOT's project generation structure through the MaPIT tool – project proponents will be able to easily see if a risky culvert exists within their proposed boundaries.

2.5.2 Data Systems and Business Intelligence

In the past year, the Highway Division has made significant progress in implementing several data systems and business intelligence tools to make its business more efficient and effective. These include:

- **VUEWorks |** VUEWorks is being implemented as the Highway Division's work order management system. It will centralize the management service requests and allow geo-location of work orders so that MassDOT can map where repairs are needed in real time.
- **Construction Field Inspection Application |** MassDOT is replacing its paper field inspection reports and diaries with an online application form. At the end of each day, MassDOT will know where all of its field staff were and what work they oversaw.
- **Business Intelligence Dashboard |** MassDOT is building a business intelligence dashboard in Microsoft PowerBI to draw information from the applications above and other existing datasets into a single map-based access point for staff. Figure 2.9 provides a screenshot of an early draft of this application.

Figure 2.9 Screenshot from the Business Intelligence Dashboard



3. 0 MBTA

According to the National Transit Database The MBTA is the fifth-largest transit property in the United States by unlinked trips, serving approximately one million passengers per day in July, 2018. It is also the most mature, having opened the nation's first subway system in 1897. It operates in 175 communities, and area of over 3,200 square miles, and provides passenger service through multiple modes, including heavy and light rail rapid transit, bus, commuter rail, ferry, and paratransit.

The MBTA submitted a compliant Transportation Asset Management Plan (TAMP) to the Federal Transit Administration (FTA), on October 1st, 2018. As TAMP development is concurrent with this report, this chapter can reference chapters approved by the MBTA Steering Committee. All chapters of the TAMP will be referenced in the 2019 PAMAC Annual Report.

3.1 MBTA Assets

The MBTA's key assets include:

- **Revenue Vehicles |** The MBTA owns and maintains 432 subway (i.e., the Red, Orange, and Blue Lines) revenue vehicles, 209 light rail (i.e., the Green and Mattapan Lines) vehicles, 502 commuter rail locomotives and coaches, 1,022 buses, and 4 ferries. The agency is wholly replacing and expanding the Orange and Red Line fleets by 2030, and has begun visioning for the replacement of the entire Green Line fleet by 2040.
- **Track and Right-of-Way |** The MBTA operates on and maintains 948 miles of track, 293 for subway and light rail and 655 for commuter rail. Its right-of-way assets include 357 revenue grade crossings. Some assets are not within the Commonwealth of Massachusetts but owned and maintained by the MBTA.
- **Power |** The MBTA owns and maintains over 5,000 pieces of power equipment (additional inventory collection in process) to generate and distribute power to its subway, light rail, and trackless trolley systems, as well as to support commuter rail and maintenance facilities. The largest of these assets are substations and two jet turbine backup emergency generators that provide power to evacuate passengers during power outages and that occasionally provide additional power to the City of Boston.
- **Signals |** The MBTA owns and maintains over 38,731 pieces of individual train control and signaling equipment – 37,697 for transit and 1,034 for commuter rail – to ensure the safe movement and control of revenue and non-

revenue service . Federally-mandated Positive Train Control (PTC) implementation will increase commuter rail signaling equipment significantly, as will renewal and expansion of new signaling technology on transit lines.

- **Stations |** Figure 3.1 (next page) illustrates the many assets that are contained within a single station. The MBTA owns and maintains 137 subway stations, 138 commuter rail stations, 176 MBTA bus shelters (487 more shelters are not owned or maintained by the MBTA) out of 7,686 bus stops, and one ferry dock. To maintain accessibility of the system for all customers, the MBTA provides 198 elevators and 178 escalators.
- **Bridges and Tunnels |** The MBTA owns and maintains approximately 230 crossovers, 974 turnouts, 46.2 miles of tunnels, 459 bridges, 1.81 miles of retaining walls and 1,303 Culverts. The MBTA's tunnel assets include walls, utility lines, ceilings, signage, de-watering equipment, ventilation systems, and electrical and lighting systems.
- **Service Vehicles |** The MBTA owns over 1,676 service vehicles (across commuter rail and transit), including general-purpose fleet, operations, and support equipment (e.g., aerial lifts, compressors, cranes, portable signs), operations and support vehicles (e.g., bucket trucks, fuel trucks, snow fighters, tow trucks), and the fleet of the Transit Police.
- **Communications |** The MBTA maintains a state-of-the-art Operations Control Center (OCC) as well as telephone equipment (including emergency phones and intercoms), automated management systems for life safety equipment, systemwide radio, a "wide area network" (i.e., intranet), and public address equipment and electronic signs.
- **Fare Equipment |** The MBTA owns and maintains approximately 1,600 fare boxes, 453 vending machines, and 611 gates. Overall, the automated fare collection (AFC) or "Charlie Card" system accounts for nearly 3,000 assets.
- **Parking |** The MBTA owns and maintains 9 parking garages and 98 parking lots.
- **Facilities |** The MBTA owns and maintains approximately 150 maintenance and administration buildings (as with stations, there are many combinations of assets), layover areas, and fueling and pumping stations across all modes (transit and commuter rail). These include facilities outside of the Commonwealth of Massachusetts, as well as elevators and escalators within these facilities.

FTA is in the process of implementing a requirement that the MBTA submit a full asset inventory to the National Transit Database (NTD) asset inventory module on an annual basis. Approximately 25% of the MBTA's assets are required to be reported for October 2018. The agency has committed to a multi-year plan to add 100% of its asset classes to the submission in October, 2019.

Figure 3.1 Assets in a Typical Transit Station

Architectural
1. Wall System
2. Ceiling Systems
3. Floor Materials
4. ADA Tactile Edging
5. Entrance Canopies
6. Fare Gate Barriers
7. Customer Service Booth
8. Escalators
9. Elevators
10. Elevator Enclosure and Cars
11. Signage and Supports
12. Green Roof
13. Building Façade Design/ Materials
14. Staircases
15. Platform Barriers/Screens
16. Steel Structures
17. Concrete Structures
18. Retaining Walls
19. Slurry Walls
20. Secant Pile Walls
21. Underground Structures
22. Waterproofing
23. Fire Protection/Ratings

Mechanical
24. Heating
25. Air Conditioning
26. Tunnel Ventilation
27. Emergency Exhaust Systems
28. Over-track Exhaust Systems

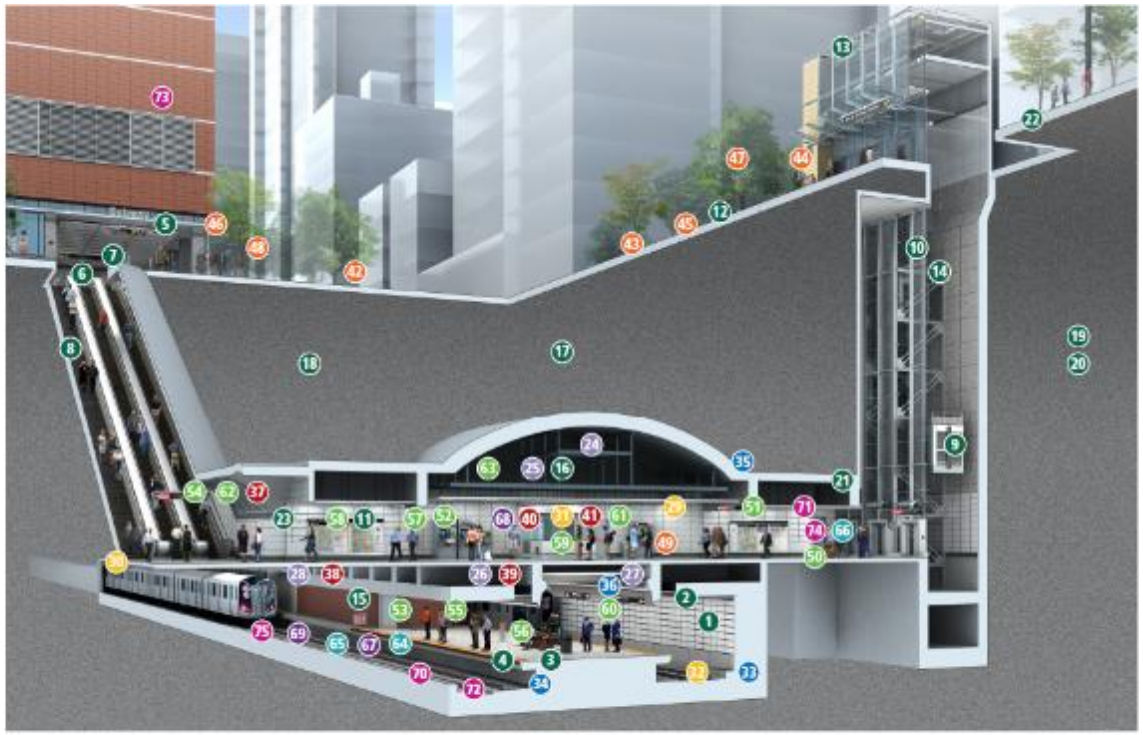
Electrical
29. Decorative/Architectural Lighting Systems in Public Areas
30. Back of House Lighting Systems
31. Electronic Signs
32. Power Systems

Plumbing
33. Sanitary Systems
34. Track Drainage
35. Cavern Drainage Systems
36. Water Supply

Fire Protection
37. Wet Sprinklers
38. Dry Sprinklers
39. Water Mist Systems
40. Halon Systems
41. Inergin Systems

Amenities
42. Street Restoration
43. Sidewalk Restoration
44. Signage
45. Pavement Markings
46. Street Lights
47. Trees and Landscaping
48. Bus Shelters
49. Fare Vending Equipment

Communication Systems
50. Fiber Optic Network
51. CCTV
52. Intrusion Access Control
53. Fire Alarm
54. Public Address and Customer Information Signs
55. Help Point and Safe Point Intercoms
56. Emergency and Office Telephone Systems
57. Mobile Communications Network
58. Supervisory Control and Data Acquisition Systems
59. Emergency Alarm (Blue Light & Emergency Shutdown of 3rd Rail)
60. Emergency Booth Communication Systems
61. Time Clock Synchronization
62. Induction Loop Intercom (ADA wireless system for deaf)
63. WiFi Networks



Track
64. Track Fixation (attachments)
65. Rail
66. Rail Switches and Crossovers

Signal Systems
67. Component Infrastructure
68. Wayside Signal Display Boxes
69. Track Circuit Hardware

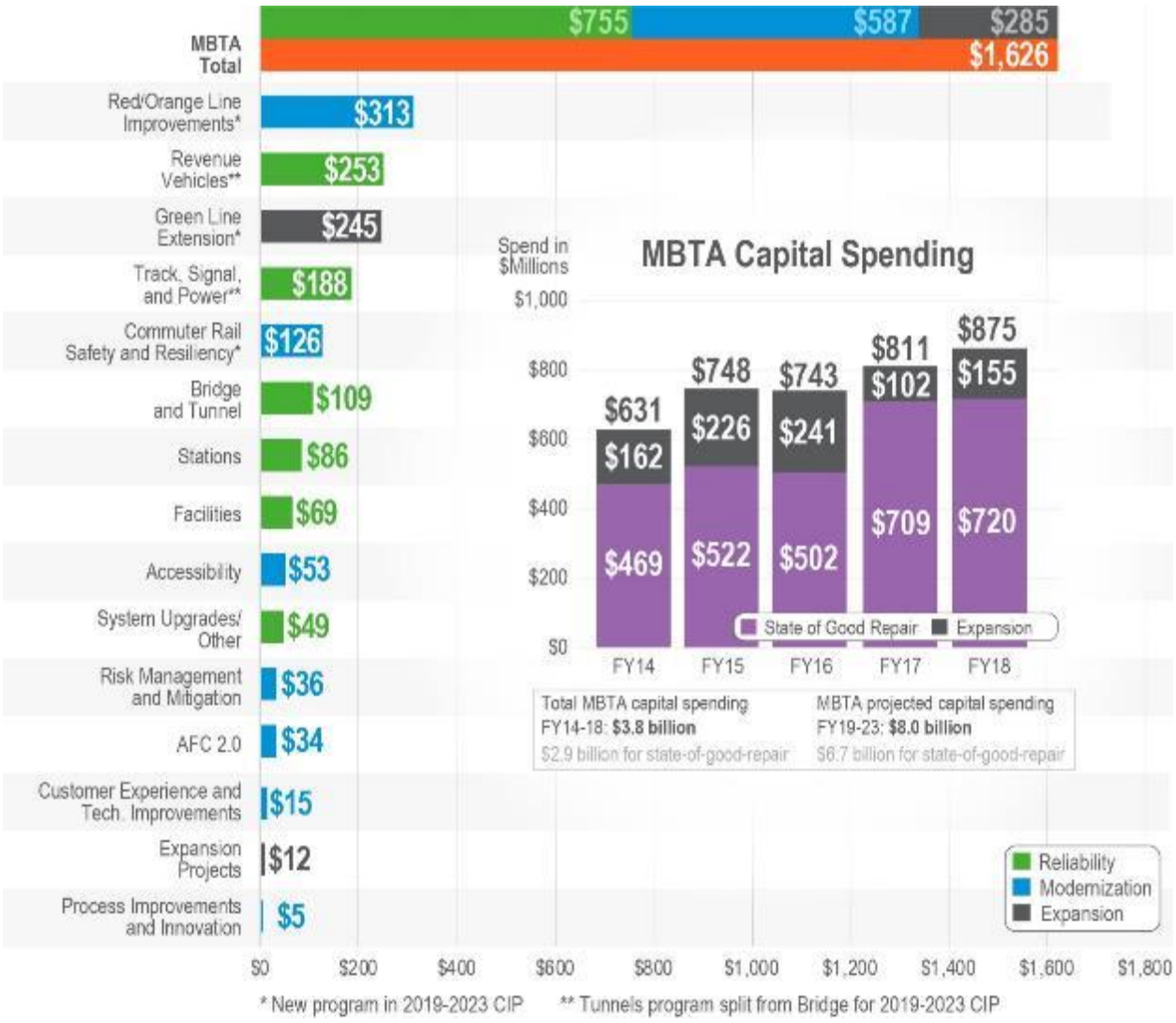
Traction Power
70. Trackbed Infrastructure
71. SCADA Train Control System
72. Third Rail (and third rail material)
73. Substation
74. Power Control Room
75. Regenerative Braking Equipped Railcar

APTA AMERICAN PUBLIC TRANSPORTATION ASSOCIATION

3.2 Investment in the MBTA

Annual average investment in each MBTA capital program the 2019-2023 CIP is shown in Figure 3.2. Note that capital programs do not perfectly align with asset classes. Figure 3.2 shows the planned average annual size of MBTA programs under the 2019-2023 CIP, as well as growth in the MBTA capital program in the years 2014-2018.

Figure 3.2 Average Annual Investment in MBTA Programs, 2019-2023



3.3 Performance and Forecasts at the MBTA

In 2012, MAP-21 mandated FTA to develop a rule establishing a strategic and systematic process of operating, maintaining, and improving public capital assets effectively through their entire life cycle. The TAM Final Rule established age-based measures for rolling stock and equipment, condition-based measures for facilities and

performance-based measures for fixed guideway assets as a minimum annual reporting requirement for transit operators.

The MBTA has produced performance measures and targets for rolling stock (revenue vehicles), equipment (service vehicles, facilities, and infrastructure (track) and has submitted them to FTA in the TAM Plan as of October, 2018.

3.3.1 Performance for Rolling Stock

Per FTA guidance, MBTA calculated the FY 2018 baseline measure for each mode and asset type by dividing the number of vehicles beyond their useful life benchmark by the total vehicles within each category. The FY 2019 performance targets use this baseline as a starting point, accounting for any decommissioning of existing vehicles or commissioning of new vehicles, and reflect the ongoing aging of the revenue vehicle fleet offset by anticipated capital investment in FY 2019.

The MBTA has several major revenue vehicle capital programs underway in FY 2019, including the complete replacement and modernization of the Red and Orange heavy rail fleets, significant replacement of the bus fleet, new Green Line light rail vehicles to support the extension of that line to Somerville and Medford, and a robust fleet program for The RIDE paratransit vehicles. Also during FY 2019, the MBTA Commuter Rail will reintroduce locomotives and coaches that were taken out of service for major rehabilitation. Overall, the MBTA anticipates the summary measure of rolling stock state of good repair will improve seven percentage points from 30% at or beyond useful life benchmark in FY 2018 to 23% at or beyond useful life benchmark in FY 2019. Performance will continue to improve as new Orange Line cars, Red Line cars, buses, and paratransit vehicles are commissioned in FY 2020 and beyond. Rolling stock performance and targets are summarized in Figure 3.3.

Figure 3.3 2018 Performance and 2019 Targets for MBTA Rolling Stock

Percentage of revenue vehicles that have met or exceeded their useful life benchmark (ULB)

Mode	Asset Type	ULB (years)	2018 Measure	2019 Target
Bus	Bus	14	25%	25%
Light Rail	Light Rail Vehicle	31	46%	41%
Heavy Rail	Heavy Rail Vehicle	31	58%	56%
Commuter Rail	Commuter Rail Locomotive	39	27%	24%
	Commuter Rail Passenger Coach	39	0%	0%
Ferry	Ferryboat	25	0%	0%
Paratransit	Automobile	6	46%	3%
	Minivan	7	0%	0%
	Van	7	29%	13%
Total			**30%**	**23%**

3.3.2 Performance for Equipment

Per FTA guidance, MBTA calculated the FY 2018 baseline measure for each mode and asset type by dividing the number of vehicles beyond their useful life benchmark by the total vehicles within each category. The FY 2019 targets use this baseline as a starting point, accounting for any decommissioning of existing vehicles or commissioning of new vehicles, and reflect the ongoing aging of the non-revenue vehicle fleet partially offset by the impact of anticipated capital investment in FY 2019. The MBTA chose to use agency-specific useful life benchmarks for non-revenue vehicles rather than the default values set by the FTA. The agency-specific ULB for each asset type varies depending on the function and purpose of the vehicle. Some equipment is stored indoors and used sporadically, and therefore can perform adequately even if well beyond its ULB.

The MBTA will initiate a new non-revenue vehicle procurement in FY 2019. However, a greater number of vehicles will exceed their useful life benchmark in FY 2019, which results in an overall increase in the percentage of non-revenue vehicles exceeding ULB. Overall, the MBTA anticipates the summary measure of equipment state of good repair will degrade two percentage points from 20% at or beyond useful life benchmark in FY 2018 to 22% at or beyond useful life benchmark in FY 2019.

The Non-Revenue Vehicle capital program is focused on replacing highest impact vehicles, including those used for winter response and track maintenance, which may not always be the oldest vehicles in the fleet. This means that our measures may degrade, even though capital investment is underway. Equipment performance and targets are summarized in Figure 3.4.

Figure 3.4 2018 Performance and 2019 Targets for MBTA Equipment

Percentage of service vehicles that have met or exceeded their useful life benchmark (ULB)

Mode	Asset Type	ULB (years)	2018 Measure	2019 Target
Transit	Automobile	varies	22%	22%
	Other Rubber Tire Vehicle	varies	25%	29%
	Steel Wheel Vehicle	varies	38%	38%
Commuter Rail	Automobile	varies	12%	17%
	Other Rubber Tire Vehicle	varies	12%	13%
	Steel Wheel Vehicle	varies	33%	33%
MBTA-Wide	Automobile	varies	20%	21%
	Other Rubber Tire Vehicle	varies	19%	21%
	Steel Wheel Vehicle	varies	34%	34%
Total			**20%**	**22%**

3.3.3 Performance for Facilities

Consistent with FTA guidance, the MBTA is undertaking physical condition assessments of all facilities and will only report condition ratings for approximately 41 percent of these facilities in the NTD submission. In order to develop performance targets, the MBTA segmented facilities between those that have a baseline condition assessment to report in the FY 2019 NTD submission and those for which condition assessments are still underway. Due to the ongoing nature of these assessments, performance measures and targets, and in line with the guidance provided by the NTD, the MBTA is only setting targets for the facilities that have undergone an on-site assessment.

Per FTA guidance, MBTA calculated the FY 2018 baseline measure for each category by dividing the number of facilities with a TERM score below a three by the total number of facilities in that category that had a completed baseline condition assessment in FY 2018. The FY 2019 targets use this baseline as a start point and reflect anticipated capital investment in FY 2019 only for facilities with a baseline condition assessment. Targets for the remainder of the system will be set once all facility condition assessments are completed.

The MBTA has several major capital projects underway at passenger, parking, maintenance, and administrative facilities. The targets reflect improved performance due to investments in parking garages and maintenance facilities during FY 2019, particularly through a roof repairs program. Facilities performance and targets are summarized in Figure 3.5.

Figure 3.5 2018 Performance and 2019 Targets for MBTA Facilities

Percent of facilities rated below 3 on the FTA TERM-Lite 5-point condition scale

Asset Type	Baseline Condition Assessment?	2018 Measure	2019 Target
Passenger/Parking Facilities	Assessed	13%	11%
	Not Assessed	In progress	TBD
	Subtotal	In progress	TBD
Administrative/Maintenance Facilities	Assessed	68%	63%
	Not Assessed	In progress	TBD
	Subtotal	In progress	TBD
Total		**In progress**	**TBD**

3.3.4 Performance for Infrastructure

Per FTA guidance, MBTA calculated the FY 2018 baseline measure for each category by dividing the annual average track miles with performance restrictions by the total directional route miles for each category. The FY 2019 performance targets use this baseline as a starting point, and reflect a modest improvement to performance due to anticipated capital investment in FY 2019.

The MBTA has several track renewal and rehabilitation programs underway, including full depth reconstruction of a segment of the Green Line - D Branch and track infrastructure improvements to the Orange, Green, and Red Lines.

The Commuter Rail has a continuous track program to maintain temporary speed restrictions below one percent. However, it is important to acknowledge that several uncontrollable factors may cause unanticipated performance restrictions, including winter storms and other extreme weather. Infrastructure performance and targets are summarized in Figure 3.6.

Figure 3.6 2018 Performance and 2019 Targets for MBTA Infrastructure

Percentage of track segments with performance restrictions

Mode	Asset Type	2018 Measure	2019 Target
Transit	Heavy Rail Fixed Guideway	12%	11%
	Light Rail Fixed Guideway	9%	8%
Commuter Rail	Commuter Rail Fixed Guideway	1%	1%
Total		**2%**	**2%**

3.4 MBTA Progress in 2018 and Next Steps

3.4.1 Transit Asset Management Plan and Performance Targets

Pursuant to the Final Rule, in 2017 the MBTA established performance baselines and reported performance targets for rolling stock, equipment, facilities, and fixed guideway assets (e.g., track, signals, power, tunnels, bridges, and right-of-way). In doing so, the Authority drew on its experience that age-based methodology is not a suitable proxy for condition across all asset types and was not reflective of the level of investment, environmental factors, usage and current maintenance practices employed.

The agency will draw on newly collected and validated asset inventory and condition data (utilizing the FTA Guidebooks as a minimum standard for establishing condition) to establish new performance measures and targets in 2019. The MBTA will also establish more refined Asset Management Condition Assessment standards for each asset type to ensure consistent condition assessments.

The MBTA is developing the TAMP as required by the FTA Final Rule (due October 1, 2018). This project is a critical priority for the MBTA in 2018 and 2019 and will help to drive decisions regarding asset management policies, approaches, and tools across the organization.

The 11 sections of the MBTA TAMP are as follows:

1. **Introduction |** Background, plan objectives, and Federal requirements.
2. **Asset Management Policy |** Guiding principles for the MBTA's asset management capability.
3. **Asset and Asset Management Performance |** Links between customer service and technical performance.
4. **Asset Portfolio |** Current infrastructure asset portfolio, with its condition.

5. **Risk Management |** Risk definitions, management options, and monitoring approach.
6. **Lifecycle Management Strategies |** Approaches including maintenance, overhaul, and replacement.
7. **Work Plans and Budget Forecasts**
8. **Asset Management Practices |** Organizational structure, business processes, and technology.
9. **Improvement Actions |** Individual actions and program for continuous improvement.
10. **Interdependencies |** Internal (MBTA departments) and external entities (e.g. Amtrak, MassDOT, and others).
11. **Appendices |** Further information on each asset class, lifecycle strategies, and unconstrained work plans to achieve a state of good repair.

In parallel with the TAMP, the MBTA is also developing a TAM Improvement Program, consisting of recommended improvements to the agencies TAM business practices in alignment with global best practices and international standards.

3.4.2 Asset Management Governance

The MBTA has established an Asset Management Governance Board consisting of senior MBTA leadership to complement PAMAC to define, enforce, and resource the TAM program throughout the agency. This council consists of representatives from across the MBTA, including the General Manager, the Deputy General Manager, and all key leadership direct reports.

Guiding the MBTA's asset management program, plans, and strategies are seven core principles aligned to each of the organization's strategic objectives and priorities:

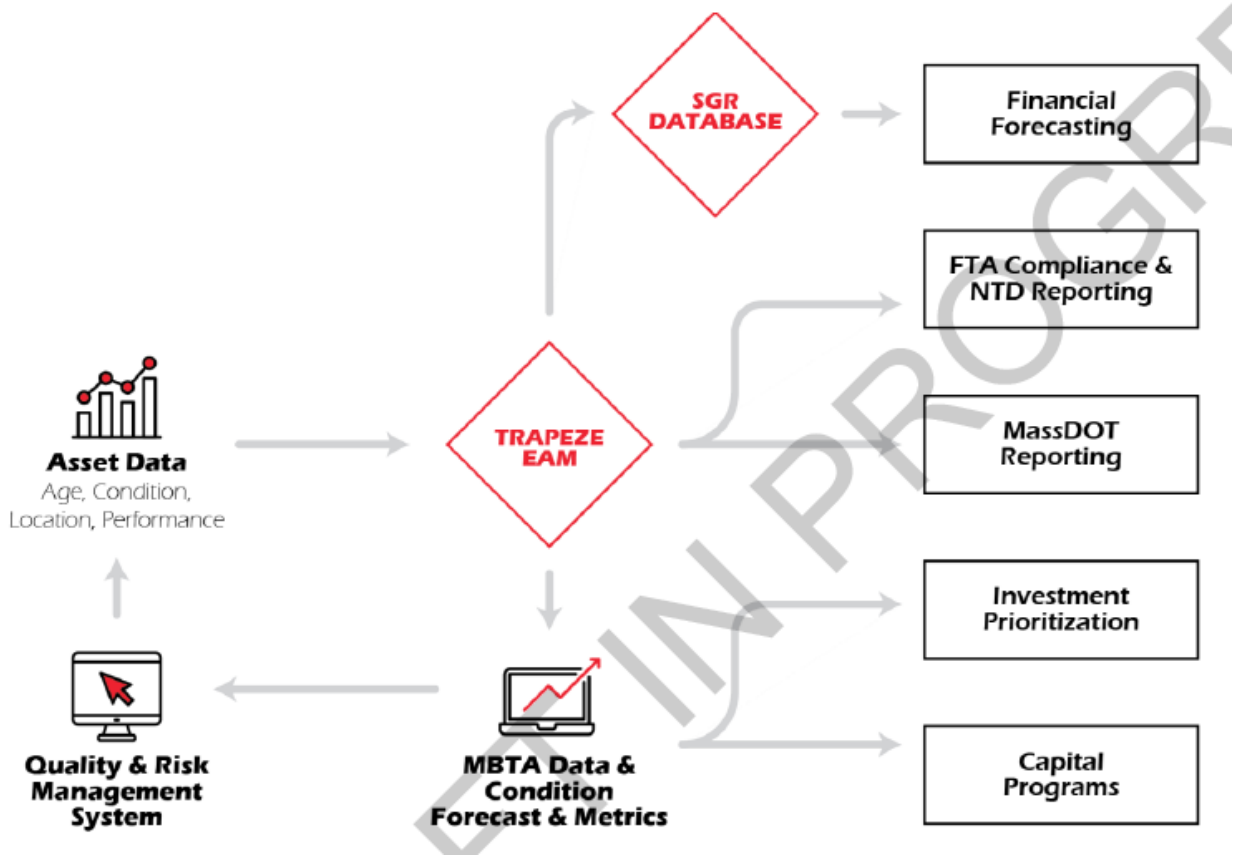
- **Focus on State-of-Good Repair |** We will work to bring all of the MBTA's assets, including fleets and facilities, to a state-of-good-repair within 15 years.
- **Transparency |** We will ensure that all decisions are data-driven, transparent, and consistent, enabling us to clearly demonstrate the prioritized investments across asset classes.
- **Efficient and Effective Delivery |** We will work to meet or exceed service delivery goals by ensuring necessary work to maintain service is undertaken for all MBTA assets and opportunities for improving service delivery are considered.
- **Cognizance of Risk |** We will effectively identify, prioritize, and manage asset and asset-related risks, including safety, reliability, financial, performance, and climate-related risk.
- **Fiscal Responsibility |** We will continue and sustain the MBTA's fiscal discipline by optimizing available resources through lifecycle management, reliability-centered maintenance, business process improvements, and the adoption of other best practices.

- **Social Responsibility |** We will work to build the confidence and trust of all internal and external stakeholders demonstrating good practice in all we do.
- **Industry Leadership |** As one of the largest agencies in the US, we will work to both achieve compliance with Federal and State requirements and serve as a leader among peer agencies.

3.4.3 Asset Management Data Systems

In addition to the NTD submission, the MBTA maintains four internal asset management databases: the State of Good Repair (SGR) Database, which computes the MBTA's backlog, and the Enterprise Asset Management System (EAMS) for infrastructure (currently being implemented), the Transit Vehicles Asset Management System, and the Commuter Rail Asset Management System, which tracks inventory and condition for major physical assets. The MBTA completed Phase 1 of the EAMS rollout in March 2018 and expects to complete Phase 2 by the end of December, 2019. The long-term vision is to combine all databases to develop a single Enterprise Asset Management System, as illustrated in Figure 3.7.

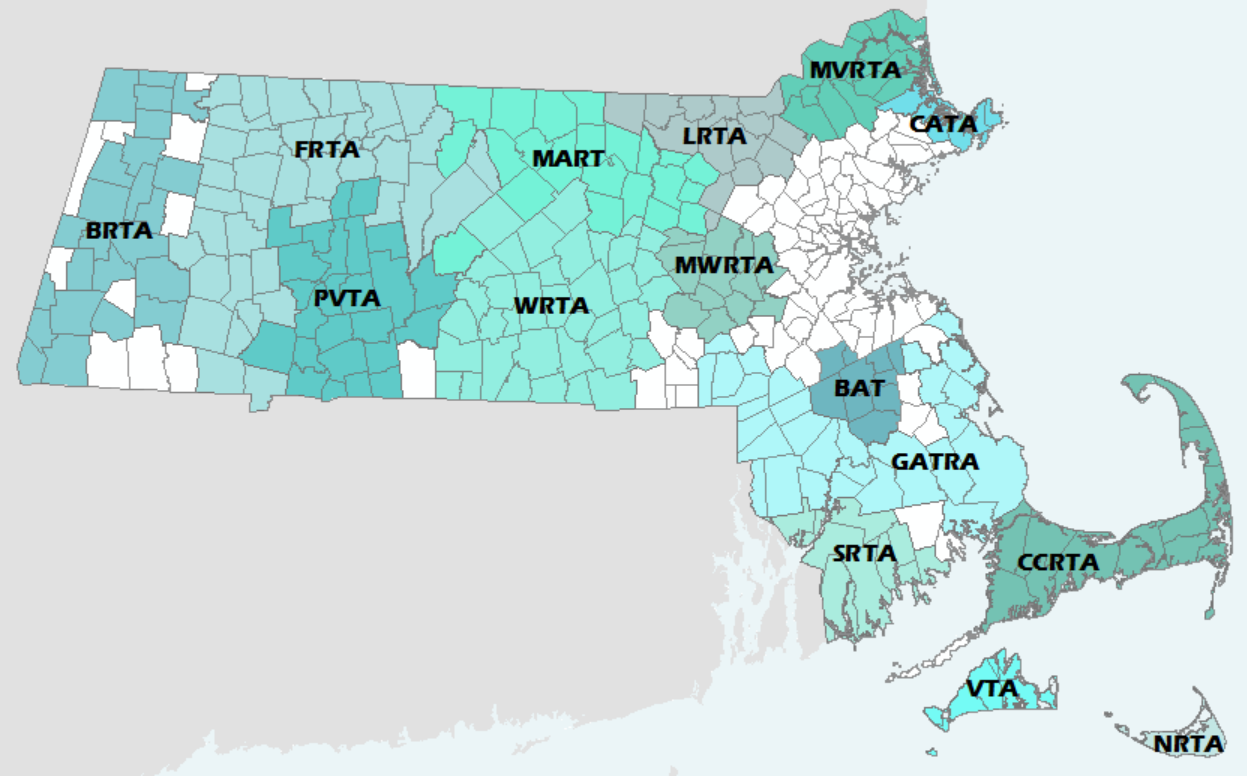
Figure 3.7 Proposed Management System for Existing Assets and Data Process Flow



4. 0 Rail and Transit Division

The MassDOT Rail and Transit Division oversees and funds the rail and transit networks outside of the MBTA's service area. It both owns and oversees railroad used for passenger and freight service. It also collaborates with 15 regional transit authorities (RTAs) that use buses, vans and paratransit vehicles to provide 29 million annual passenger trips on 282 routes in 231 communities. A map of the RTA's service area is provided in Figure 4.1.

Figure 4.1 Regional Transit Authorities (RTAs) in Massachusetts



The Rail and Transit Division also administers Federal Transit Administration (FTA) Section 5310 Enhanced Mobility of Seniors and Individuals with Disabilities funds and state Mobility Assistance Program (MAP) funds through the annual Community Transit Grant Program (CTGP). Recipients of this funding include the RTAs, private non-profit organizations, municipal governments, and private taxi services (including Uber and Lyft).

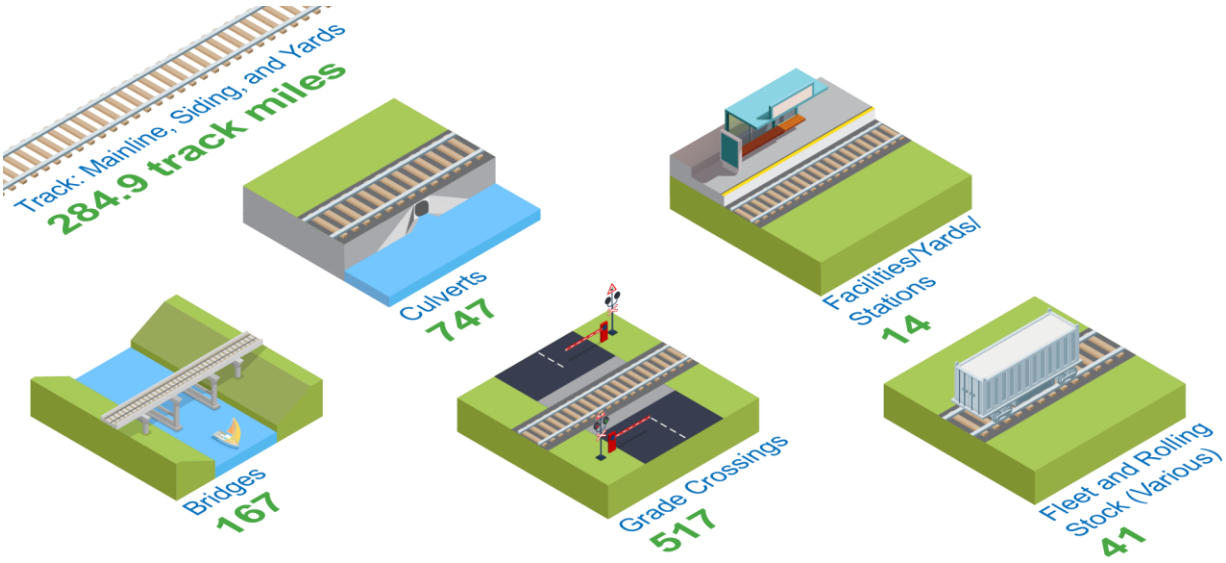
4.1 Rail and Transit Division Assets

4.1.1 Rail Assets

The Rail and Transit Division assets include 285 route-miles of active rail across 10 lines. Assets on these lines include track and right-of-way, switches, bridges, culverts, grade crossings, signals and yards, facilities and stations. In addition, the Rail and Transit Division owns a small fleet of surplus MBTA locomotives and carriages that are used for passenger rail pilots, and as substitute vehicles for the MBTA.

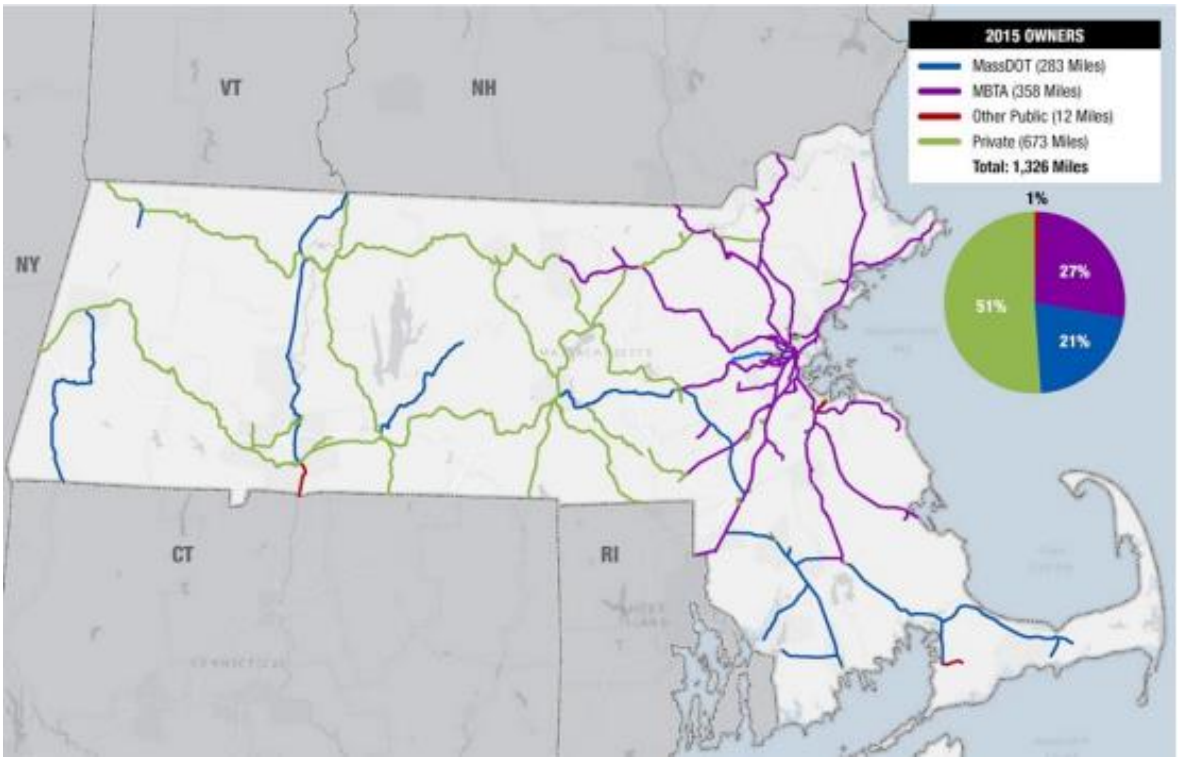
The Rail and Transit Division maintains an Excel-based inventory of its rail lines including track, switches, bridges, culverts, grade crossings, facilities, and various types of rolling stock including ballast cars and rail maintenance vehicles. A count of each of the major asset classes is provided in Figure 4.2.

Figure 4.2 Inventory of MassDOT Rail Assets



Overall, 58% of the active railroad system in Massachusetts is publicly-owned (25% MassDOT, 32% MBTA, 1% MWRA/Amtrak/Federal). The owners of rail in Massachusetts is shown in Figure 4.3.

Figure 4.3 Ownership of Active Rail Lines in Massachusetts



4.1.2 Transit Assets

Transit assets overseen by MassDOT include:

- **Vehicles for mobility assistance |** The Community Transit Grant Program (CTGP) utilizes Section 5310 and Mobility Assistance Program (MAP) funds to purchase accessible vehicles to meet the statewide needs of seniors and persons with disabilities (operated by the RTAs, Council on Aging and eligible non-profit organizations). In general, these vehicles are vans or cutaway (short) buses.
- **Intercity buses |** MassDOT owns a fleet of intercity buses that are operated by private companies to improve regional and intercity transportation throughout the Commonwealth.
- **RTA assets |** The 15 RTAs own revenue vehicles (for fixed-route and demand response service), non-revenue vehicles and facilities.

As recipients of Federal funding, MassDOT and the RTAs must complete a Transit Asset Management (TAM) plan including an inventory of capital assets by October 2018. Asset inventories must include rolling stock, facilities and equipment (non-revenue support-service vehicles, maintenance vehicles and equipment over $50,000 in acquisition value). Condition assessments must be included for any asset for which an agency has direct capital responsibility. MassDOT uses the GrantsPlus grant tracking software to keep this inventory for mobility assistance vehicles and intercity buses.

Several RTAs have adopted TransAM, an open-source asset management platform for managing transportation assets. The system contains an inventory of revenue and support vehicles, facilities and equipment, including age and condition, and can forecast SGR and compute backlog. Other RTAs have adopted and implemented other tools and strategies to meet Federal requirements.

4.2 Investment in the Rail and Transit Division

4.2.1 Investment in Rail

MassDOT's investment in rail in 2018 has produced notable results. Some examples of particularly visible investments include:

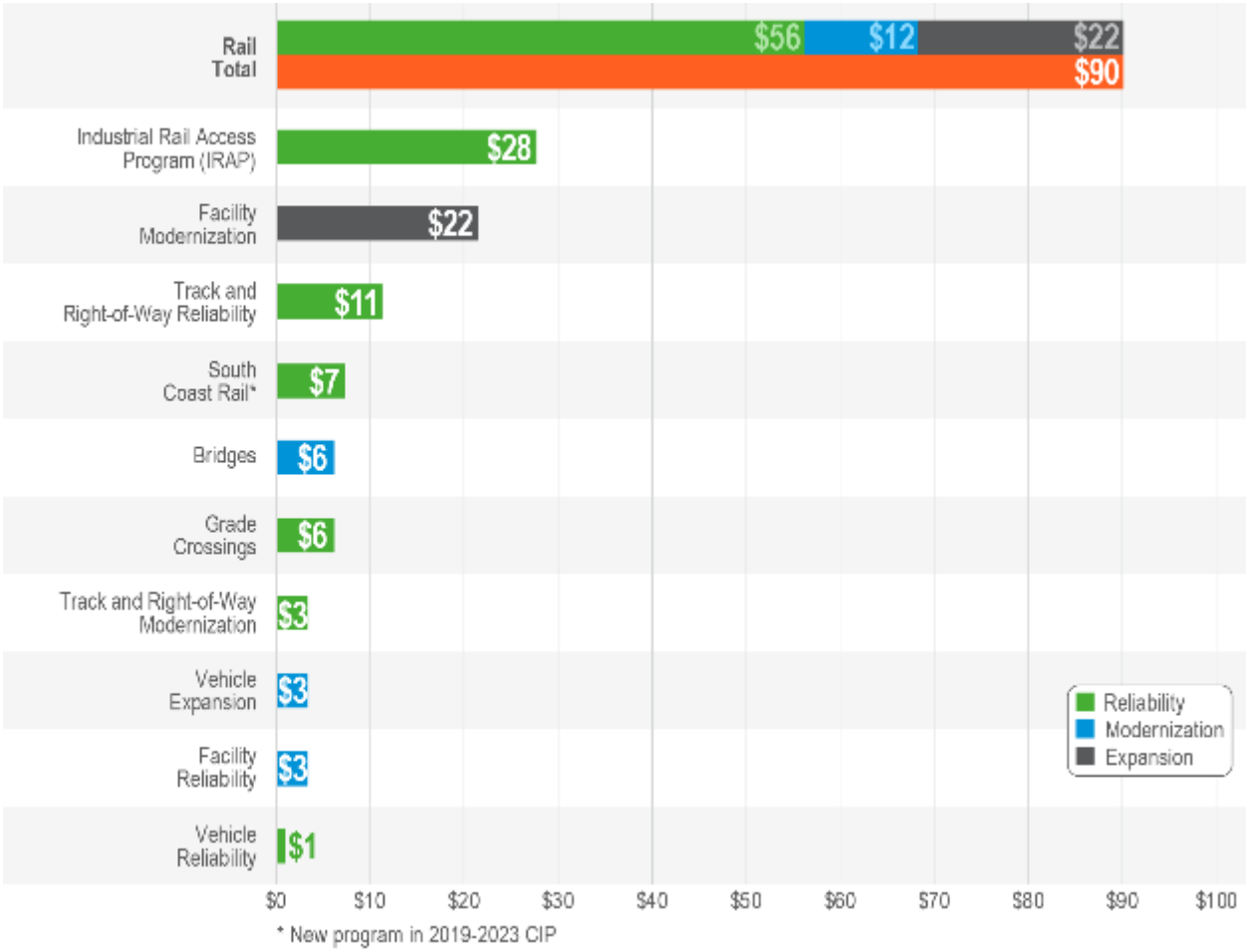
- **Framingham/Middleborough Line Improvements |** Since purchasing the Framingham/Middleborough Line in 2015, MassDOT has embarked on an aggressive improvement program, including track replacement, culvert replacement, bridge improvement, and grade crossing improvement and replacement. Taken together, this program has raised the line to Class III and to a load rating of 286,000 lb per car ("286K"), the national standard for freight rail. In addition, a section of the line has been prepared for use by a pilot MBTA service to Foxborough and nine miles have been de-stressed with joint elimination work.
- **Industrial Rail Access Program (IRAP) |** MassDOT has recently awarded its sixth round of IRAP funding. IRAP is a public-private partnership that combines funding to help eligible applicants invest in industry-based freight rail infrastructure improvement projects. The goals of the program are to stimulate economic development, grow Massachusetts corporations, keep manufacturing jobs and create new jobs through increased efficiency, production capacity, and improved distribution logistics. IRAP VI will invest $1.8 million in public funds – matched to $2.4 million in private funds – in five projects:
  - Western Recycling Rail Spur Project | **Wilbraham** | $500,000.
  - Middlesex Corporation Concrete Plant Siding Restoration | **Littleton** | $500,000.
  - Patriot Beverage/Injection Molding Enterprise Siding Extension Project | **Littleton** | $500,000.
  - Rousselot Gelatin Rail Extension Project | **Peabody** | $221,640.
  - Grafton and Upton Railroad Bulk Liquid Transloading Railyard Expansion Project | **Upton** | $133,045.
- **Eastern Massachusetts Capital Improvements |** MassDOT recently completed the following capital improvements throughout the eastern part of the Commonwealth:
  - Installed 73,459 new ties and 1,684 switch timbers.
  - 50,170 tons of ballast and 212,243 track-feet of tamping/surfacing.
  - Crossing reconstruction was completed at 12 locations.
  - 3,400 TF of track reconstruction completed .

- Bridge repairs were completed on the Framingham Secondary and the Middleboro Subdivision.
- Four culvert replacement were completed along the Watuppa Branch.

- **Western Massachusetts Capital Improvements |** MassDOT recently completed the following capital improvements throughout the western part of the Commonwealth:
  - Knowledge Corridor | Installed 5,000 ties, installed 1 mile of CWR, installed 3 turnouts, surfaced 5 miles of track, inspected 10 bridges and completed 30 miles of brush cutting.
  - Berkshire Line | Installed 1,000 ties, installed timber bridge caps at 2 bridges, inspected 130 culverts, 53 public and private grade crossings, completed 37 miles of brush cutting and rehabilitated 1 grade crossing.
  - Adams Branch | Installed 1 mile of track and completed 8 miles of brush cutting.

Annual average investment in each Rail capital program 2019-2023 CIP is shown in Figure 4.4. Note that capital programs do not perfectly align with asset classes.

Figure 4.4 Average Annual Investment in Rail Programs, 2019-2023 CIP



4.2.2 Investment in Transit

MassDOT's investment in transit in 2018 has produced notable results. Some examples of these investments include:

- **FY18 RTA Vehicle Replacement |** MassDOT contributed $14.5 Million to replace 179 RTA vehicles (136 buses and 43 minibuses).
- **SFY18 CTGP Vehicle Replacement |** MassDOT awarded 153 replacement vehicles to RTAs, private non-profit organizations and municipal governments.

Annual average investment in each Transit capital program 2019-2023 CIP is shown in Figure 4.5. Note that capital programs do not perfectly align with asset classes.

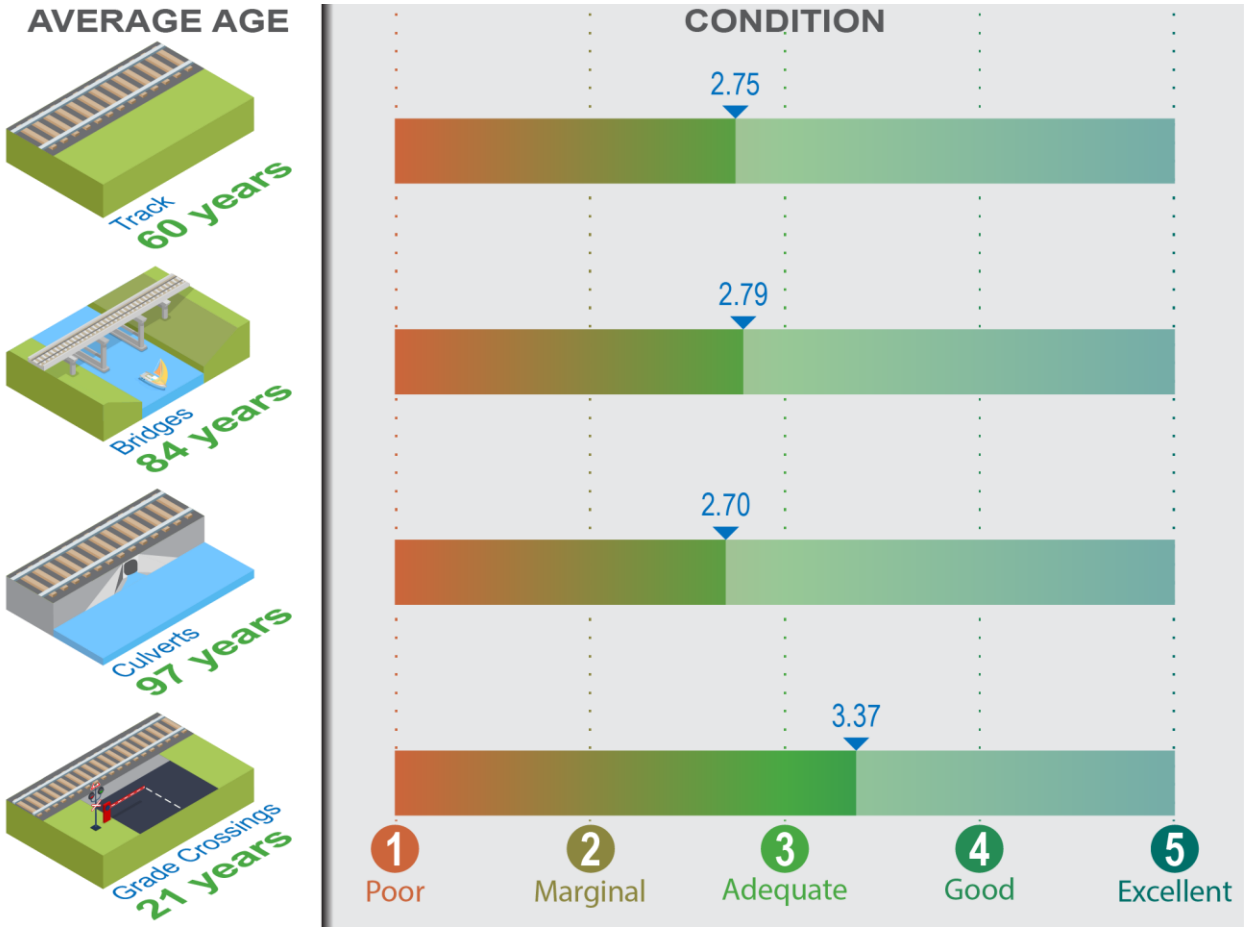
Figure 4.5 Average Annual Investment in Transit Programs, 2019-2023 CIP

4.3 Asset Performance and Forecasts in the Rail and Transit Division

4.3.1 Performance and Forecasts for Rail

MassDOT has reviewed and refined existing rail inventory and condition data to perform an initial assessment of its current portfolio. The condition evaluation considered a variety of factors as available including: age, maintenance history, visual assessment, and remaining life. Based on preliminary analysis, MassDOT has profiled the average age and condition of its assets and will be developing estimated funding forecasts, as summarized in Figure 4.6.

Figure 4.6 Performance of MassDOT Rail Assets

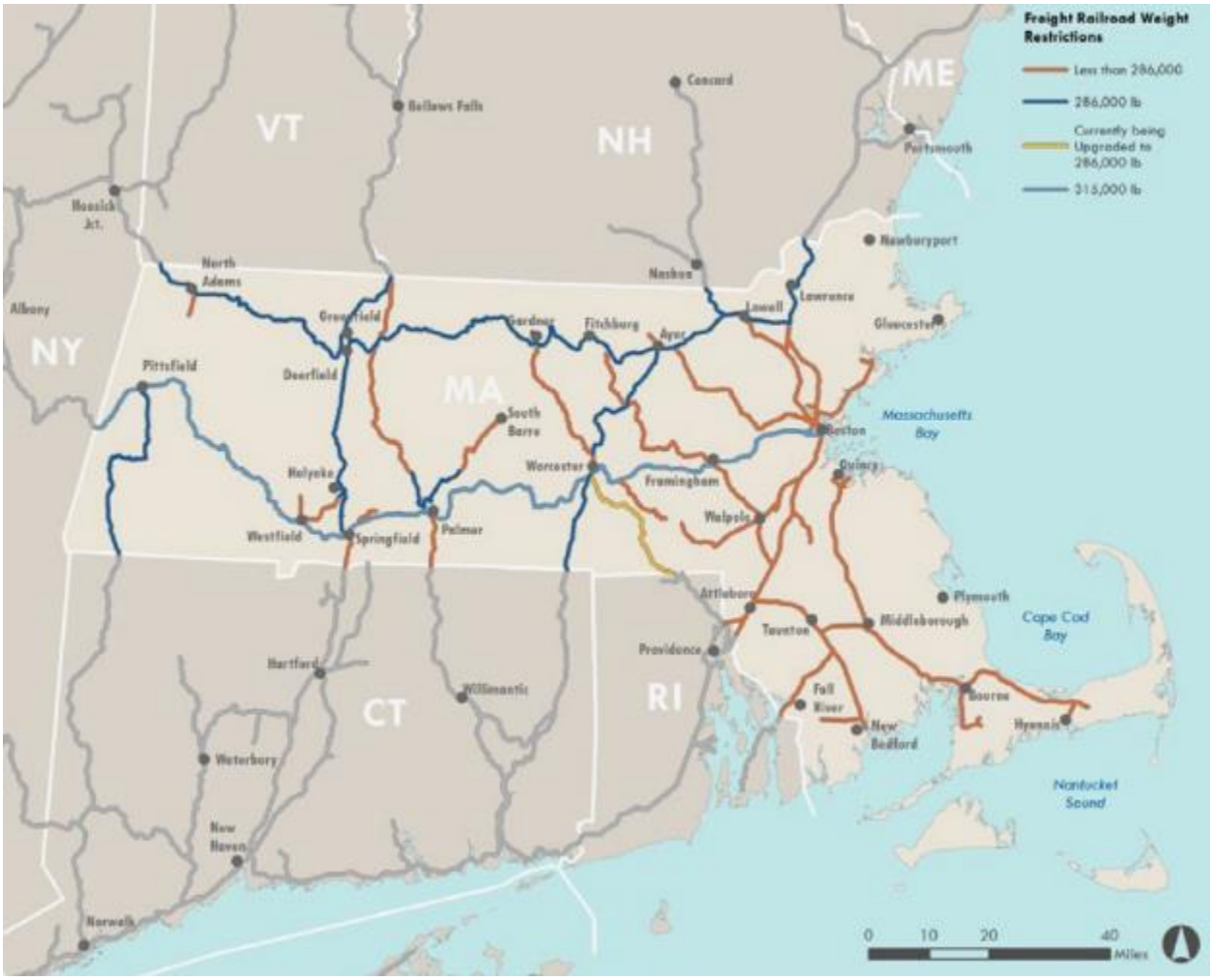


Through future asset management planning efforts, MassDOT will be developing more formal condition assessment criteria to provide more refined analysis and decision-making criteria and guide ongoing evaluation and prioritization of renewal needs.

At the segment and line level, passenger corridors are rated for speed, while freight corridors are rated for weight. Both are rated for height clearance. Given that limited passenger service occurs on MassDOT-owned lines, the Department's principal rating concern is weight. MassDOT has a goal of raising all its freight rail lines to a rating of 286,000 lb cars, ("286k") the national standard. While major cross-Commonwealth corridors typically meet or exceed this threshold, secondary lines, branches, spurs, and other lines with economic potential are currently rated at 263,000 lb cars. Industrial customers on these lines must therefore use cars that are only partially filled, necessitating more cars and higher costs relative to highway trucking.

A map of the weight ratings on freight lines in Massachusetts is provided in Figure 4.7.

Figure 4.7 Freight Rail Lines in Massachusetts by Weight Rating



4.3.2 Performance and Forecasts for Transit

MassDOT and the RTAs are required to develop Transit Asset Management (TAM) plans and submit their performance measures and target to the National Transit Database (NTD) by October 2018. The specific TAM Plan elements that are required depend on the category of provider (Tier I or II).

In 2012, MAP-21 mandated FTA to develop a rule establishing a strategic and systematic process of operating, maintaining, and improving public capital assets effectively through their entire life cycle. The TAM Final Rule established age-based measures for rolling stock and equipment, condition-based measures for facilities and performance-based measures for fixed guideway assets as a minimum standard for transit operators.

Performance of MassDOT Transit Assets

MassDOT holds the title for mobility assistance vehicles and intercity buses, though they are all operated by others. MassDOT has defined a ULB of 5 years/100,000 miles (whichever comes first) for vans and 7 years/150,000 miles for

cutaways (whichever comes first). By rule, MassDOT does not hold title for vehicles older than these benchmarks – the title is released to the operator. To reflect this practice, MassDOT has set a performance metric of **0% of MassDOT transit revenue vehicles exceed ULB.**

4.4 Rail and Transit Division Progress in 2018 and Next Steps

4.4.1 Continued Development of Rail Asset Management

In 2017 and 2018, MassDOT has developed a full inventory and condition database for its rail assets. In 2019, MassDOT will further develop its rail asset management practice by evaluating performance measurement approaches and forecasting opportunities. In addition, MassDOT is working to hire project managers who will identify improvements that are necessary on lines, advocate for resources, and manage improvement projects through completion.

4.4.2 Completion of Transit Asset Management Plans and Targets

MassDOT and the RTAs will complete TAM Plans by October, 2018. Information in these plans will be reviewed and presented to the Council, along with performance targets, in the 2019 PAMAC Annual Report.

5. 0 Aeronautics Division

The MassDOT Aeronautics Division is a steward for 36 public use airports across the Commonwealth. The Massachusetts Port Authority (Massport) owns and operates Boston Logan International Airport, Hanscom Field, and Worcester Regional Airport independently of MassDOT. In addition to the public use facilities, the Aeronautics Division oversees a variety of private landing strips, seaplane bases, and heliports.

While the Aeronautics Division performs top-down planning and makes recommendations to individual airports, it does not own facilities; 22 of the public-use airports under its purview are managed by cities and towns, while 14 have private owners. MassDOT provides grants of mostly Federal aid to airports through the CIP process. Publicly owned airports can also apply directly to the FAA Airport Improvement Program (AIP) for projects identified and justified in master plans, environmental analyses, airport inspections and financial evaluations.

5.1 Aeronautics Division Assets

The Aeronautics Division does not directly own assets but funds improvements to airports in response to performance metrics.

- **Airport Pavement |** The Federal Aviation Administration (FAA) will fund pavement projects on runways, taxiways, and aprons based on their existing condition and useful service life. Airports overseen by MassDOT own over 40 million square feet of pavement.
- **Vegetation Management Areas |** Airports receive funding to clear hazards to flight (trees and brush) from areas in and adjacent to runway approaches.
- **Fencing and Gates |** MassDOT encourages that airports install fencing and gates around areas where aircraft operate and at other sensitive areas (e.g., fuel farms) located on airport property.
- **Security Upgrades |** Security at airports is essential to ensure the safety of the traveling public. MassDOT suggests that airports with commercial passenger service install video surveillance cameras at access points among other upgrades as funding permits.
- **State Airport Administration Buildings |** MassDOT funds the rehabilitation of general aviation administration buildings, which often serve both customer service and operational functions.

5.2 Investment in the Aeronautics Division

Massachusetts relies heavily on matching grants from the FAA's AIP, as do all states. Recognizing that not all airport sponsors are eligible for Federal funding, MassDOT initiated the Airport Safety and Maintenance Program (ASMP), which can provide state-funded grants-in-aid to close the funding gap for these sponsors.

The ASMP serves to leverage funds for safety, maintenance, and security projects that have been selected for the CIP. ASMP typically supports a state share of 80% and a local airport share of 20% with no Federal participation. These projects are often routine maintenance that address deficiencies noted in MassDOT airport inspections (such as pavement condition, security issues and vegetation overgrowth). Airport planning, new construction and equipment grants are also eligible.

Planned annual average investment in each asset class from 2019-2023 is shown in Figure 5.1.

Figure 5.1 Average Annual Aeronautics Division Capital Investments, 2019-2023

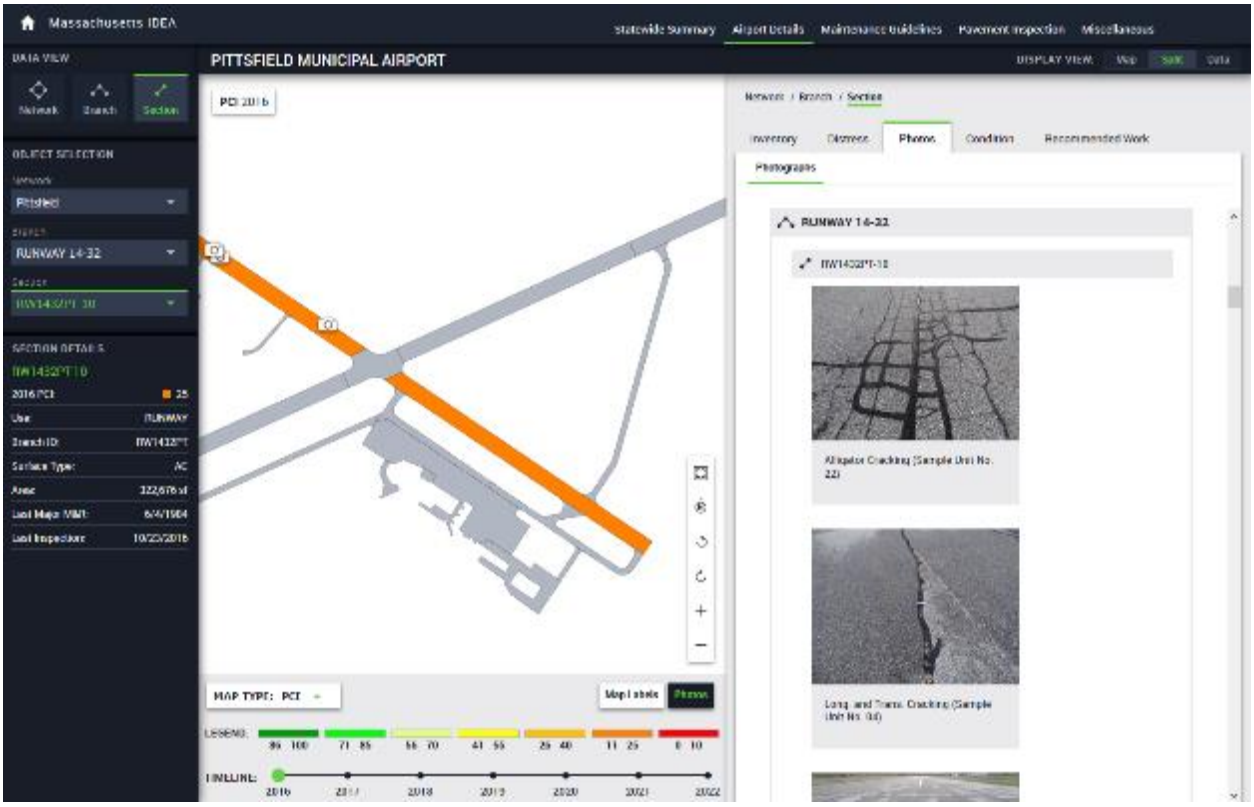
5.3 Asset Performance and Forecasts in the Aeronautics Division

Pavement represents one of the largest capital investments in the Massachusetts statewide airport system, and the condition of these pavements is important both from cost-effectiveness and safety standpoints. Timely airport pavement maintenance and rehabilitation are crucial because repairs are much more costly once the condition deteriorates below a certain level. Additionally, airport pavement weaknesses, such as cracks and loose debris, pose a significant safety risk to aircraft.

The FAA requires that pavements be inspected every three to five years. A new statewide pavement assessment was completed by an outside contractor in June, 2017, with the next scheduled for 2020 and every three years thereafter. In 2018 and in other intervening years, MassDOT Aeronautics staff complete annual in-house assessments.

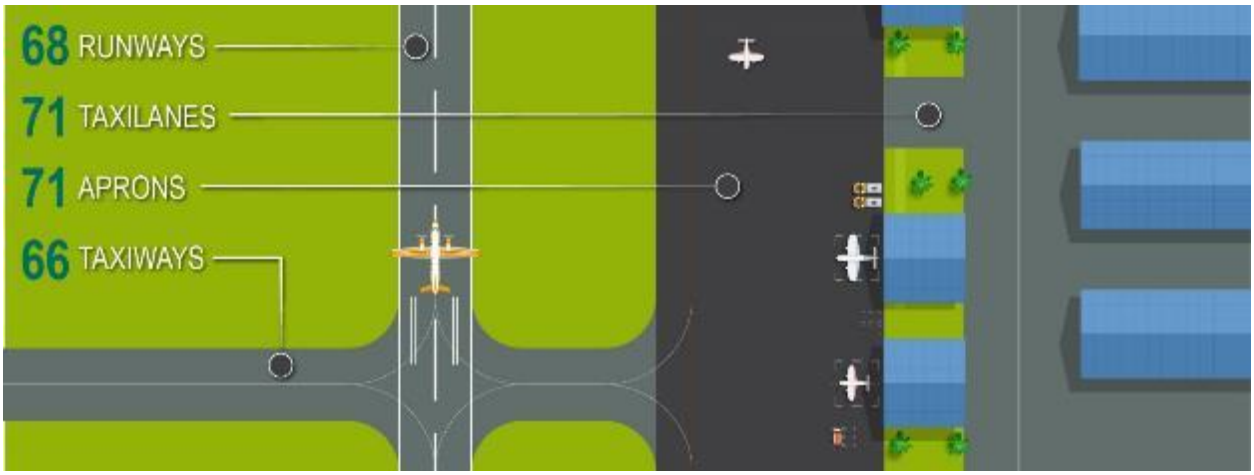
A web portal for airport pavement condition data provides both summaries of statewide pavement condition by airport type and pavement use. It also provides an interactive pavement viewer for all MassDOT-sponsored airports which color-codes a map of all pavement at each facility and representative photographs, as shown in Figure 5.2.

Figure 5.2 Screen Capture of MassDOT Airport Pavement Management System



MassDOT uses a Pavement Condition Index (PCI). PCI was developed and proposed by the FAA and ranges from zero to 100 – "good" PCI is defined as 75 and above for runways. Statewide, MassDOT measures the percent of system airports with overall good PCI across all their runways. In the Summer 2018 pavement condition assessment, the average PCI for runways at non-Massport facilities was 68. PCI by pavement location is shown in Figure 5.3.

Figure 5.3 Airport Pavement Condition in 2012 and 2016, by Use



MassDOT has collaboratively set the following performance targets for airport PCI:

- 70 in 2020.
- 72 in 2022.
- 75 in the long-term.

5.4 Aeronautics Division Next Steps

The Aeronautics Division is planning an update to the Massachusetts Statewide Airport System Plan in FY2019. This update will:

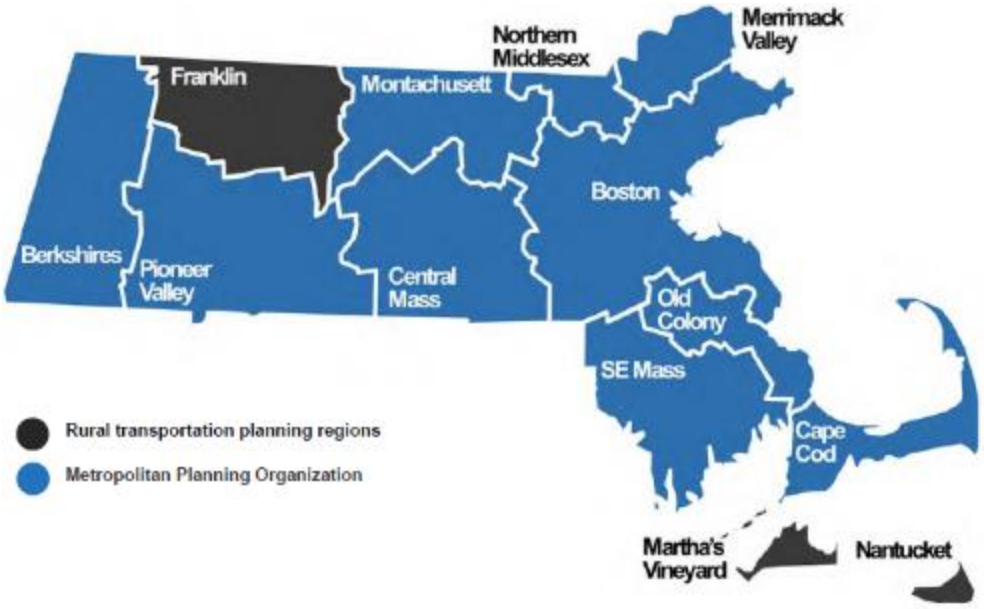
- Extensively assess the current statewide airport system.
- Assess current and future deficiencies in the system.
- Establish a long-term vision for the system and guidelines to continue its successful development.
- Plan for meeting the current and future needs of the system while evaluating the impact of new technologies related to aviation.

The development of goals and measurements is a critical step in the system planning process. The SASP will capture a level of data that enables MassDOT to make informed decisions. Once a vision has been established, the SASP will identify specific and individual system goals that will direct and track progress toward that vision and will ultimately produce a benchmarking system for potential projects.

6. 0 Municipalities and Regions

Massachusetts is comprised of 351 cities and towns (collectively "municipalities"). The Commonwealth provides aid to municipalities to support the upkeep of their pavement and bridge assets, primarily through the "Chapter 90" reimbursement program and the Municipal Small Bridge Program. Municipalities may support preservation on pavement and bridges with their own funds in addition to State Aid. Municipalities are also allocated Federal aid through metropolitan planning organizations (MPOs) that cover urban regions, as well as through rural planning regions. A map of these regions is shown in Figure 6.1.

Figure 6.1 Metropolitan and Rural Planning Regions in Massachusetts



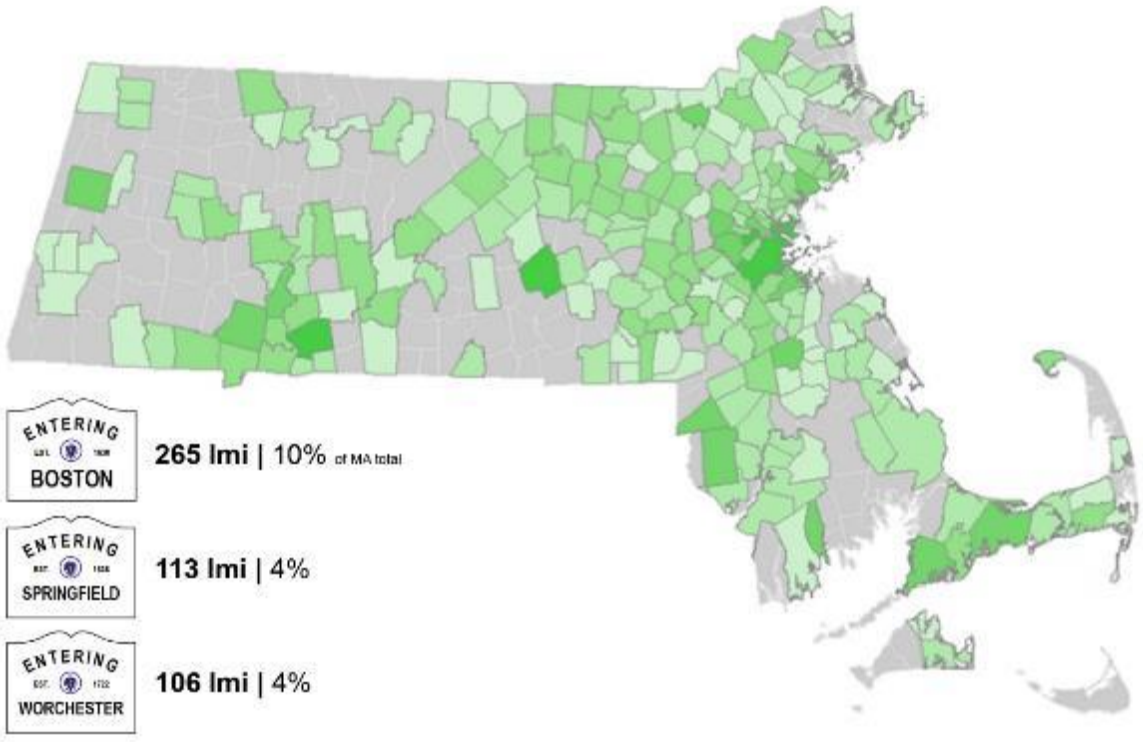
6.1 Municipal and Regional Assets

Municipalities own many of the same assets and asset classes as MassDOT; in addition to bridges and pavement, they may be responsible for signs and signposts, streetlights, sidewalks, ramps for the disabled, traffic signals, retaining walls, and maintenance vehicles and equipment.

6.1.1 Municipal Pavement

Of the 72,700 lane-miles of pavement in Massachusetts, 56,000 are owned by municipalities. 2,400 of these are on the NHS, approximately 25% of the overall system in the Commonwealth. 28% of the total is in communities in the top ten statewide by lane-mileage. The distribution of municipal NHS pavement is shown in Figure 6.2.

Figure 6.2 Municipal NHS Lane Miles by Town



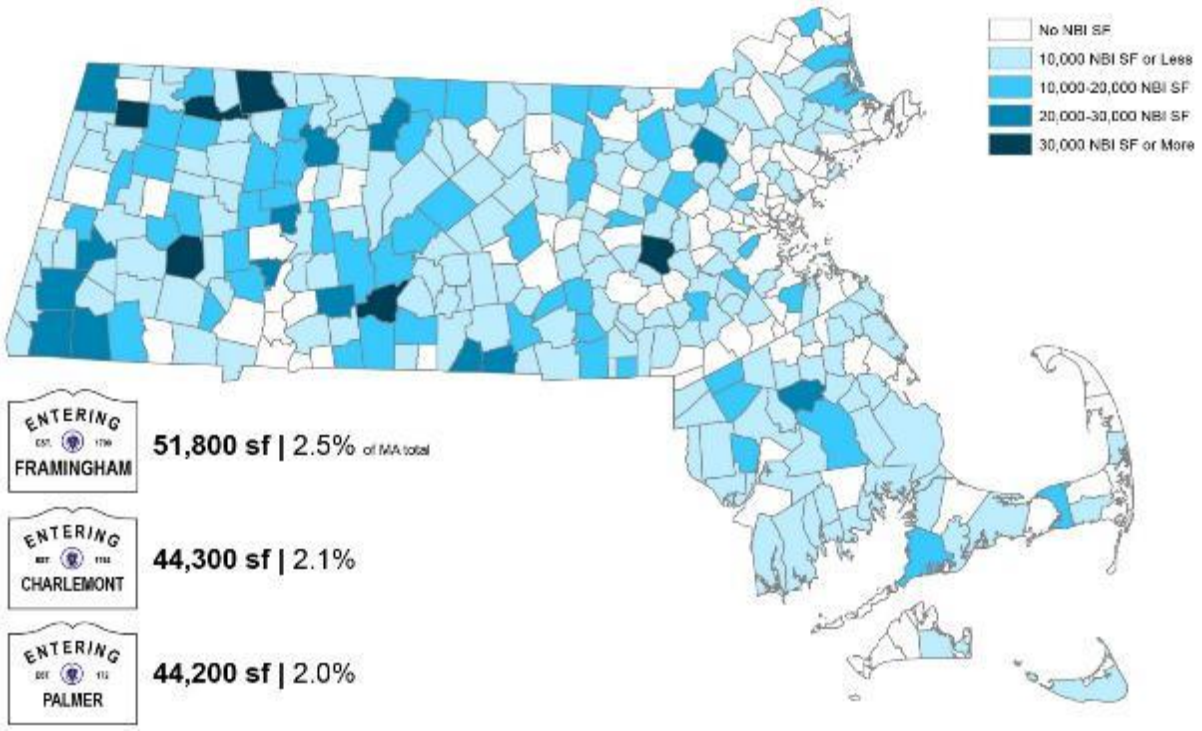
MassDOT collects a biannual condition survey of the entire NHS regardless of owner, and condition data for the municipal NHS are stored with MassDOT's own dataset. In addition, communities collect their own condition data for both NHS and the much larger non-NHS subsets of their road networks in their own pavement management systems (PMS). Of the 351 cities and towns in Massachusetts, 142 responded to the MMA IN 2017 that they currently operate a PMS. An additional 82 responded to the MMA that they do not, and 127 did not respond to the survey.

6.1.2 Municipal Bridges

In addition to the distinction between bridges located on and off the NHS, municipal bridges are divided by size. As for structures owned by MassDOT, FHWA distinguishes bridges with a span length in excess of 20 feet as National Bridge Inventory (NBI) bridges. MassDOT refers to those between 10 and 20 feet as "BRI" or "small" bridges, and those between 4 and 10 feet as culverts.

In contrast to pavement, the strong majority of NBI deck area in the Commonwealth is owned by MassDOT – 4 million of 37 million square feet are owned by municipalities. In another contrast to pavement, municipal bridge area is concentrated away from Boston (96% of BRIs are located outside of District 6), as shown in Figure 6.3. It should be noted that many bridges cross waterways that define the borders of communities, so square footage for each community is approximate.

Figure 6.3 Municipal NBI Deck Area by Town



MassDOT's goal is to inspect small bridges with the same biannual frequency as is required for NBIs (which have a 20-foot span length or greater), and the initial round of statewide inspections is underway. There are currently 1,464 known small bridge locations in the state (this number is updated periodically due to field confirmation), with approximately 1,000 owned by municipalities, and the remainder owned by MassDOT.

The overall inventory is 99% complete (up from 64% last year). Based on current data, approximately 15% of municipally-owned small bridges are rated poor. The progress of BRI inspections is shown in Figure 6.4.

Figure 6.4 BRI Inspection Progress, 2016 to 2018

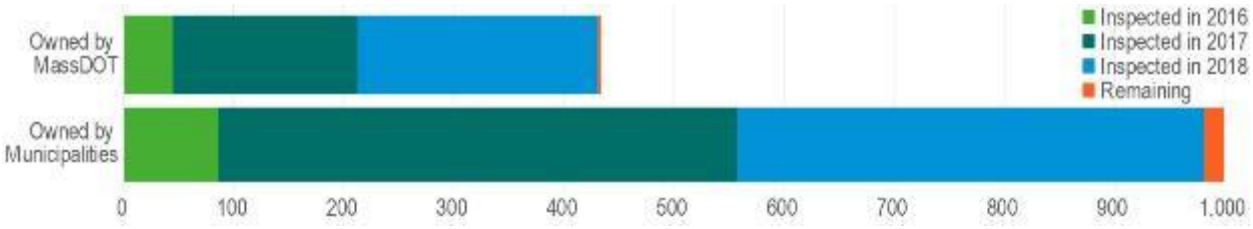


Figure 6.5 shows the impact that recent investment by MassDOT has had on a municipally-owned BRI. In 2017, MassDOT replaced the Hadsell Street bridge over the Umpachene River in New Marlborough. The picture on the left shows the closed bridge before construction; the picture on the left shows a new, modern bridge after replacement.

Figure 6.5 Hadsell Street Bridge Before and After 2017 Replacement

Note Photo credit (left): Berkshire Eagle

6.2 Investments in Municipalities and Regions

Annual investment in municipal pavement can be compared with the MassDOT-owned Non-Interstate system. In the most recent Highway predictive model (2015), where the state system was at 64% good and excellent (compared with the current estimate for Municipal Roads of 70%), the projection to maintain condition was an annual investment of $200 million. The municipal lane mile inventory is eight times the size of the state system, and is currently funded through Chapter 90 at $200 million. At face value, this would suggest that municipally owned roads are underfunded, though there are many qualifiers for this comparison, including contrasting levels of traffic between the two systems.

The Massachusetts Municipal Association (MMA) stated in 2014 (https://www.mma.org/boost-needed-ch-90-local-road-funding) that cities and towns across the Commonwealth need to spend at least $639 million annually to maintain and bring 30,000 miles of local roads into a state of good repair (SGR). Estimated annual budget to attain SGR was self-reported by municipalities in 2017 as between $10,000 and $60,000 per centerline mile.

6.2.1 Chapter 90

MassDOT provides municipal aid for roadway projects through the Chapter 90 Program. Chapter 90 projects are 100% reimbursable, meaning that municipalities are not required to contribute to them, though municipalities may contribute significantly to the general upkeep of their roadway network. Permissible uses of Chapter 90 funds include resurfacing

and related work (e.g., bridges, right-of-way acquisition, shoulders, side road approaches, landscaping, drainage, sidewalk, traffic control and service facilities, and lighting).

Municipalities are allocated Chapter 90 funds based a composite of three factors:

- Road miles – 58.33%.
- Population – 20.83%.
- Employment – 20.83%.

After the total apportionment for a city or town is calculated, municipalities apply for reimbursement against it on a project-by-project basis.

6.2.2 Municipal Small Bridge Program

As small bridges are not recognized by the Federal Government, they are not eligible for Federal Funding. To close this gap, the Legislature has established the Municipal Small Bridge Program at $50 million over five years. The municipality is responsible for procuring a pre-approved designer, securing right-of-way, securing permits, procuring a pre-approved contractor, and administrating the construction contract. MassDOT's only responsibility is to select the projects and reimburse the funds spent up to a $500,000 maximum per sponsor.