July 2024

Beyond Mobility
Massachusetts 2050 Transportation Plan

Appendix C: Needs Assessment

Final Plan

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1.0 Overview

The *Beyond Mobility* Needs Assessment was conducted to gain an understanding of the barriers to transportation access and major problem areas across the Commonwealth. The barriers included those caused by lack of service, congestion, poor safety, asset condition, and/or limited access to jobs, retail, open space, healthcare, and other destinations. The assessment incorporated research of previously adopted plans and policies, data analysis, and public engagement from across the Commonwealth.

Needs Assessment Objectives

- Inform the *Beyond Mobility's* Problem Statements
- Showcase well-known transportation barriers that represent structural barriers for users
- Inform targeted action steps for plan implementation

The Needs Assessment helped identify transportation-related barriers, needs, and inequalities in the Commonwealth. Data analysis summaries highlighted challenges in each of the *Beyond Mobility* Priority Areas and informed the Plan's Problem Statements.

First, elements of the transportation system—including service, congestion, safety, asset condition, and accessibility to jobs, retail, open space, health care, and other destinations—were identified for evaluation. Then, an inventory of plans and policies was used to identify over 300 transportation barriers from previous efforts and policies across Massachusetts. Transportation barriers varied by geography and theme. Barriers were mapped when possible and summarized by theme. Next, an in-depth analysis of transportation needs utilized data to support each *Beyond Mobility* Priority Area. The analysis considered social and geographic equity in order to understand trends and help define the Problem Statements.

2.0 Previous Plan Review & Public Engagement

The initial phase of the Needs Assessment involved understanding the existing conditions as outlined in previous plans and policies and communicated during public engagement. These sources helped to frame the current state of the transportation system and illustrate barriers and needs.

2.1 Previous Plan Review

The review of plans leveraged previous planning efforts and policies throughout the Commonwealth to identify barriers. Plans and policies from various authors were compiled, including MassDOT; MBTA; each of the 13 MPOs; various municipalities; and project-specific plans. Thorough review of each plan yielded documentation of visions, barriers, and recommendations for further analysis. Each of the barriers were summarized by transportation category, themes, and location (if possible) and analyzed for trends. From the 90 plans that were researched, there were a total of 378 barriers identified and categorized as shown in Table 2.1.

Table 2.1 Summary of Previously Identified Transportation Barriers

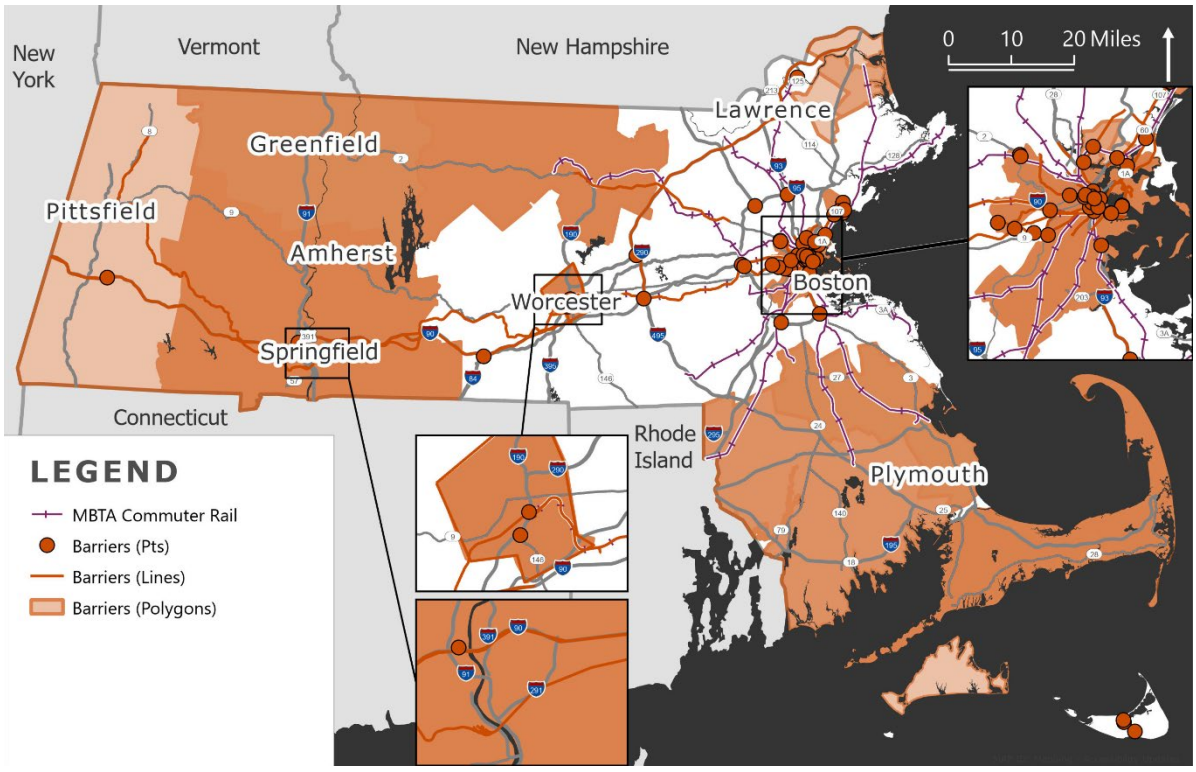
Category	Site-Specific	Non-Site-Specific	Total
Safety	18	75	**93**
Roadways	80	101	**181**
Public Transportation	100	121	**221**
Active Transportation	44	64	**108**
Airports	13	35	**48**
Goods Movement	39	57	**96**
Total[1]	**167**	**211**	**378**

[1] *Barriers could be assigned to more than one category.*

Transportation Barriers Mapping

Where possible, site-specific barriers identified from the plan review were mapped to understand issues across geographies as shown in Figure 2.1. There were barriers identified in the plan review that focused on policy, statewide themes or general improvements and were unable to be mapped. The site-specific barrier mapping exercise helped to understand the various themes that are present throughout the state (i.e., safety, mobility, and environmental concerns). While many plans identified issues at specific locations, as can be seen in Figure 2.1, there are large parts of the Commonwealth that are not represented in the plans inventoried.

Figure 2.1 Previous Plan Review—Barriers by Geography



Key Findings

Plans identified a range of problems, from site-specific issues (e.g., roadway bottlenecks) to broad issues (e.g., housing affordability). The barriers were reviewed for trends and informed the development of *Beyond Mobility* problem statements. Key findings are summarized below, organized by *Beyond Mobility* Priority Areas.

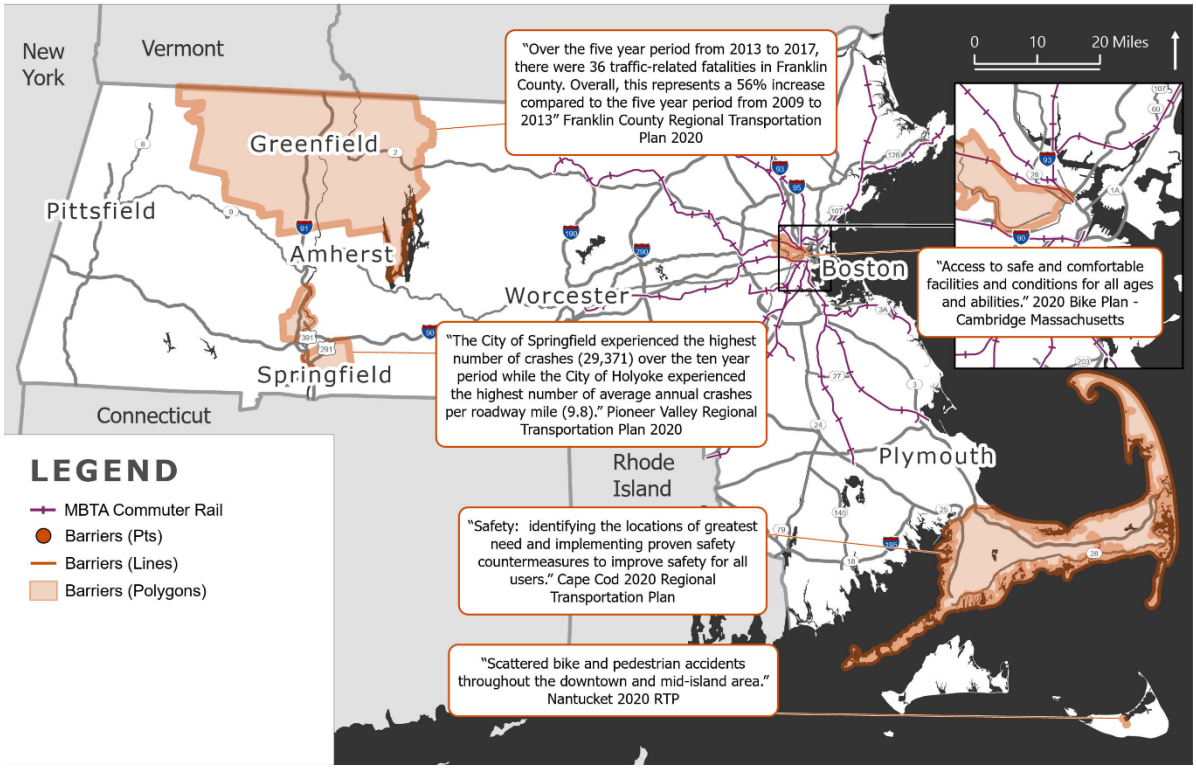
Safety

Most safety barriers documented in the needs assessment, across all transportation modes, were identified through research into previous plans. The review showed disparities in safety, especially for walkers and bicyclists, in rural communities and traditionally marginalized populations; highlighted safety concerns related to public transportation; and emphasized a need for continued safety research and education. Table 2.2 summarizes the key findings related to barriers that support the *Beyond Mobility* Safety problem statements. Figure 2.2 illustrates site-specific examples of safety barriers.

Table 2.2 Non-Site-Specific Safety Barriers

Beyond Mobility Problem Statements	Supporting Non-Site-Specific Source(s)	Non-Site-Specific Example Quote(s)
Environmental Justice communities are disproportionately burdened by transportation-related injuries and deaths, particularly those involving pedestrians and bicyclists.	*Strategic Highway Safety Plan* *MassDOT Statewide Pedestrian Transportation Plan* *Destination 2040: Needs Assessment*	"Data shows that while minority group individuals make up 34.9% of the national population, they suffer 46.1% of pedestrian deaths." *MassDOT Statewide Pedestrian Transportation Plan*
Massachusetts traffic fatalities and fatalities rates have risen since 2019, despite lower vehicle miles traveled.	*Strategic Highway Safety Plan* *MassDOT Statewide Pedestrian Transportation Plan* *Destination 2040: Needs Assessment* *Massachusetts State Rail Plan*	"Actual fatalities exceeded the targets set, further emphasizing the need to correct course and change the approach." *Strategic Highway Safety Plan 2023*
People bicycling in Massachusetts experience an unsafe and low-comfort network and people in Massachusetts' Gateway Cities and rural areas often experience safety issues when walking due to poor sidewalk quality and limited sidewalk coverage in these communities.	*Healthy Transportation Policy Directive* *Strategic Highway Safety Plan* *MassDOT Statewide Pedestrian Transportation Plan* *MassDOT Statewide Bicycle Transportation Plan* *Destination 2040: Needs Assessment* *2020 Bike Plan—Cambridge Massachusetts*	"When pedestrian facilities, including sidewalks, ramps, and crosswalks, are absent, poorly maintained, or unsafe, it puts people in danger, encourages trips in cars that could reasonably be made on foot, or limits mobility altogether." *MassDOT Statewide Pedestrian Transportation Plan* "Even the most developed local bike networks in Massachusetts do not form a connected network, and most shared-use paths lack high-comfort connections to adjacent town centers. A simple bike trip can quickly become uncomfortable, unappealing, or even unsafe when navigating discontinuous bikeways, a single stressful intersection, or poor transitions between bikeways." *MassDOT Statewide Pedestrian Transportation Plan*
Residents perceive an unsafe environment on public transportation due to a combination of high-profile safety events and more personal incidents.	*Destination 2040: Needs Assessment*	"The MBTA reported recent increases in fatalities on its system, particularly on the commuter rail. The MBTA and the RTAs in the Boston region must continue to monitor and reduce bus collisions, derailments, and other accidents that may contribute to negative safety outcomes." *Destination 2040: Needs Assessment*
There is a need for additional safety-related research and education in a number of other areas, including emerging technologies, drivers' education, and implications of the lack of cellular service in rural areas.	*Choices for Stewardship: Recommendations to Meet the Future of Transportation* *Envision Cambridge* *Montachusett 2020 RTP* *Old Colony 2020 LRTP*	"A transportation system can be very efficient, but if people do not believe it serves their needs, know how to navigate the system, or use it reliably and safely, that efficiency is wasted. Modern communications tools and an expanded education program will improve mobility, especially when grouped with improvements to physical infrastructure." *Envision Cambridge*

Figure 2.2 Examples of Site-Specific Safety Barriers



Destination Connectivity

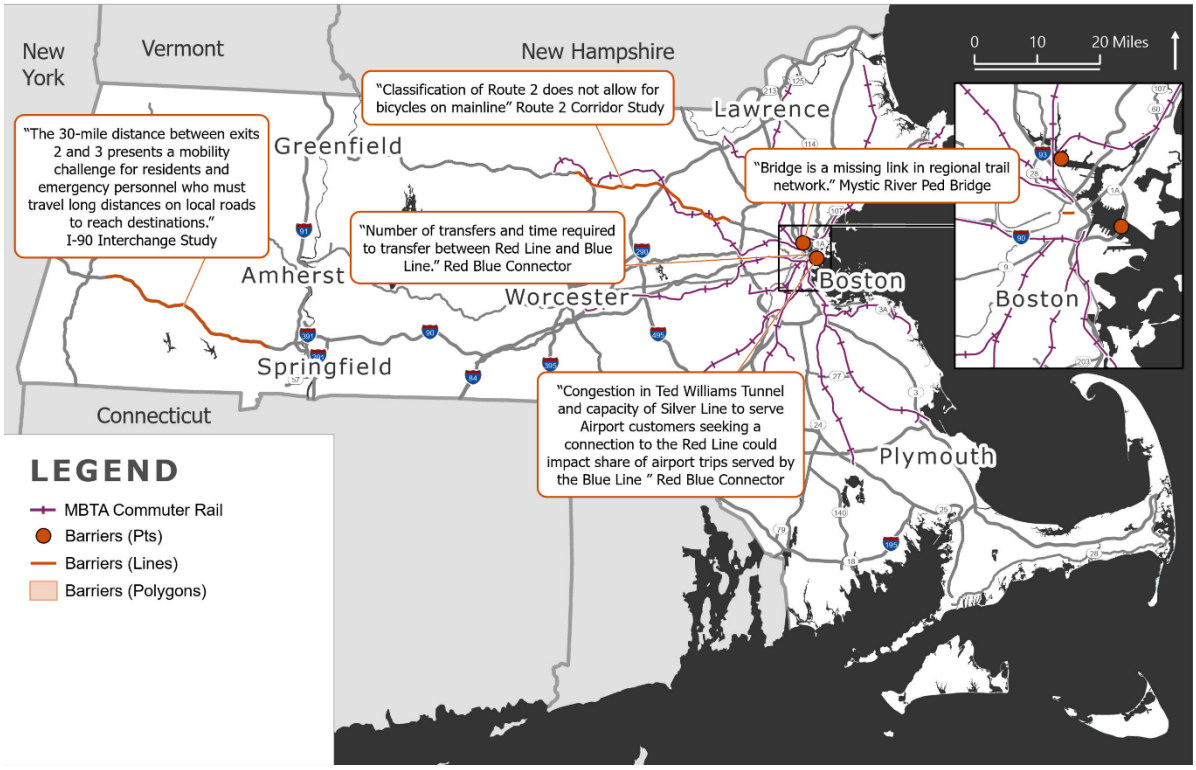
Network connectivity barriers were frequently observed in previous plans and policies. Common themes related to transportation system inequities, limited multimodal connections and options, and disproportionate connectivity barriers outside the urban core—all impacting access to destinations. Table 2.3 summarizes the key findings related to barriers that support the *Beyond Mobility* Destination Connectivity problem statements. Figure 2.3 illustrates site-specific examples of connectivity barriers.

Table 2.3 Non-Site-Specific Destination Connectivity Barriers

Beyond Mobility Problem Statements	Supporting Non-Site-Specific Source(s)	Non-Site-Specific Example Quote(s)
People living in Environmental Justice communities are burdened by connectivity inequities across our transportation system, limiting their access to opportunities.	*Reimagining the Future of Massachusetts* *Go Boston 2030* *Choices for Stewardship: Recommendations to Meet the Future of Transportation* *MBTA Rail Vision* *Montachusett 2020 RPT*	"Significant portions of Dorchester, Hyde Park, Jamaica Plain, Mattapan, and South Boston continue to face long walks to rapid transit stations. Residents in these areas rely on less frequent buses or other modes to get around." *Go Boston 2030*

Beyond Mobility Problem Statements	Supporting Non-Site-Specific Source(s)	Non-Site-Specific Example Quote(s)
The lack of contiguous, safe, high-comfort bicycle or pedestrian pathways connecting existing bicycle facilities limits the ability of people bicycling to access key destinations.	*Go Boston 2030* *SRPEDD Regional Bicycle Plan* *SRPEDD Regional Pedestrian Plan*	"Routes 1, 28, 6, 44, 105, 123 and 138—These corridors have very limited bicycle facilities but are, in many cases, the only option for accessing major employment, retail, transit and other priority destinations. They vary in composition in regard to lane layout, speed and other factors, but they all present a challenge for cyclists due to lack of safe infrastructure, safe crossing mechanisms and general bicycle friendliness. In some cases, bicycle travel is prohibited." *SRPEDD Regional Bicycle Plan*
Residents outside of inner core areas, particularly those in rural areas, lack convenient transit services and other non-vehicular transportation options, and feel disconnected from cultural, economic, and other opportunities.	*Choices for Stewardship: Recommendations to Meet the Future of Transportation* *Montachusett 2020 RTP* *2020 Merrimack Valley RTP* *SRPEDD RTP 2020*	"Approximately 84% of respondents would use transit to work if available." *Montachusett 2020 RTP* "Over a 3-month period, almost 62% were unable to a make a medical appointment due to lack of transportation; 57% said transportation was a major factor in whether or not they schedule a medical appointment." *Montachusett 2020 RTP*
Though reduced car travel supports decarbonization, people traveling in Massachusetts find it difficult to get around using other modes, including transit.	*MassDOT Statewide Bicycle Transportation Plan* *SRPEDD RTP 2020*	"Many gaps exist in the transit system within the SRPEDD region, as well as from the SRPEDD region to other regions and across the Rhode Island state line. Connections are needed to bridge the transit gaps between urban areas to cover the entire SRPEDD area and beyond." *SRPEDD RTP 2020*

Figure 2.3 Examples of Site-Specific Destination Connectivity Barriers



Travel Experience

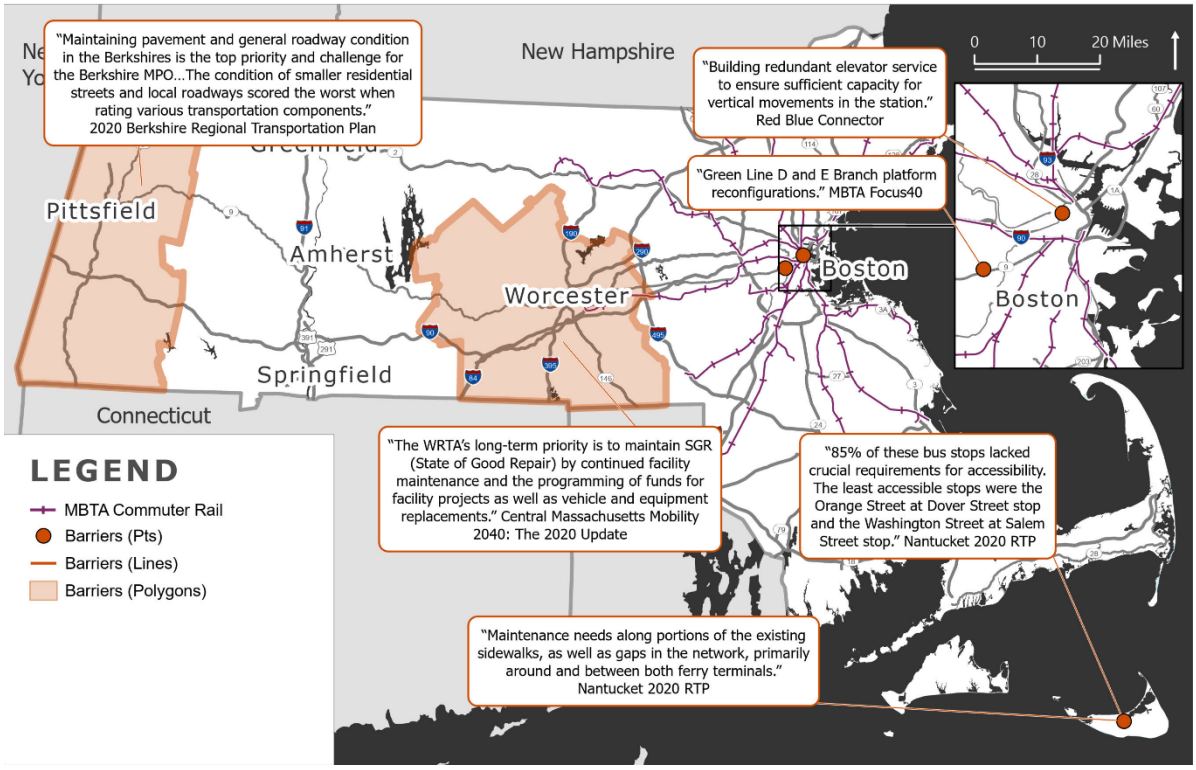
Related to travel experience, the previous plans and policies highlighted challenges with the ability to navigate the transit and active transportation networks, the impact of high transportation costs on historically marginalized populations, and accessibility issues at transit stops/stations. Table 2.4 summarizes the key findings related to barriers that support the *Beyond Mobility* Travel Experience problem statements. Figure 2.4 illustrates site-specific examples of barriers related to travel experience.

Table 2.4 Non-Site-Specific Travel Experience Barriers

Beyond Mobility Problem Statements	Supporting Non-Site-Specific Source(s)	Non-Site-Specific Example Quote(s)
Environmental Justice communities are in need of an enhanced user experience and increased affordability on transit.	*Go Boston 2030* *Montachusett 2020 RTP*	"Transportation costs exceed the Boston average, relative to housing cost, in the entirety of Dorchester, Hyde Park, Jamaica Plain, Mattapan, Roslindale, South Boston, and West Roxbury." *Go Boston 2030*
Missing sidewalks, curb ramps, and crosswalks limit mobility options for older adults and people with disabilities. This is a particular issue in rural communities, which	*Franklin County RTP 2020* *Pedestrian Plan for Franklin County 2020*	"Some improvement may be needed where there are gaps in the sidewalk, missing connections to other neighborhood roads, sidewalks in poor condition, and missing crosswalks and

Beyond Mobility Problem Statements	Supporting Non-Site-Specific Source(s)	Non-Site-Specific Example Quote(s)
have higher concentrations of these residents.		curb ramps." *Pedestrian Plan for Franklin County 2020*
Transit customers often find it challenging to understand and navigate the transit options available to them.	*2020 Comprehensive Regional Transit Plan (CRTP)—WRTA* *Nantucket 2020 RTP* *Lynn Transit Action Plan*	"While most of Lynn residents live within a quarter mile of a bus stop, only 40 percent of the 408 stops in Lynn are considered accessible and most bus stops do not feature amenities like shelters or real-time bus arrival information, affecting customer experience." *Lynn Transit Action Plan*
Bicyclists report that wayfinding and amenities at facilities are confusing or substandard.	*2020 Bike Plan—Cambridge Massachusetts* *SRPEDD Regional Bicycle Plan*	"There were requests for greater separation on some of the major streets, which we recognize may be desirable for people riding bikes because they provide the most direct path of travel to some destinations." *2020 Bike Plan—Cambridge Massachusetts*
The systems and protocols that support excellent customer service are not always prioritized.	*Massachusetts Freight Plan* *2020 Comprehensive Regional Transit Plan (CRTP)—WRTA*	"Some users experienced challenges in Massachusetts when transferring, acquiring, and renewing commercial drivers' licenses for truckers." *Massachusetts Freight Plan*

Figure 2.4 Example of Site-Specific Travel Experience Barriers



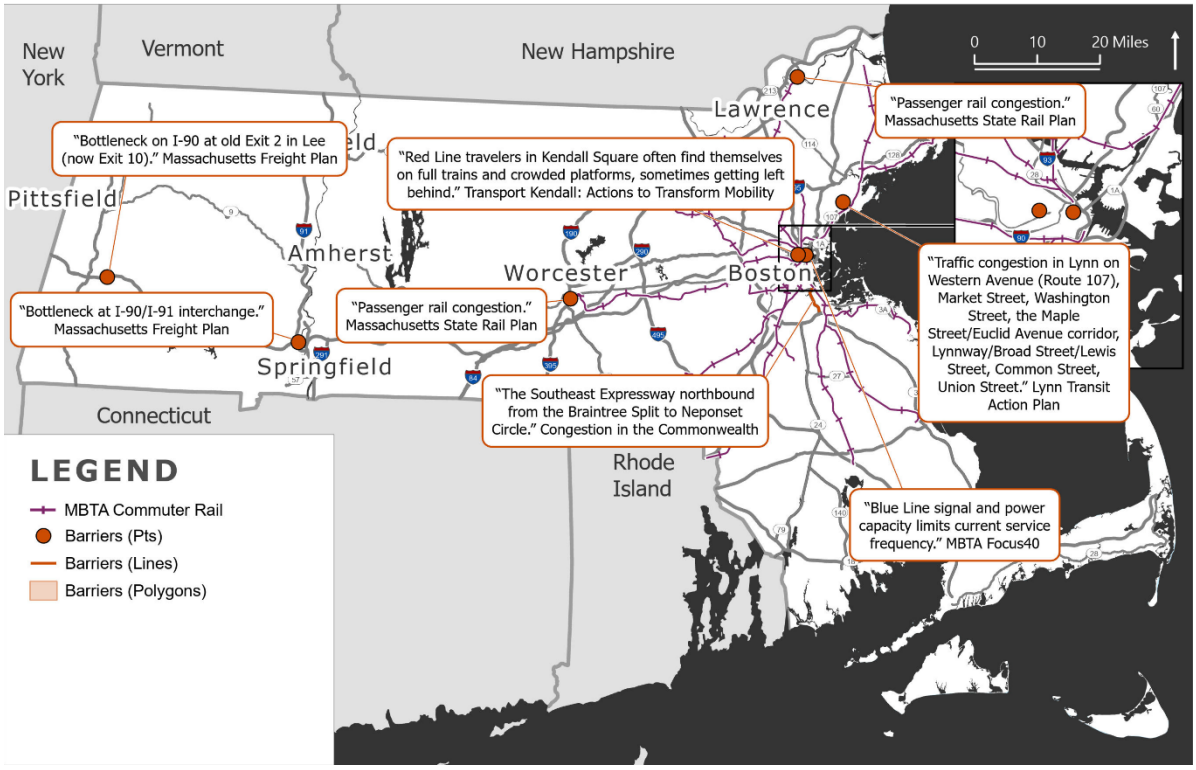
Reliability

The previous plans and policies highlighted reliability challenges, including its impact on the ability for people to access destinations and its impact on the attractiveness of transit and goods movement by freight. Table 2.5 summarizes the key findings related to barriers that support the *Beyond Mobility* Reliability problem statements. Figure 2.5 illustrates site-specific examples of reliability barriers.

Table 2.5 Non-Site-Specific Reliability Barriers

Beyond Mobility Problem Statements	Supporting Non-Site-Specific Source(s)	Non-Site-Specific Example Quote(s)
Massachusetts travelers by any mode are highly vulnerable to reliability issues, resulting in diminished access to everyday needs.	*Congestion in the Commonwealth* *MBTA Rail Vision* *Managed Lanes Screening Study 2020* *Old Colony 2020 LRTP* *Cape Cod 2020 Regional Transit Plan* *Rte. 128 Land Use and Transportation Plan*	"It's the unpredictability of their commutes that shape how people feel about transportation: the difference between an "average" day and a "bad" day can be enormous in terms of how much time people spend in traffic, whether on cars, buses, or trains." *Congestion in the Commonwealth* "On many of these segments, travel times during the morning peak are now more than double travel times under free-flow conditions. And on Routes 1 and 2, travel times are three times free-flow travel." *Congestion in the Commonwealth*
MassDOT's roadway and transit networks do not optimize travel during off-peak periods and must adapt to changing congestion patterns.	*Coordinated Human Services Transportation Plan* *2020 Comprehensive Regional Transit Plan (CRTP)—WRTA* *Managed Lanes Screening Study 2020* *Berkshire County RTP*	"The need for evening and weekend service has been repeatedly expressed by communities and individuals throughout the region and is considered to be a top priority transit need." *Coordinated Human Services Transportation Plan*
Roadway congestion diminishes transit reliability, limiting the competitiveness of sustainable transportation options.	*Congestion in the Commonwealth* *MBTA Focus40*	"But the congestion that is the subject of this report is affecting the attractiveness and reliability of buses. As noted in Chapter 2, the MBTA now assumes that buses will travel at 11.5 miles per hour on average, the slowest speeds since data has been made available." *Congestion in the Commonwealth*
Supply chains are disrupted when freight travel is unreliable.	*Destination 2040: Needs Assessment* *SRPEDD Freight Action Plan 2022* *Old Colony 2020 LRTP*	"Traffic congestion, including time-consuming commutes and longer truck freight travel times, can contribute to slowing economic growth and a less competitive regional economy." *Destination 2040: Needs Assessment*

Figure 2.5 Examples of Site-Specific Reliability Barriers



Supporting Clean Transportation

The previous plans and policies highlighted challenges related to the impact of single occupancy vehicle trips on climate change and barriers to advancing clean transportation options such as infrastructure needs and land use/zoning policies. Table 2.6 summarizes the key findings related to barriers that support the *Beyond Mobility* Supporting Clean Transportation problem statements.

Table 2.6 Non-Site-Specific Supporting Clean Transportation Barriers

***Beyond Mobility* Problem Statements**	**Supporting Non-Site-Specific Source(s)**	**Non-Site-Specific Example Quote(s)**
Transportation is the largest contributor of carbon emissions in Massachusetts and transportation-related emissions are disproportionately concentrated in Environmental Justice communities.	*Choices for Stewardship: Recommendations to Meet the Future of Transportation* *Montachusett 2020 RTP* *Cape Cod 2020 Regional Transportation Plan*	"Transportation is not only affected by climate change—it is now the largest and fastest growing emitter of greenhouse gas emissions." *Choices for Stewardship: Recommendation to Meet the Future of Transportation*
Availability of suitable infrastructure is a potential barrier to low or zero emission transportation choices.	*Choices for Stewardship: Recommendations to Meet the Future of Transportation* *Interim Clean Energy and Climate Plan for 2030*	"Growth in EV buses and other heavy-duty vehicles may require costly transmission and distribution system upgrades." *Choices for Stewardship: Recommendation to Meet the Future of Transportation*

Beyond Mobility Problem Statements	Supporting Non-Site-Specific Source(s)	Non-Site-Specific Example Quote(s)
Existing land use patterns reinforce car travel and exclude lower-income people from having sufficient modal choices.	*Choices for Stewardship: Recommendations to Meet the Future of Transportation* *15-Minute Neighborhoods* *Rte. 128 Land Use and Transportation Study*	"Despite easy commuter rail access to Boston and good bones with a village center, Downtown Reading's built environment is nonetheless very car centric. This is typical of many suburban towns throughout Greater Boston; they have valuable commuter rail stations but are not able to maximize their potential. Zoning has been largely exclusionary, leading to low housing density, a lack of residential diversity, and only light suburban downtown activity." *15-Minute Neighborhoods*

Resiliency

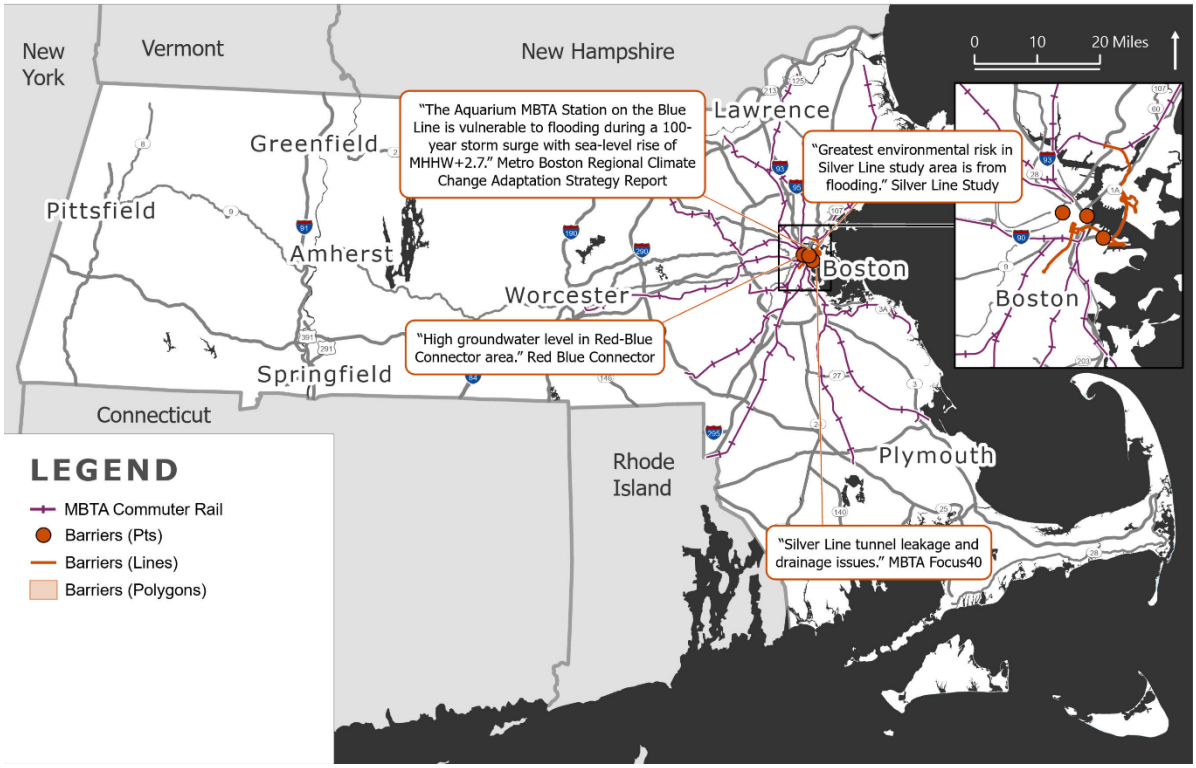
Related to resiliency, the previous plans and policies noted the significant transportation infrastructure and residents across the Commonwealth that are vulnerable to the impacts of climate change such as extreme weather and sea level rise. Table 2.7 summarizes the key findings related to barriers that support the *Beyond Mobility* Resiliency Problem Statements. Figure 2.6 illustrates site-specific examples of resiliency barriers.

Table 2.7 Non-Site-Specific Resiliency Barriers

Beyond Mobility Problem Statements	Supporting Non-Site-Specific Source(s)	Non-Site-Specific Example Quote(s)
Significant transportation infrastructure in Massachusetts is potentially exposed to natural hazards, including sea level rise and storm surge, riverine and coastal flooding, extreme heat, and others.	*Massachusetts State Hazard Mitigation and Climate Adaptation Plan* *Go Boston 2030* *Metro Boston Regional Climate Change Adaptation Strategy Report* *Montachusett 2020 RTP* *Envision Cambridge* *Pioneer Valley Regional Housing Plan*	"The Commonwealth is exposed to numerous natural hazards, and these hazards are being exacerbated by rising temperatures, changes in precipitation, extreme weather, and sea level rise." *Massachusetts State Hazard Mitigation and Climate Adaptation Plan* "As sea level rise progresses, roadways, subway and highway tunnels, Logan International Airport, and other critical elements in our transportation network could be inundated." *Massachusetts State Hazard Mitigation and Climate Adaptation Plan* "Particularly pavement, exposed to high temperatures over longer periods of time, which can cause buckling and lead to increased failures… Railroad tracks can expand in extreme heat, causing the track to "kink" and derail

Beyond Mobility Problem Statements	Supporting Non-Site-Specific Source(s)	Non-Site-Specific Example Quote(s)
		trains." *Massachusetts State Hazard Mitigation and Climate Adaptation Plan*
A significant share of Massachusetts' population lives in areas at high risk of natural hazards.	*Massachusetts State Hazard Mitigation and Climate Adaptation Plan* *Imagine Boston 2030* *Go Boston 2030* *Metro Boston Regional Climate Change Adaptation Strategy Report*	"For the purposes of the SHMCAP, the entire population of the Commonwealth of Massachusetts is considered to be exposed to extreme temperatures. While extreme temperatures are historically more common in the inland portions of the Commonwealth, the impacts to people may be more severe in densely developed urban areas around the state." *Massachusetts State Hazard Mitigation and Climate Adaptation Plan*

Figure 2.6 Examples of Site-Specific Resiliency Barriers



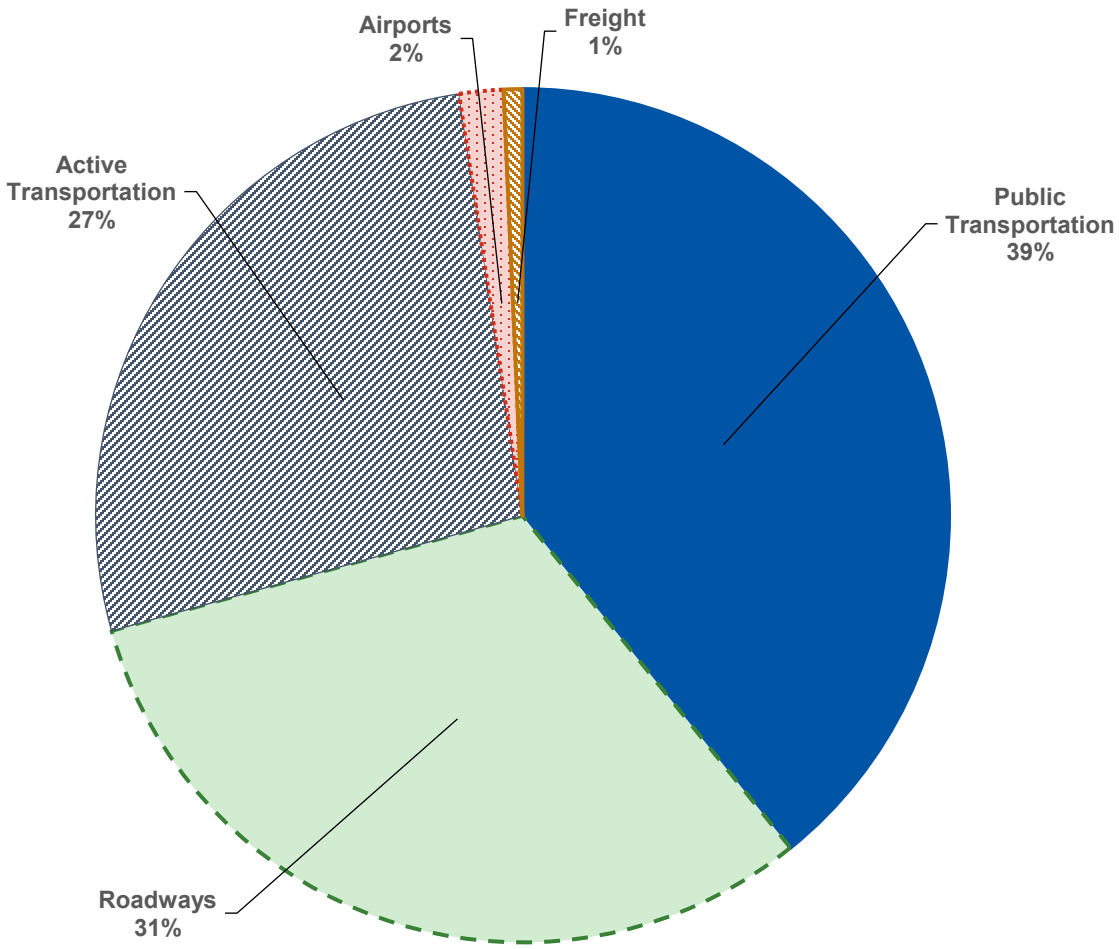
2.2 Public Engagement

The results of the Summer 2022 *Beyond Mobility* Phase I Vision, Values, & Needs Survey were also used to pinpoint specific themes or locations for further investigation. This public survey asked participants to highlight up to three locations throughout the Commonwealth where transportation improvements are needed. Nearly 1,000 locations with transportation issues were identified and

analyzed in order to support an understanding of needs from the perspective of transportation system users. Figure 2.7 summarizes the responses by transportation mode category.

The *Beyond Mobility* Phase II Priorities & Tradeoffs Survey—conducted in the Fall of 2022—garnered over 2,500 responses. Since the *Beyond Mobility* Phase II Priorities & Tradeoffs Survey focused on tradeoffs across budgetary programs and not site-specific needs, those results are not discussed in detail in this Appendix. Those results are summarized throughout *Beyond Mobility*, particularly in Chapter 3.

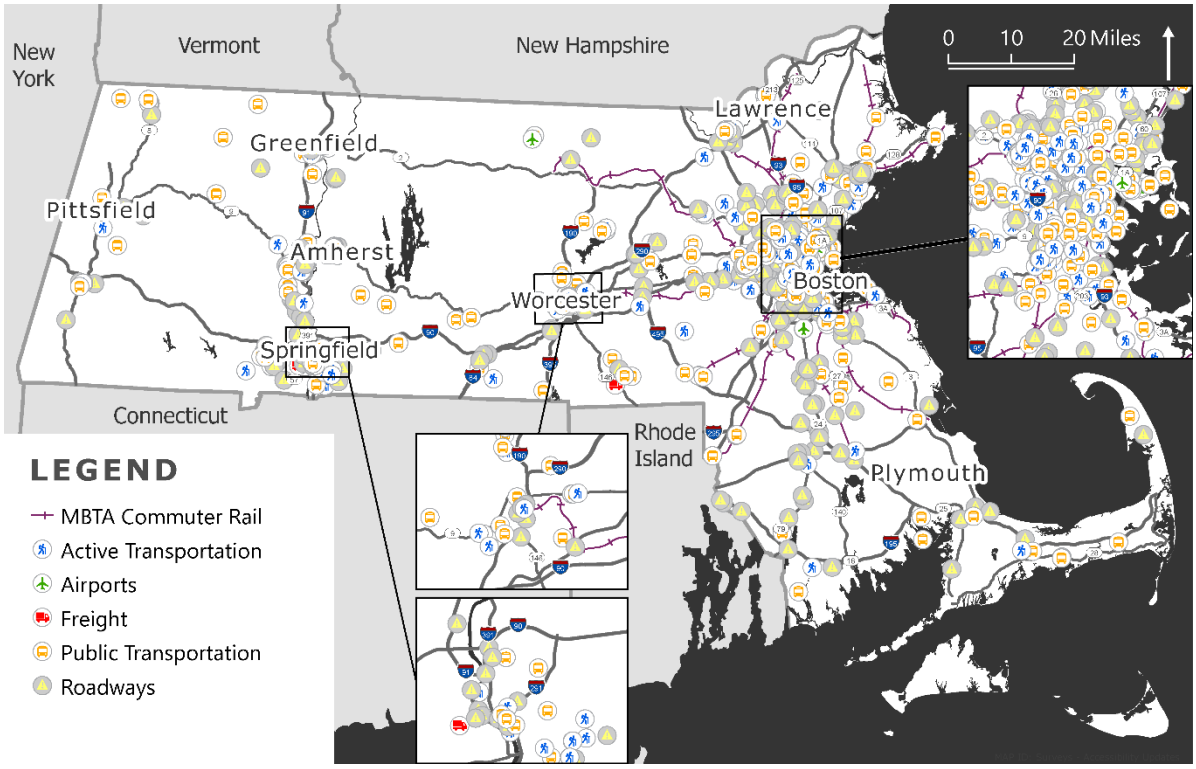
Figure 2.7 Transportation Needs Identified by Transportation Category



Source: Beyond Mobility Phase I Vision, Values, & Needs Survey, Summer 2022. Includes all survey responses.

Over half of the site-specific issues were clustered in Greater Boston, with a relatively even distribution of remaining responses across the Commonwealth, as shown in Figure 2.8.

Figure 2.8 Site-Specific Transportation Needs Identified by Transportation Category



Source: Beyond Mobility Phase I Vision, Values, & Needs Survey, Summer 2022. Includes only site-specific responses. Broad/general theme responses could not be mapped.

Participants highlighted challenges such as a lack of transportation options, missing multimodal connections that impact their ability to access jobs and other locations, safety concerns for walking and biking, transit and highway unreliability, resiliency concerns, and roadway congestion and bottlenecks. Trends among various respondent groups include:

- Over 125 responses were received from people of color. Common concerns among this demographic include a lack of transit connectivity and reliability challenges.
- Over 100 responses were received from people 65 and over. This group highlighted challenges with transit connectivity, safety when biking, and unreliability of the roadway and transit systems.
- More than half of respondents indicated they use transit. These respondents most frequently noted concerns with safety and connectivity.
- Nearly half of respondents reported using a bicycle as at least one mode of travel. Over 80 percent of these respondents noted connectivity concerns.

Table 2.8 provides example quotes from survey responses that illustrate these key takeaways.

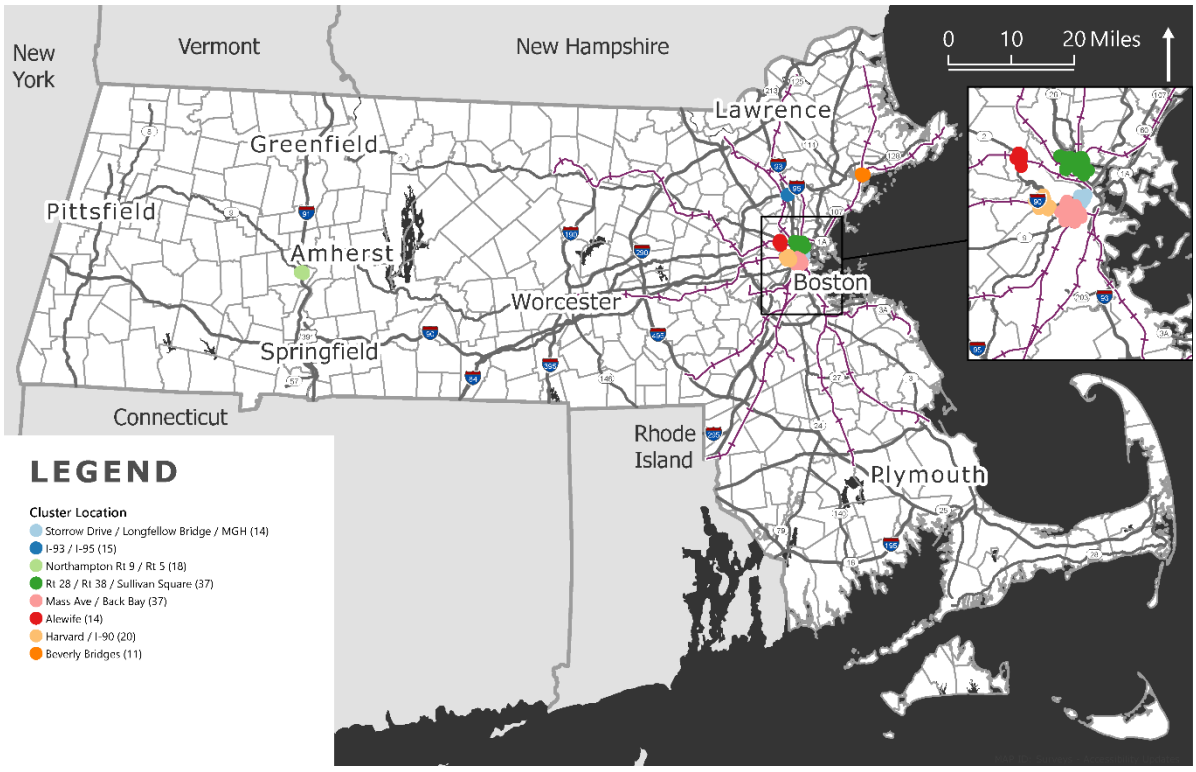
Table 2.8 Site-Specific Transportation Needs Identified by *Beyond Mobility* Respondents

Example Quotes from Respondents	Respondent Demographics
"My area has limited transportation options. Taking the bus costs money but it's not always reliable. I have to walk to get to my job when my parents or siblings' transportation isn't available. I don't have a driver's license as of yet."	22 to 34/Low Income/ White/Central Mass Walker
"I drive by myself most often because of the convenience (I go when I want) and the time it takes for point-to-point travel. Biking to my major destinations feels too far or unsafe or both. The bus/train/transit system is too infrequent, not reliable, and too indirect, taking too much time compared to the alternative (driving or Uber/Lyft)."	65 & Over/White/Greater Boston Walker
"The main challenge for getting outside of my area is that I simply cannot. My town has no rail connection for a majority of the year, only having service for 3 months, and even then, with only 3 trains a day. Even if I want to get around my area, it's difficult. Buses only typically come every hour and it's quite slow. Life would be made much better if I was able to bike to places, but it's straight up dangerous in many places to bike, and even if I can bike there is nowhere to lock my bike."	Under 18/Cape Cod/Person of Color/Transit (Bus) User
"I do not commute into Boston but go suburb to suburb."	Rural/White/Metro West Walker
"Boston needs to prioritize the quality of life and the safety of its residents and bike users over the needs of out-of-town commuters."	Person of Color/Greater Boston Biker and Walker
"I have to commute every day through Sullivan circle, mainly by bike and sometimes walking. It is so dangerous. Cars just don't pay attention to anyone who are not in cars. Even the lights put in place explicitly for us to cross and give the cars a red light are often ignored."	35 to 44/White/Greater Boston Transit User & Walker/Biker
"I feel unsafe bicycling anywhere. I have been hit by a car on Mass Ave and broke bones and was in the hospital."	45-54/Urban/White/Greater Boston Transit User & Walker/ Biker
"Unsafe infrastructure for pedestrians and bicyclists. The road network was designed with cars as the primary users. We need a complete rethinking that puts *people* (NOT CARS) at the center. This means BRT, protected and separated bike lanes, full sidewalk networks, etc."	22 to 34/White/North Shore Private Vehicle Owner and Walker/Biker
"This underpass* floods every time it rains, hindering bicycle traffic and bus service." (*Referencing Washington Street under railroad tracks in Somerville)	22 to 34/White/Greater Boston Non-Automobile User
"Congestion getting into Boston and the Cape; lack of railway to get from Western MA to Eastern MA which would help reduce congestion on our roadways; limited airline choices in Worcester—need something on par to Logan to help spread the demand."	45 to 54/White/Rural/Western Massachusetts Private Vehicle Owner and Walker

Source: Beyond Mobility Phase I Vision, Values, & Needs Survey, Summer 2022.

Further analysis was completed to understand if there were locations repeatedly commented on. The results of this analysis are shown in Figure 2.9 and illustrate several clusters of issues. The Sullivan Square area and Massachusetts Avenue corridor in Boston were noted most frequently and challenges with biking were highlighted. Congestion and safety issues around the interchange of I-93 and I-95 in Woburn and challenges with ongoing construction in Beverly were noted. Another notable cluster of comments in Northampton was observed, with many comments focusing on a lack of public transportation options in this area.

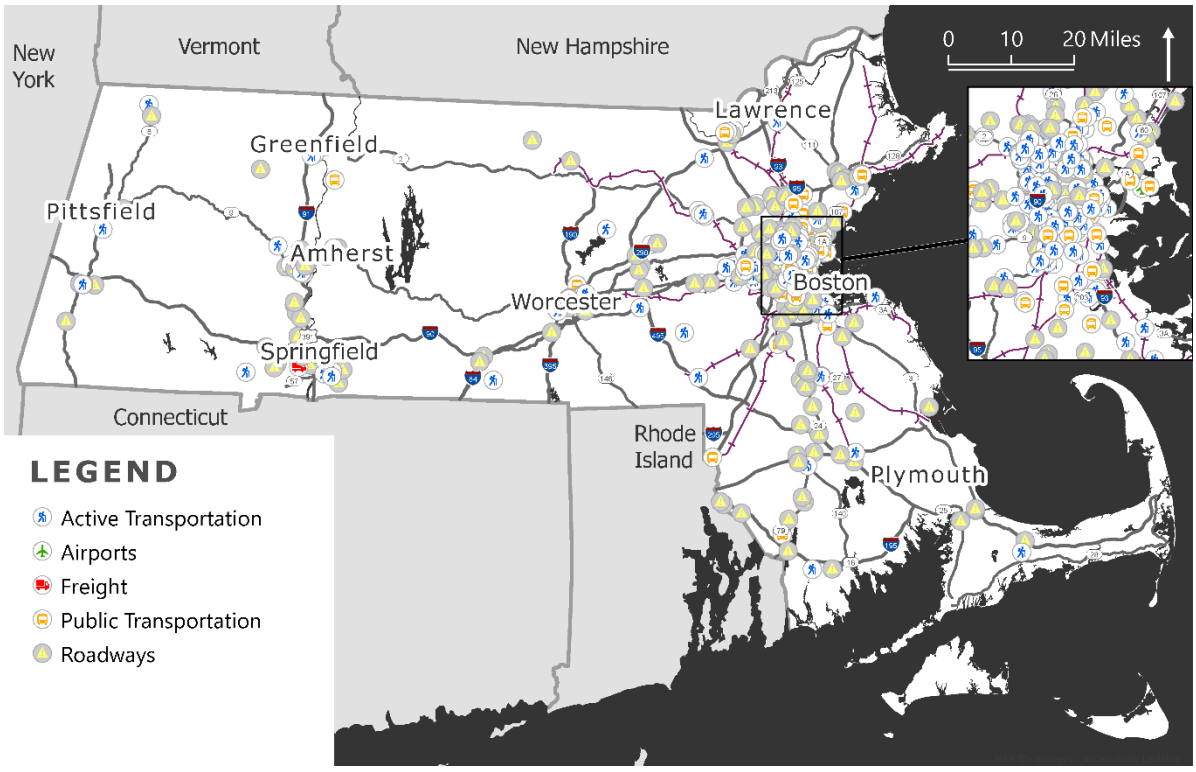
Figure 2.9 Clusters of Site-Specific Transportation Barriers Reported by Respondents



Source: Beyond Mobility Phase I Vision, Values, & Needs Survey, Summer 2022.

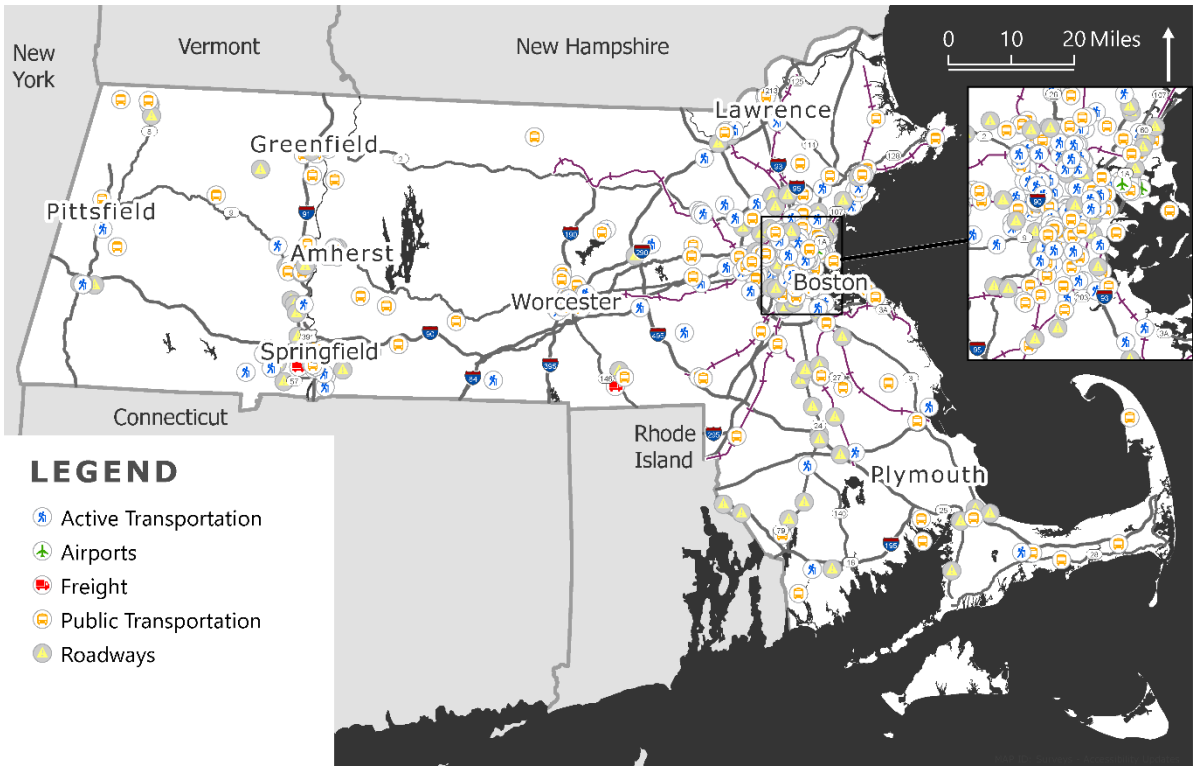
Respondents were asked to describe the problem they experience. More than half of the responses noted safety as a concern, with an emphasis on walking, bicycling, and roadways (Figure 2.10). Another common concern was connectivity, with over 400 responses (Figure 2.11). Finally, respondents raised nearly 80 resiliency concerns, with comments related to flooding of roadways, transit stations, and active transportation facilities (Figure 2.12).

Figure 2.10 Safety Site-Specific Transportation Needs Identified by Respondents



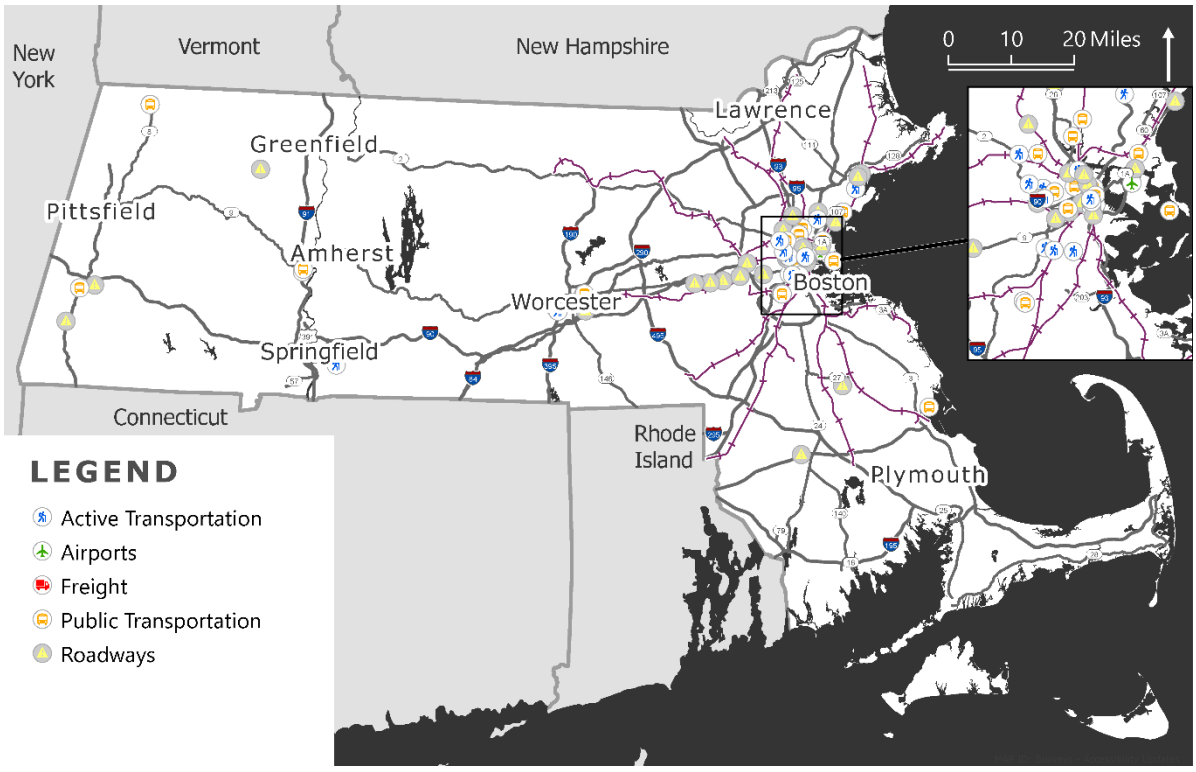
Source: Beyond Mobility Phase I Vision, Values, & Needs Survey, Summer 2022.

Figure 2.11 Connectivity Site-Specific Transportation Needs Identified by Respondents



Source: Beyond Mobility Phase I Vision, Values, & Needs Survey, Summer 2022.

Figure 2.12 Resiliency Site-Specific Transportation Needs Identified by Respondents



Source: Beyond Mobility Phase I Vision, Values, & Needs Survey, Summer 2022.

The previous plan reviewed inventory of existing transportation barriers and public engagement findings informed the data analysis described below and factored into developing the problem statements and overall *Beyond Mobility* Priority Areas.

3.0 Data Analysis

The Needs Assessment included an analysis of transportation data representative of each *Beyond Mobility* Priority Area. These data have been analyzed against social and geographic equity definitions to understand trends and inform and the definition of Problem Statements for each Priority Area.

3.1 Methodology

The Needs Assessment methodology was designed to better understand the transportation needs and barriers for a variety of different transportation users and communities. Key indicators were identified that align with each *Beyond Mobility* Priority Area and considered social and geographic equity definitions and, for some indicators, closeness to a public transit stop. The Needs Assessment key indicators were paired with the plan and policy review and public engagement findings to support the definition of Problem Statements for each *Beyond Mobility* Priority Area.

Defining Equity Areas of Focus

Through policies, practices, programs, and budgets, MassDOT has an opportunity to advance equitable access to safe, efficient, and affordable transportation systems across Massachusetts. Historically, transportation investment decisions have perpetuated inequities in communities such as Black, Latino, Indigenous and Native American persons, Asian Americans and Pacific Islanders and other persons of color; members of religious minorities; lesbian, gay, bisexual, transgender, and queer (LGBTQ+) persons; persons with disabilities; persons who live in rural areas or urban cores; and persons otherwise adversely affected by persistent poverty or inequality. Entrenched disparities have been embedded in the design of transportation planning and investment decision-making processes over time and *Beyond Mobility* is envisioning a variety of approaches to move towards transportation justice.

Acknowledging that transportation equity can be achieved only with intent and focus, MassDOT developed a definition of equity populations. This definition was used to understand how transportation needs and barriers vary across different communities. Building this understanding of how outcomes vary by communities, *Beyond Mobility* can highlight decision-making practices, intentional approaches, and actionable mechanisms, to strategically reduce harms and adverse impacts, and continuously increase equity in future transportation investments.

Equity Areas of Focus

To define equity areas of focus, *Beyond Mobility* used demographic data to identify areas with high concentrations of communities that experience disproportionate burdens resulting from the impacts of the transportation system. While referenced as “Environmental Justice communities” throughout Beyond Mobility, the specific definition of these equity areas of focus is Regional Environmental Justice “Plus” (REJ+), representing a holistic understanding of communities that are most impacted by transportation planning and decision-making. The *Beyond Mobility* Environmental Justice community designation is distinct from the traditional Environmental Justice definition in that it

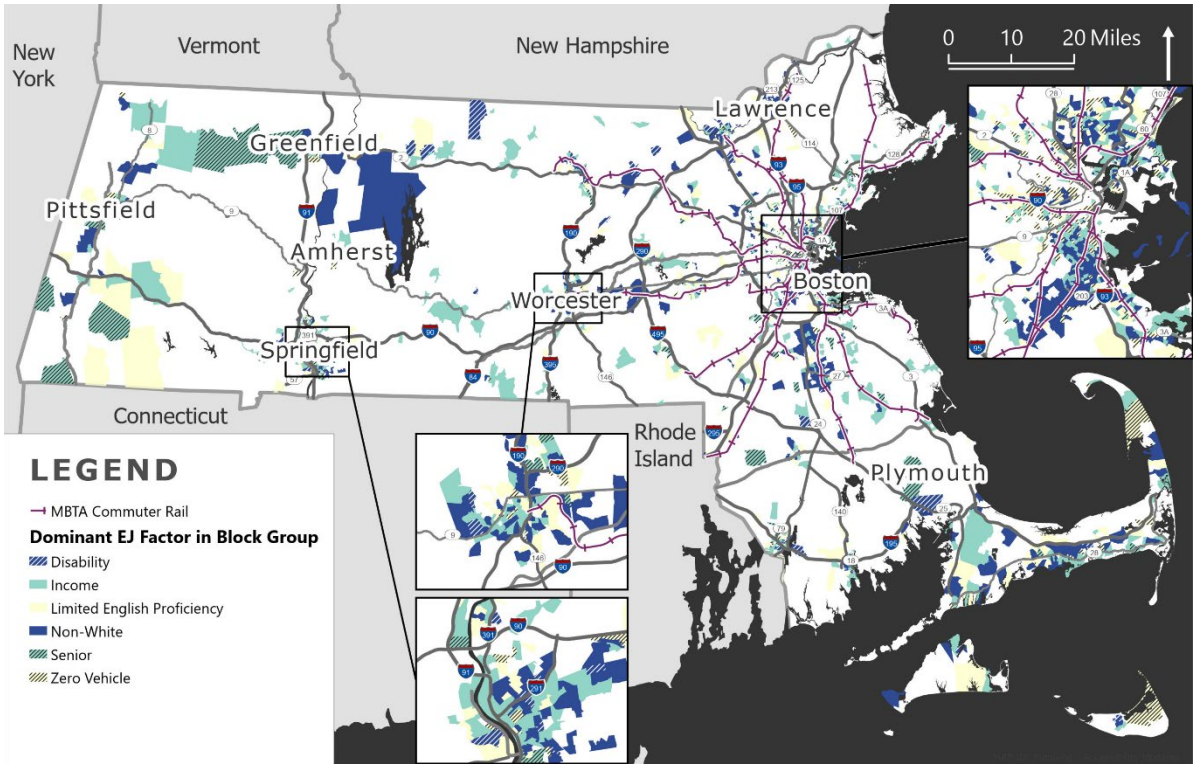
incorporates data on vehicle access, disability status, and age in addition to more traditional data on income, race, and limited English proficiency.

In addition to providing a more holistic and transportation-specific definition of equity, the Environmental Justice communities designation incorporations information on each Census block group's characteristics for each variable compared to the average of its MPO. This allows for a more localized understanding of equity, since statewide data is often skewed by larger metropolitan areas such as Boston. This differs from the traditional approach of comparing a block group's characteristics to statewide averages. For a community to be designated as Environmental Justice in this plan, it must have a higher concentration of these criteria than other communities in its region.

To be defined as an Environmental Justice community, a community must meet one of the following criteria:

- Higher concentration of poverty than in nearby communities
- Higher concentration of non-white households than in nearby communities
- Higher concentration of people with limited English proficiency than in nearby communities

Figure 3.1 Equity Areas of Focus, Most Dominant Equity Factor by Region



The following community characteristics were also factored into the Environmental Justice community definition to demonstrate which variable(s) were influencing the designation:

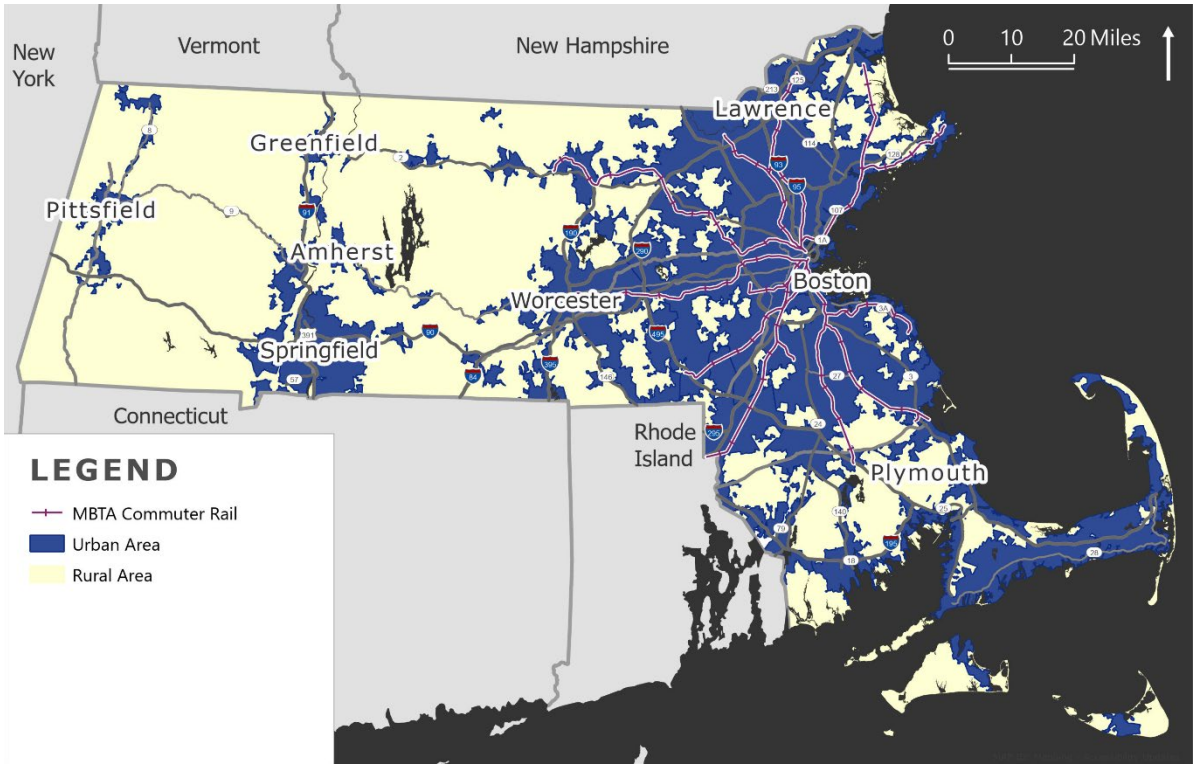
- Higher concentration of households without access to a vehicle than nearby communities

- Higher concentration of people with disabilities than nearby communities
- Higher concentration of people aged 65 years and over than nearby communities

Geographic Equity

Massachusetts Census block groups are organized into urban and rural areas. There are four types of urban areas: large urbanized area, small urbanized area, large urbanized cluster, and small urbanized cluster. In total, there are 21 urban areas in the state. If an area is not included in an urban region, it is considered rural. These urban and rural boundaries, shown in Figure 3.2, were used to understand how transportation needs and barriers vary across different parts of the state and to identify if users in urban or rural areas experience disproportionate burdens resulting from the impacts of the transportation system.

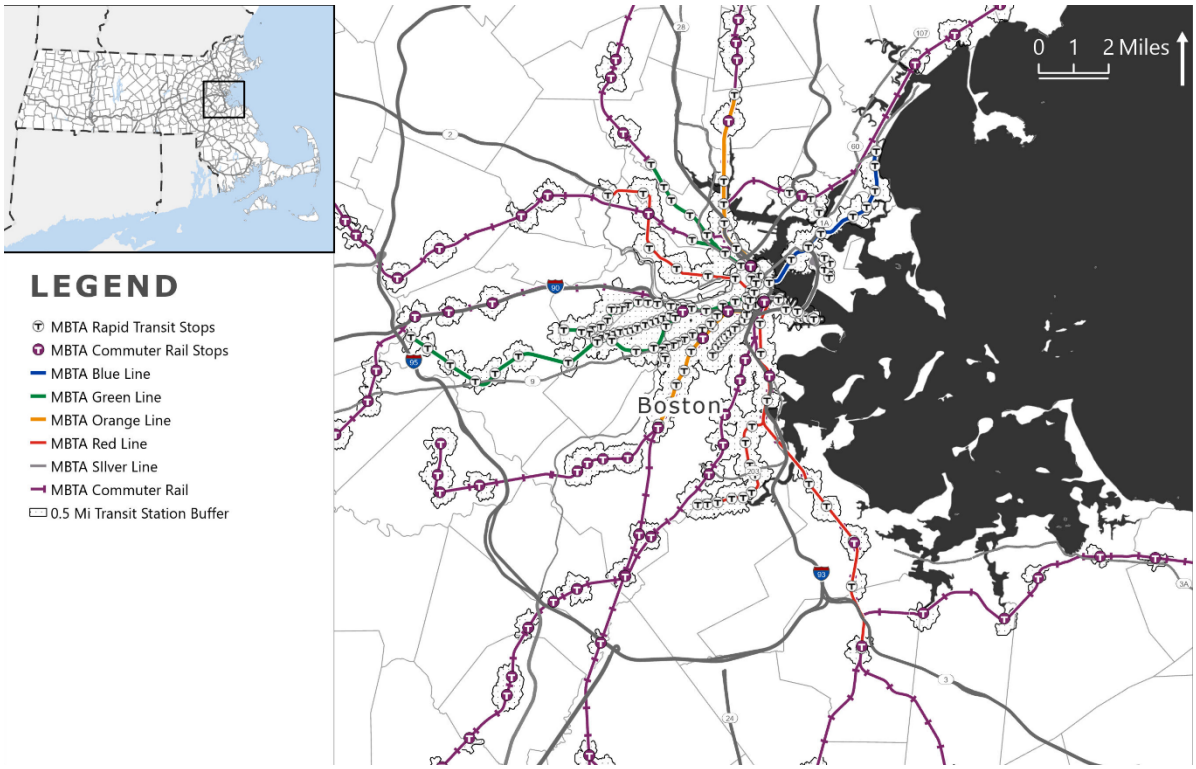
Figure 3.2 Urban and Rural Areas



Public Transit Access

For some analysis, the presence of an MBTA rapid transit or Commuter Rail station within one half and one mile was also considered, shown in Figure 3.3. This additional level of analysis was used to understand how transportation needs and barriers may be concentrated near access to transit and to identify if transit users experience disproportionate burdens resulting from impacts of the transportation system.

Figure 3.3 Public Transit Stations



3.2 Key Indicators

Publicly available data were used to develop indicators of transportation needs related to the *Beyond Mobility* Priority Areas: Safety, Access and Connectivity, Travel Experience, Reliability, and Resiliency. Table 3.1 presents a full list of the key indicators and associated data sources used in the analysis.

Table 3.1 Needs Assessment Key Indicators

Priority Area	Key Indicator	Description	Source and Source Link	Source Link
All	All	Data layers that apply to all analyses	Massachusetts State Boundary, MassGIS, 2020	MassGIS Data: State Outlines | Mass.gov
All	All	Data layers that apply to all analyses	Urban Area Centers (UACs), Census, 2020	https://data.census.gov/
All	All	Data layers that apply to all analyses	Environmental Justice Areas (REJ+, with and without Dominant Factor), MassGIS, 2023[1]	Not publicly available
All	All	Data layers that apply to all analyses	Block Groups—Decennial Census, Census, 2020	https://data.census.gov/
All	All	Data layers that apply to all analyses	Total Population, 2016-2020 5-Year American Community Survey (ACS)	https://data.census.gov/
Safety	Fatal & Serious Injury Crashes per Capita	Crashes occurring in the 2017 to 2019 timeframe that had a crash severity of "fatal" or "serious injury" per 1,000 capita.	MassDOT Crash Inventory, GeoDOT, 2017–2019	https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::2019-crash-level-details/about https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::2018-crash-level-details/about https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::2017-crashes/about
Safety	Fatal & Serious Injury Crashes by Jurisdiction and Functional Class	Crashes occurring in the 2017 to 2019 timeframe that had a crash severity of "fatal" or "serious injury," summarized by jurisdiction and functional class.	MassDOT Crash Inventory, GeoDOT, 2017–2019 MassDOT Road Inventory, GeoDOT, 2020	https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::2019-crash-level-details/about https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::2018-crash-level-details/about https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::2017-crashes/about https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::road-inventory-2020/about
Safety	Pedestrian Crashes per Capita	Crashes occurring in the 2017 to 2019 timeframe that had a non-motorist type of pedestrian per 1,000 capita.	MassDOT Crash Inventory, GeoDOT, 2017–2019	https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::2019-crash-level-details/about https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::2018-crash-level-details/about https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::2017-crashes/about
Safety	Pedestrian Crash Clusters per Capita	Multiple crashes involving pedestrians within 100 meters per 1,000 capita.	MassDOT Top Crash Locations, GeoDOT, 2010–2019	https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::2010-2019-hsip-pedestrian-cluster/about
Safety	Bicycle Crash Clusters per Capita	Multiple crashes involving bicyclists within 100 meters per 1,000 capita.	MassDOT Top Crash Locations, GeoDOT, 2010–2019	https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::2010-2019-hsip-bicycle-cluster/about
Safety	Percentage of Speeding Roadway Risk Miles	Percentage of roadway miles identified as high risk with emphasis area as "Speeding."	MassDOT Crash Inventory, Network Screening Risk Based, 2013–2017	https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::speed-aggressive-driving-risk-statewide-ranking-2013-2015/about
Safety	Percentage of Lane Departure Roadway Risk Miles	Percentage of roadway miles identified as high risk with emphasis area as "Lane Departure."	MassDOT Crash Inventory, Network Screening Risk Based, 2013–2017	https://massdot-impact-crashes-vhb.opendata.ArcGIS.com/datasets/MassDOT::roadway-departure-risk-mpo-ranking-2013-2017/about
Safety	Percentage of Bicycle Roadway Risk Miles	Percentage of roadway miles identified as high risk with emphasis area as "Bicyclist Related."	MassDOT Crash Inventory, Network Screening Risk Based, 2013–2017	https://massdot-impact-crashes-vhb.opendata.ArcGIS.com/datasets/MassDOT::bicycle-safety-risk-mpo-ranking-2013-2017/about
Safety	Percentage of Pedestrian Roadway Risk Miles	Percentage of roadway miles identified as high risk with emphasis area as "Pedestrian."	MassDOT Crash Inventory, Network Screening Risk Based, 2013–2017	https://massdot-impact-crashes-vhb.opendata.ArcGIS.com/datasets/MassDOT::pedestrian-safety-risk-statewide-ranking-2013-2017/about
Destination Connectivity	Potential for Walkable Trips	Latent demand for practical walking trips	GeoDOT, Potential for Walkable Trips, 2019	https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::potential-for-walkable-trips-2022-update-2/about
Destination Connectivity	Potential for Bicycle Trips	Latent demand for practical bicycling trips	GeoDOT, Potential for Everyday Biking, 2019	https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::potential-for-everyday-biking-2022-update-2/about
Destination Connectivity	Bicycle Facility Coverage	Statewide database of existing and planned bikeways.	GeoDOT, Bike Inventory, 2020	https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::bike-inventory-2020/about
Destination Connectivity	Bicycle Share Coverage	Bike share locations.	Bluebikes,	https://member.bluebikes.com/map/, https://valleybike.org/[2]

Priority Area	Key Indicator	Description	Source and Source Link	Source Link
Destination Connectivity	Sidewalk Gaps	Sidewalk width filter in Road Inventory file.	MassDOT Road Inventory, GeoDOT, 2020	https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::road-inventory-2020/about
Travel Experience	Pavement Condition	Segment with pavement condition of "Poor" or "Fair."	GeoDOT, Pavement Condition, 2020	https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::pavement-condition-2020/about
Travel Experience	Bridge Condition	Bridge with condition of "Structurally Deficient."	GeoDOT, Bridges, 2022	https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::bridges/about
Travel Experience	Curb Ramps	Curb ramp with condition of "Deficient"	GeoDOT, Pedestrian Curb Cuts, 2018	https://geo-massdot.opendata.ArcGIS.com/datasets/MassDOT::pedestrian-curb-cuts/about
Reliability	Congestion	Relationship of roadway segment where 70th percentile speed is slower than free flow speed.	RITIS, Inrix March 2022 to February 2023	Not publicly available.
Reliability	Planning Time Index	Comparison of 95th percentile speed and free flow speed to determine reliability of segment.	RITIS, Inrix March 2022 to February 2023	Not publicly available.
Resiliency	Sea Level Rise	Potential sea level rise inundation of coastal areas from a projected 1 to 10 feet rise in sea level.	MassGIS, NOAA Sea Level Rise, 2019	https://www.mass.gov/info-details/massgis-data-noaa-sea-level-rise
Resiliency	Hurricane Inundation Zone	Hurricane Surge Inundation areas for Category 1 through 4 striking the coast of Massachusetts.	MassGIS, Hurricane Surge Inundation Zones, 2013	https://www.mass.gov/info-details/massgis-data-hurricane-surge-inundation-zones

[1] *The Beyond Mobility Environmental Justice community designation is distinct from the traditional Environmental Justice definition in that it incorporates data on vehicle access, disability status, and age in addition to income, race, and limited English proficiency. It also compares each Census block group's characteristics for each variable to the average of its MPO region rather than statewide averages.*

[2] *ValleyBike program did not operate in 2023. It is expected that this program will resume Spring 2024.*

Note: Per capita is based on the number of people residing in the specific community (block group, REJ+, non-REJ+, Urban, or Rural).

3.3 Findings

The analysis identified trends relating to each *Beyond Mobility* Priority Area.

Safety

The safety analysis investigated data such as crash history, high-crash location areas, and top crash risk sites to gain an understanding of safety related challenges across the Commonwealth. These data were screened to identify inequalities based on geography and demographics as well as proximity to transit stations.

The resulting safety analysis demonstrated that historically marginalized communities experience fatal and serious injury collisions at a higher rate than other communities. This is especially true for crashes that involved a pedestrian and/or a bicyclist. Rural communities have a slightly higher rate of fatal/serious injury crashes per capita than urban communities. However, urban communities have significantly higher pedestrian or bicycle crash rates per capita than rural communities.

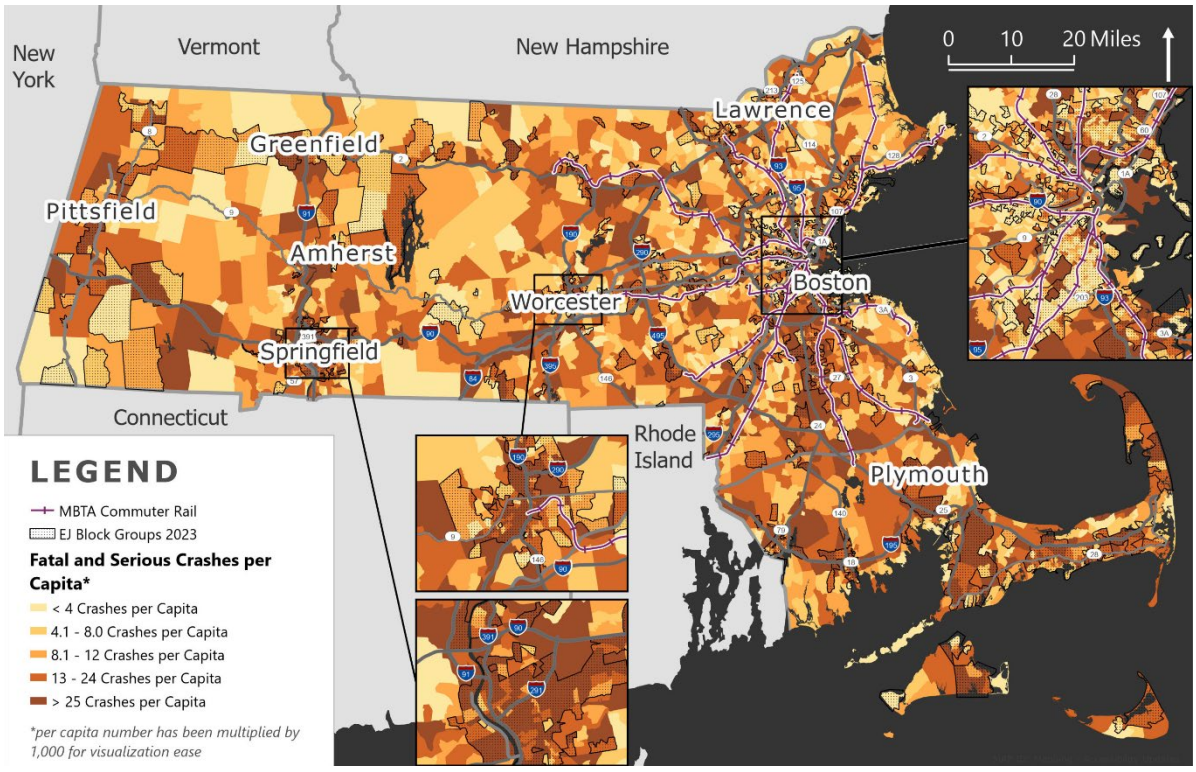
Roadways—Fatal & Serious Crashes

Vehicle crashes in Massachusetts are reported to the RMV and summarized by MassDOT. MassDOT data for crashes that resulted in a fatality or severe injury from 2017–2019 were reviewed to identify trends and screened to identify inequalities based on geography and demographics. In addition, the analysis included a comparison of roadway jurisdiction and functional classification. The analysis showed that:

- Massachusetts statewide has on average 4.99 fatal or serious crashes per 1,000 capita per year.
- Environmental Justice communities 1.25 times the fatal or serious crashes per capita than non-Environmental Justice communities.
- Rural communities have 1.06 times the fatal or serious crashes per capita than urban communities.
- Communities with concentrations of populations with a disability, low-income households, and/or senior households have the highest fatal/serious crash per capita of Environmental Justice communities.

As indicated above, Environmental Justice communities experience a higher rate of fatal or serious injury crashes per capita than non-Environmental Justice communities. Figure 3.4 illustrates the prevalence of fatal and serious injury crashes and Environmental Justice (REJ+) areas.

Figure 3.4 Fatal and Serious Injury Crashes (2017-2019), Environmental Justice



Source: 2016-2020 5-Year ACS, MassDOT Crash Data 2017-2019.

MassDOT-owned roadways make up approximately eight percent of roadways statewide. However, about 31 percent of fatal or serious injury crashes occurred on MassDOT-owned roadways (Table 3.2).[1]

Table 3.2 Jurisdiction of Crashes (2017–2019)

Jurisdiction	Total Fatal/Serious Injury Crashes	Percent of Total
MassDOT Owned	31,937	31%
Other Ownership	70,929	69%

Interstates make up approximately two percent of all roadways in Massachusetts. However, nearly nine percent of fatal or serious injury crashes occurred on Interstates, as show in Table 3.3. Conversely, local roads make up 68 percent of all roadways and only experience about 11 percent of fatal/serious injury crashes. MassDOT's crash reports indicate that speeding may be a factor in the prevalence of fatal and serious injury crashes along interstates and arterials. According to the 2021 report, nearly 50 percent of exceeding speed crashes of any severity occurred on arterials.[2]

1 Road Inventory Year-End Report 2020, MassDOT Office of Transportation Planning. https://www.mass.gov/doc/2020-road-inventory-year-end-report/download, July 19, 2023.

2 MassDOT IMPACT Phase II – Identification of Risk Factors for SHSP Emphasis Areas (Speeding and Aggressive Driving); VHB for MassDOT; August 2021.

Table 3.3 Functional Class of Crashes (2017–2019)

Classification	Total Fatal/Serious Injury Crashes	Percent of Total
Interstate	8,842	8.60%
Local	11,204	10.89%
Rural minor arterial/urban principal arterial	26,026	25.30%
Rural or urban principal arterial	11,014	10.71%
Urban collector or rural minor collector	10,267	9.98%
Urban minor arterial or rural major collector	31,760	30.88%
Null/Other	3,753	3.65%

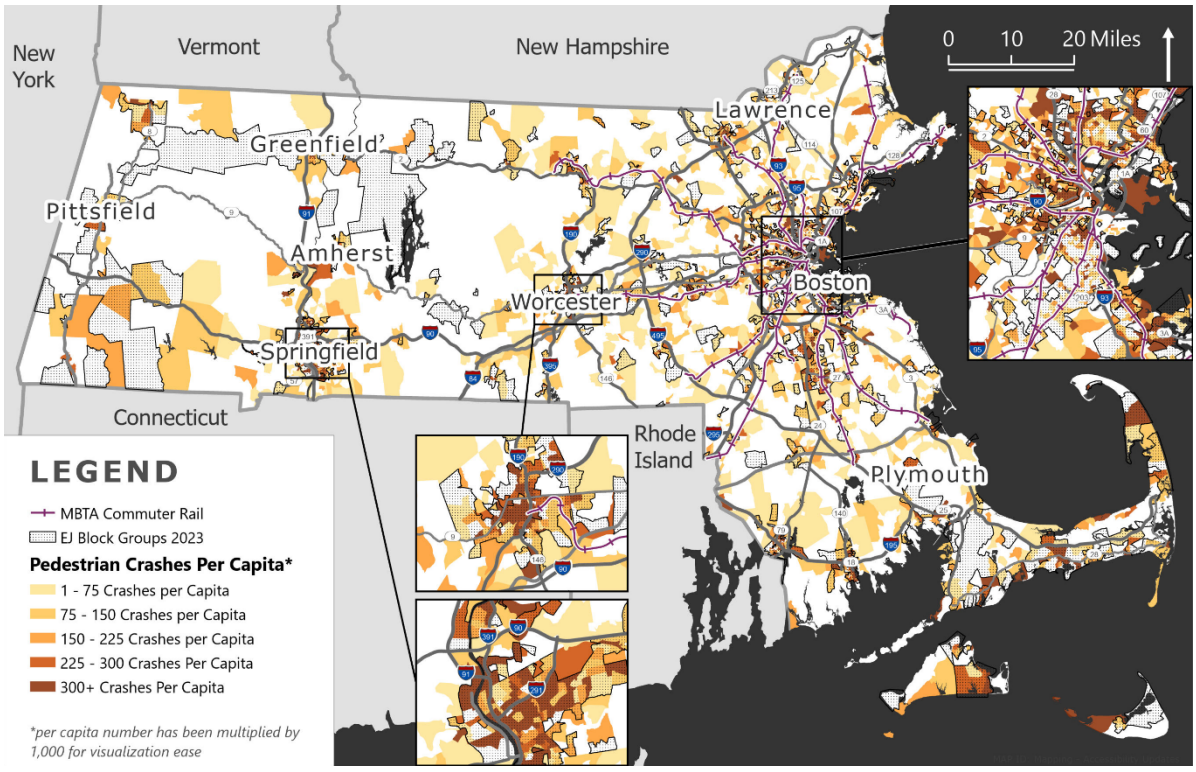
Active Transportation—Pedestrian Crashes & Crash Clusters

MassDOT data for crashes that involved pedestrians from 2017-2019 were reviewed. An additional step that MassDOT takes with crash data is to define crash clusters based on distance to nearby crashes. Pedestrian crashes within 100 meters of each other are grouped into a pedestrian crash cluster. The top 10 percent of clusters for each MPO is included in the statewide crash cluster list and ranked by crash severity. MassDOT data for pedestrian crashes and pedestrian crash clusters were reviewed to identify trends and screened to identify inequalities based on geography and demographics. The analysis showed that:

- Environmental Justice communities have 1.72 times the pedestrian crashes per capita than non-Environmental Justice communities.
- Environmental Justice communities have 7.08 times the pedestrian crash cluster area per capita than non-Environmental Justice communities.
- Environmental Justice communities have 20 times the number of pedestrian crash clusters per square mile than non-Environmental Justice communities.
- Urban communities have 4.47 times the pedestrian crashes per capita than rural communities.
- Urban communities have nearly 10,000 times the pedestrian crash cluster area per capita than rural communities.
- Among Environmental Justice groups, communities with concentrations of zero-vehicle households and low-income households have the highest pedestrian crash cluster area per capita.

As indicated above, Environmental Justice communities experience a higher rate of pedestrian crashes per capita than non-Environmental Justice communities. Similarly, urban communities experience a higher rate of pedestrian crashes per capita than rural communities. Figure 3.5 illustrates pedestrian crashes per capita, with the Environmental Justice overlay.

Figure 3.5 Pedestrian Crashes per Capita, Environmental Justice Communities



Source: 2016–2020 5-Year ACS, MassDOT HSIP Pedestrian Crash Cluster Data 2010-2019.

Active Transportation—Bicycle Crashes & Crash Clusters

MassDOT data for crashes that involved bicyclists from 2017–2019 were reviewed. Additionally, similar to pedestrian crash clusters, MassDOT evaluates bicycle crash clusters. The bicycle crash cluster analysis is done in the same manner as the pedestrian crash cluster approach. MassDOT data for bicycle crashes and bicycle crash clusters were reviewed to identify trends and screened to identify inequalities based on geography and demographics. The analysis showed that:

- Environmental Justice communities have 1.10 times the bicycle crashes per capita than non-Environmental Justice communities.
- Environmental Justice communities have 7.32 times the bicycle crash cluster area per capita than non-Environmental Justice communities.
- Environmental Justice communities have 14.4 times the bicycle crash clusters per square mile than non-Environmental Justice communities.
- Urban communities have 2.57 times the bicycle crashes per capita than rural communities.
- Urban communities have 356 times the bicycle crash cluster area per capita than rural communities.

- Among Environmental Justice groups, communities with concentrations of zero-vehicle households and low-income households have the highest bicycle crash cluster area per capita.

As indicated above, Environmental Justice communities experience a higher rate of bicycle crashes per capita than non-Environmental Justice communities. Similarly, urban communities experience a higher rate of bicycle crashes per capita than rural communities.

Multimodal—Roadway Risk

In addition to crash-based screening, MassDOT also uses risk-based analysis. This analysis identifies locations with the highest risk of fatal and serious injury crashes for a number of emphasis areas of the *MassDOT Strategic Highway Safety Plan*. The Needs Assessment analysis considered the speeding, lane departure, bicycle, and pedestrian emphasis areas. In addition, a composite analysis of "total risk" was developed. MassDOT data for roadway risk were reviewed to identify trends and screened to identify inequalities based on geography and demographics. The analysis showed that:

Total Risk

- Environmental Justice communities have 1.96 times the percentage of total risk miles than non-Environmental Justice communities.
- Rural communities have 1.03 times the percentage of total risk miles than urban communities.
- Among Environmental Justice groups, communities with concentrations of zero-vehicle households and low-income households have the highest percentage of total risk miles.

As indicated above, Environmental Justice communities experience a higher rate of total risk miles per capita than non-Environmental Justice communities. Similarly, urban communities experience a higher rate of total risk miles per capita than rural communities.

Speeding

- Environmental Justice communities have 1.29 times the percentage of speeding risk miles than non-Environmental Justice communities.
- Urban communities have 1.06 times the percentage of speeding risk miles than rural communities.
- Among Environmental Justice groups, communities with concentrations of low-income households and minority households have the highest percentage of speeding risk miles.

As indicated above, Environmental Justice communities experience a higher rate of speeding risk miles per capita than non-Environmental Justice communities. Similarly, urban communities experience a higher rate of speeding risk miles per capita than rural communities.

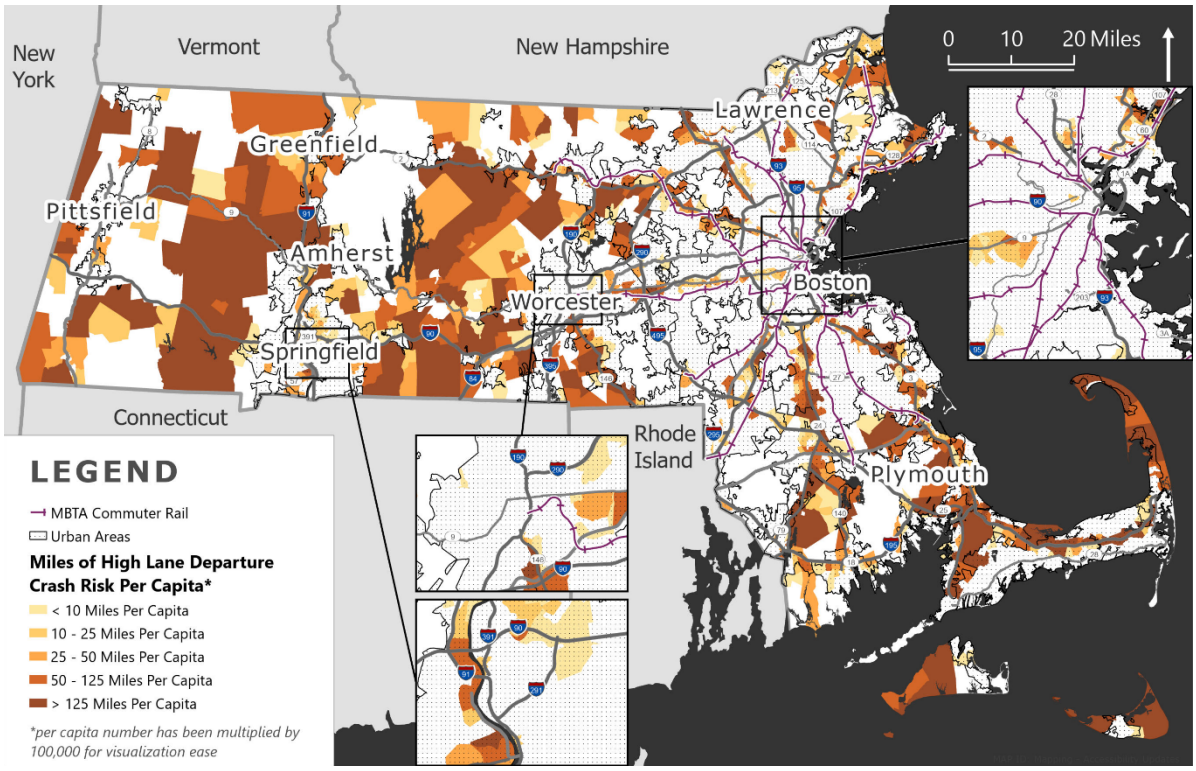
Lane Departures

- Non-Environmental Justice communities have 1.33 times the percentage of lane departure risk miles than Environmental Justice communities.
- Rural communities have 2.61 times the percentage of lane departure risk miles than urban communities.
- Among Environmental Justice groups, communities with concentrations of zero-vehicle households, low-income households, and limited English proficient households have the highest percentage of lane departure risk miles.

As indicated above, non-Environmental Justice communities experience a higher rate of lane departure risk miles per capita than Environmental Justice communities. Similarly, rural communities experience a higher rate of lane departure risk miles per capita than urban communities.

Figure 3.6 illustrates roadway miles at high risk for lane departure per capita and urban and rural areas.

Figure 3.6 Roadway Miles at High Risk for Lane Departure per Capita, Urban/Rural



Source: 2016–2020 5-Year ACS, MassDOT IMPACT Roadway Departure Safety Risk MPO Ranking 2013–2017.

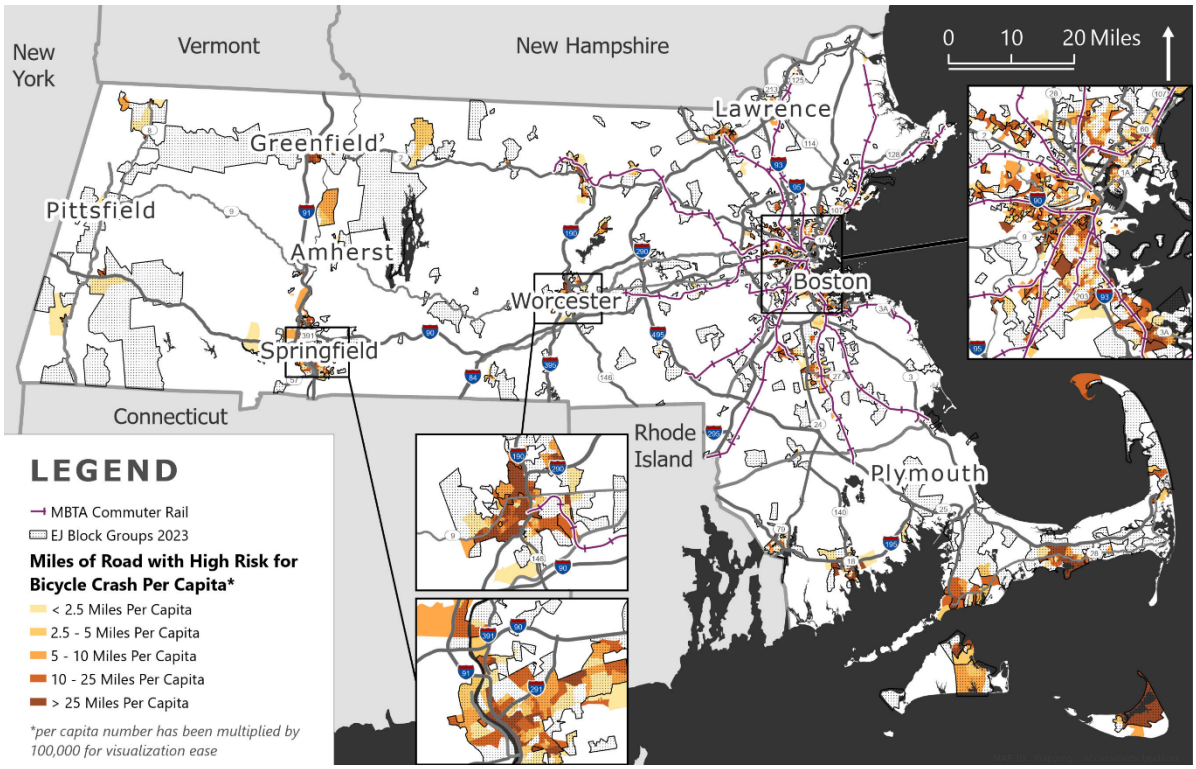
Bicyclist Related Risk

- Environmental Justice communities have 13.7 times the percentage of bicycle-related risk miles than non-Environmental Justice communities.
- Urban communities have 83.7 times the percentage of bicycle-related risk miles than rural communities.
- Among Environmental Justice groups, communities with concentrations of zero-vehicle households and low-income households have the highest percentage of bicycle-related risk miles.

As indicated above, Environmental Justice communities experience a higher rate of bicycle-related risk miles per capita than non-Environmental Justice communities. Similarly, urban communities experience a higher rate of bicycle-related risk miles per capita than rural communities.

Figure 3.7 illustrates roadway miles at high risk for bicycle-related crashes per capita and Environmental Justice communities.

Figure 3.7 Roadway miles at High Risk for Bicycle Crashes per Capita, Environmental Justice Communities



Source: 2016–2020 5-Year ACS, MassDOT IMPACT Bicyclist Safety Risk MPO Ranking 2013–2017.

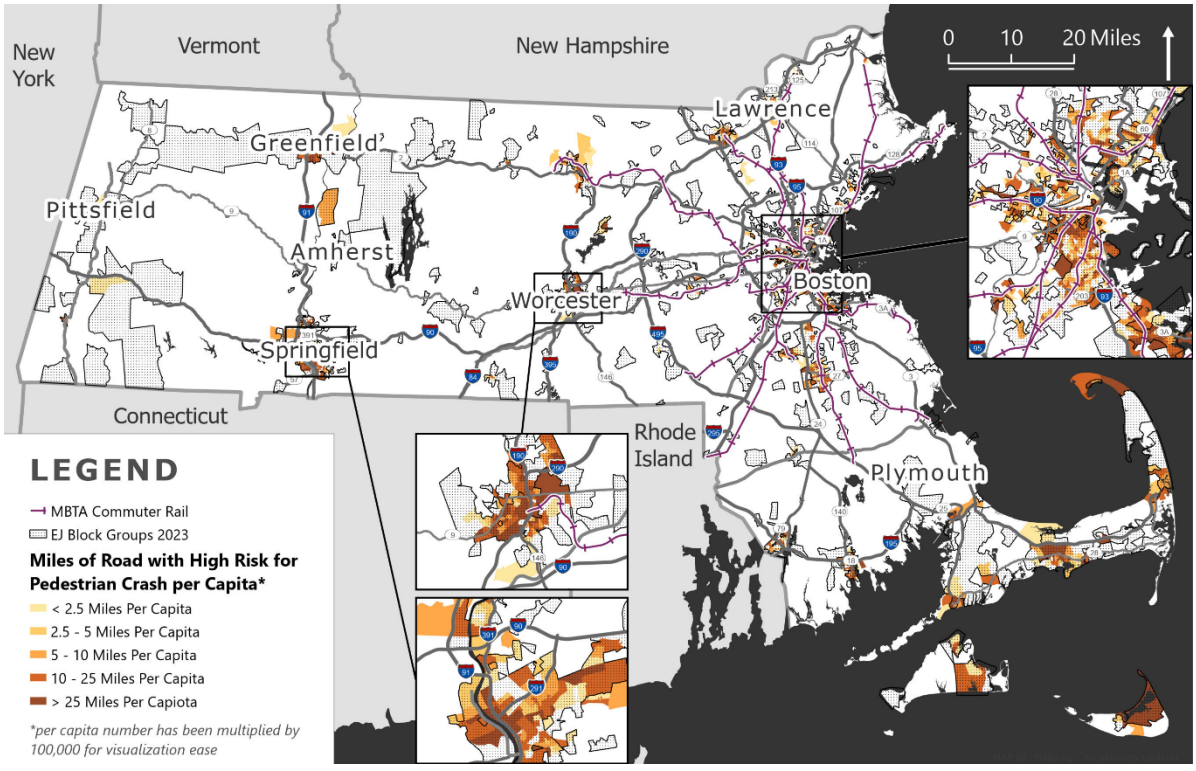
Pedestrian Risk

- Environmental Justice communities have 18.4 times the percentage of pedestrian risk miles than non-Environmental Justice communities.
- Urban communities have 108.5 times the percentage of pedestrian risk miles than rural communities.
- Among Environmental Justice groups, communities with concentrations of zero-vehicle households and low-income households have the highest percentage of pedestrian risk miles.

As indicated above, Environmental Justice communities experience a higher rate of Pedestrian Risk miles per capita than non-Environmental Justice communities. Similarly, urban communities experience a higher rate of Pedestrian Risk miles per capita than rural communities.

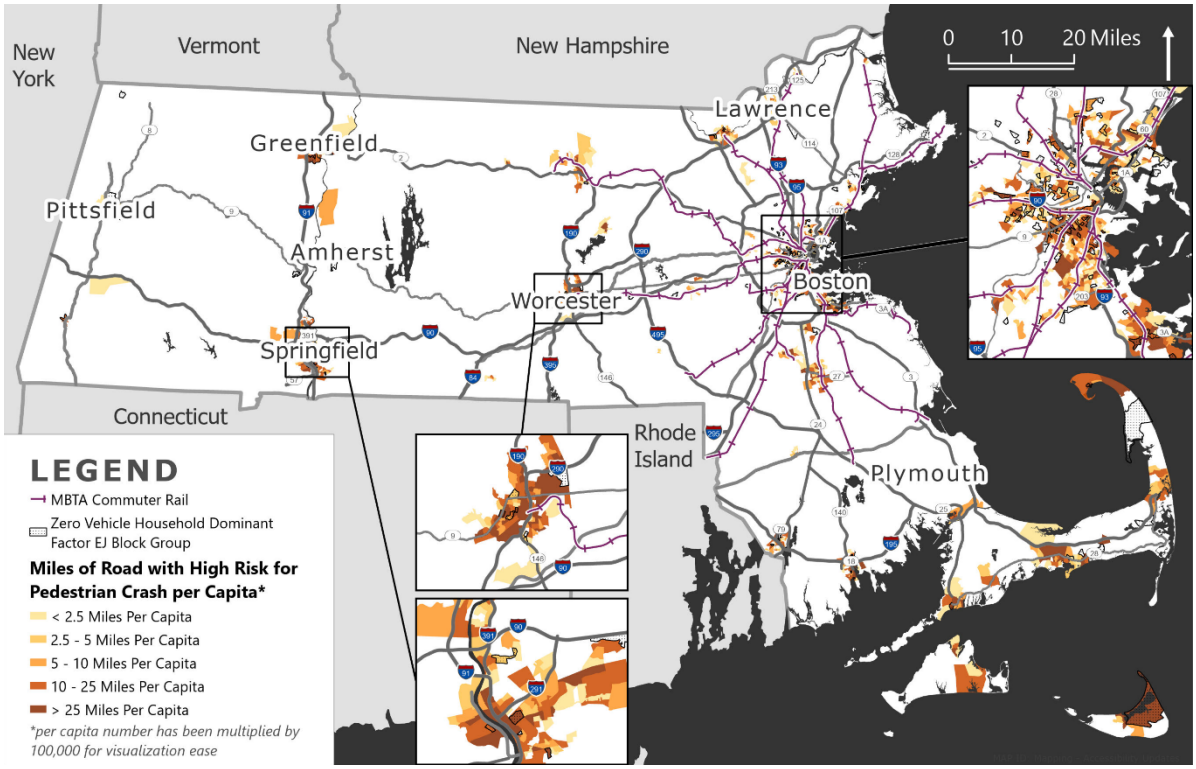
Figure 3.8 illustrates roadway miles at high risk for pedestrian crashes per capita, with the Environmental Justice overlay. Figure 3.9 illustrates roadway miles at high risk for pedestrian crashes per capita, with the Environmental Justice overlay highlighting the most dominant factor of zero-vehicle households.

Figure 3.8 Roadway Miles at High Risk for Pedestrian Crashes per Capita, Environmental Justice



Source: 2016–2020 5-Year ACS, MassDOT IMPACT Pedestrian Safety Risk MPO Ranking 2013–2017.

Figure 3.9 Roadway Miles at High Risk for Pedestrian Crashes per Capita, Environmental Justice (Zero-Vehicle Household-MDF)



Source: 2016–2020 5-Year ACS, MassDOT IMPACT Pedestrian Safety Risk MPO Ranking 2013–2017, REJ+ Most Dominant Factor—Zero-Vehicle Households.

Destination Connectivity

The destination connectivity analysis investigated data such as the extent of bicycle and pedestrian facilities across the state and MassDOT's analysis of potential for walkable trips and potential for everyday biking. These analyses helped frame an understanding of the availability of active transportation elements across the Commonwealth and where there is potential for more walking and biking trips. These data were also screened to identify inequalities based on geography and demographics as well as proximity to transit stations.

The analysis demonstrated that traditionally marginalized communities have a higher potential for walking and bicycling than other communities even though these communities have fewer existing and planned bicycle facilities. Rural communities have more bike facilities per capita than urban communities, even though urban communities have a higher rate of potential miles for bicycle trips.

Active Transportation—Potential for Walkable Trips

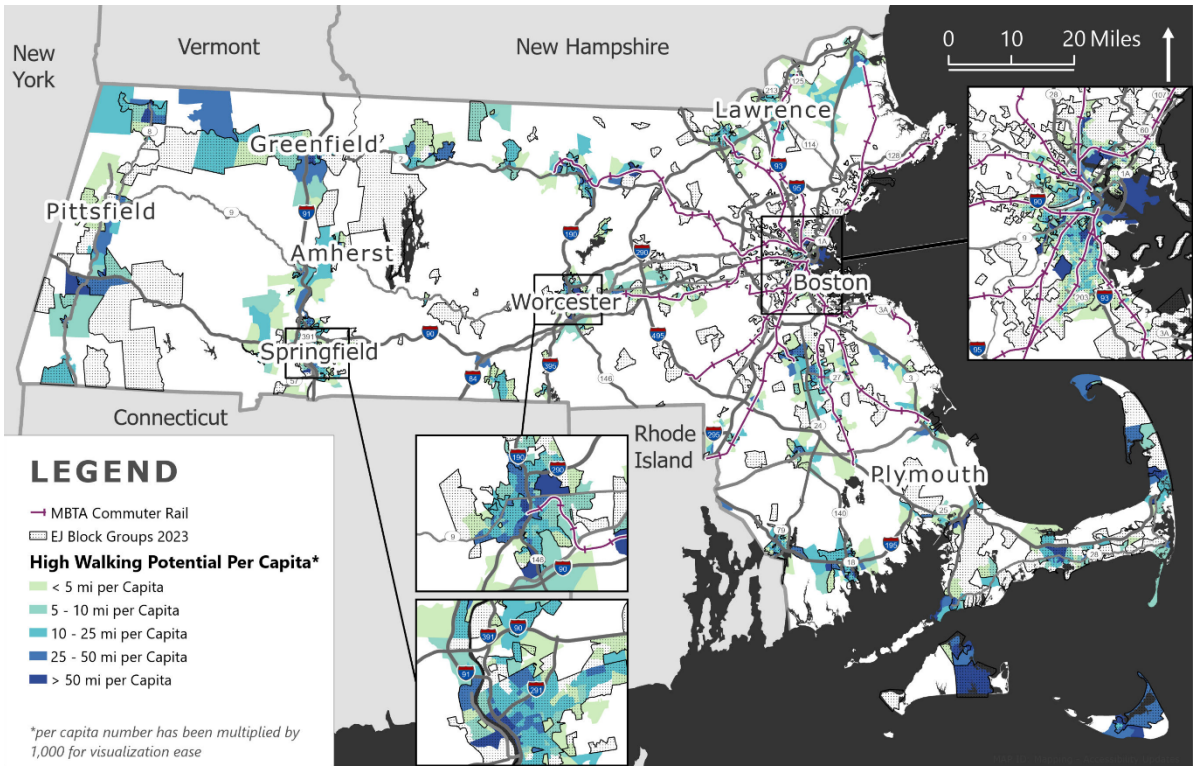
MassDOT has developed an analysis to estimate the potential demand for pedestrian activity throughout the Commonwealth roadway network based on access to destinations—such as schools, parks, shopping, or transit—and proximity to reported pedestrian crashes. Roadways with a high

potential demand for walkable trips were reviewed to identify trends and screened to identify inequalities based on geography and demographics. In addition, the analysis included a review of the relationship of high potential roadways in proximity of transit stops/stations. The analysis showed that:

- Environmental Justice communities have 5.92 times the percentage of high potential for walkable trips miles than non-Environmental Justice communities.
- Urban communities have 2.1 times the total potential for walkable trips miles than rural communities, but 28.3 times the high potential for walkable trips miles.
- Communities with concentrations of zero-vehicle households and low-income households have the highest percentage of high potential for walkable trips miles of Environmental Justice communities.
- Environmental Justice communities have nearly 1.34 times higher percentage of high potential for walkable trips miles than non-Environmental Justice communities within half a mile of MBTA rapid transit stations.
- Environmental Justice communities have nearly 2.55 times higher percentage of high potential for walkable trips miles than non-Environmental Justice communities within half a mile of MBTA Commuter Rail stations.

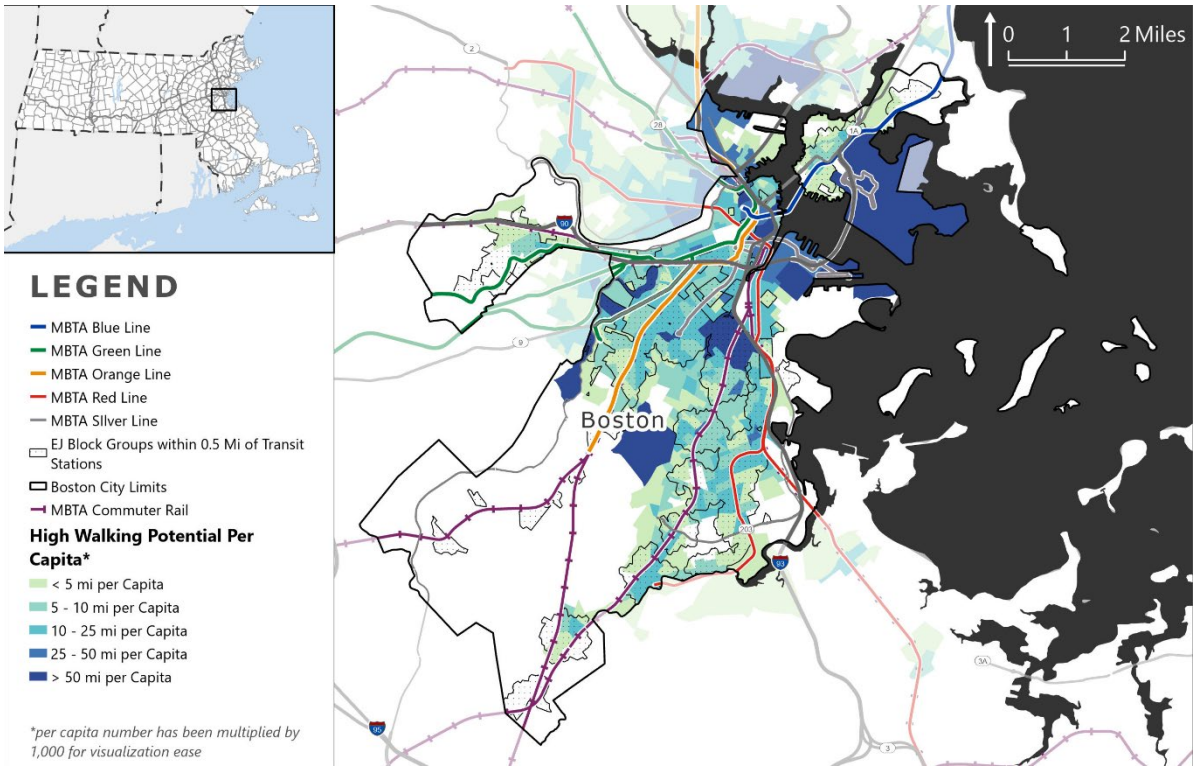
As indicated above, Environmental Justice communities experience a higher rate of High Potential for Walkable Trips per capita in general and in proximity to transit stops or stations compared with non-Environmental Justice communities. Figure 3.10 illustrates the high potential for walkable trips per capita. Figure 3.11 illustrates the high potential for walkable trips per capita and the location of transit stations.

Figure 3.10 High Potential for Walkable Trips per Capita



Source: 2016-2020 5-Year ACS, MassDOT Potential for Walking 2022.

Figure 3.11 High Potential for Walking per Capita, Transit Buffer



Source: 2016–2020 5-Year ACS, MassDOT Potential for Walking 2022, MBTA Transit Stops.

Active Transportation—Potential for Everyday Biking

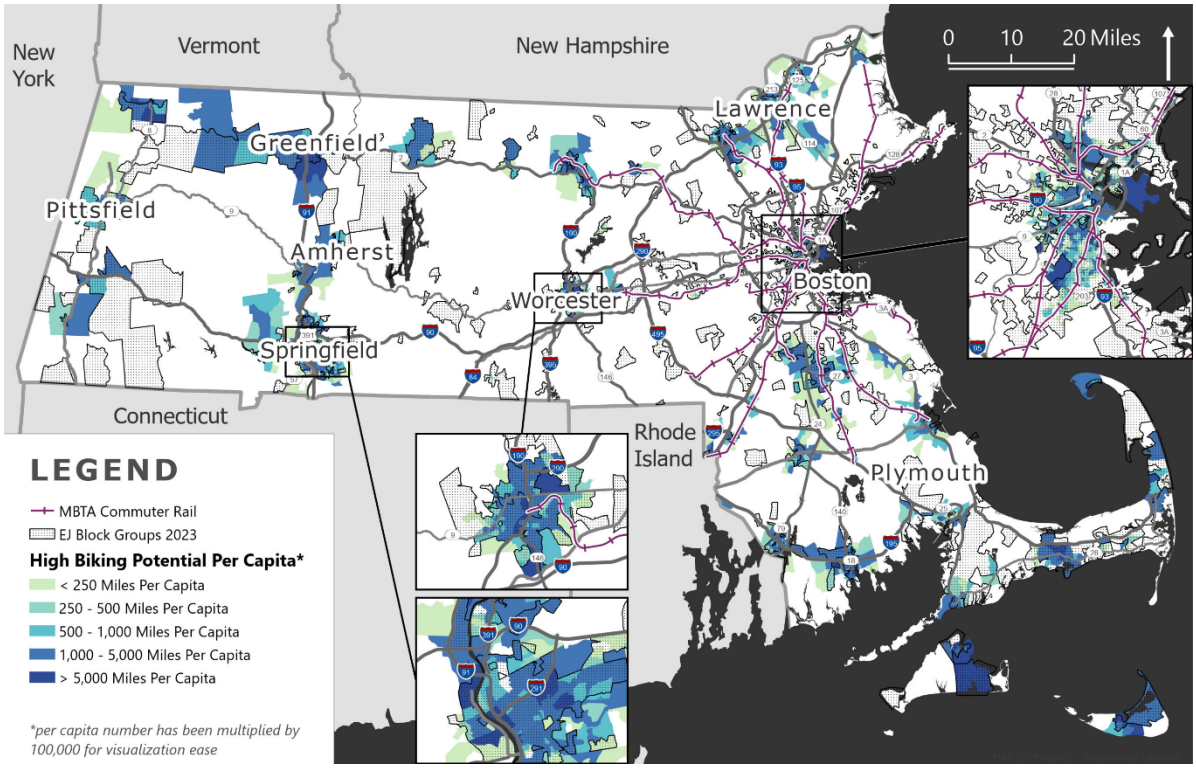
In addition to walkable trips, MassDOT has evaluated the potential demand for bicycle trips throughout the Commonwealth. Roadways with a high potential demand for everyday biking were reviewed to identify trends and screened to identify inequalities based on geography and demographics. In addition, the analysis included a review of the relationship of high potential roadways in the proximity of transit stops/stations. The analysis showed that:

- Environmental Justice communities have 5.92 times the percentage of high potential for everyday biking miles compared to non-Environmental Justice communities.
- Urban communities have 2.1 times the total potential for everyday biking miles compared to rural communities but 35.7 times the high potential for everyday biking miles.
- Among Environmental Justice groups, communities with concentrations of zero-vehicle households, LEP households, and low-income households have the highest percentage of high potential for everyday biking miles of Environmental Justice communities.
- Environmental Justice communities have nearly 1.13 times the potential for everyday biking miles than non-Environmental Justice communities within half a mile of MBTA rapid transit stations.

- Environmental Justice communities have nearly 2.62 times the potential for everyday biking miles than non-Environmental Justice communities within half a mile of commuter rail stations.

As indicated above, Environmental Justice communities experience a higher rate of high potential for everyday biking per capita in general and in proximity to transit stops/stations than non-Environmental Justice communities. Figure 3.12 illustrates the high potential for everyday biking per capita and the Environmental Justice (REJ+) overlay.

Figure 3.12 High Potential for Everyday Biking per Capita, Environmental Justice



Source: 2016–2020 5-Year ACS, MassDOT Potential for Everyday Biking 2022.

Active Transportation—Bicycle Facilities Coverage

MassDOT maintains a statewide inventory of existing and planned bicycle facilities. Table 3.4 shows the existing and planned length of bicycle facilities by type.

Table 3.4 Bicycle Facility Coverage

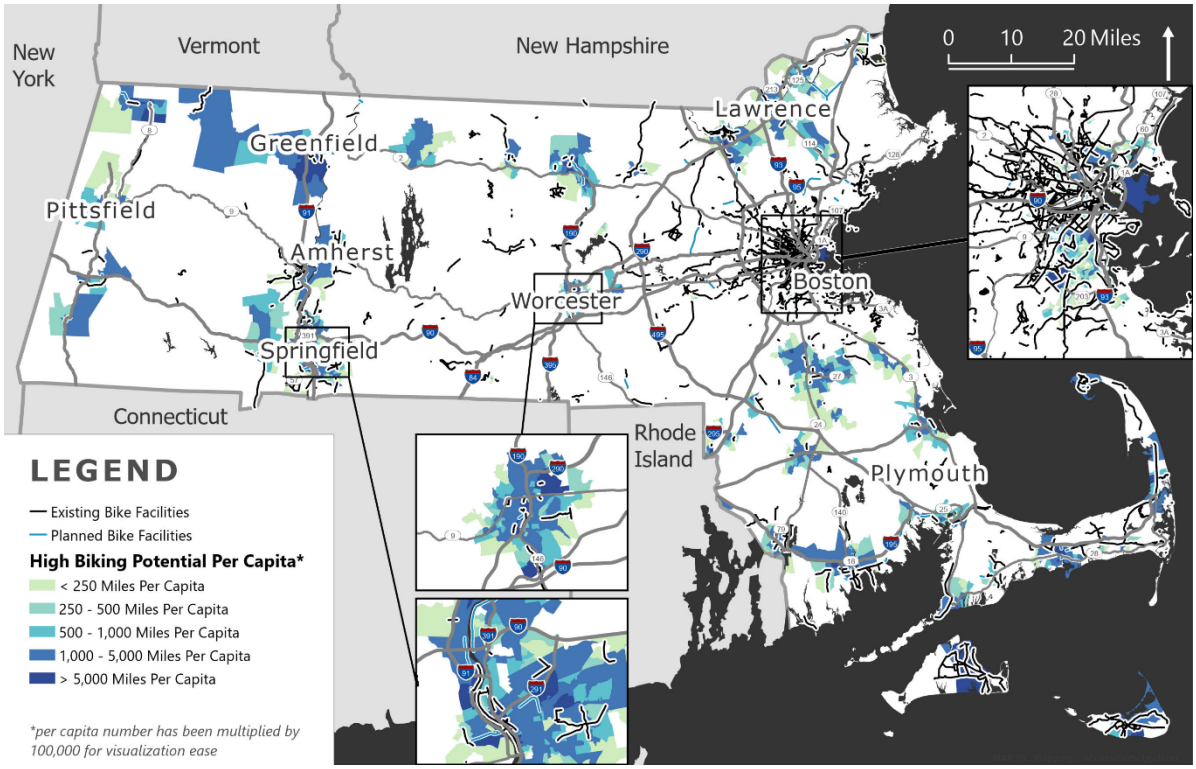
Facility Type	Total Existing Miles	Total Planned Miles	Total Miles	Share
Bike Lane	478.43	2.73	481.16	33%
Cycle Track/Separated Bike Lane	29.53	3.57	33.10	2%
Shared Use Path	844.31	101.96	946.27	65%
Bicycle/Pedestrian Priority Roadway	2.46	0.00	2.46	0%
Other	0.11	0.00	0.11	0%

The existing and planned bicycle facilities were reviewed to identify trends and screened to identify inequalities based on geography and demographics. In addition, the analysis included a review of the relationship of high potential roadways in the proximity of transit stops/stations. The analysis showed that:

- Non-Environmental Justice communities have 1.22 times the existing bike facilities and 1.02 times the planned bike facilities per capita than Environmental Justice communities.
- Rural communities have 3.01 times the miles of existing bike facilities per capita than urban communities; rural communities also have and 1.99 times the miles of planned bike facilities per capita than urban communities.
- Urban communities have 1.6 times the miles of existing bike facilities and 2.42 times the mileage of planned bike facilities as a percentage of total roadway miles than rural communities.
- Communities with concentrations of minority populations and low-income households have the least existing bike infrastructure per capita of Environmental Justice communities.
- Communities with concentrations of LEP populations and zero-vehicle households have the fewest planned bike facilities per capita of Environmental Justice communities.

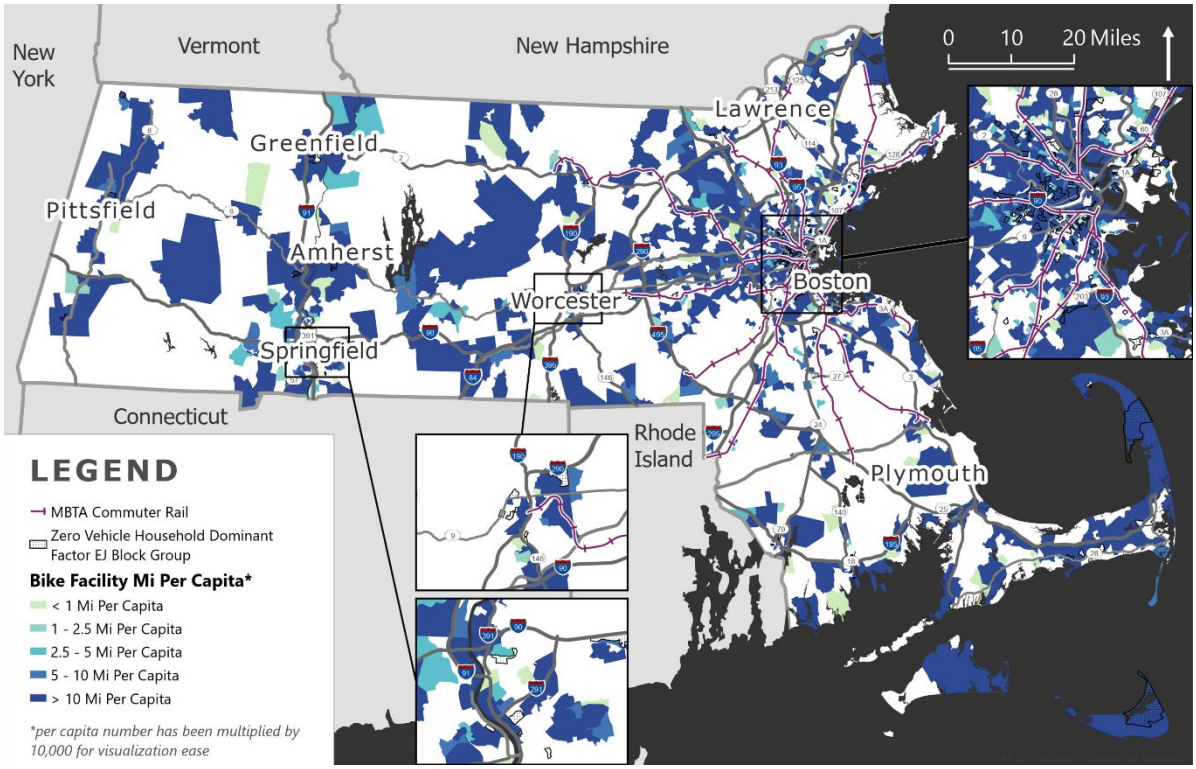
As indicated above, non-Environmental Justice communities have more bike facilities (existing and planned) per capita than Environmental Justice communities. Similarly, rural communities have more bike facilities (existing and planned) per capita than urban communities. Figure 3.13 illustrates high potential for everyday bicycling per capita and the location of Environmental Justice communities and bicycle facilities (existing and planned). Figure 3.13 illustrates the existing and planned bicycle facilities per capita, with Environmental Justice block groups where the most dominant factor is zero-vehicle households highlighted in Figure 3.14.

Figure 3.13 High Potential for Everyday Biking per Capita, Environmental Justice Communities, and Existing and Planned Bicycle Facilities



Source: 2016–2020 5-Year ACS, MassDOT Potential for Everyday Biking 2022, MassDOT Bike Inventory 2020.

Figure 3.14 Existing and Planned Bicycle Facilities per Capita, Environmental Justice Communities (Zero-Vehicle Household-MDF)



Source: 2016–2020 5-Year ACS, MassDOT Bike Inventory 2020.

Active Transportation—Bicycle Share Coverage

Two bike share companies (Bluebikes and ValleyBike) operate in Massachusetts. Bike share locations were mapped to identify trends and screened to identify inequalities based on geography and demographics. In addition, the analysis included a review of the bike share locations in the proximity of transit stations. The analysis showed that:

- Environmental Justice communities have 1.92 times the bike share stations per capita than non-Environmental Justice communities.
- Rural communities have three bike share stations, while urban communities have over 500 bike share stations.
- Urban communities have 16.4 the bike stations per capita than rural communities.
- Approximately 82 percent of MBTA rapid transit stations within Environmental Justice communities have bike share stations, compared to 77 percent stations within non-Environmental Justice communities.
- Approximately 18 percent of MBTA Commuter Rail stations have bike share stations.

As indicated above, Environmental Justice communities have more bike share locations per capita than non-Environmental Justice communities. Similarly, urban communities have more bike share locations per capita than rural communities.

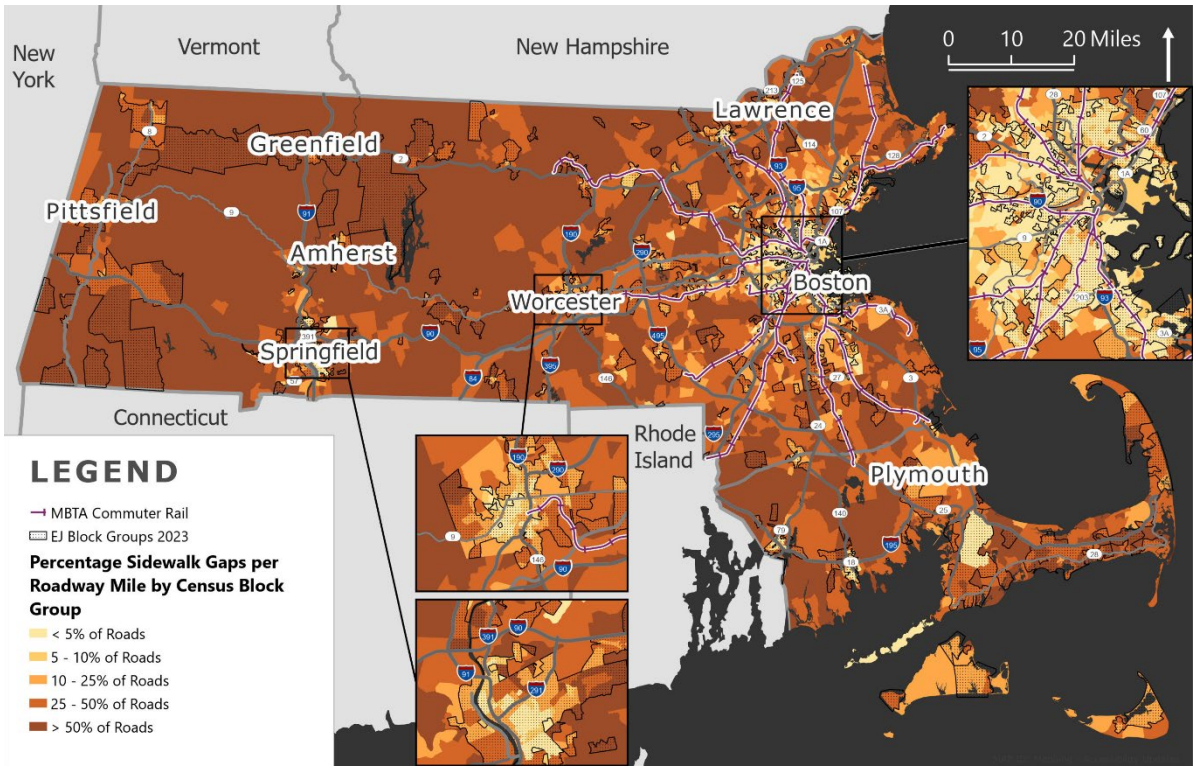
Active Transportation—Sidewalk Gaps

MassDOT maintains a database of statewide roadway characteristics, including presence of a sidewalk. Gaps in sidewalk coverage were established, reviewed to identify trends, and screened to identify inequalities based on geography and demographics. In addition, the analysis included a review of the sidewalk gaps in proximity to transit stations. The analysis showed that:

- Sidewalk gaps per capita within Environmental Justice communities are highest where the percentage of older adults, limited English proficient, and people with disability are the highest Environmental Justice designations.
- More than half of the sidewalk gaps by linear mile are on local roadways.
- Rural communities have 1.65 times more sidewalk gaps as a percentage of total roadway miles than urban communities.
- Rural communities have 7.98 times more sidewalk gaps per capita than urban communities.
- Approximately 22 percent of roadway miles within ½ mile of transit stops (MBTA Commuter Rail and rapid transit) have sidewalks gaps.
- Within a ½ mile of transit stops only 16 percent of roadway miles in Environmental Justice communities have sidewalks gaps, while 26 percent of roadway miles in non-Environmental Justice communities have sidewalk gaps.

As indicated above, rural communities have more sidewalk gaps than urban communities. Figure 3.15 illustrates the sidewalk gaps, with the Environmental Justice overlay.

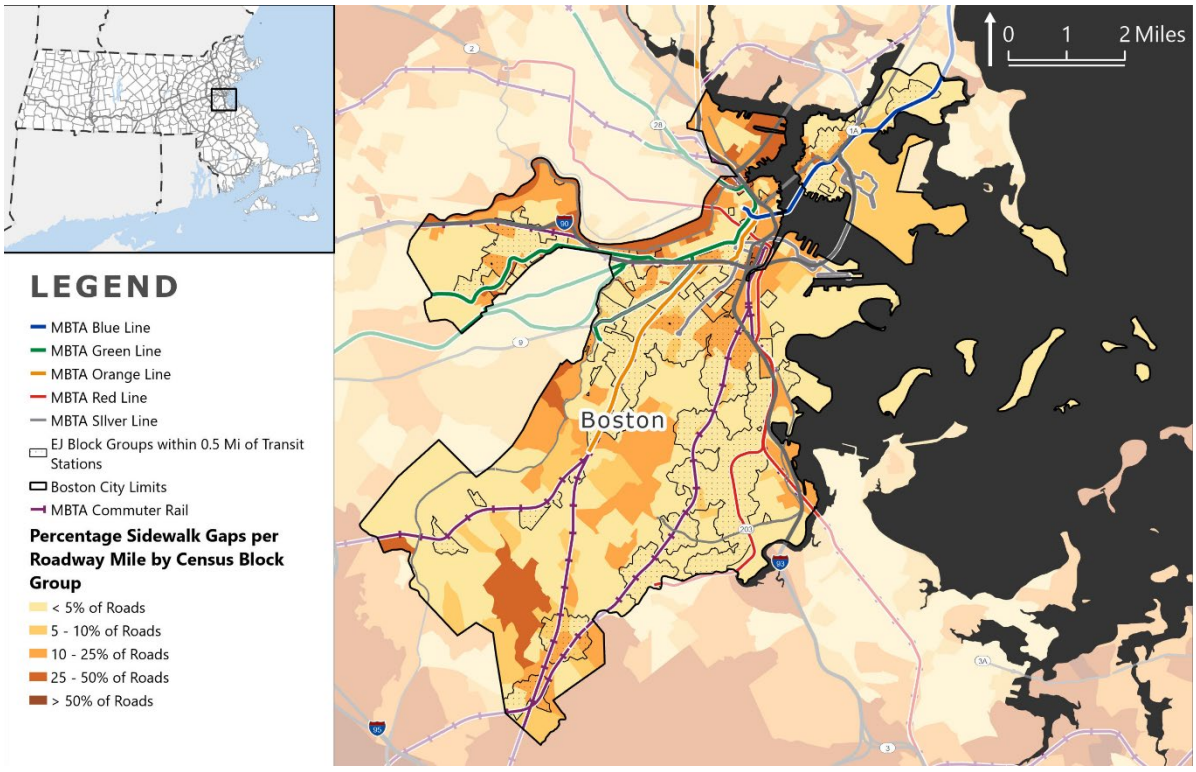
Figure 3.15 Sidewalk Gaps, Environmental Justice Communities



Source: 2016–2020 5-Year ACS, MassDOT Road Inventory 2021.

As indicated above, non-Environmental Justice communities experience a higher rate of sidewalk gaps in roadway miles within ½ mile of transit stops than Environmental Justice communities. Figure 3.16 illustrates the sidewalk gaps, with the Environmental Justice overlay and the proximity to transit stations.

Figure 3.16 Sidewalk Gaps, Environmental Justice Communities & Transit Buffer



Source: 2016–2020 5-Year ACS, MassDOT Road Inventory 2021.

Travel Experience

The travel experience analysis considered the condition of assets across the Commonwealth to gain an understanding of concentration of assets needing repair. These data were also screened to identify inequalities based on geography and demographics as well as proximity to transit stations.

The travel experience analysis demonstrated that traditionally marginalized communities and urban communities experience fewer roadways and bridges in poor/fair condition per capita than other communities. Similarly, fewer curb ramp deficiencies exist in traditionally marginalized communities and urban communities. In contrast, there are more deficient curb ramps adjacent to transit stops traditionally in marginalized communities, indicating an inequity for transit users.

State of Good Repair—Pavement Condition

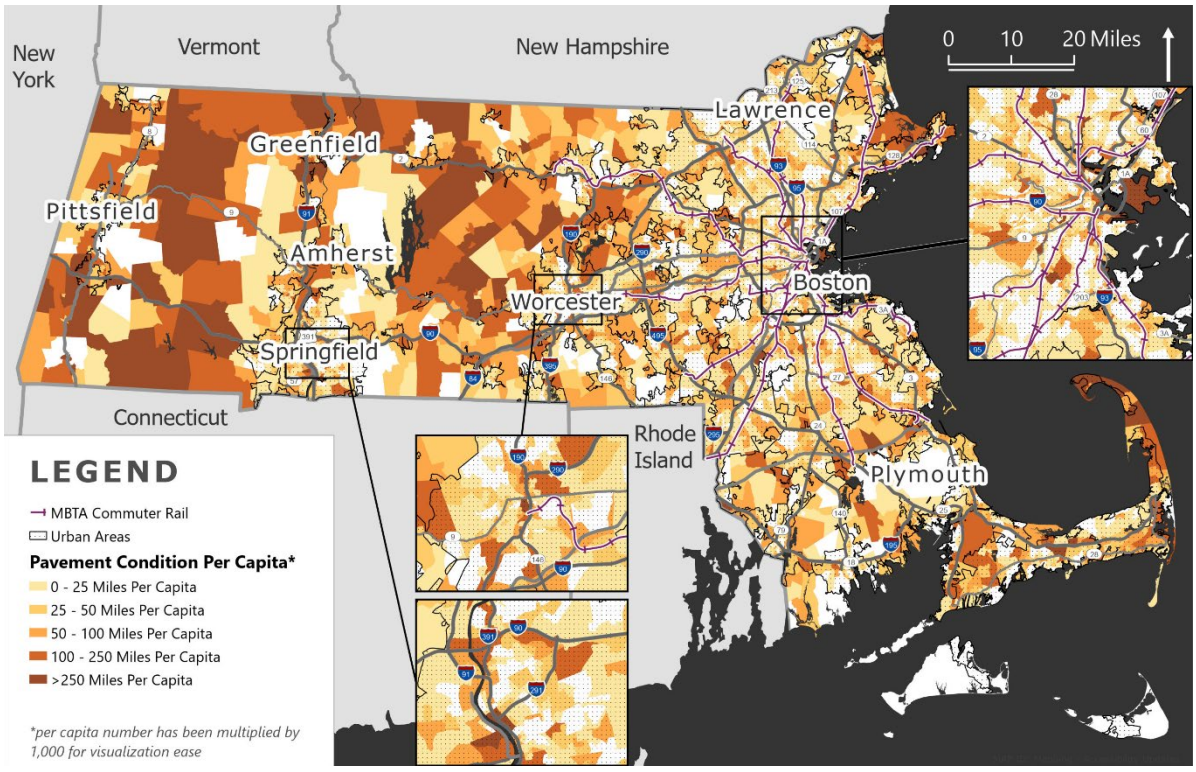
MassDOT maintains a pavement condition database for roadways throughout the state. The pavement condition was reviewed to identify trends in pavement in poor/fair condition and screened to identify inequalities based on geography and demographics. The analysis showed that:

- Non-Environmental Justice communities have 1.46 times more poor/fair road condition per capita than Environmental Justice communities.

- Rural communities have 3.53 times more poor/fair road condition per capita than urban communities.
- Within Environmental Justice communities, communities with concentrations senior populations and low-income households have the most poor/fair road condition miles per capita.

As indicated above, non-Environmental Justice communities experience a higher rate of poor/fair pavement condition than Environmental Justice communities. Similarly, rural communities experience a higher rate of poor/fair pavement condition than Urban communities. Figure 3.17 illustrates the pavement condition per capita, with urban/rural boundaries overlaid.

Figure 3.17 Pavement Condition, Urban/Rural Boundaries



Source: 2016–2020 5-Year ACS, MassDOT Pavement Condition 2020.

State of Good Repair—Bridge Condition

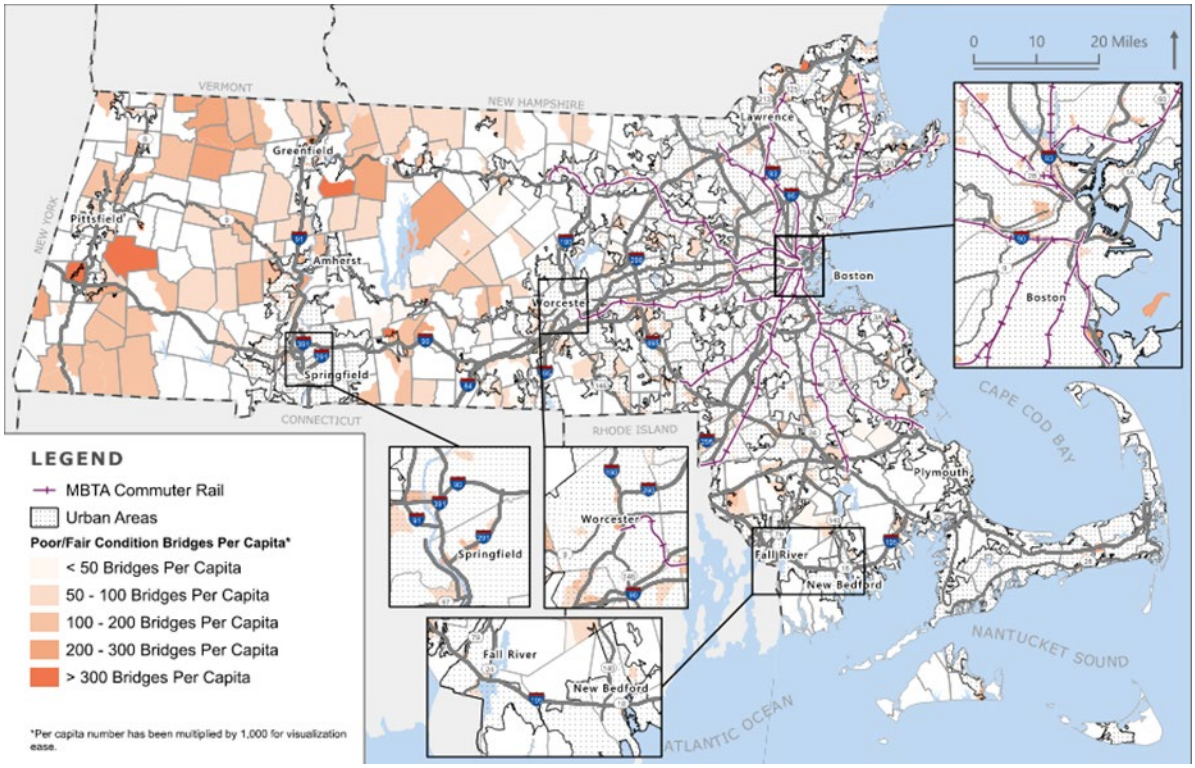
MassDOT maintains a statewide database of bridge condition. The bridge condition data was reviewed to identify trends of bridges in poor/fair condition and screened to identify inequalities based on geography and demographics. The analysis showed that:

- Non-Environmental Justice communities have 1.32 times more bridges in poor/fair condition per capita than Environmental Justice communities.
- Rural communities have 4.37 times more bridges in poor/fair condition per capita than urban communities.

- Communities with concentrations of senior and limited English proficient households have the most bridges in poor/fair condition per capita of Environmental Justice communities.

As indicated above, non-Environmental Justice communities experience a higher rate of bridges in poor/fair condition than Environmental Justice communities. Similarly, rural communities experience a higher rate of bridges in poor/fair condition than urban communities. Figure 3.18 illustrates the bridges in poor/fair condition per capita, with urban/rural boundaries.

Figure 3.18 Bridge Condition, Urban/Rural Boundaries



Source: 2016–2020 5-Year ACS, MassDOT Bridges 2022.

State of Good Repair—Curb Ramps

MassDOT maintains data regarding the presence and condition of curb ramps throughout the state. Deficient curb ramps were reviewed to identify trends and screened to identify inequalities based on geography and demographics. In addition, the analysis included a review of curb ramp deficiencies in the proximity of transit stations. The analysis showed that:

- Non-Environmental Justice communities have 1.47 times the deficient curb ramps per capita than Environmental Justice communities.
- Urban communities have 8.2 times the deficient curb ramps than rural communities; however, rural communities have 1.27 times the deficient curb ramps per capita than urban communities.

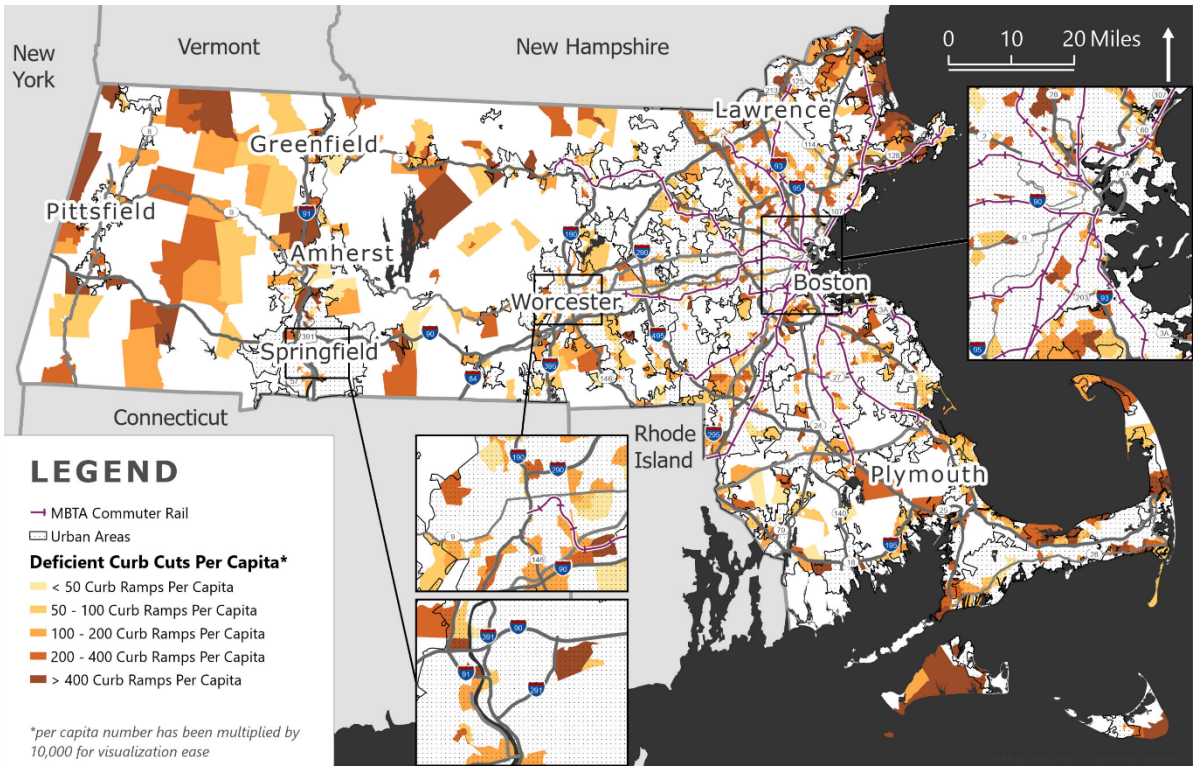
- Communities with concentrations of LEP households, seniors, and people with disabilities have the most deficient curb ramps per capita of Environmental Justice communities.
- Within half a mile of MBTA rapid transit stations, nine percent of the curb ramps are deficient.
- Within half a mile of MBTA rapid transit stations, 18 percent of the curb ramps within Environmental Justice communities are deficient while five percent of curb ramps within non-Environmental Justice communities are deficient.
- Within half a mile of MBTA Commuter Rail stations, 11 percent of the curb ramps are deficient.
- Within half a mile of MBTA Commuter Rail stations, 14 percent of the curb ramps within Environmental Justice communities are deficient while nine percent of curb ramps within non-Environmental Justice communities are deficient.

As indicated above, non-Environmental Justice communities experience a higher rate of deficient curb ramps than Environmental Justice communities per capita. Similarly, rural communities experience a higher rate of deficient curb ramps than urban communities per capita. Figure 3.19 illustrates the curb ramp condition per capita and with urban/rural boundaries.

Table 3.5 Deficient Curb Ramps within Half a Mile of Transit Stops

Community	Deficient Curb Ramps	Total Curb Ramps	% Deficient
Environmental Justice Community	126	792	16%
Non-Environmental Justice Community	129	1,766	7%

Figure 3.19 Curb Ramp Condition, Urban Boundaries



Source: 2016–2020 5-Year ACS, MassDOT Pedestrian Curb Cuts 2018.

Reliability

The reliability analysis considered how travelers experience varying levels of congestion and reliability on different segments of the roadway network at different times of day. It followed a similar methodology and updates portions of MassDOT's *Congestion in the Commonwealth* including roadway segments or corridors included in this analysis. The analysis considered PTI, a measure of travel time reliability that is commonly used in transportation planning. PTI is a reliability measure that represents the total travel time that should be planned when an adequate buffer time is included. It compares near-worst case (95th percentile) travel time to a travel time in free-flow traffic. A value of 2.0 means that for a 20-minute trip in little to no traffic, a traveler should plan on the trip taking 40 minutes.

Of the segments evaluated, the analysis identified the most consistently congested and unreliable segments of the Commonwealth's roadway network and weighted this information by MPO to take into account the diversity of transportation conditions across the state. The analysis showed that:

- People traveling via roadways across the Commonwealth must consistently plan for at least 2.5 times longer than free flow travel time and must be prepared for the possibility of their commute taking up to 8 times longer than free flow conditions during the most vital daily travel times. This finding is supported by calculations showing that the average planning time index (PTI) is above 2.5 for all of the top 20 most congested corridors in the state from 5 a.m. to 8

p.m., with some corridors averaging over eight PTI during morning peak periods and seven during evening peak periods.

- Several major commuter corridors in the Boston MPO region have average PRI above 3.5, making it the most consistently and intensely congested region in Massachusetts. Other MPO regions, such as Cape Cod and Central Massachusetts, also contain corridors where the average PTI exceeds two, illustrating that congestion and travel time variability extend far beyond the Boston region.

- Only six percent of major commuter corridors in the state have a PTI below or equal to one, meaning commuters across all regions must plan travel time in excess of free flow conditions at any given point during the day.

Travel Time Reliability

Estimates of travel time reliability were also developed using the same data set as the congestion frequency and severity analysis. Travel time reliability was evaluated across an average day and during the morning and evening peak commuting hours. Table 3.6, Table 3.7, and Table 3.8 show the 20 most unreliable corridors based on average PTI for the daily, morning, and evening peak periods, respectively.

Table 3.6 Top 20 Unreliable Corridors (Statewide)—Average PTI for Entire Day (5 a.m. to 8 p.m.)

Corridor	MPO	Average PTI
I-93 | MA-3 to MA-203 (Northbound)	Boston Region	4.96
Leverett Connector (Eastbound)	Boston Region	4.79
I-93 | Morrissey to I-90 (Southbound)	Boston Region	4.23
I-93 | I-90 to U.S.-1 (Southbound)	Boston Region	3.89
I-93 | MA-203 to Morrissey (Northbound)	Boston Region	3.58
I-93 | U.S.-1 to MA-16 (Southbound)	Boston Region	3.47
I-93 | Morrissey to I-90 (Northbound)	Boston Region	3.30
Leverett Connector (Westbound)	Boston Region	3.25
I-93 | MA-3 to MA-203 (Southbound)	Boston Region	2.94
I-90 | I-95 to Newton Corner (Eastbound)	Boston Region	2.90
I-93 | MA-16 to MA-28 (Southbound)	Boston Region	2.86
MA-28 | Bourne Bridge (Southbound)	Cape Cod	2.85
I-93 | MA-203 to Morrissey (Southbound)	Boston Region	2.83
I-93 | MA-24 to MA-3 (Southbound)	Boston Region	2.73
I-93 | MA-24 to MA-3 (Northbound)	Boston Region	2.68
I-93 | I-90 to U.S.-1 (Northbound)	Boston Region	2.68
U.S.-1 | I-93 to MA-16 (Southbound)	Boston Region	2.65
I-90 | I-93 to MA-1A (Westbound)	Boston Region	2.64

Corridor	MPO	Average PTI
U.S.-1 | MA-16 to MA-99 (Northbound)	Boston Region	2.63
I-93 | U.S.-1 to MA-16 (Northbound)	Boston Region	2.60

Table 3.7 Top 20 Unreliable Corridors (Statewide)—Average PTI for AM Period (7 a.m. to 9 a.m.)

Corridor	MPO	Average PTI
I-93 | MA-16 to MA-28 (Southbound)	Boston Region	8.16
U.S.-1 | I-93 to MA-16 (Southbound)	Boston Region	7.44
I-93 | MA-3 to MA-203 (Northbound)	Boston Region	6.66
MA-28 | Bourne Bridge (Southbound)	Cape Cod	5.25
Leverett Connector (Eastbound)	Boston Region	5.07
I-93 | MA-203 to Morrissey (Northbound)	Boston Region	5.07
I-90 | I-95 to Newton Corner (Eastbound)	Boston Region	5.01
I-93 | MA-28 to I-95 (Southbound)	Boston Region	4.58
MA-1A | I-90 to MA-60 (Southbound)	Boston Region	4.55
I-90 | I-93 to MA-1A (Westbound)	Boston Region	4.44
I-90 | Natick to I-95 (Eastbound)	Boston Region	4.28
I-90 | Newton Corner to Allston (Eastbound)	Boston Region	4.27
MA-2 | MA-60 to MA-16 (Westbound)	Boston Region	4.19
I-93 | U.S.-1 to MA-16 (Southbound)	Boston Region	4.16
I-93 | MA-24 to MA-3 (Northbound)	Boston Region	4.09
MA-24 | MA-28 to I-93 (Northbound)	Boston Region	4.66
I-95 | I-93 to MA-128 (Westbound)	Old Colony	3.29
I-95 | I-93 to MA-128 (Westbound)	Boston Region	3.88
I-90 | MA-9 to Natick (Eastbound)	Boston Region	3.87
MA-60 | MA-1A to MA-107 (Westbound)	Boston Region	3.79

Table 3.8 Top 20 Unreliable Corridors (Statewide)—Average PTI for PM Period (4 p.m. to 6 p.m.)

Corridor	MPO	Average PTI
I-93 | I-90 to U.S.-1 (Southbound)	Boston Region	7.36
I-93 | Morrissey to I-90 (Southbound)	Boston Region	7.02
I-93 | Morrissey to I-90 (Northbound)	Boston Region	6.02
I-93 | MA-3 to MA-203 (Northbound)	Boston Region	5.88
Leverett Connector (Eastbound)	Boston Region	5.82
U.S.-1 | MA-16 to MA-99 (Northbound)	Boston Region	5.59
I-93 | U.S.-1 to MA-16 (Northbound)	Boston Region	5.54
I-93 | U.S.-1 to MA-16 (Southbound)	Boston Region	5.33
I-93 | MA-24 to MA-3 (Southbound)	Boston Region	5.11
I-91 | U.S.-5 to I-291 (Southbound)	Pioneer Valley	5.10
Leverett Connector (Westbound)	Boston Region	5.08
I-95 | U.S.-3 to I-93 (Eastbound)	Boston Region	5.07
I-93 | MA-3 to MA-203 (Southbound)	Boston Region	5.02
I-93 | MA-16 to MA-28 (Northbound)	Boston Region	4.74
I-93 | I-90 to U.S.-1 (Northbound)	Boston Region	4.72
I-90 | I-95 to Newton Corner (Eastbound)	Boston Region	4.65
MA-9 | I-95 to HPP (Westbound)	Boston Region	4.38
I-90 | Natick to I-95 (Westbound)	Boston Region	4.32
MA-2 | W. Concord to MA-2A (Eastbound)	Boston Region	4.26
I-90 | I-95 to Newton Corner (Westbound)	Boston Region	4.18

As can be seen in the tables above, there are several corridors, mostly in the Boston Region, that require drivers to plan for a commute that may take up to five times longer than free-flow conditions.

The analysis also considered average travel time reliability by functional classification. Table 3.9 shows the average PTI for an entire day.

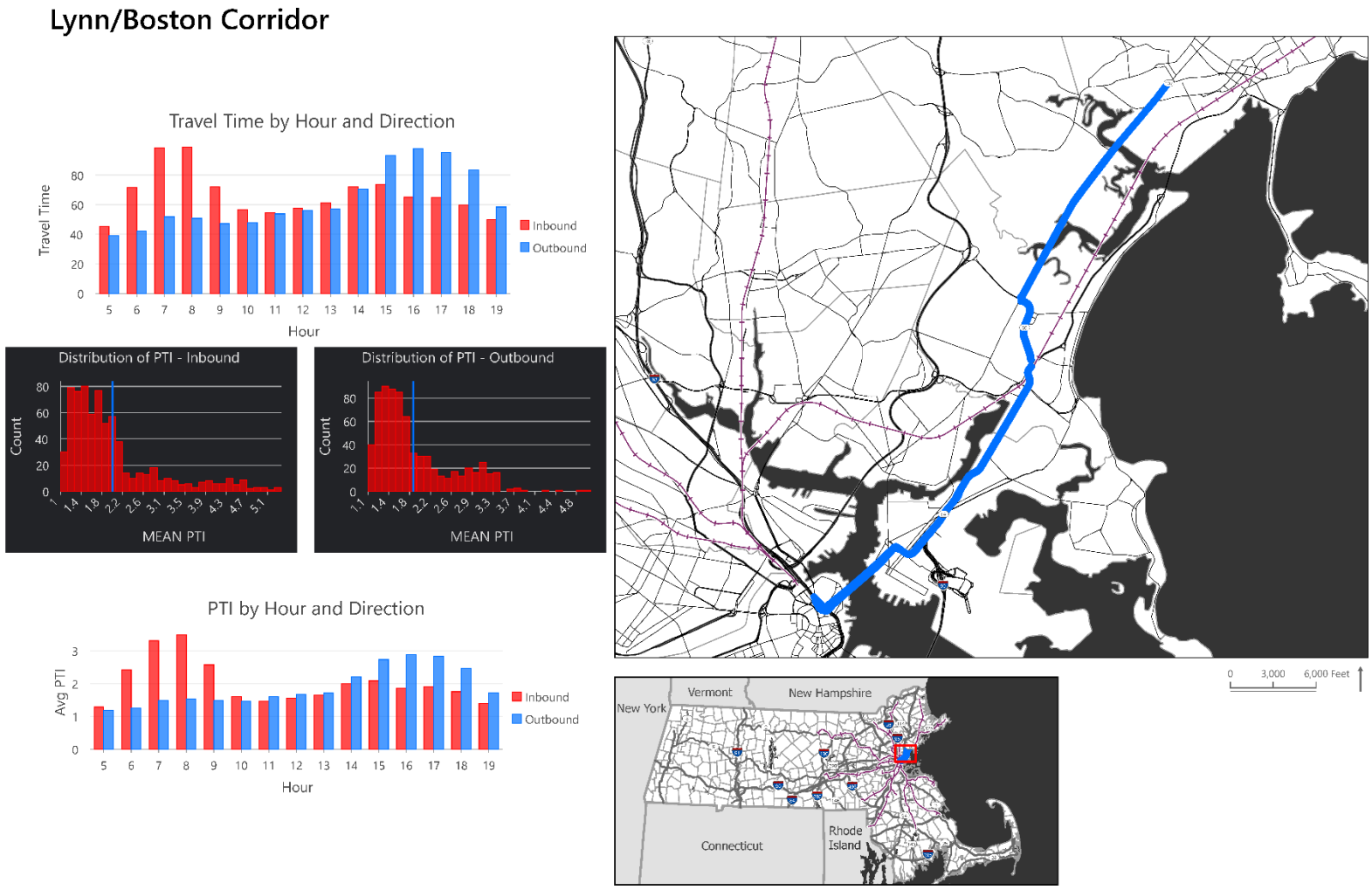
Table 3.9 Federal Functional Class—Average PTI for Entire Day (5 a.m. to 8 p.m.)

Federal Functional Class	Mean PTI
1—Interstate	1.49
2—Principal Arterial—Other Freeways	1.35
3—Principal Arterial—Other	1.50

As can be seen in Table 3.9, all Federal functional classes analyzed have average PTIs greater than 1.35 during the day.

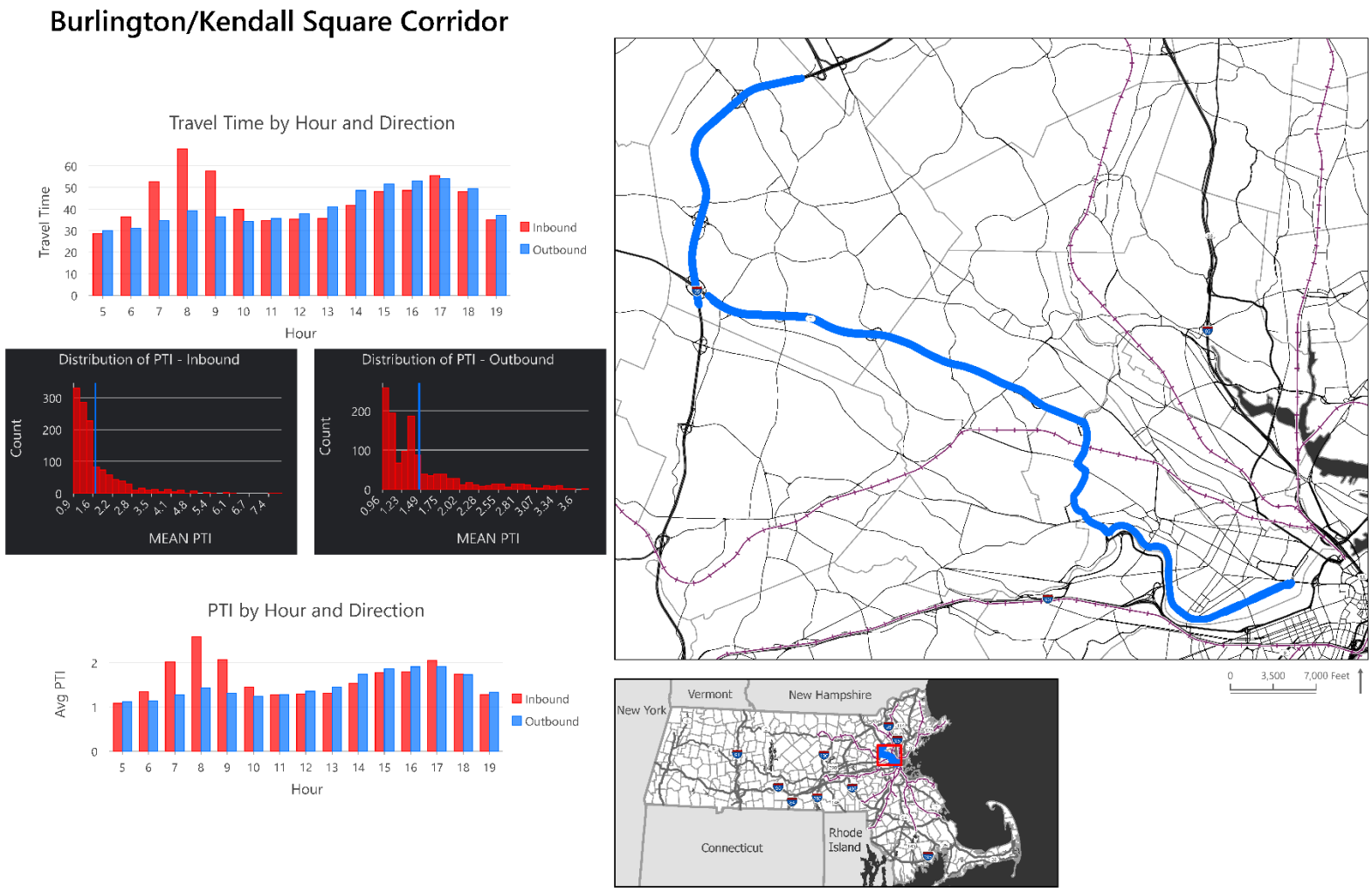
Specific corridors were reviewed with the PTI data to understand reliability for commutes throughout the commonwealth. As can be seen in Figure 3.20 through Figure 3.22, corridors near the Boston region experience high unreliability for inbound commutes during the morning peak commuter period and for outbound commutes during the evening peak commuter period. As shown in the figures, the Lynn to Boston corridor has a PTI greater than 3.0 for both the 7:00 a.m. and 8:00 a.m. periods for inbound commutes, while the Framingham to Northeastern University corridor has a PTI greater than 3.0 for the inbound direction in the 8:00 a.m. period. The Burlington to Kendall corridor has a PTI greater than 2.0 for the inbound direction during the 7:00 a.m., 8:00 a.m., 9:00 a.m., and 5:00 p.m. time periods.

Figure 3.20 PTI—Lynn to Boston Corridor



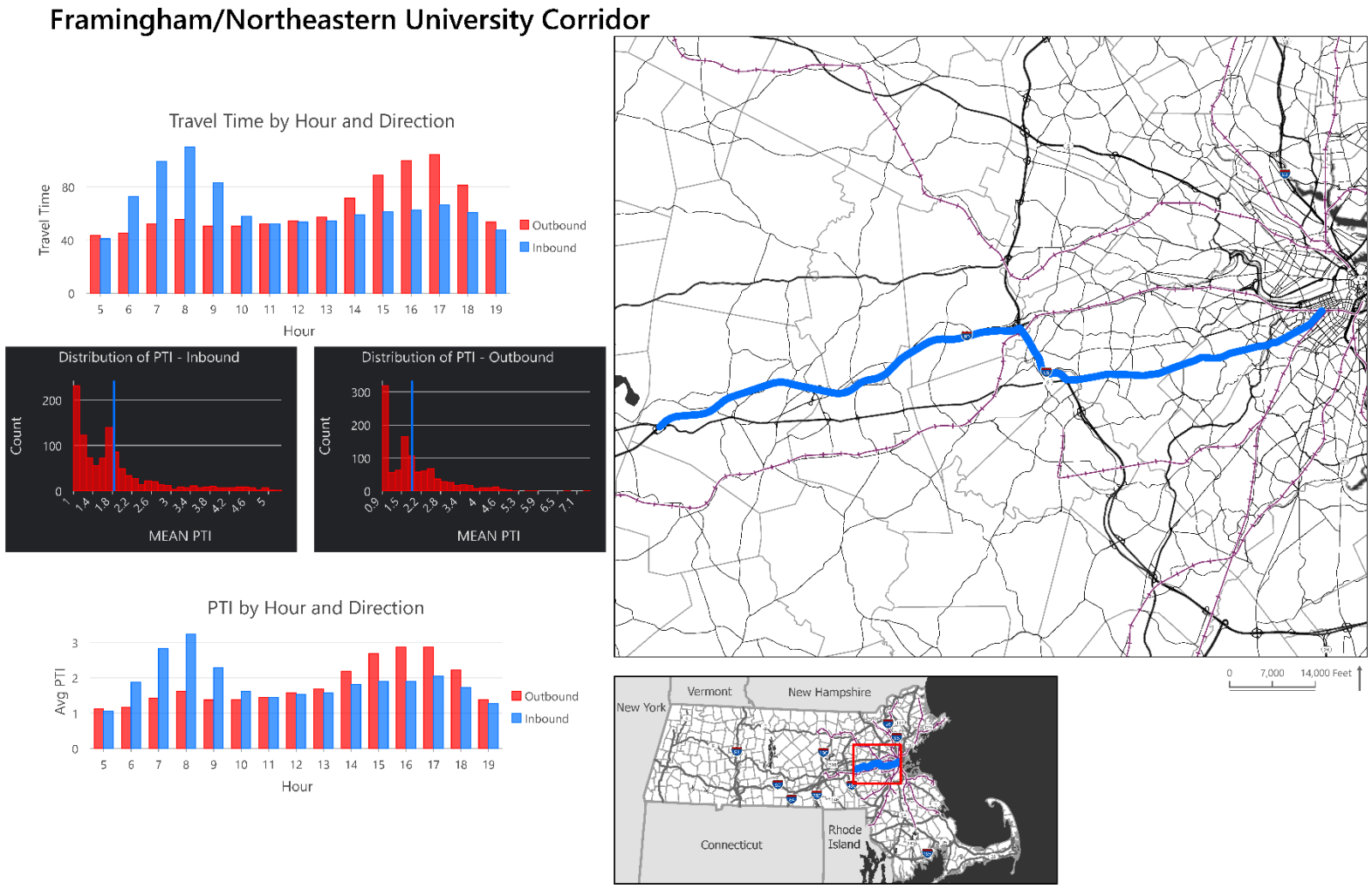
Source: RITIS API to access INRIX data; April 2022-March 2023.

Figure 3.21 PTI—Burlington to Kendall Corridor



Source: RITIS API to access INRIX data; April 2022-March 2023.

Figure 3.22 PTI—Framingham to Northeastern University Corridor



Source: RITIS API to access INRIX data; April 2022-March 2023.

Supporting Clean Transportation

Beyond Mobility integrates findings from the *Clean Energy and Climate Plan (*CECP*)* related to clean transportation. Although no unique analysis was completed for the *Beyond Mobility* needs assessment task under this category, a great deal of the other analyses under the Destination Connectivity, Reliability, and Resiliency Priority Areas overlap with this priority.

Resiliency

The resiliency analysis considered data related to sea level rise and flooding to understand elements of the network at highest risk from the effects of climate change. These data were also screened to identify inequalities based on demographics as well as potential impact to transit stations.

Resiliency analysis demonstrated that 10 feet of sea level rise (SLR) is expected to impact 2,000 cumulative miles of roadway, 81 MBTA stops, 15 commuter rail stops, and 1,249 bus stops. Category 4 hurricane inundation is expected to impact 3,000 cumulative miles of roadway, 102 MBTA stops, 21 commuter rail stops, 2,232 bus stops. SLR and hurricane inundation is expected to impact non-marginalized communities at a higher rate than Environmental Justice communities.

Sea Level Rise

The National Oceanic and Atmospheric Administration Office for Coastal Management (NOAA) compiles SLR data, quantifying the potential inundation of coastal areas resulting from a projected one- to ten-foot rise in sea levels above current “mean higher high water” conditions. Table 3.10 shows the jurisdiction of roadway miles projected to be impacted by SLR of up to 10 feet. As shown, more than 2,000 cumulative miles of roadway are impacted with 10 feet of SLR. Nearly 500 additional roadway miles are impacted with a shift from four to five feet of SLR.

Table 3.10 Roadway Miles Impacted by Sea Level Rise (up to 10 feet) by Jurisdiction

Jurisdiction	Total Length of Roads (Mi)	Percent of Total
Total Miles	**2,013**	**100%**
MassDOT Owned	148	7%
Other Ownership	1,865	93%

Table 3.11 Roadway Miles Impacted by Sea Level Rise (up to 10 feet)

Sea Level Rise (feet)	Cumulative Miles of Roadway Impacted
1	53
2	96
3	200
4	383
5	855
6	1,201
7	1,492
8	1,734
9	1,967
10	2,184

The SLR data were also screened to identify inequalities based on geography and demographics and showed that SLR is expected to impact non-Environmental Justice communities 2.73 times more per capita than Environmental Justice communities.

In addition, the analysis included a review of SLR in the proximity of transit stations, finding that:

- No MBTA rapid transit or commuter rail stations are impacted until at least four feet of SLR
- 81 MBTA rapid transit stations are impacted at 10 feet of SLR
- 15 MBTA commuter rail stations are impacted at 10 feet of SLR
- 1,249 MBTA bus stops are impacted at 10 feet of SLR

Table 3.12 shows the cumulative transit stops impacted by sea level rise (up to 10 feet).

Table 3.12 Transit Stops Impacted by Sea Level Rise

Sea Level Rise (feet)	Cumulative MBTA Stops Impacted	Cumulative CR Stops Impacted	Cumulative Bus Stops Impacted
1	0	0	2
2	0	0	2
3	0	0	21
4	2	1	78
5	22	5	364
6	40	9	648
7	56	11	842
8	64	14	970
9	74	14	1,120
10	81	15	1,249

The analysis also included a review of SLR in relationship to pavement and bridge conditions, finding that:

- 161 miles of roadways in poor/fair are impacted at 10 feet SLR.
- SLR on roadways in poor/fair condition is expected to occur in Environmental Justice communities; 1.08 times more per capita than non-Environmental Justice communities.
- 87 bridges in poor/fair condition are impacted at 10 feet SLR

Table 3.13 shows the cumulative miles of roadways in poor or fair condition and bridges in poor/fair condition impacted by SLR of up to 10 feet.

Table 3.13 Roadways and Bridges Impacted by Sea Level Rise

Sea Level Rise (feet)	Cumulative Miles of Roadways in Poor/Fair Condition	Cumulative Number of Bridges in Poor/Fair Condition
1	8	26
2	9	27
3	12	28
4	18	29
5	63	32
6	90	62
7	115	67
8	133	72
9	148	77
10	161	81

Hurricane Inundation Zone

The U.S. Army Corps of Engineers, New England District, compiles Hurricane Inundation Zone (HIZ) data to assist emergency management officials in hurricane preparedness and operations. This data represents worst-case Hurricane Surge Inundation areas for Category 1 through 4 hurricanes striking the coast of Massachusetts. More than 3,000 cumulative miles of roadways lie within Hurricane Category 4 impact areas in the state. Table 3.14 shows the jurisdiction of roadway miles impacted by hurricane inundation (up to Category 4).

Table 3.14 Roadway Miles Impacted by Hurricane Category 4 by Jurisdiction

Jurisdiction	Total Length of Roads (Mi)	Percent of Total
Total Miles	**3,385**	**100%**
MassDOT Owned	241	7%
Other Ownership	3,144	93%

The HIZ data was further reviewed to identify trends and screened to identify inequalities based on geography and demographics. Hurricane Inundation is expected to impact non-Environmental Justice communities 1.94 times more per capita than Environmental Justice communities.

In addition, the analysis included a review of SLR in the proximity of transit stations, finding that:

- 102 MBTA rapid transit stations are located within Hurricane Category 4 impact area
- 21 MBTA commuter rail stations are located within Hurricane Category 4 impact area
- 2232 MBTA bus stops are located within Hurricane Category 4 impact area

Table 3.15 shows the cumulative transit stops impacted by hurricane inundation (up to Category 4).

Table 3.15 Transit Stops Impacted by Sea Level Rise

Hurricane Category	Cumulative MBTA Rapid Transit Station Impacted	Cumulative Commuter Rail Stations Impacted	Cumulative MBTA Bus Stops Impacted
1	37	5	529
2	84	13	1,338
3	95	14	1,842
4	102	21	2,232

The analysis also included a review of hurricane inundation in relationship to pavement and bridge conditions, finding that:

- 232 miles of roadways in poor or fair condition are located within Hurricane Category 4 impact area
- 81 bridges in poor or fair condition are located within Hurricane Category 4 impact area

Table 3.16 shows the infrastructure impacted by hurricane inundation (up to Category 4).

Table 3.16 Roadways and Bridges Impacted by Hurricane Inundation

Hurricane Category	Cumulative Miles of in Poor/Fair Condition Roads	Cumulative Number of Bridges in Poor/Fair Condition
1	53	23
2	143	54
3	187	63
4	231	81

4.0 Conclusions

The *Beyond Mobility* Needs Assessment identifies transportation-related barriers, needs, and inequalities throughout the Commonwealth. It highlights challenges in each of Priority Area and informs both the Plan's Problem Statements and ultimately the development of Action Items for implementation, as outlined below.

- The Safety analysis shows that traditionally marginalized communities experience fatal and serious injury collisions at a higher rate than other communities. This is especially true for crashes that involved a pedestrian and/or bicyclist. Rural communities have a slightly higher rate of fatal/serious injury crashes per capita than urban communities. However, urban communities have significantly higher pedestrian and/or bicycle crash rates per capita than rural communities. These findings contribute to Action Items committed to prioritizing safety projects in communities disproportionately burdened by unsafe conditions and tracking safety action items, measures, and crash rate disparities.

- The Destination Connectivity data indicate that Environmental Justice communities have a higher potential for walkable trips and potential for everyday biking than non-Environmental Justice communities, even though these communities have fewer existing and planned bicycle facilities. The data also shows that rural communities have nearly eight times the sidewalk gaps per capita than urban communities. These conclusions helped inform Action Items focused on exploring opportunities to support expanding employment transportation to low-income individuals and further assessing commute time disparities.

- The Travel Experience data conclude that rural communities have a higher rate per capita of poor/fair condition of bridges, pavement conditions, and deficient curb ramps than urban communities. These findings contribute to Action Items related to building out high-quality data layers to maintain the most up-to-date condition information and utilize this data to pursue funding opportunities.

- The Reliability data conclude that most major commuter corridors in the state are unreliable, regardless of functional classification, region, or mode. These conclusions helped inform action items centered around investing in planning studies, a roadway pricing study, and efforts to expand transit infrastructure and reduce roadway bottlenecks and delays.

- The Resiliency data conclude that both sea level rise and hurricane inundation are extreme threats to Massachusetts infrastructure. A major sea level rise or hurricane inundation event would impact thousands of miles of roadway, hundreds of transit stations, and dozens of bridges throughout the Commonwealth. These conclusions helped inform action items focused on prioritizing funding and grant opportunities for resiliency projects, project screening for climate risk, and exploration of a culvert replacement and improvement program.

Thank you