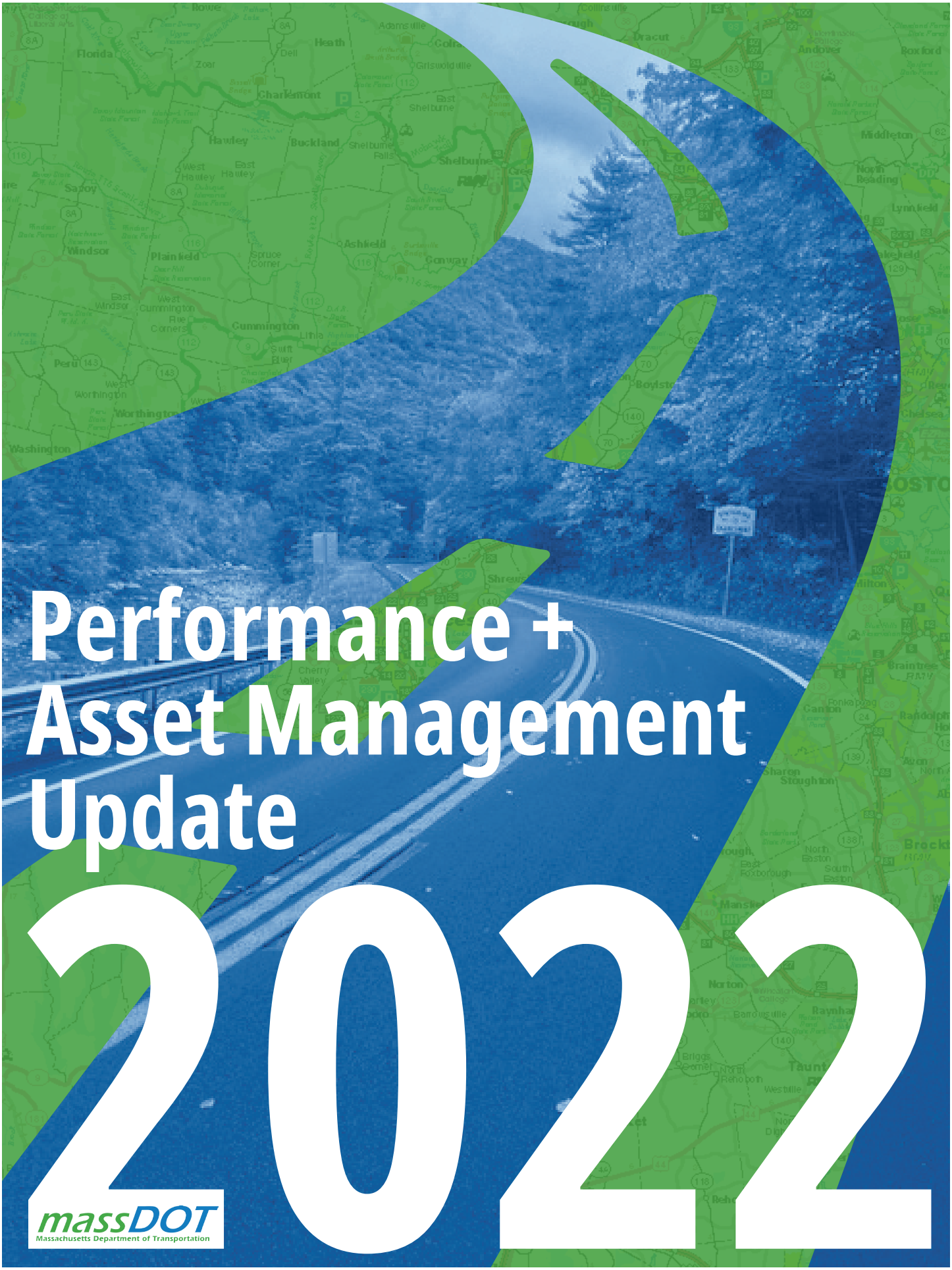


Performance + Asset Management Update

2022

massDOT
Massachusetts Department of Transportation

December 28, 2022

The Honorable Michael J. Rodrigues
Chair
Senate Committee on Ways and Means
24 Beacon St, Room 212
Boston, MA 02133

The Honorable Aaron Michlewitz
Chair
House Committee on Ways and Means
24 Beacon St, Room 243
Boston, MA, 02133

The Honorable Brendan P. Crighton
Senate Chair
Joint Committee on Transportation
24 Beacon Street, Room 109-C
Boston, MA 02133

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

Members of the General Court:

We appreciate the opportunity to update you once again on MassDOT asset and performance management. In this past year, our teams have been focused on delivery of additional programs and funding from the Federal Bipartisan Infrastructure Law (BIL) and accompanying MassTRAC transportation bond bill. The combined state and federal transportation investment from these authorizations is responsive to a growing recognition of system need, which has been made possible through the advocacy and leadership of our elected officials, and we hope aided by reporting such as this. In this year's report we have prepared a summary of current state performance, forecasted outcomes from BIL/MassTRAC, and gaps to long-term state of good repair for major asset classes where they are apparent.

Pavements serve as a foundational asset for all transportation modes and priorities. I am happy to report that the overall condition of state-owned pavements is trending in a positive direction, which has been made possible through a combination of consistent funding and greater emphasis on preservation treatments. Our pavement management team continue to improve pavement durability through research and development of high-performance mix designs, and we are building sustainably through expanded use of recycled materials. I can also report that the Municipal Pavement Program (authorized by the 2021 Transportation Bond Bill (TBB)) is off to a roaring start in 2022, with 135 lane miles of roadway preserved in 15 different Massachusetts communities, and a larger program planned for 2023. This program is a great example of MassDOT supporting municipalities with local asset management.

Massachusetts bridge needs have been well documented in previous reports to the legislature. In response, the 2021 TBB authorized the $1.25 Billion Next Generation Bridge Program (NGB), and the Bipartisan Infrastructure Law afforded Massachusetts a similar sized allocation through the BIL Bridge Formula Program. MassDOT is fully prepared to take advantage of the additional bridge funding, and has programmed 150 bridge projects in the 2023-2027 State Transportation Investment to improve conditions of more than 300 bridges. However, with NGB & BIL funds largely committed to projects, long term funding is needed to reach a sustainable state of good repair (SoGR). Analysis shows a sustained investment of $750M/year in future years is needed to achieve an SoGR, which can be contrasted to a pre-BIL/NGB bridge program of $400M.

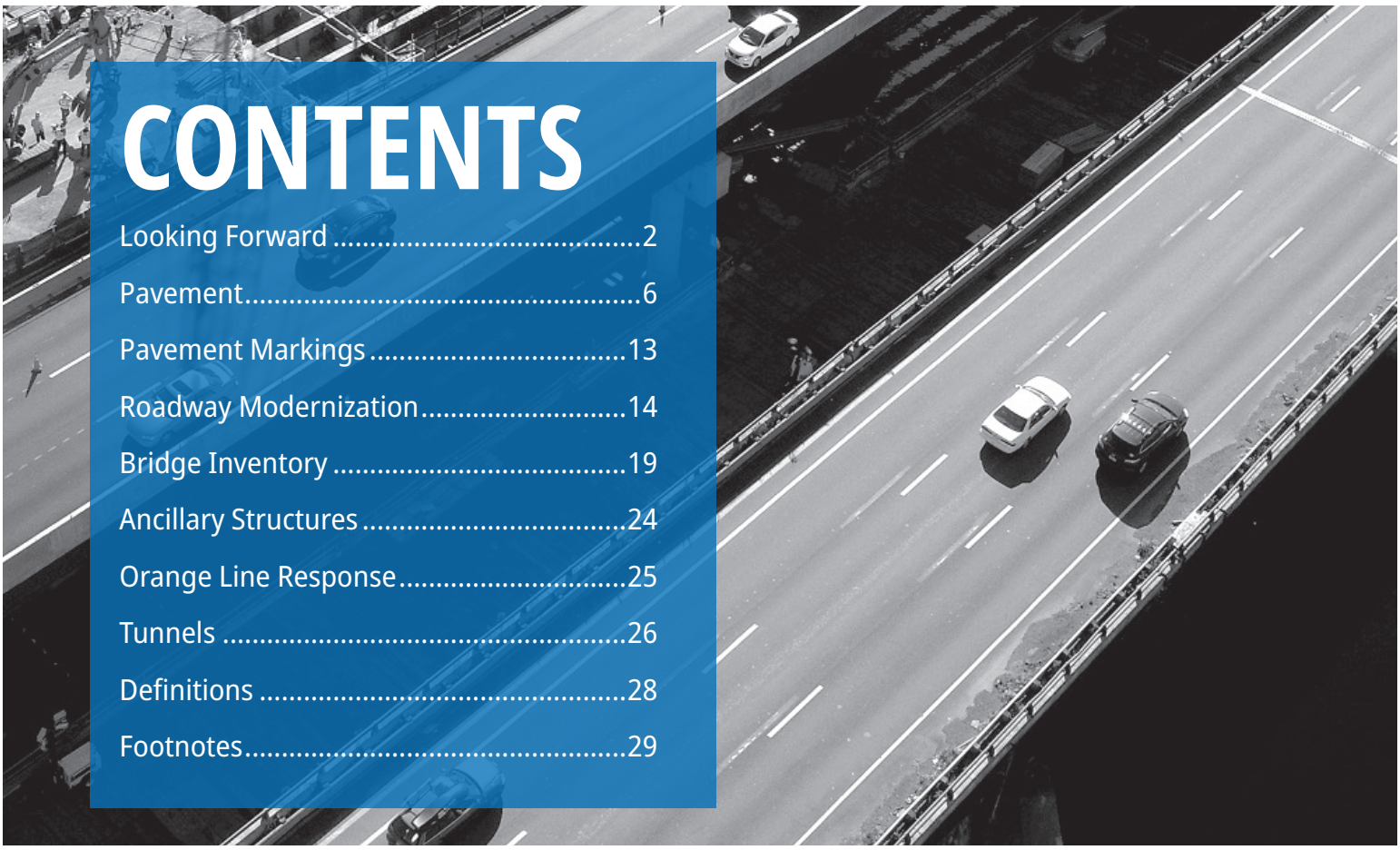
State of good repair has been the primary focus of asset management, but MassDOT must also consider infrastructure modernization alongside the repair of legacy assets. Roadway assets are integral to safety, mobility and resiliency goals, and we are now beginning to approach roadway modernization with the same analytical approach employed for state of good repair. The goal is to identify program investment levels necessary for substantive outcomes. The strategy behind this effort is included in the following pages.

Concurrent with this report, MassDOT has been preparing its first update to the Massachusetts Federal Transportation Asset Management Plan (TAMP). The TAMP focuses on bridges and pavements, and we have also included documentation on tunnels, ancillary structures, and pavement markings, which is consistent with our goal to fully represent the needs of Massachusetts roadways, and ensure we have the management processes in place for success.

We hope you find this report informative and appreciate your continued interest, support and oversight.

Respectfully Submitted,

Jonathan Gulliver
Highway Administrator, MassDOT



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LOOKING FORWARD

The following are key take-aways from each chapter:

PAVEMENT

1. MassDOT interstate and non- interstate pavements met performance targets for 2022. Sustained investment is needed to maintain the network past the 2023-2027 Capital Investment Plan (CIP) and avoid condition losses.
2. The department is pursuing environmentally friendly approaches to pavement design through warm mix technology and recycled materials.
3. In 2023, the successful MassDOT Municipal Pavement Program will continue into its second construction season after partnering with 15 communities to improve 60 miles of roads across Massachusetts in its first year.

PAVEMENT MARKINGS

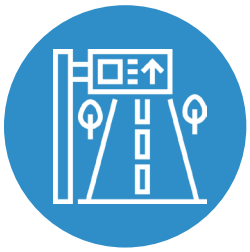
1. Pavement markings are one of the most cost-effective safety countermeasures on the roadway system, but need to be periodically refreshed to maintain effectiveness.
2. National standards have been proposed to establish minimum retro reflectivity
3. MassDOT is developing a marking program and will identify funding needs to maintain a high-quality pavement marking system and be responsive to new standards.

ROADWAY MODERNIZATION

1. Asset management must consider modernization needs in tandem with state of good repair.
2. Safety, mobility, and resiliency-focused investments are necessary for a viable modern roadway network.
3. An asset management approach to modernization priorities will help inform actual invest levels necessary to achieve substantive outcomes from an infrastructure perspective.

BRIDGE INVENTORY

1. MassDOT received a significant share of Bipartisan Infrastructure Law Bridge Formula Funds (BFP), which combined with funding through Massachusetts Next Generation Bridge Financing (NGB), will deliver a comprehensive bridge investment through the State Transportation Investment Plan (STIP), including over 150 bridge projects within 120 towns across the Commonwealth.
2. The additional bridge funding is sorely needed to address a considerable backlog of repair, and MassDOT will also be making a significant investment in bridge preservation, a more efficient long term management strategy for Massachusetts bridges. With the new funding largely programmed, a significant gap exists to long term state of good repair without sustained funding beyond BFP/NGB.
3. The Massachusetts Small Bridge Program was reauthorized in the 2021 bond bill for $70 million, and now includes optional MassDOT project management services to assist communities in getting projects to construction quicker. 56 small bridge grants were awarded in 2022.



ANCILLARY STRUCTURES

1. Sign, lighting, signal, and intelligent transportation systems require structural elements for support within the roadway space, these elements are known as ancillary structures.
2. A comprehensive inspection of the inventory is approximately 83% complete through a comprehensive inspection of the inventory. At an estimated 24,500 structures, the inventory is nearly five times larger than bridge.
3. MassDOT will complete initial inspections by spring/summer 2023, and is evaluating the need for organizational changes and positions to effectively manage these important assets.

TUNNELS

1. MassDOT emphasizes regular and comprehensive inspection of all Metropolitan Highway System (MHS) tunnel network systems.
2. The network is comprised of facilities built over a 75-year period, each requiring different life cycle management plans.
3. The Sumner Tunnel Restoration project is underway with a four-month closure planned for summer 2023.

Risk Management and the MassDOT PMO

MassDOT makes asset improvements through the capital plan, and therefore the department has placed a major emphasis on mitigating risks to capital delivery. In 2021, the Highway Project Management Office (PMO) was created to evolve and refine how process improvement projects are managed within the organization. Through the PMO, workstreams have been working to streamline and improve process in the following key areas, limiting risk exposure for the capital plan.

TRAFFIC CONTROL
Optimize construction staging and improve work zone safety for all roadway users

RISK-BASED DESIGN AND REVIEW
Establish improvements and tools to decrease design duration timeline

ENVIRONMENTAL
Streamline environmental processes and permitting to support the Advertisement Program

RIGHT-OF-WAY
Identify ROW acquisition bottlenecks and accelerate project advertisement

DISTRICT BRIDGE MAINTENANCE CONTRACTING
Improve contract quality and consistency across districts to support BIL funding increase

ALTERNATIVE PROJECT DELIVERY
Improve and promote alternative delivery at MassDOT

WORKFORCE MODERNIZATION
Adapt MassDOT's workforce to new challenges including increased levels of investment and new demands on the infrastructure

MassDOT has submitted the first update to its Federal Transportation Asset Management Plan (TAMP). Per Federal Regulation, the TAMP is updated every 4 years. This update incorporates Bipartisan Infrastructure Bill funding and new performance targets.

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Pavement is a significant Commonwealth asset. MassDOT owns just 13% of the Commonwealth's roads yet more than half of annual state vehicle miles traveled are on department-owned facilities. The MassDOT road network includes the interstate system, freeways, and other major roadways which together provide local, regional, and national connectivity. The character of MassDOT roads can vary from limited access highways with heavy commercial traffic, to urban downtowns and rural villages. A well maintained pavement surface is necessary for all uses, and MassDOT seeks to efficiently manage the entire network to optimum conditions.

PAVEMENT

CURRENT STATE (2022)

The non-interstate network has been a priority in recent years as the department worked to address worsening conditions and stave off forecasted downward trends. Through a combined federal and state investment, non-interstate conditions have improved by nearly 10% since 2016. As anticipated last year, condition improvements are leveling off as more complicated and expensive projects incorporating complete street elements reach construction.

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Roadway ownership involves investments beyond pavement, and nearly all MassDOT pavement projects address state of repair for safety systems (guardrail, barrier), bridges, drainage and existing bicycle and pedestrian infrastructure. For more comprehensive roadway improvements, moving forward MassDOT will look to prioritize these investments through modernization programs of the CIP. More information on this strategy is provided in the Roadway Modernization section of this report.

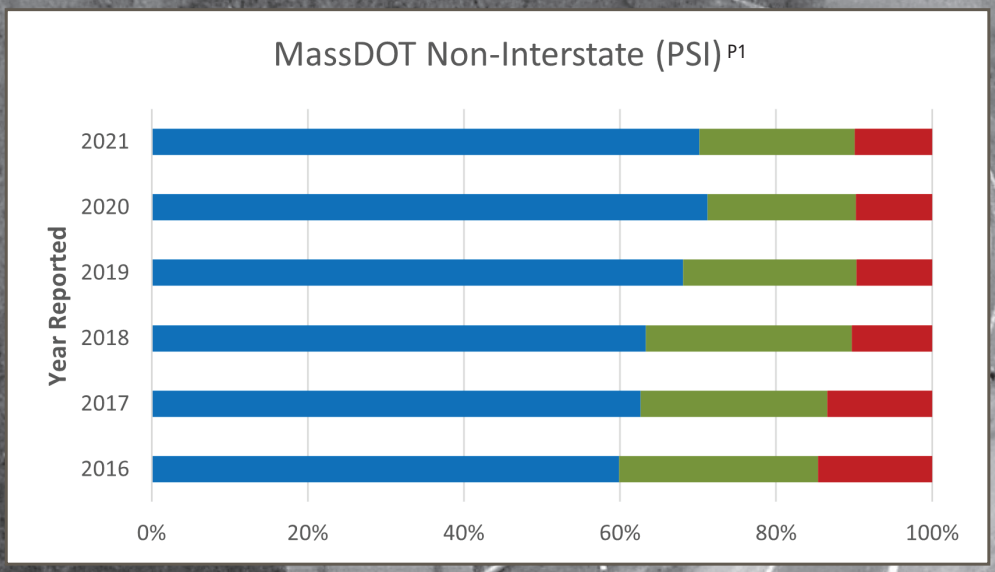
With marginal condition improvements over the past 5 years, interstate pavement has reached an equilibrium for the short term. Good and Excellent pavement quality accounted for 90.7% of the lane miles. This was slightly lower that the 2020 condition ratings, but the Poor-quality pavement also decreased this year from 1.5% to 1.2%. MassDOT has been able to maintain conditions on the interstate using lower-cost preservation treatments. When timed correctly, preservation treatments can arrest deterioration and extend service life, forestalling more costly interventions. This strategy will be effective in the short term, but greater investment will be needed later in the decade as conditions on preserved corridors necessitate more comprehensive treatments.

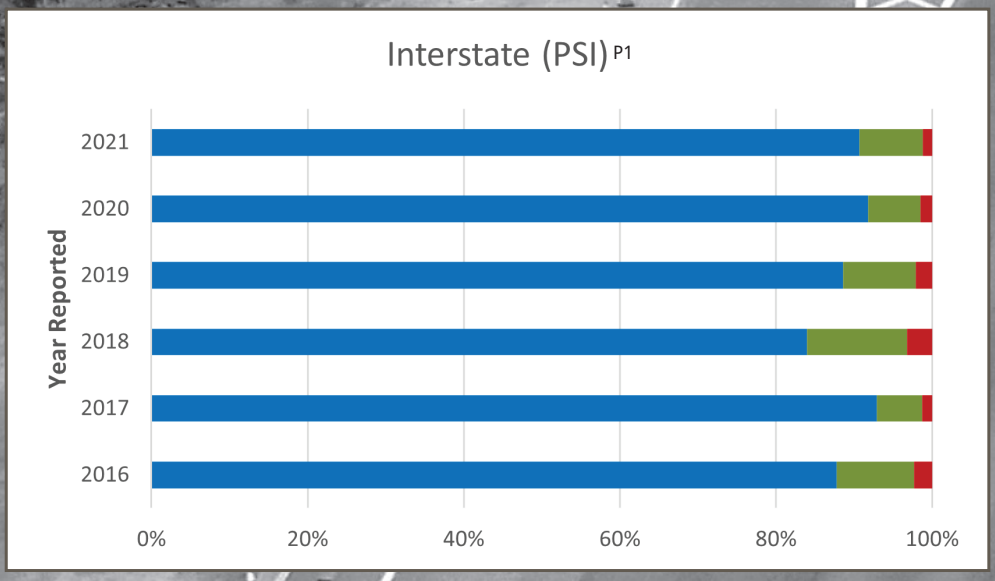
For all state-maintained roads (interstates and non-interstate combined), the percentage of "poor" pavement has been less than 8% (or about 700 lane miles) since 2018.

	% Good & Excellent Condition *Desired trend = UP* ↑				% Poor Condition *Desired trend = DOWN* ↓			
	2022 Target	**Achieved**	**2024 Target**	**2026 Target**	**2022 Target**	**Achieved**	**2024 Target**	**2026 Target**
Interstate	88%	91% (good)	88%	88%	<4%	1% (Poor)	<3%	<3%
MassDOT	62%	70% (good)	70%	70%	<12%	10% (Poor)	<10%	<10%

MassDOT has achieved all 2022 targets for interstate and state-maintained pavement. The DOT is also on track to achieve the 2024 targets if funding and direction remain constant.

The pavement serviceability index (PSI) is the condition rating scale used by MassDOT. Each graph below represents 100% of the lane mile network for interstates and non- interstate roads, separately. So, for example, the 1.2% of PSI-rated "poor" interstate lane miles is shown in the top graph.





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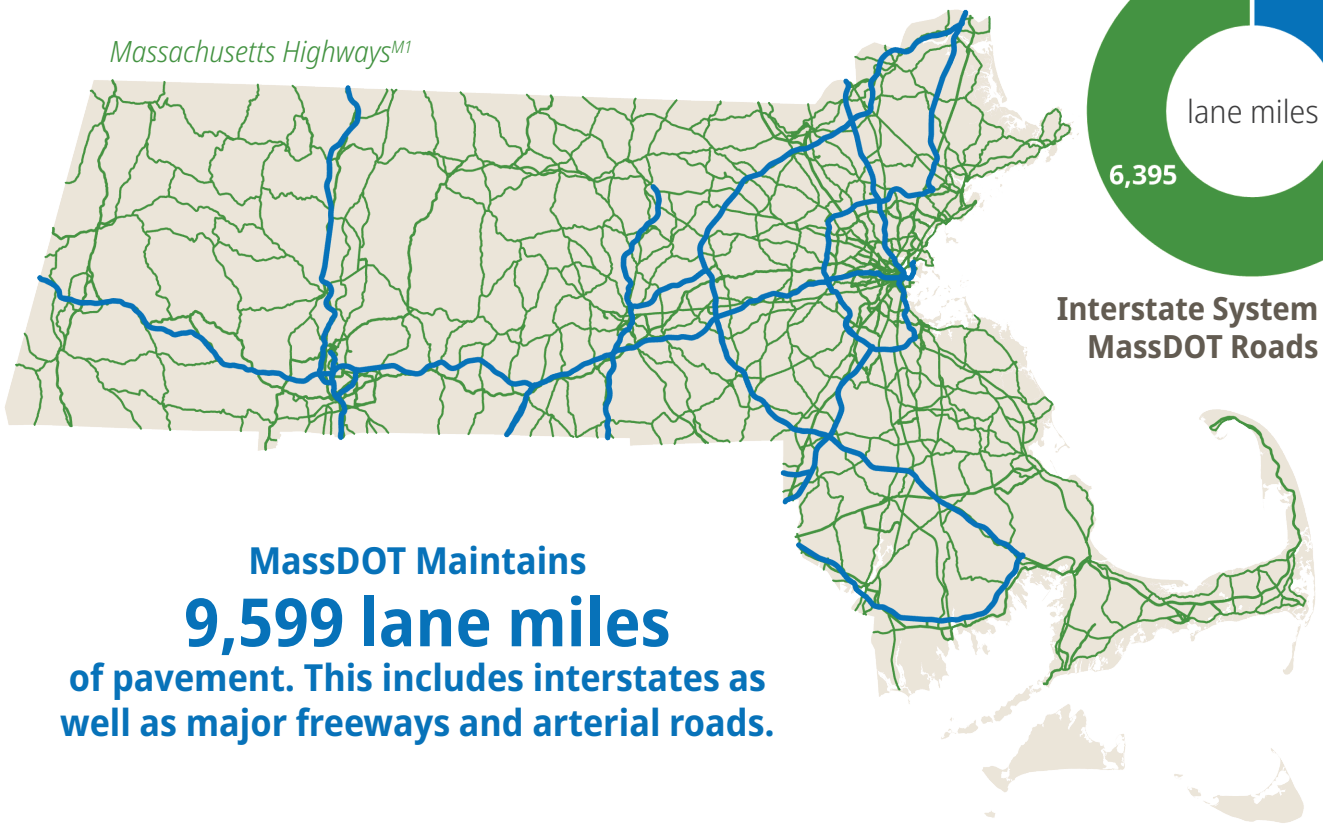
MassDOT employs performance-based capital planning to provide transparency on how and why transportation funds are invested. Each MassDOT Division works with the Office of Transportation Planning and the Office of Performance Management and Innovation (OPMI) to develop program level measurements and targets which are then used to support funding levels in the capital plan and measure outcomes.

The table provides two-year and four-year targets for the 2022-2026 period of performance for MassDOT pavement condition measures. As shown, the 2022 Targets were achieved for all four measures. State measures are used in parallel with Federal pavement performance measures, with the main difference that state performance management encompasses MassDOT-owned roads beyond the NHS.

In the 2022 construction season, MassDOT began work through the Municipal Pavement Program, a multi-year initiative authorized by the 2021 Transportation Bond Bill. The program provides MassDOT with funding to support municipalities and improve locally-owned road conditions, with an emphasis on state numbered routes, and those on the National Highway System. In 2022, MassDOT preserved or rehabilitated 135 lane miles of roadway in 15 different Massachusetts communities, with a similar-sized program planned for 2023.

Municipally-owned state numbered routes have nearly three times the percentage of poor mileage than the MassDOT-owned non-interstate system. At current funding levels, it would take 20 years to address the current municipal backlog through the program.

Massachusetts Highways[M1]



MassDOT Maintains

9,599 lane miles

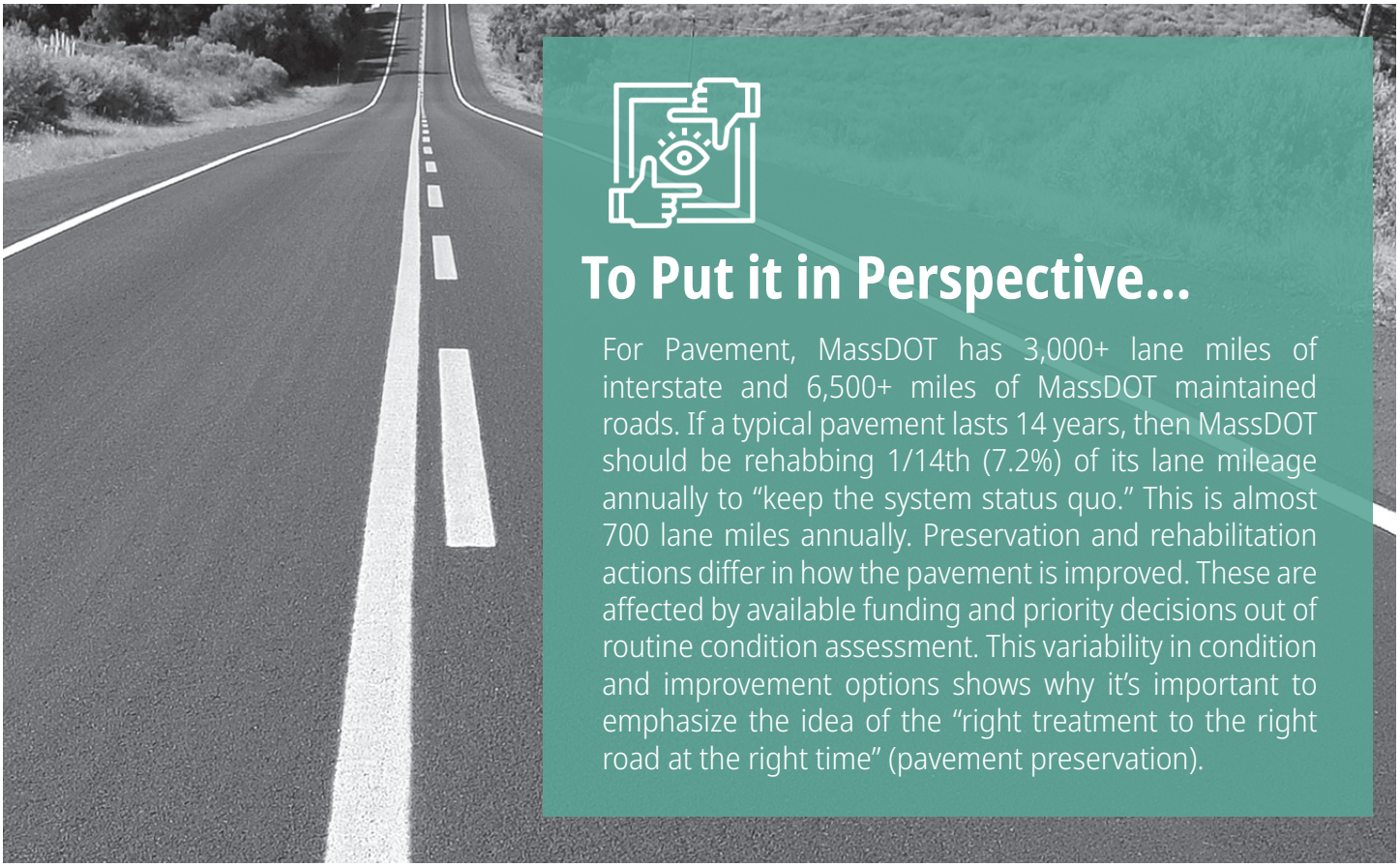
of pavement. This includes interstates as well as major freeways and arterial roads.

LOOKING FORWARD (2023)

MassDOT will continue to focus on maintaining good pavement conditions on all state-owned roadways through the interstate and non-interstate programs. Conditions are currently within target and are expected to remain stable through the current CIP. Funding levels will be reevaluated in coming years to identify gaps in long term state of repair.

The MassDOT Pavement Management Section is researching environmentally friendly modifications to pavement design, including increased use of recycled materials and warm mix technology, which reduce energy demand in asphalt production. These technologies are developed in concert with research universities, piloted, and heavily analyzed before larger industry adoption. Applied use of this research can be found in the project examples.

MassDOT will continue to implement the municipal pavement program in 2023. The map below shows the location of planned work in the coming season.



To Put it in Perspective...

For Pavement, MassDOT has 3,000+ lane miles of interstate and 6,500+ miles of MassDOT maintained roads. If a typical pavement lasts 14 years, then MassDOT should be rehabbing 1/14th (7.2%) of its lane mileage annually to "keep the system status quo." This is almost 700 lane miles annually. Preservation and rehabilitation actions differ in how the pavement is improved. These are affected by available funding and priority decisions out of routine condition assessment. This variability in condition and improvement options shows why it's important to emphasize the idea of the "right treatment to the right road at the right time" (pavement preservation).

Example Projects

Durability

Gill-Erving Resurfacing and Related Work on Route 2

Status: In Construction

Test four different high-performance asphalt pavement overlays for crack resistance to a wider range of traffic, environmental, and existing pavement conditions.

Preservation

Bolton-Boxborough-Harvard-Littleton Pavement Preservation on I-495

Status: In Construction

10 miles of interstate preservation with ultra-thin bonded overlay completed in 2022, but still active for bridge repairs.

Sustainability

Gardner-Westminster Pavement Preservation and Related Work on Route 2

Status: In Construction

Pavement design incorporates higher amounts of recycled asphalt (targeted between 25-30% RAP binder replacement[P2]) thus reducing project carbon footprint.

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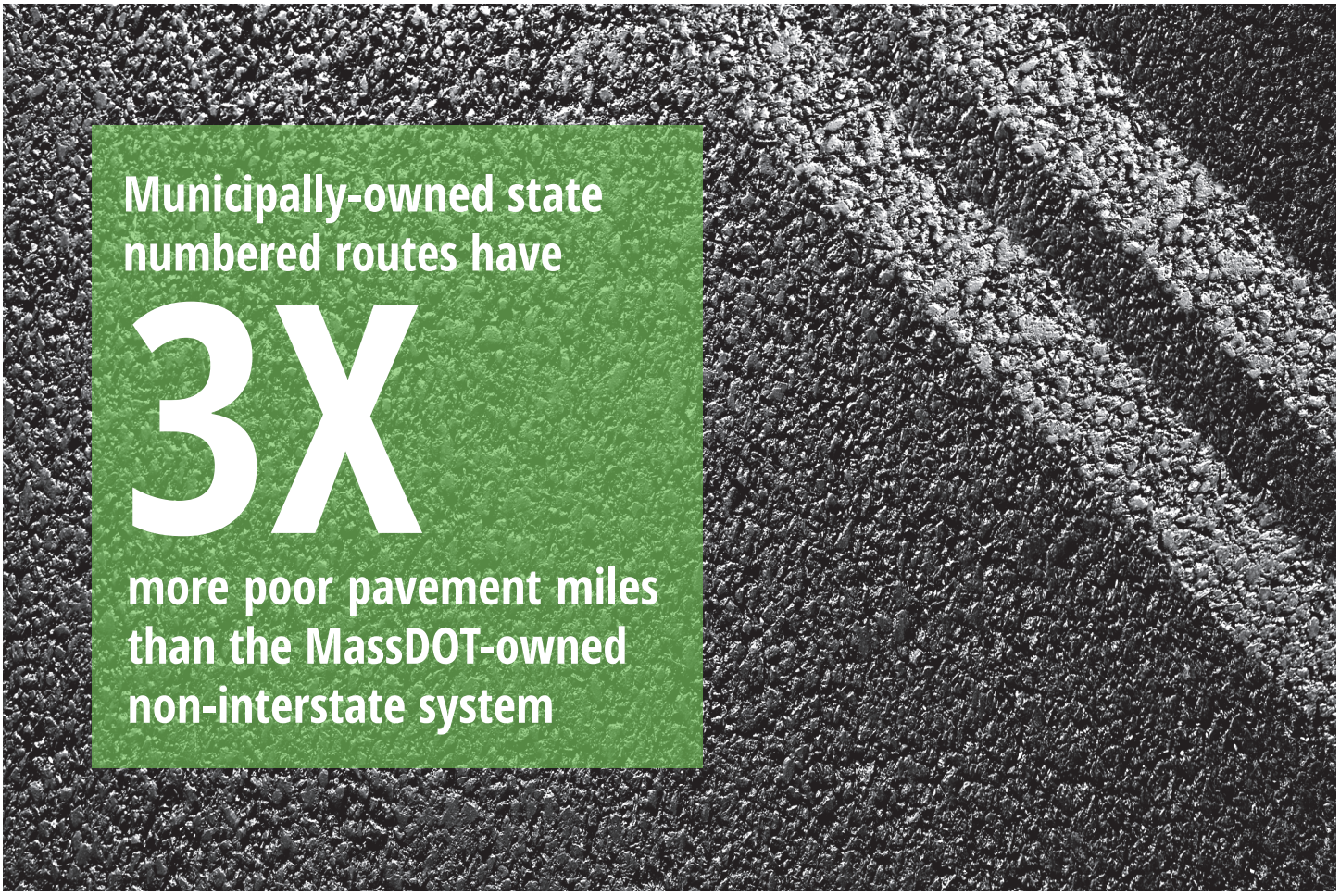
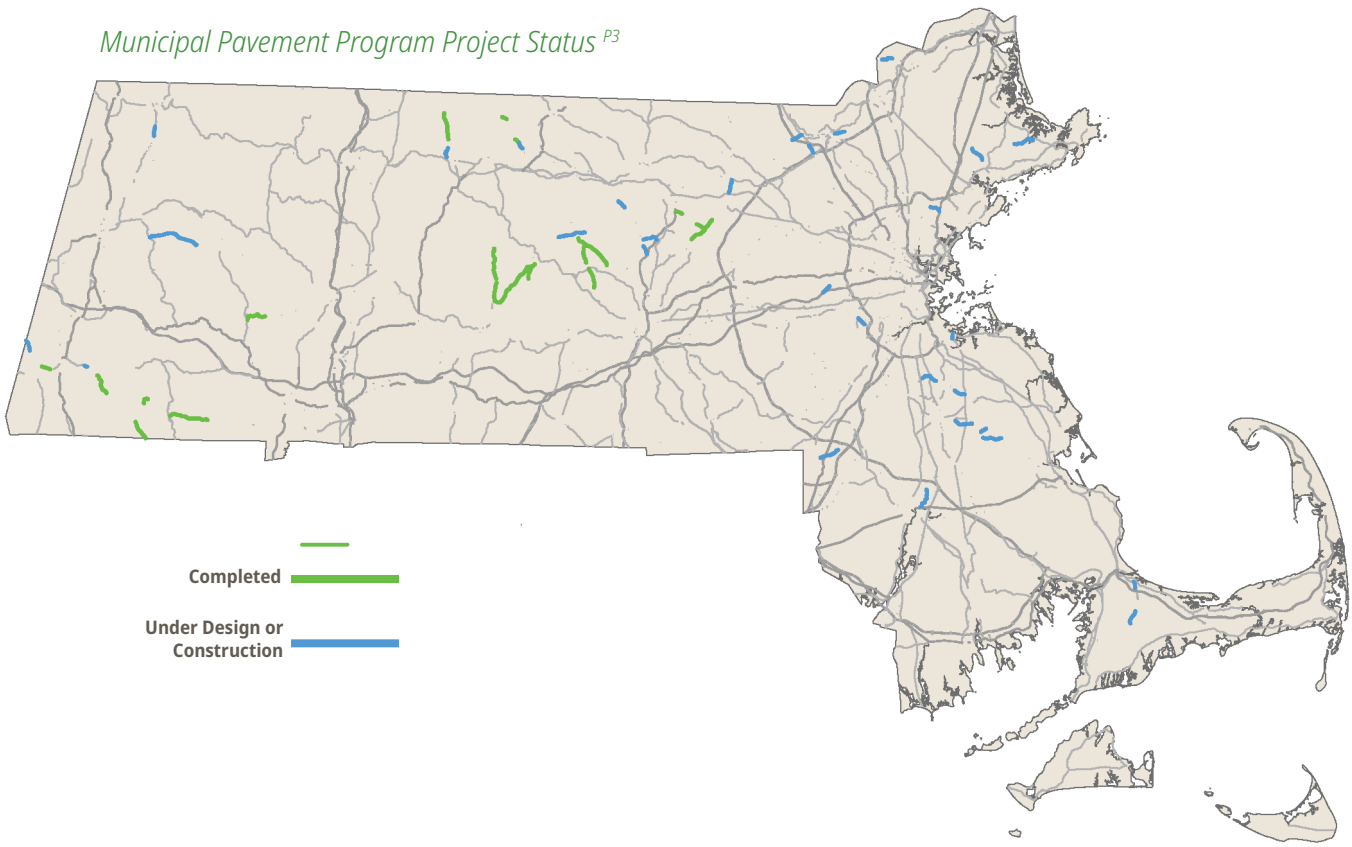


Municipal Pavement Program Project Status [P3]



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Drivers intuitively rely upon roadway pavement markings to provide feedback on vehicle position, speed and surrounding hazards. The utility of pavement markings is even more apparent at night during rain events. Similar to any asset, pavement markings have a discrete lifecycle, and require periodic replacement to maintain reflective at low light. Life expectancy is further reduced due to high traffic and winter snow and ice operations. To maintain state markings, maintenance crews spend the summer months re-striping thousands of miles of highway around the state. Pavement markings are one of the most cost-effective devices on the roadway system, and MassDOT is developing a program to manage the inventory more effectively.

PAVEMENT MARKINGS

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CURRENT STATUS (2022)

On August 5, 2022, FHWA published a final rule in the federal register adding new provisions to the Manual on Uniform Traffic Control Devices (MUTCD) and establish minimum levels of pavement marking retroreflectivity. FHWA believes, by formalizing this standard, transportation agencies can reduce the number of severe crashes occurring at night. This new standard will directly affect MassDOT by requiring the agency to develop an inventory and internal process to maintain striping reflectivity.

LOOKING FORWARD (2023)

MassDOT has and continues to conduct research on automated inspection of marking reflectivity.[PM1] It is reasonable to plan for marking replacement on a 4- to 5-year cycle. The department estimates that there are approximately 56 M linear feet of edge and lane line markings on the state system. **On a 4.5 year cycle, the department should be replacing approximately 12.5 M feet each year.** In 2022, the department installed 7.8 M linear feet. The gap between the work done (7.8M) and estimated annual need (12.5M) suggests more investment is needed within this asset class. Funding for striping will be evaluated in the next planning cycle, and MassDOT will formalize a marking management program responsive to upcoming retroreflectivity standards.

A primary focus of the asset management process has been on state of good repair of vehicle pavement condition and bridge structures. MassDOT has fully adopted performance-based capital planning around key performance indicators of pavement and bridge asset condition. The maintenance of transportation infrastructure in good working order is a baseline expectation and priority for the agency, and imperative to the mobility, economic and quality of life patterns which exist today and can be expected in the near term.

However, in addition to SoGR, MassDOT must also prioritize adaptation of infrastructure to contemporary needs. This includes taking steps to adopt a more holistic approach to asset management, which integrates mobility, accessibility, safety, and resiliency priorities alongside condition goals.

MassDOT has a three-pronged approach: 1) Making improvements through pavement and bridge asset management projects, 2) Stand-alone modernization projects, and 3) Providing funding to municipalities through Community Grant programs to support projects by cities and towns. This work is guided by state plans and analysis, including the 2019 Pedestrian Plan, 2019 Bicycle Plan, Curb Ramp Inventory, and Top Crash Risk Location analysis.

ROADWAY MODERNIZATION

CURRENT STATE (2022)

Mobility

Mobility investments are primarily found within the Bicycle and Pedestrian, ADA retrofit, and Roadway Reconstruction programs of the MassDOT CIP. They involve modernization of roadway accommodations beyond vehicular usage, including improvements to expand the pedestrian and bicycle networks and roadway improvements to better accommodate transit services.

The goal is to provide all people safe, comfortable, and convenient mobility options. Roadway assets play a significant role in doing so. The 2019 Statewide Bicycle Plan and 2019 Statewide Pedestrian Plan identified the need for pedestrian- and bicycle-specific projects on MassDOT-owned roadways and bridges to address critical gaps in

The League of American Bicyclists ranked Massachusetts #1 in state rankings for the first time, including receiving an "A" grade for Infrastructure and Funding due to the use of state and federal funding for bicycle infrastructure.

connectivity and accessibility. As of 2021, 43% of MassDOT-owned roadways have sidewalks and 2.5% have designated bicycle facilities. The goal is to make walking and biking a safe, comfortable, and convenient option for everyday short trips given that the majority of trips in Massachusetts are short trips (less than 3 miles, equivalent to a 16 minute bicycle ride) and non-commuting trips. **Working towards this vision, in 2022 MassDOT constructed 20 miles of bicycle facilities on state roadways, and 20 miles of new shared use paths. MassDOT also advertised $44 million of shared use path projects for construction.**

To complement larger roadway projects, MassDOT also deploys quick-build improvements to realize asset improvements within one year through six locations, one in each MassDOT district. Improvements include new or reconstructed sidewalks, new or reconstructed curb ramps, crosswalk enhancements with pedestrian crossing aids, pavement markings, and signage upgrades, and bicycle lanes. **In 2022, MassDOT completed 4 miles of sidewalks, 2 miles of bicycle lanes, and improved 28 crosswalks for approximately $6.6 million.**

Safety

In 2021, 418 people died and 2,884 people were seriously injured due to roadway crashes in Massachusetts - the highest number of annual deaths in 14 years. The Commonwealth's top priority is to ensure the safety of all roadway users: whether they are driving a vehicle, truck, or motorcycle, are a passenger, taking transit, walking, bicycling, or using any other mobility device. Massachusetts is committed to the goal of zero roadway fatalities and serious injuries.

To achieve zero roadway fatalities and serious injuries, Massachusetts adopted a Safe System Approach in 2022, a U.S. DOT-endorsed framework for addressing roadway safety holistically as a system. A Safe System Approach works by anticipating human mistakes and keeping impact

energy on the human body at tolerable levels. Critical to success are identifying and mitigating risks in the transportation system to prevent serious crashes, rather than waiting for crashes to occur and reacting afterward. Implementing this approach requires shared responsibility across agencies and communities. Everyone is accountable and has a role to play, including those who plan, program, design, construct, maintain and utilize the roads, as well as those who create, enforce, and adjudicate laws.

The new Strategic Highway Safety Plan (2022) provides a framework for how the Commonwealth will work to make Massachusetts roadways safer for all people. The plan outlines six initiatives:

1. Implementing speed management
2. Addressing highest risk locations and populations
3. Taking an active role to affect vehicle design, features, and use
4. Accelerating research and adoption of technology
5. Implementing new approaches to public education and awareness
6. Doubling down on what works

Supporting safety policy work requires a robust asset management system to know where and in what condition safety-related amenities exist, including pedestrian signals, pedestrian crossings, bicycle markings, pavement markings, and traffic calming measures, for example.

Resiliency

MassDOT began strategic planning for resiliency in 2019, through formation of a Resiliency Task Force with the Massachusetts Department of Environmental Protection, the Division of Ecological Restoration, and the Division of Fisheries and Wildlife (the latter two from the Massachusetts Department of Fish and Game), charged with developing a mission and vision for a

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A Safe System Approach prioritizes the elimination of crashes that result in death and serious injuries.

resiliency program. The Bipartisan Infrastructure Law has created a federal funding source for resiliency-focused projects (PROTECT, Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation) and MassDOT is well positioned to program these funds and harden infrastructure across the state.

The plan for the resiliency program starts first with addressing known issues, which can include replacement of undersized culverts, stabilization of roadway embankments and slopes in areas subject to erosion during heavy precipitation events, and improved drainage systems to manage stormwater more efficiently for improved roadway operational safety and environmental quality. Secondly, and in parallel, enhanced project screening through geo-spatial tools and multi-disciplined project scoping ensures that the infrastructure projects are using the best available information to assess climate risk. The third approach, facilitated through the MassDOT Office of Transportation Planning led Climate Adaptation Vulnerability Assessment, seeks to identify transportation assets which are at risk of riverine and coastal flooding over the coming decades.

Analysis + Technology =

In 2022, MassDOT started a project to convert pedestrian signals to countdown time in high crash locations.

LOOKING FORWARD (2023)

In designing the roads of tomorrow, MassDOT is expanding its organizational capacity to advance modernization projects and is developing plans for expanding its asset management work to include mobility, safety, resiliency, and non-vehicle related assets. Robust analysis is needed to identify the level of investment needed to do so. MassDOT is using new data and engagement strategies to guide where re-imagined roadway cross sections can bring the most benefit, but first MassDOT has to understand what exists today (baseline inventory) and in what condition (condition assessment).

In 2022, MassDOT kicked off two planning studies to identify where investments are needed to meet bicycle and pedestrian goals. Further analysis and evaluation is required to understand

Massachusetts Avenue Bridge between Boston and Cambridge, Before (2012) and After (2022)

what level of investment is needed and how to manage assets to realize a complete, comfortable and connected multimodal network.

Additionally, MassDOT's Safety Section has commissioned Road Safety Audits (RSAs) at high crash locations around the state, which look at safety countermeasures ranging from short term to long term. These efforts have provided us with many ideas for how to improve safety but not always a mechanism for implementation. MassDOT is piloting a "Safety at Various Locations" program in District 5 to address safety in a systematic and cost-effective way. The program seeks to bundle short-term enhancements at locations across the district, rather than relying on and waiting for long-term reconstruction projects to improve safety. Beyond RSAs, MassDOT will identify potential treatments that can be systematically employed based on known and identified safety needs.

Although MassDOT makes every effort to include bicycle and pedestrian infrastructure in projects, the construction may not be conducive to the time and budget constraints of pre-existing state of good repair projects. In these cases, a separate, full reconstruction of the roadway is needed, with more complex design and a higher budget. With the prospect for increased funding through the Federal Bipartisan Infrastructure Bill, MassDOT is prioritizing roadways where reconstruction is necessary and complete street can be realized.

MassDOT is committed to making investments that make the transportation system more sustainable. In December 2022, the MassDOT Highway Division was named a 16th Annual Leading by Example award winner for its work across the building, energy, and transportation sectors. Since 2013 MassDOT has installed more than 80 EV charging ports for fleet and public use, and MassDOT continues to play a leadership role as it works to install 1.5MW of solar canopies and an innovative, first-of-its-kind solar PV installation along a noise barrier in Lexington, and implementing a comprehensive DC fast charging plan for federal highways.

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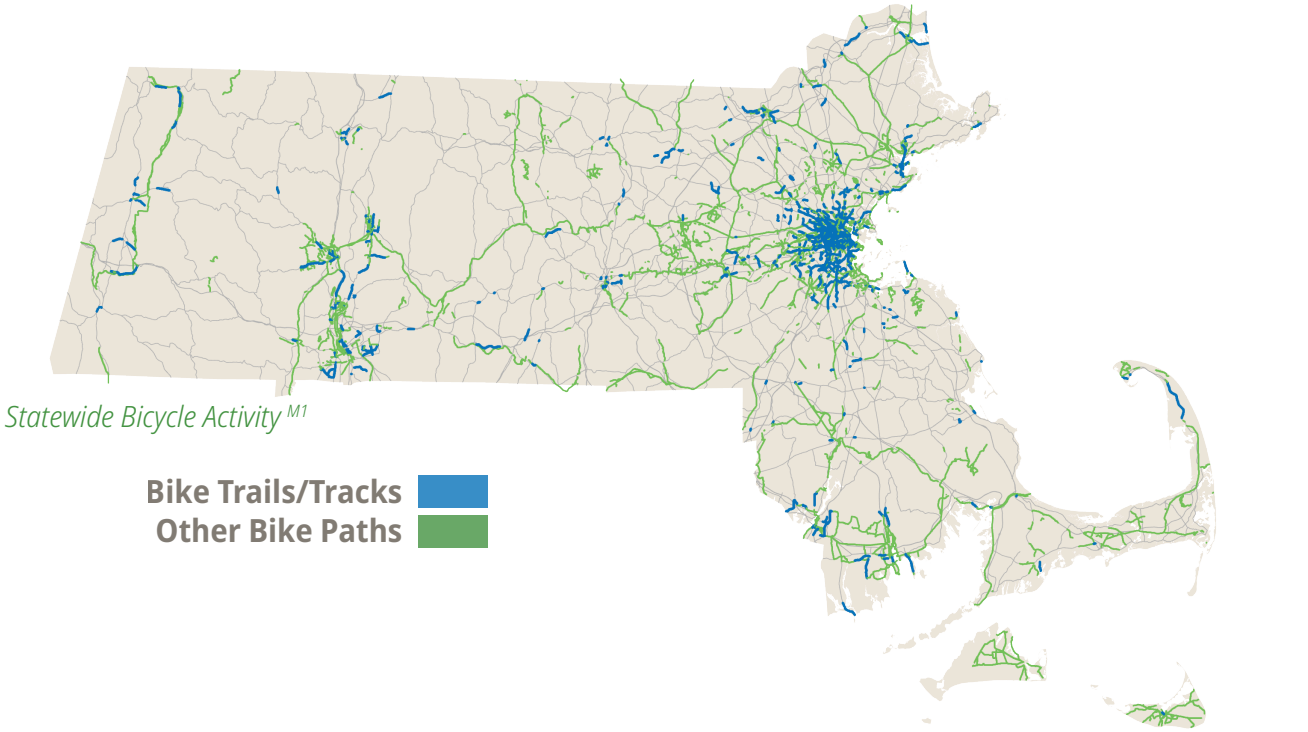

Statewide Bicycle Activity [M1]

A sustainable bridge inventory is key to the long-term viability of Massachusetts surface transportation. Beyond the movement of personal vehicles, bridges are integral to the transport of goods and services, public transit, active transportation, and the response of emergency services.

THE MASSACHUSETTS BRIDGE INVENTORY

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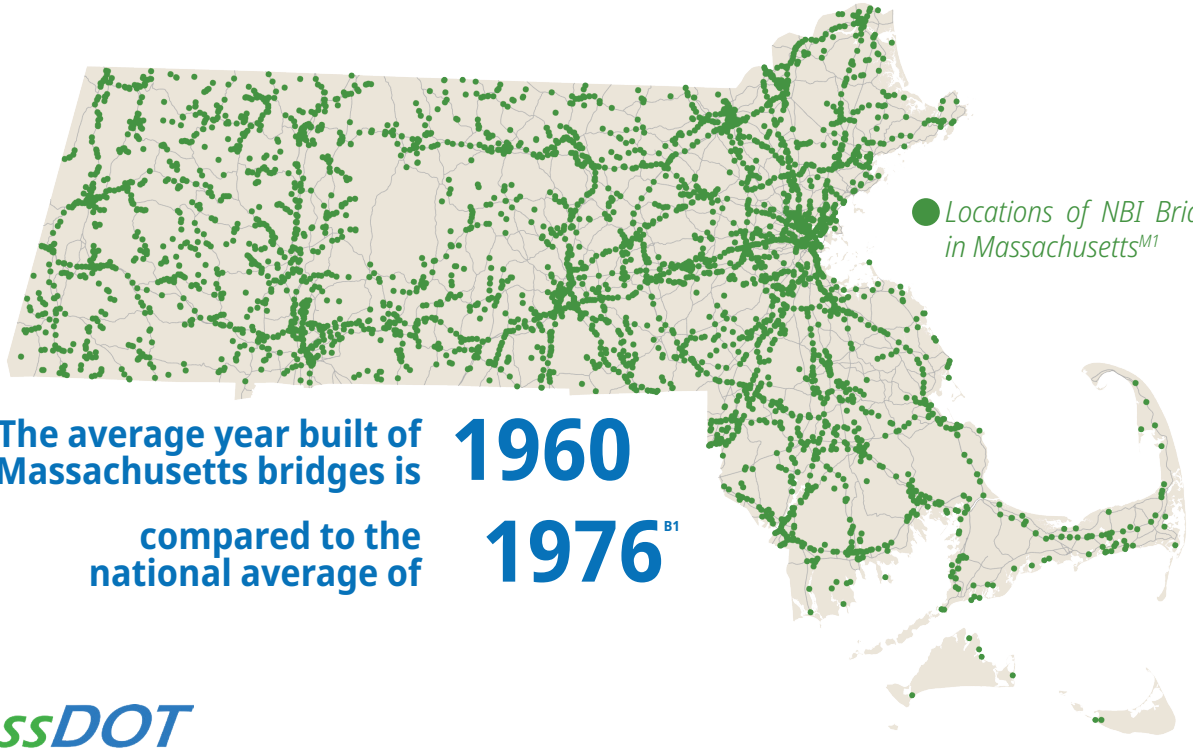
The standards used for National Bridge Inventory (NBI) define a bridge as a structure with a span length over 20 feet, and there are approximately 5,252 examples of NBI bridges in Massachusetts. MassDOT has direct ownership of 3,481 bridges, and also inspects the 1,642 municipally owned NBI structures. The remaining balance of Massachusetts NBI structures (129) are owned by the Massachusetts Bay Transportation Authority (MBTA), Massachusetts Port Authority, Department of Conservation and Recreation, or various federal agencies. Capital improvements to the state and municipally-owned inventory are managed through the MassDOT bridge program and MassDOT STIP/ CIP.

The average age of Massachusetts bridges is significantly older than the national inventory, which, combined with unforgiving winters, and traffic from an active and growing state, has resulted in a considerable repair backlog. Massachusetts currently has the 14th largest percentage of poor bridges in the US, and fourth largest share of poor bridges with respect to the National Highway System. Within this context, the 2021 Massachusetts Transportation Bond Bill authorized the Next Generation Bridge Financing Program in 2021, which was then approximately matched with bridge formula funding through the 2022 Federal Bipartisan Infrastructure Law. This year's update includes a description for how these funds will be used, what they will achieve and what gaps remain to achieving sustainable bridge conditions.



Locations of NBI Bridges in Massachusetts[M1]

The average year built of Massachusetts bridges is 1960

compared to the national average of 1976[B1]

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CURRENT STATE (2022)

MassDOT has programmed 150 projects in the 2023-2027 State Transportation Investment Plan (STIP) to improve conditions of more than 300 bridges. The strategy is based on two basic goals: slow the rate of deterioration through preservation and reduce backlog by increasing the rate of capital rehabilitations and replacements. Beginning with federal fiscal year 2023, preservation funding has quadrupled from $10M to $40M, emphasizing corridor projects that address multiple locations to stave off future decline along key NHS roads. The remaining balance of new bridge funding is dedicated to accelerating rehabilitation and replacements and is expected to resolve conditions of over 100 poor structures. The plan includes high priority bridge locations in all areas of the Commonwealth, including large NHS bridges, technically challenging movable structures, and local bridges with limited options for detour routes.

Bridges under MassDOT oversight receive an extensive hands-on inspection every two years, with more frequent inspections performed on bridges in poor condition or with a known issue. Inspections are conducted by both MassDOT resources and consultant teams, often requiring special measures and equipment to access challenging locations. A specially trained group of MassDOT Divers perform underwater inspections of subsurface elements at water crossings, and the MassDOT Aeronautics Division has operationalized use of unmanned aerial systems (drones) as an effective tool for information-gathering in specific use cases. Overall bridge condition ratings are assigned based on the results of these inspections.

National bridge condition measures rate each state's:

- Percentage of NHS bridge deck area classified as in Good condition
- Percentage of NHS bridge deck area classified as in Poor condition.

Out of a total area of 29,741,772 ft^2 for NHS bridges in Massachusetts, 16% (4,943,000 ft^2) are in good condition. Federal regulations have instituted a minimum condition threshold of less than 10% poor for state NHS bridge inventories. In Massachusetts, approximately 3,485,000 ft^2, or 12%, are classified in poor condition. This is 2% over the allowed threshold. To understand the magnitude of this bridge area, consider the football field analogy on the following page. This helps to illustrate the need for funding to address the backlog of poor bridges, while simultaneously investing in preservation strategies to prevent bridges from becoming poor.

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% Good Condition *Desired trend = UP* ↑					% Poor Condition *Desired trend = DOWN* ↓				
2022 Target	**Achieved**	**2024 Target**	**2026 Target**	**SoGR**	**2022 Target**	**Achieved**	**2024 Target**	**2026 Target**	**SoGR**
16%	16% (good)	**16%**	16%	18%	12%	**12%** (Poor)	12%	12%	8%

MassDOT has achieved all 2022 targets for interstate and state-maintained pavement. The DOT is also on track to achieve the 2024 targets if funding and direction remain constant.

To Put it in Perspective...

Total Area of 4 NHS Bridges = **1** Football Field (approximately)

Total Area of NHS Bridges = **515** Football Fields (approximately)

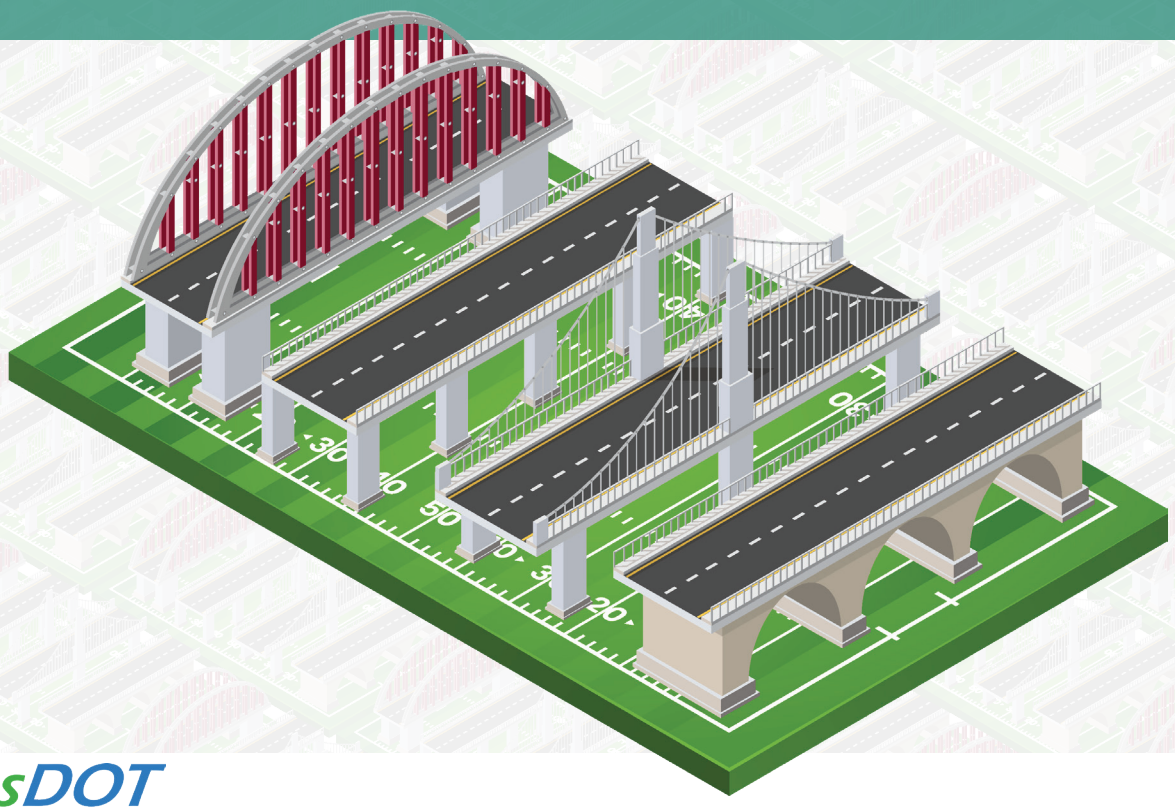
Existing Performance Gap = 60 (12% in Poor Condition) - 51 (10% Federal Threshold) = **9** Football Fields (approximately) or 36 NHS Bridges

9 Football fields need to be replaced to reach the threshold of < 10% poor area

and

5 Football fields need to be replaced each year to maintain the threshold of < 10% poor area

or Tackle the performance gap while heavily investing in preservation to drive down growth of poor area



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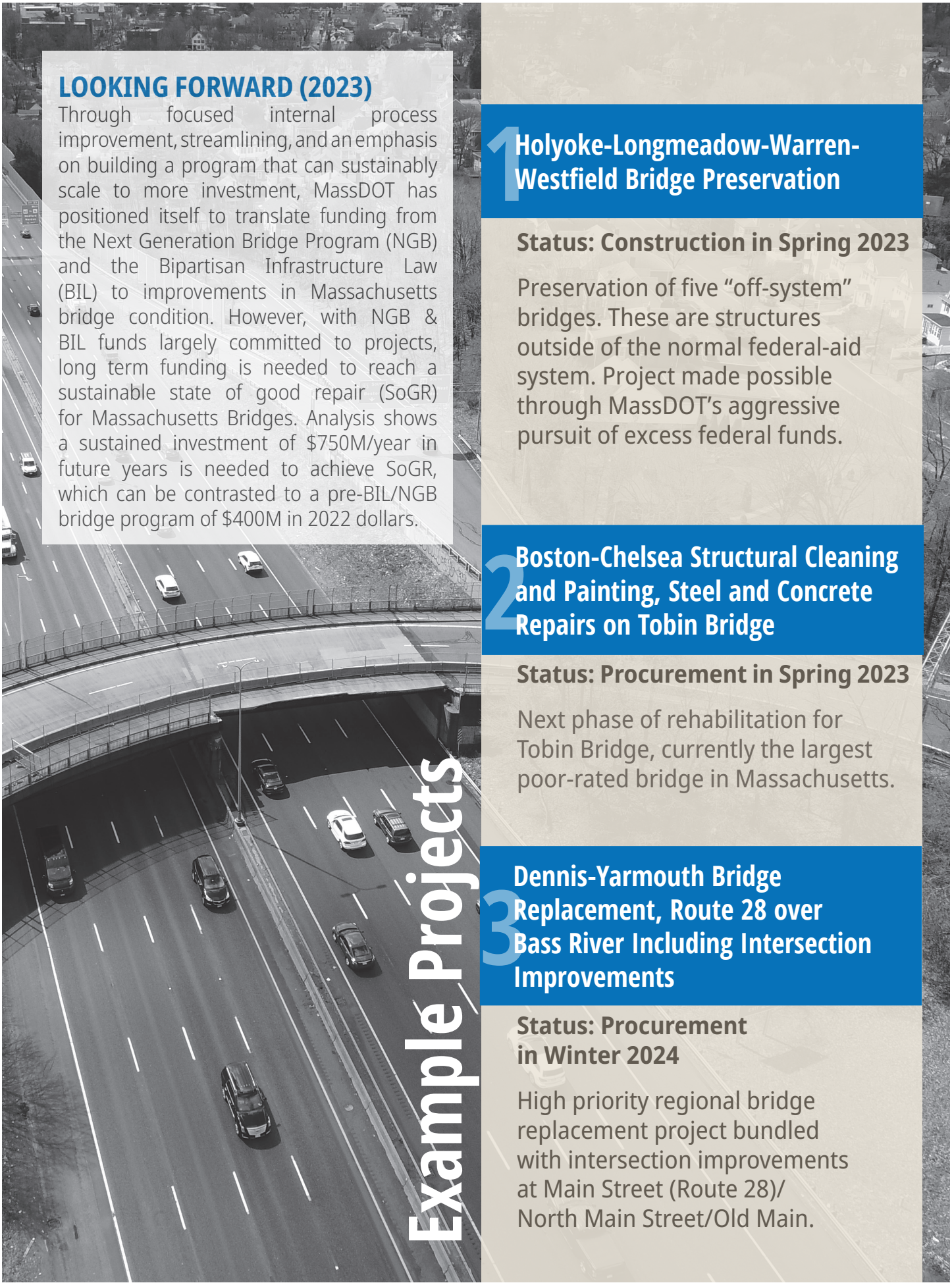

LOOKING FORWARD (2023)

Through focused internal process improvement, streamlining, and an emphasis on building a program that can sustainably scale to more investment, MassDOT has positioned itself to translate funding from the Next Generation Bridge Program (NGB) and the Bipartisan Infrastructure Law (BIL) to improvements in Massachusetts bridge condition. However, with NGB & BIL funds largely committed to projects, long term funding is needed to reach a sustainable state of good repair (SoGR) for Massachusetts Bridges. Analysis shows a sustained investment of $750M/year in future years is needed to achieve SoGR, which can be contrasted to a pre-BIL/NGB bridge program of $400M in 2022 dollars.

Example Projects

1 Holyoke-Longmeadow-Warren-Westfield Bridge Preservation

Status: Construction in Spring 2023

Preservation of five "off-system" bridges. These are structures outside of the normal federal-aid system. Project made possible through MassDOT's aggressive pursuit of excess federal funds.

2 Boston-Chelsea Structural Cleaning and Painting, Steel and Concrete Repairs on Tobin Bridge

Status: Procurement in Spring 2023

Next phase of rehabilitation for Tobin Bridge, currently the largest poor-rated bridge in Massachusetts.

3 Dennis-Yarmouth Bridge Replacement, Route 28 over Bass River Including Intersection Improvements

Status: Procurement in Winter 2024

High priority regional bridge replacement project bundled with intersection improvements at Main Street (Route 28)/ North Main Street/Old Main.

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MassDOT Bridge Model used for investment analysis

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To support performance management within the state and federal framework, the above bridge model forecasts performance by are area and count, and can be filtered by NHS, MassDOT region, and a variety of other attributes.

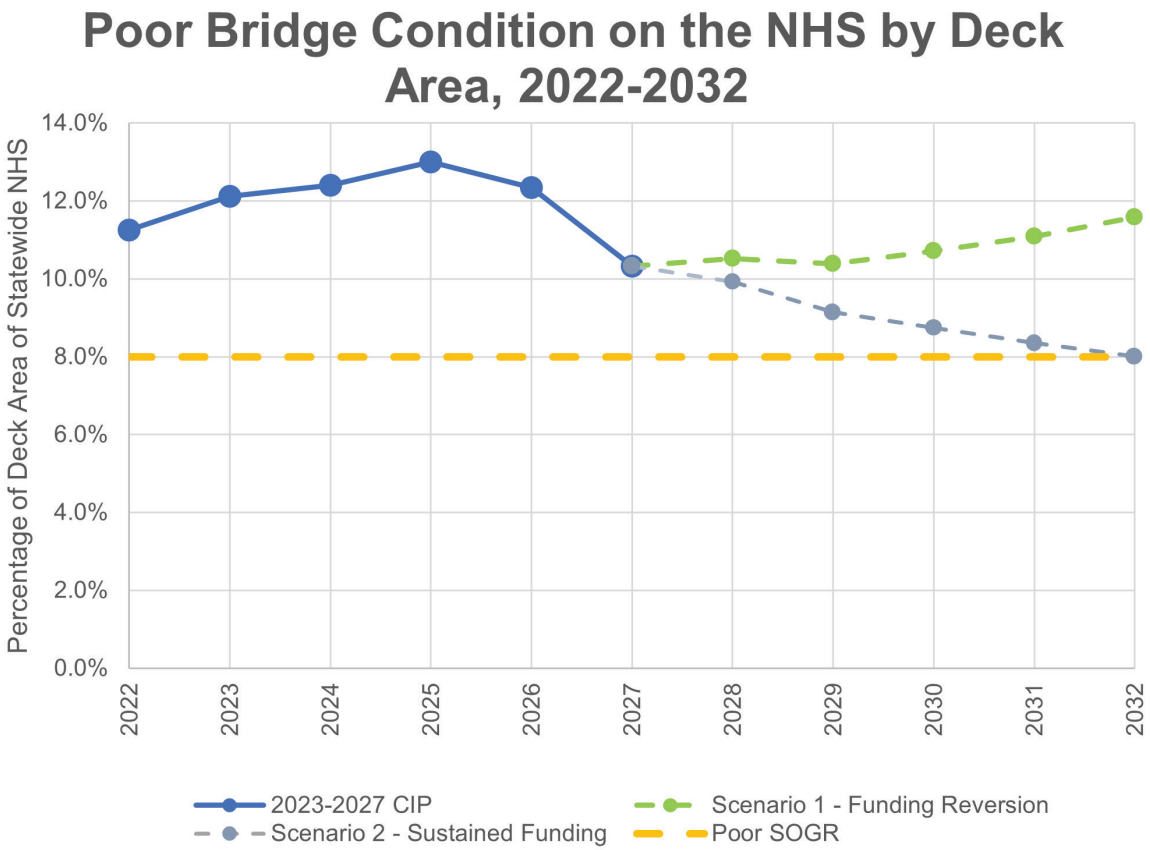
1. Top row has important items like Bridge Inspection data, the current and projected area percentage, and the impact of work scheduled on structurally deficient bridges. On the graphic, it shows 3.42M ft^2 as a result of the projected ft^2 minus the planned investments added to the current structurally deficient area. The growth shows the accruing deficiency is outpacing the planned upgrades, resulting in an increase in structurally deficient area.

2. The improvement map shows the project locations, and the investment list itemizes each location with project details.

3. A graphical representation of the investment strategy for each year and its impact on the percent area. Also shown is the target goal line that MassDOT wants to stay below.

4. The outputs of the investment strategy for each year. This year-over-year accounting reflects the forecasted levels of spending and the impact of those investment levels on work performed and the percent deck area target metric.

Tobin Bridge



Analysis shows a sustained investment of $750M/year in future years (scenario 2) is needed to achieve SoGR, which can be contrasted to a pre-BIL/NGB bridge program of$400M (scenario 1) in 2022 dollars.

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The modern roadway employs multiple systems to support safety, way-finding, and traffic management. Assets within these systems include signs, luminaries, traffic signals, closed circuit cameras, and changeable message signs. In most cases, the assets include significant structural elements that also require life cycle management. MassDOT manages the structural components of these assets through the Ancillary Structure program.

ANCILLARY STRUCTURES

CURRENT STATE (2022)

As of the writing of this report, MassDOT has completed a full inspection of approximately 83% of this inventory. The inventory is estimated to include over 24,000 individual structures, nearly 5 times the size of the state bridge inventory. For the inspection process, inspectors conduct a hands-on assessment of all major structural components, and where necessary employ non-destructive testing to assess underlining conditions. Ancillary inspections require properly trained inspectors, lane closures to gain roadway access, specialized equipment, and dedicated staff to manage the program and inspection findings.

LOOKING FORWARD (2023)

MassDOT plans to complete initial inspections by spring/summer of 2023. With full understanding of the inventory, MassDOT will look to employ a risk-based approach to future inspections and more efficiently manage the inventory into the future. Inspection results will also inform life cycle management of the various classes and align structure repair and replacement projects with observed conditions. The department is evaluating needs for organizational changes and positions to manage these important assets effectively.

MassDOT RESPONDS

Orange Line Shutdown

In a multi-modal transportation network, infrastructure projects can have broad regional impacts. In response to the MBTA Orange Line closure of summer 2022, MassDOT led an effort alongside municipalities and advocacy groups to consolidate the impact of the shutdown, tackling complex issues including:

- Moving people through the region, including normal commuters and displaced transit riders
- Managing traffic for large shuttle buses across jurisdictions
- Keeping vulnerable road users (bicycles and pedestrians) safe during this increased surface traffic period
- Accommodating the needs and disabilities of all users

Since an increase in communication and coordination was required, four subgroups were established:

1. Traffic Operations – to coordinate pop-up bus lanes and monitor traffic congestion
2. Vulnerable Road Users – to address the concerns of pedestrians and bicycles and the disabled community
3. Public Safety and Police Details – to coordinate with police and set up agency command centers
4. Communications – to communicate updates to the public and press releases.

The shutdown allowed crews to work on dozens of projects that would have taken five years to finish on nights and weekends. It also had positive impacts on commuters, increasing Bluebikes ridership by 53%, and on the agencies in several ways, including:

- Enhanced coordination among participants
- Streamlined process for decision-making
- Collaboration through ongoing communication
- Sharing of resources (labor and material)
- Extensive monitoring of the entire corridor
- Real-time tweaks to strategies

This experience and subsequent processes that were established can serve as a model for how to manage major disruptions from projects and events in the future.

Tunnels are the most technologically complex examples of transportation infrastructure, resembling buildings with full mechanical, electrical and life safety systems. Massachusetts has the third-largest tunnel inventory in the US, primarily contained within the Metropolitan Highway System network (MHS) and located within the city of Boston. The Massachusetts Tunnel inventory was constructed over a period of 75 years, both reflecting and changing the Boston region in the process.

TUNNELS

Due to the size complexity of the tunnel system, inspection crews are active most nights of a typical week to evaluate the condition of structural, civil, mechanical, electrical, fire/life safety/security, and material protective systems. The entire network is fully inspected on a rolling two-year schedule. All overhead elements are inspected annually, with additional inspections performed in response to damage, fire, deterioration, and as condition dictates. In addition to the extensive inspections performed by MassDOT forces, every three years the department commissions a third-party assessment of the entire MHS. The latest report was filed in October of 2021.

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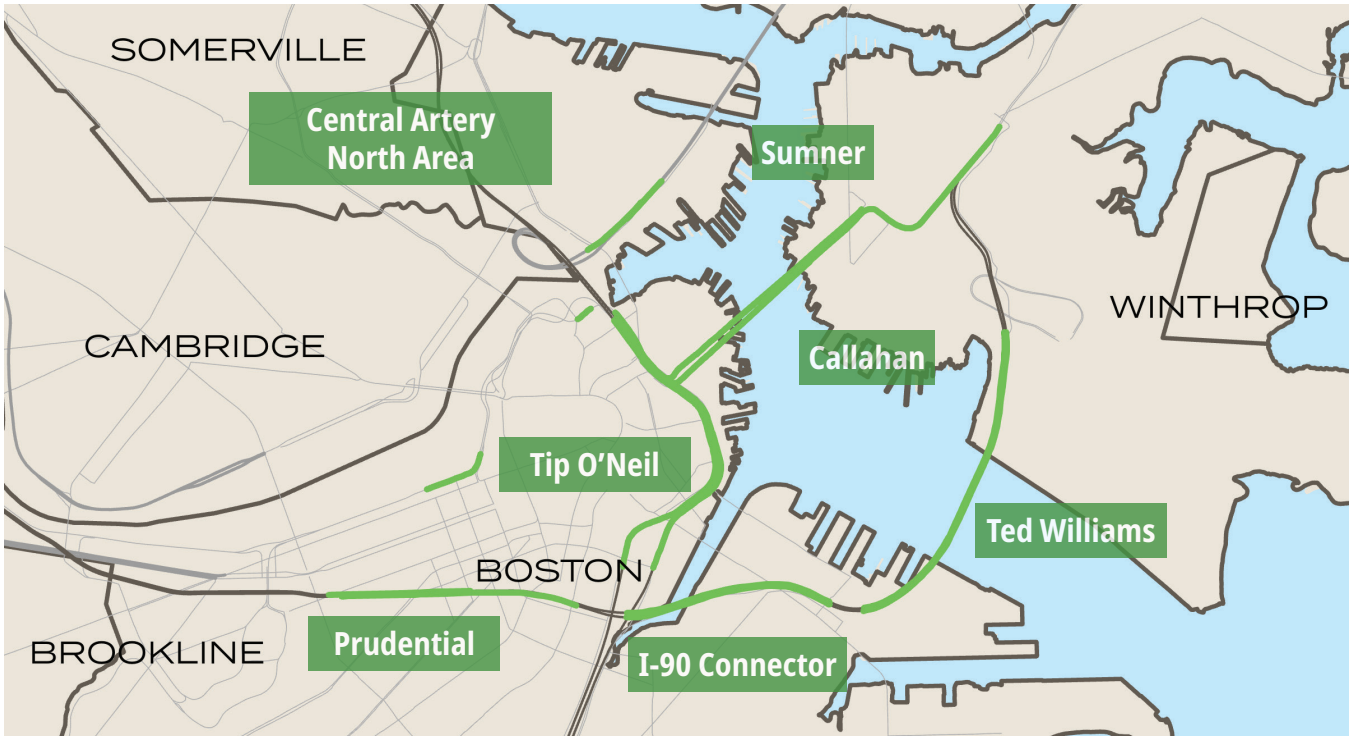
CURRENT STATE (2022)

Given the complexity, integral role within regional transportation, and varied design and age, the MHS tunnels (along with a small number of tunnels outside of Downtown Boston) pose a considerable challenge for MassDOT as asset owners.

In addition to day-to-day operations and rigorous inspections, capital planning must be responsive to the unique life cycle needs of each facility. MassDOT is currently managing a major project to rehabilitate the oldest tunnel in the MHS (Sumner Tunnel, 1934), while simultaneously upgrading the lighting systems of all "Big Dig" tunnels to modern, energy efficient fixtures.

MassDOT Major Tunnels



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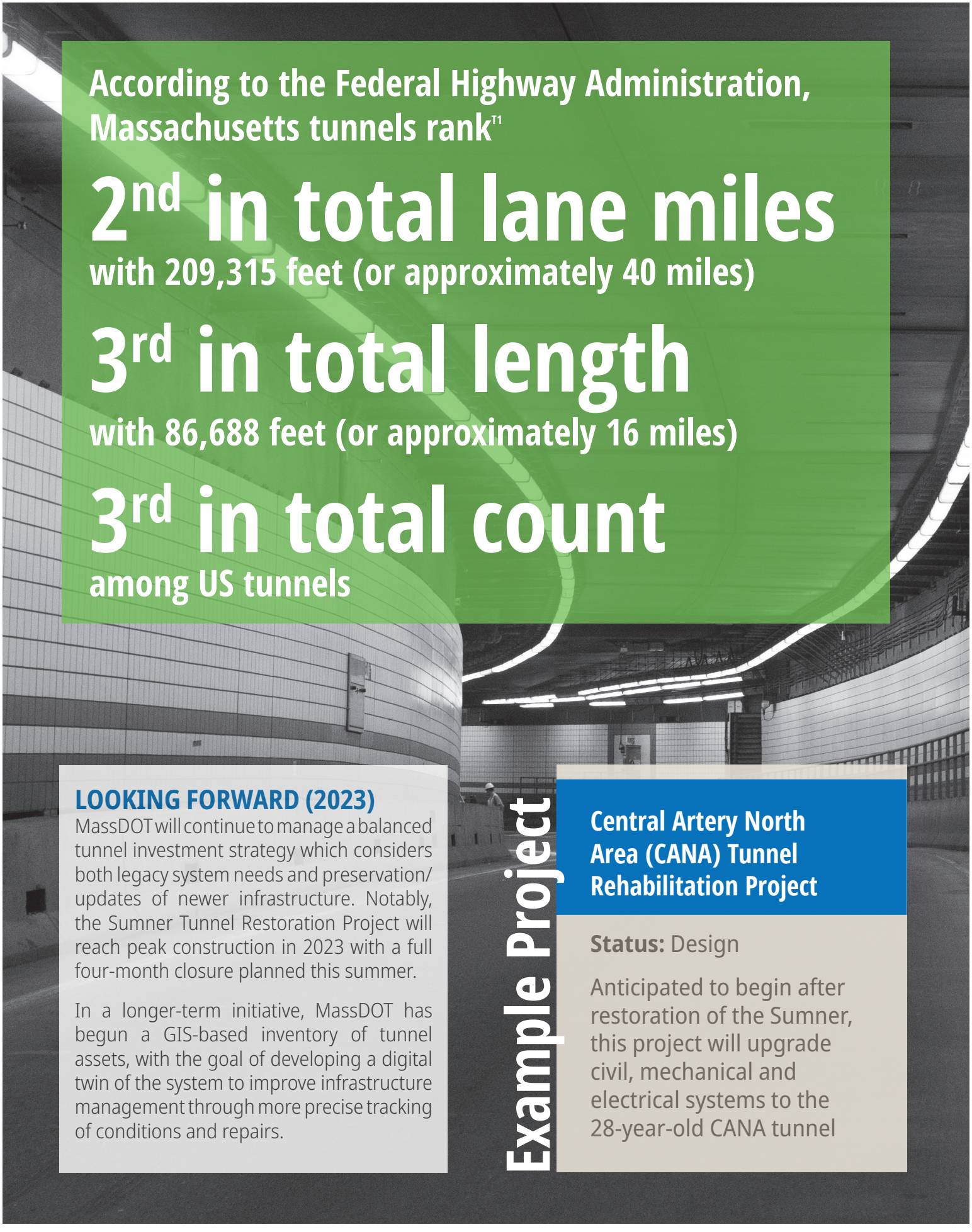

According to the Federal Highway Administration, Massachusetts tunnels rank[T1]

2nd in total lane miles

with 209,315 feet (or approximately 40 miles)

3rd in total length

with 86,688 feet (or approximately 16 miles)

3rd in total count

among US tunnels

LOOKING FORWARD (2023)

MassDOT will continue to manage a balanced tunnel investment strategy which considers both legacy system needs and preservation/ updates of newer infrastructure. Notably, the Sumner Tunnel Restoration Project will reach peak construction in 2023 with a full four-month closure planned this summer.

In a longer-term initiative, MassDOT has begun a GIS-based inventory of tunnel assets, with the goal of developing a digital twin of the system to improve infrastructure management through more precise tracking of conditions and repairs.

Example Project

Central Artery North Area (CANA) Tunnel Rehabilitation Project

Status: Design

Anticipated to begin after restoration of the Sumner, this project will upgrade civil, mechanical and electrical systems to the 28-year-old CANA tunnel

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DEFINITIONS

AFC | Alternative fuel corridor. FHWA initiative for network of plug-in electric vehicle charging and hydrogen, propane, and natural gas fueling infrastructure along national highway system corridors.

BIL | Bipartisan Infrastructure Law

CANA | Central Artery North Area tunnel in Boston.

Centerline Miles | Miles of roadway not accounting for direction or lanes. Measured according to the center of the roadway.

CIP | Capital Investment Plan. Usually, a five-year plan that is updated annually, but programs state and federal funds to pay for long-term improvements.

DOT | Department of Transportation

FHWA | The U.S. Department of Transportation Federal Highway Administration

Lane Miles | Centerline miles multiplied by the number of lanes. Example: 10 miles of 4-lane interstate would be 40 lane miles.

MassDOT Roads | This includes interstates as well as major freeways and arterial roads maintained by MassDOT.

MBTA | Massachusetts Bay Transportation Authority

MHS | Metropolitan Highway System. Legislatively defined to include the tolled highway system that consists of the Boston Extension, the Callahan Tunnel, the Central Artery, the Central Artery North Area of the Massachusetts Turnpike, the Sumner Tunnel, and the Ted Williams Tunnel, as defined in M.G.L. c. 6C, § 1.

NBI | National Bridge Inventory. Any bridge with a span of more than 20 feet.

NHS | National Highway System. Interstates and other roadways that are important to the nation's economy, defense, and mobility.

O&M | Operations and maintenance

OPM&I | MassDOT Office of Performance Management and Innovation

OTP | MassDOT Office of Transportation Planning

PSI | Pavement serviceability index. A scale from 0 to 100 that rates the pavement condition.

RUC | Road user cost. A user-based alternative revenue mechanism for surface transportation.

SoGR | Sustainable state of good repair

STIP | State Transportation Improvement Program. A combined effort between MassDOT and many state agencies that work together to design and build highways and transit projects. Updated annually.

TAMP | Transportation Asset Management Plan.

FOOTNOTES

P1 Pavement Management System, MassDOT, 2021 Pavement Condition of the Interstate and State Maintained System - Including Massachusetts Turnpike

P2 This also was a result of a multi-year statewide research project to characterize RAP, Characterization of Reclaimed Asphalt Pavement (RAP) for HMA Surface Courses in Massachusetts. The research project was also considered one of the 16 most valuable transportation research projects in 2021 by AASHTO and its' peers. Transportation Research Quarterly 2021 Q3 (mass.gov)

P3 MassDOT, Munipave.gdb, December 2022

PM1 https://highways.dot.gov/safety/other/visibility/pavement-markings-regulations-standards

B1 National Bridge Inventory Submittal, 2022 Data, MassDOT, Submitted Spring 2022.

T1 https://www.fhwa.dot.gov/bridge/inspection/tunnel/inventory/tunnelsbystate2022.cfm

M1 geoDOT, https://massdot.maps.arcgis.com/home/index.html

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MassDOT Mission

Our mission is to deliver excellent customer service to people traveling in the Commonwealth by providing transportation infrastructure which is safe, reliable, robust and resilient. We work to provide a transportation system which can strengthen the state's economy and improve the quality of life for all.

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