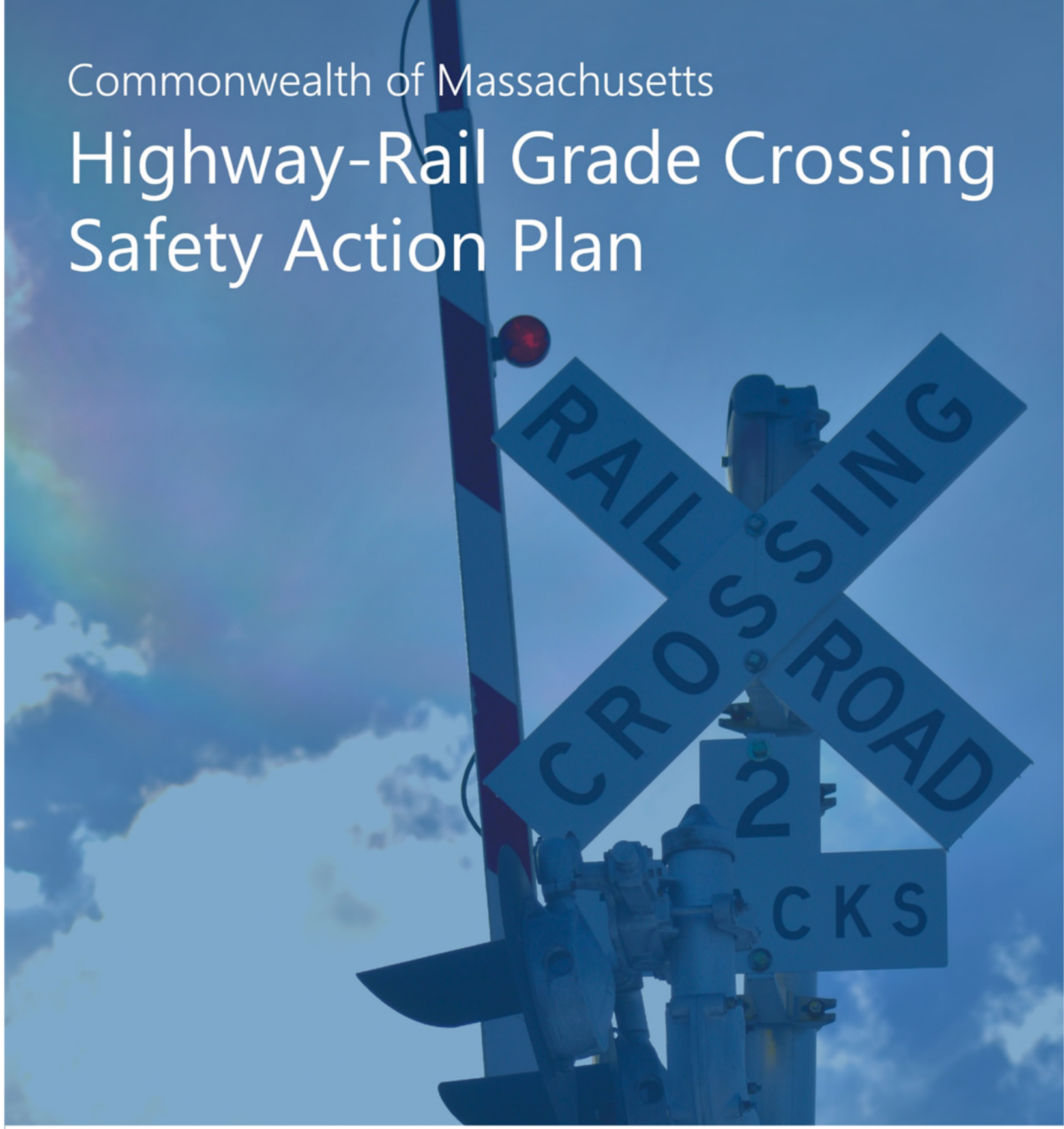
Commonwealth of Massachusetts

Highway-Rail Grade Crossing Safety Action Plan



February 2022

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Massachusetts Department of Transportation

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Commonwealth of Massachusetts

Highway-Rail Grade Crossing Safety Action Plan

February 2022

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Executive Summary

To meet Fixing America's Surface Transportation Act (FAST Act) requirements (Section 11401(b)), Federal Railroad Administration (FRA) published a Final Rule in the Federal Register (effective January 13, 2021), that requires all states (and D.C.) to develop, implement, and update (if applicable) highway-rail grade crossing action plans (49 CFR § 234.11). The FAST Act specifies that Action Plans must identify grade crossings that:

- Have experienced recent grade crossing accidents or incidents
- Have experienced multiple grade crossing accidents or incidents
- Are at high-risk for accidents or incidents

It specifies that Action Plans must identify specific strategies for improving safety at grade crossings and identify a State official responsible for managing the implementation of the plan.

The Commonwealth of Massachusetts seeks to implement a Highway-Rail Grade Crossing Safety Action Plan (Action Plan) that reduces risk and promotes a safe, economical, and efficient railroad transportation system in the public interest. Implementation of the plan will occur through the joint efforts of the Massachusetts Department of Transportation's (MassDOT) Rail and Transit Division, MassDOT's Highway Division, the Massachusetts Department of Public Utilities, and the railroads that operate in the Commonwealth to ensure compliance with all applicable state and federal laws.

The plan addresses safety at both highway-rail grade crossings and pathway grade crossings. Grade crossings are the primary places where railroad equipment, which have limited ability to stop quickly, are operating in close proximity to vehicles, pedestrians, and bicycle users. Warning devices are often installed at grade crossings to avoid collisions. The plan builds on existing plans that guide the development and safety of rail transportation in the Commonwealth of Massachusetts.

Existing conditions and historical data has been derived from FRA grade crossing collision reports and the FRA National Grade Crossing Inventory database. The results of the data analysis informed the Plan's risk assessment and was used to identify state-level safety challenges and considerations. Specific strategies, objectives, and actions to achieve the goal of reducing crossing fatalities and incidents are identified.

Acronyms

AADT	Average Annual Daily Traffic
AAR	Association of American Railroads
CIP	Capital Investment Plan
FAST Act	Fixing America's Surface Transportation Act
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
HI	Hazard Index
HSIP	Highway Safety Improvement Program
LIRR	Long Island Railroad
MassDOT	Massachusetts Department of Transportation
MassDPU	Massachusetts Department of Public Utilities
MBTA	Massachusetts Bay Transportation Authority
MGL	Massachusetts General Law
PW	Providence and Worcester Railroad
RDE	Railroad Dynamic Envelope
ROW	Right-of-way
SHSP	Strategic Highway Safety Plan
USC	United States Code

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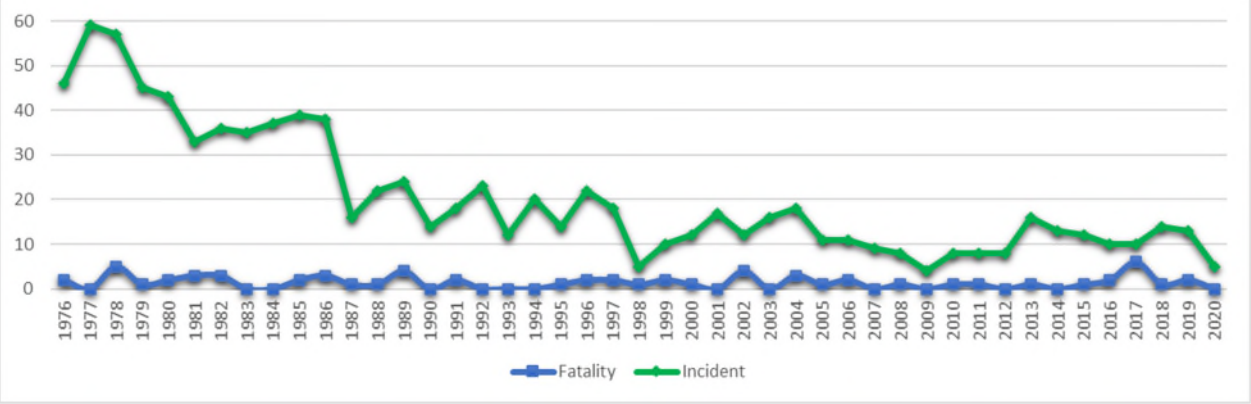
1 Introduction

The Commonwealth of Massachusetts seeks to implement a Highway-Rail Grade Crossing Safety Action Plan (Action Plan) that reduces risk and promotes a safe, economical, and efficient railroad transportation system in the public interest. Implementation of the plan will occur through the joint efforts of the Massachusetts Department of Transportation's (MassDOT) Rail and Transit Division, MassDOT's Highway Division, the Massachusetts Department of Public Utilities, and the railroads that operate in the Commonwealth to ensure compliance with all applicable state and federal laws.

Grade crossing incidents and fatalities have decreased dramatically in the United States since 1975, when a national program was implemented to reduce them. In 1976, there were 13,030 grade crossing incidents nationally, resulting in 1,901 fatalities at public and private crossings. As of 2020, there were 1,069 incidents, resulting in 196 fatalities nationally.

The number of incidents in Massachusetts has also declined over time, decreasing from 60 incidents in 1977 to five in 2020. **Figure 1** illustrates this trend. Although travel patterns in 2020 were not typical due to the COVID-19 pandemic, grade crossings incidents in 2020 were consistent with the continuing trend in Massachusetts of having, on average, less than 10 incidents per year. The number of fatal grade crossing incidents has historically been low in Massachusetts, ranging from zero to six annually. In 2017, six fatalities occurred, representing the highest number in a single year since detailed records have been kept (45 years). Over the past 45 years, there have been eight years in which there were more than two fatalities at grade crossings. As part of this Action Plan, the conditions involved in the elevated number of fatalities in 2017 were analyzed and the information informed action strategies. Recent incidents in 2021 and early 2022 demonstrate the need for implementing this Action Plan and Chapter 6 of this report describes key mitigation measures ranging from increased education, oversight, and training for our workforce and the public to physical and technological improvements to reduce incidents. MassDOT will continue to assess and identify needed improvements on an ongoing basis.

Figure 1. Massachusetts Grade Crossing Incident and Fatalities by Year (1976-2020)



Source: Federal Rail Administration Highway-Rail Grade Crossing Inventory database

Regulatory authority for certain aspects of grade crossing safety at public highway-railroad grade crossings in Massachusetts lies with the Massachusetts Department of Public Utilities, Transportation Oversight Division under Massachusetts General Law (MGL) Sections 160 and 161. Public grade crossing improvement capital construction projects are overseen by the MassDOT Rail & Transit Division and the MassDOT Highway Division, as may be applicable. Federal funding is available under Section 130 of federal surface transportation law for these types of safety projects. Chapter 2 includes additional details related to specific roles and responsibilities.

1.1 Defining Grade-Crossings

This plan will address safety at both highway-rail grade crossings and pathway grade crossings. Highway-rail grade crossing means a location where a public highway, road, street, or private roadway, including associated sidewalks and pathways, crosses one or more railroad tracks at grade.[1] Pathway grade crossing means a pathway that crosses one or more railroad tracks at grade and is (1) explicitly authorized by a public authority or a railroad; (2) dedicated for the use of non-vehicular traffic, including pedestrians, bicyclists, and others; and (3) not associated with a public highway, road, or street, or a private roadway.[2] The term crossing or grade crossing will be used throughout this plan to refer to both highway-rail grade crossings and pathway grade crossings.

There are safety concerns at highway-rail grade crossings and pathway grade crossings since they are the primary places where railroad equipment, which have limited ability to stop quickly, are in operation in close proximity to vehicles, pedestrians, and bicycle users. Warning devices are often installed at grade crossings to avoid collisions. Various types of warning devices exist, including both active and passive warning devices. Active warning devices are ones that provide an additional warning when a train is approaching and typically include bells, flashing lights, and gates. Passive warning devices, such as crossbuck, yield or stop signs, and pavement markings, simply provide an indication of the existence of a crossing. Grade crossings may be under the jurisdiction of and maintained by a public authority (public grade crossings) or on privately owned roadways (private grade crossings).

1.2 Regulatory Background

Federal Railroad Administration (FRA) published a Final Rule in the Federal Register (effective January 13, 2021), that requires all states (and Washington, D.C.) to develop, implement, and update (if applicable) highway-rail grade crossing action plans (49 CFR § 234.11). The Final Rule meets Fixing America's Surface Transportation Act (FAST Act) requirements (Section 11401(b)(2)). According to the FAST Act, Action Plans must identify highway-rail grade crossings that:

a) Have experienced recent highway-rail grade crossing accidents or incidents
b) Have experienced multiple highway-rail grade crossing accidents or incidents
c) Are at high-risk for accidents or incidents

Additionally, the FAST Act mandates Action Plans identify specific strategies for improving safety at grade crossings, including highway-rail grade crossing closures or grade separations. The Plan must also designate a State official responsible for managing the implementation of the plan.

In the Final Rule, FRA identified seven key factors states are required to consider when identifying high-risk crossings. The key factors include:

1. Average annual daily traffic
2. Total number of trains per day that travel through the crossing
3. Total number of motor vehicle collisions that have occurred at the crossing during the previous 5-year period
4. Number of main railroad tracks at the crossing
5. Number of roadway lanes at the crossing
6. Sight distance and roadway geometry at the crossing

[1] 49 CFR § 234.401 - Definitions. *Public crossing* means a highway-rail or pathway crossing where the approaches are under the jurisdiction of and maintained by a public authority and open to public travel. All approaches must be under the jurisdiction of the public authority and no approach may be on private property, unless State law or regulation provides otherwise.
[2] 49 CFR § 234.5 - Definitions

7. Maximum timetable speed at the crossing

States can consider other factors as applicable, such as density of neighborhood development near crossings or high pedestrian volumes.

1.3 Mission Statement

The purpose of the Action Plan is to advance MassDOT's mission *to deliver excellent customer service to people traveling in the Commonwealth by providing transportation infrastructure, which is safe, reliable, robust and resilient.* The Action Plan will provide an assessment of grade crossing safety across the Commonwealth and an updated framework for evaluating and prioritizing safety investment

1.4 Goal

The goal of this Action Plan is to identify specific strategies that will reduce collisions, accidents or incidents between trains or on-track equipment, and vehicles, pedestrians, or bicyclists at grade crossings. Specific goals, strategies, and challenges are identified in Section 6.

1.5 Scope

The scope of this Action Plan is to develop a Grade Crossing Action Plan for the Commonwealth of Massachusetts, consistent with federal regulations, that supports the mission of the Massachusetts Department of Transportation. The Action Plan will meet the goal of identifying specific strategies for grade crossing accident reduction by evaluating existing grade crossing conditions and investment priorities for strategies that will result in improved outcomes. The format of the Action Plan includes the following:

Section 1 provides an introduction to the Action Plan and its mission.

Section 2 details the existing plans that guide the development and safety of rail transportation in the Commonwealth of Massachusetts.

Section 3 describes the Working Group that provided expertise and input on the Massachusetts Highway-Rail Grade Crossing Safety Action Plan.

Section 4 contains data analysis, data sources, existing conditions, and accident/ incident data.

Section 5 summarizes the results of the data analysis included in Section 4 and highlights the state-level safety challenges and considerations that will be made in establishing the strategic actions.

Section 6 identifies specific strategies, objectives, and actions to achieve the goal of reducing crossing fatalities and incidents. It also identifies challenges and implementation responsibility.

Appendix A provides the language from the State Highway-rail Grade Crossing Action Plan Regulation (49 CFR 234.11) as a reference.

Appendix B presents a table summarizing Massachusetts Strategic Highway Safety Plan (SHSP) strategies and implementation compared to Massachusetts Highway-Rail Grade Crossing Safety Action Plan strategies and implementation to show synergies between the two plans.

Appendix C identified a list of references and endnotes for the report.

2 Statewide Highway-Rail Grade Crossing Safety Efforts

2.1 Highway-railway grade crossing planning

Multiple plans exist to guide the development and safety of rail transportation in the Commonwealth of Massachusetts. The plans are summarized in this section to provide context and, where applicable, describe the relationship of highway-railway crossing safety planning within existing Commonwealth plans.

2.1.1 Massachusetts State Rail Plan

Published in 2018, the State Rail Plan defines the Commonwealth's long-term plan for the development of the statewide rail system. It provides an overview of the existing rail system, the rail system's role in the state's transportation network, rail system financing, near-term priorities, and a long-term investment strategy. **Figure 2** shows freight rail line ownership in Massachusetts.

The State Rail Plan has six goals, as follows:

1. Maintain the Commonwealth's existing rail system in a state-of-good-repair, expand accessibility, and preserve railroad rights-of-way.
2. Support economic growth throughout the State and enable Massachusetts to compete in the changing global economy.
3. Improve the safety and security of the rail system.
4. Provide a rail system that is environmentally and financially responsible.
5. Improve intermodal connectivity for both passenger and freight rail facilities by stronger coordination between rail system users to promote system use and efficiency.
6. Maximize the return on public dollars towards rail investment by maximizing the use of existing rights-of-way.

Figure 2. Freight Rail Line Ownership in Massachusetts (2018)

Source: Massachusetts State Rail Plan, 2018

Specifically relating to grade crossings, the Massachusetts State Rail Plan identifies accomplishments since the 2010 Rail Plan, including a variety of safety improvements. Between 2010 and 2016, 100 grade crossing projects were completed to improve safety in key corridors throughout the Commonwealth. Projects primarily involve installation, replacement, or upgrades such as:

- Standard warning devices such as signs and pavement markings
- Active warning devices such as flashers and gates
- Track circuitry improvements and interconnections with highway traffic signals
- Crossing illumination
- Crossing surface improvements
- General roadway approach improvements

These projects are funded through the federal Section 130 program and prioritized based on risk. Section 130 program funding can also be used to help fund projects that provide separation of rail and highway (e.g., roadway overpass). Eliminating highway-rail grade crossings is the only way to completely remove the possibility of crashes. While in some cases it may be impractical or too costly to close crossings, such an objective can be achieved via crossing consolidation, and/or grade separation. MassDOT has reduced the number of highway-railroad grade crossings on public thoroughfares by closing dozens of highway-railroad grade crossings since 2011. Improving the safety of at-grade crossing locations was identified as a near-term initiative in the state's 2018 Capital Investment Plan (CIP).

2.1.2 Strategic Highway Safety Plan (SHSP)

The Massachusetts SHSP provides a comprehensive framework for reducing highway fatalities and serious injuries on all public roads. It contains 14 emphasis areas based on identified priorities. At-grade crossings are one of the emphasis areas included in the plan. Of all of the emphasis areas, at-grade crossings had the lowest annual fatality average from 2012-2016.

The plan includes data-driven strategies and actions for improving transportation safety in Massachusetts. The strategies and actions associated with the at-grade crossing emphasis area are summarized in **Table 1**.

Table 1. MA SHSP At-grade Crossings Strategies and Actions

Strategies	Actions and Implementing Agencies
Enhance at-grade rail crossing safety	• Continue implementing Section 130 of the Rail-Highway Crossing Safety Program (MassDOT Rail and Transit). • Prioritize and select projects utilizing data-driven processes, including crash data analysis, site visits (similar to road safety audits), and surveys of crossings that may require improvements (MassDOT Rail and Transit, MBTA). • Implement measures recommended in the Highway Design Handbook for Older Drivers and Pedestrians regarding visual improvements at at-grade crossings that will enhance support for older drivers and alternative road users (MassDOT Rail and Transit, MBTA). • Conduct pedestrian and motor vehicle enforcement near at-grade rail crossings (Local Law Enforcement). • Utilize proven crash prevention methods at grade crossings, including the increase of signage and pavement markings and changing from passive to active devices (MassDOT Rail and Transit, MBTA).

Strategies	Actions and Implementing Agencies
Educate general public about safe crossing practices	• Develop a campaign that will educate the public and increase awareness about safety precautions needed at railroad crossings (MassDOT Rail and Transit, MassDOT Highway, MBTA). • Continue implementing "Operation Lifesaver," a public awareness campaign that includes safety blitzes, press conferences, and other community awareness events with the goal of reducing rail tragedies. In addition, expand outreach to areas surrounding new or modified Commuter Rail services such as the Foxborough Pilot program. (MBTA, MassDOT Rail and Transit). • Implement Rail Safety Week activities each year (MassDOT, MBTA, Transit Police, Keolis).
Improve data collection and analysis capabilities	• Collaborate with local and railroad police departments, the MBTA, and the Federal Railroad Administration to improve data collection for at-grade crossing incidents involving fatalities and serious injuries (MassDOT Highway).
Improve communication and collaboration among those responsible for at-grade rail crossing safety	• Continue collaborating with entities responsible for at-grade crossing safety (MassDOT Rail and Transit, MBTA, and DPH).
Source: Massachusetts Strategic Highway Safety Plan. 2018. Appendix A. https://www.mass.gov/doc/massachusetts-shsp-2018/download	

2.2 Massachusetts Railway-Highway Crossing Program Administration

As provided by Title 23, United States Code, Section 130 (23 U.S.C. 130), the Section 130 Program provides federal funds to improve safety at existing public at-grade highway-railroad crossings. The purpose of the Section 130 Program is to reduce the number, severity, and potential of hazards to motorists, bicyclists, and pedestrians at highway-rail at-grade crossings.

The Section 130 program in Massachusetts is a cooperative effort between the Federal Highway Administration (FHWA), the Massachusetts Department of Transportation (MassDOT), railroad companies, and local municipalities. FHWA delegated the authority to manage this program to MassDOT.

This section summarizes information submitted as part of the programmatic description in State Highway Safety Improvement Program (HSIP) Section 130 annual reports.

2.2.1 Project Identification Process Overview

MassDOT identifies projects that could improve safety at existing public at-grade highway-railroad crossings through funding from the Section 130 program. Candidate crossing improvement projects are identified for potential funding from various sources, including input from railroads, input from municipal safety departments/officials, assessments of existing hazard potential, and planned or anticipated changes to the transportation network. Candidate grade crossing improvement projects may include those along privately-owned railroad lines in current operation or along publicly owned (MassDOT or MBTA) railroad corridors.

An annual listing of candidate projects is developed based on information provided to MassDOT by railroads, municipal officials, and MassDOT staff. In addition to the recommended candidate projects, crossings where significant changes to rail or highway traffic levels are being planned are also considered. The list is also augmented with an analysis of hazard indicators at public at-grade crossings

that are included in the FRA inventory, including past accidents and high accident predication value based on the U.S. Department of Transportation Accident Prediction Model.

Once the annual list of candidate projects is developed, an in-depth diagnostic field review, or condition survey, is conducted at each crossing. The result of the diagnostic review is assessed in combination with other factors, such as federal program requirements and project eligibility criteria to determine if there is a potential project improvement to be funded through the Section 130 program.

Due to the finite amount of funding, the final priority list is created based on a combination of priority ratings, project effectiveness, and regional equity. Priority ratings include a Sufficiency Rating that utilizes data collected during the diagnostic team review. The Sufficiency Rating utilized by MassDOT has been effectively used for the past seven years and is based on a modification of prioritization approaches undertaken by other states but calibrated for the highway, railroad and geographic conditions in Massachusetts. The Sufficiency Rating is a relational rating approach that establishes a numerical value for each crossing based on the following crossing attributes:

- Hazard Index (HI)
- Accident History
- Crossing Geometry (approach grades, crossing skew, sight distance)
- Traffic Attributes (school bus, passenger rail service, frequent hazardous material roadway traffic)
- Conditions of Elevated Risk (frequent false activations)

Each attribute is given a weighted score that is calibrated to conditions in Massachusetts. This calibration provides a range in sufficiency scores that differentiate among hazard conditions at the crossings in the state, considering the levels of train service, numbers of active and passive crossings, and the importance of approach conditions and train service types.

The HI utilized is a modification of the New Hampshire Hazard Index formula, which takes into account annual average daily traffic (AADT), daily train traffic, and existing warning devices (i.e., cross bucks, flashers and/or gates) quantified as a protection factor. The protection factors have been modified to provide relative hazard index scores that differentiate crossings given the limited number of passive public crossings across the state.

Use of the Sufficiency Rating approach was first initiated to account for several conditions present in Massachusetts that made other approaches less effective.

- The reliability of the data included in the FRA database did not allow for a complete statewide assessment of risk conditions. MassDOT did not have other reliable data sources for crossing conditions.
- Many of the crossings have similar attributes and cannot be differentiated on a risk basis without incorporating additional crossing attributes into the analysis.
- The desire to incorporate the potential severity of crossing accidents into the analysis.

MassDOT has developed an extensive project waiting list over the last several years. The recent focus of the program has been on advancing projects on the existing priority list instead of actively soliciting potential locations and performing diagnostic reviews.

Activities eligible for the use of Section 130 safety funds are as follows:

- Crossing consolidations (including the funding of incentive payments to local governments of up to $100,000).
- Installation of grade separations at crossings or repair of existing grade separations.
- Installation of pedestrian and vehicular gates.
- Regulatory signage (including the W10 series), yield and/or stop signs and crossbucks.
- Pavement markings including standard reflectorized advance warning and stop bars as needed.
- Installation/replacement of highway-railroad grade crossing signals.
- Upgraded highway-railroad grade crossing signals or circuits.
- Improved crossing surfaces.
- Traffic signal interconnection/preemption.
- Sight distance or geometric improvements.
- Data improvements (up to 8 percent of apportionment).

MassDOT develops a funding schedule and solicits plans and cost estimates for scheduled projects. Upon approval of the plans and estimates package by FHWA, MassDOT enters into construction force accounts with the operating railroad to construct the improvements and oversee the completion of the project.

2.3 Crossing Oversight Massachusetts Department of Public Utilities (MassDPU)

Historically, the Massachusetts Department of Public Utilities (MassDPU) had broad jurisdiction over railroads and grade crossings. (See G.L. c. 160 and G.L. c 161). However, much of MassDPU's authority has been preempted by federal regulation and many former responsibilities are now under the jurisdiction of the U.S. Department of Transportation or the Federal Railroad Administration. MassDPU has issued Orders acknowledging federal pre-emption on certain matters, and MassDPU has rescinded several of its own regulations in light of federal pre-emption.

MassDPU continues to exercise jurisdiction over certain discrete matters dealing with site-specific local practices. Permission for a railroad crossing at grade level with a public way requires the consent of the MassDPU. In addition, the MassDPU must consent to the construction or alteration of highway-rail grade crossings and construction of overpasses over railroad tracks. In reviewing proposed construction or alteration, MassDPU must determine whether a proposal is consistent with public safety. MassDPU may also exercise jurisdiction to specify the installation of warning devices, including crossing signals, audible and visual warning devices, signs, gates, and flashing lights, pursuant to G.L. c. 160, §§ 135-149. MassDPU also reviews petitions for exemptions from the vertical clearance requirements of G.L. c. 160, § 98.

MassDPU participates in Diagnostic Team Reviews to review plans or proposed changes at highway-rail grade crossings to ensure that site-specific features are addressed at crossings. The Diagnostic Team method has been adopted in the FHWA's Highway Safety Engineering Study Procedural Guide. This interdisciplinary approach allows for the Diagnostic Team's evaluation of the crossing and allows for a group consensus as to the improvements.

2.4 Operation Lifesaver

The Massachusetts Operation Lifesaver program supports three critical principles:

- **Education**: Operation Lifesaver strives to provide education to people of all ages about the hazards at highway-rail crossings. Methods used to reach the public include civic presentations, early elementary and driver education curriculum activities, school bus driver training, industrial safety, law enforcement training, and media coverage.
- **Enforcement**: Along with education, enforcement is necessary to provide rules and regulations to motorist and pedestrian as to the rights and responsibilities at highway-rail crossings.
- **Engineering**: Highway-rail crossings must be kept as physically and operationally as safe as possible, with improvements made where needed.

The public should be educated about federal, state, and railroad programs that plan, install and maintain grade crossings. Massachusetts Operation Lifesaver and its partners conduct public information campaigns and "Rail Safety Blitzes" in designated areas. Locations and dates are identified to meet increased train activity or areas of concern.

3 Stakeholder Engagement

3.1 Working Group

The Working Group convened experts to obtain their expertise and input on the Massachusetts Highway-Rail Grade Crossing Safety Action Plan.

The group provides a variety of perspectives on issues related to grade crossing safety. The working group comprises stakeholders representing federal agencies, state and local agencies, and railway users. The working group included representatives from:

- Federal Railroad Administration
- Federal Highway Administration
- MassDOT Rail & Transit Division
- MassDOT Highway Division
- Massachusetts Department of Public Utilities
- Massachusetts Bay Transportation Authority
- Massachusetts Operation Lifesaver

The Working Group met three times during the formation of the Plan. Working Group members provided insight to various components of the Action Plan, including:

- Data analysis
- Goals and objectives
- Safety strategies
- Recommendations

3.2 Stakeholder Involvement in State Action Plan Implementation

The Action Plan will be shared with the public electronically via the MassDOT website. The MassDOT Rail & Transit Division and Highway Division are responsible for the implementation of the Action Plan.

4 Data Analysis

4.1 Data Sources

To maintain consistency during analysis, data from FRA grade crossing collision reports[3] (FRA Form 6180.57) and the FRA National Grade Crossing Inventory database[4] was used. **All data in this section is derived from these sources.** Generally, the data analysis is limited to open public at-grade crossings within Massachusetts from the Grade Crossing Inventory database. There is limited confidence in the accuracy of data related to private at-grade crossings in Massachusetts; therefore, incorporating private crossing data into the analysis would raise questions about the accuracy of the results. However, the analyses focused on past incidents include all crossing types regardless of crossing ownership/control or if the crossing has been closed since the time of the incident.

The data for the FRA Grade Crossing Inventory is provided by the States and the railroads. According to FRA's guidance documentation, a railroad must update the Grade Crossing Inventory record for each open at-grade crossing at least once every three years; however certain changes require more frequent updates:

- New crossings must be reported to the Inventory within six months of becoming operational
- Closure or sale of a crossing must be reported to the Inventory within three months
- Change in crossing surface must be reported to the Inventory within three months
- Changes in warning devices must be reported to the Inventory within three months

The FRA grade crossing collision reports were used in this analysis for all collisions reported to FRA within Massachusetts over the 10-year period, beginning January 1, 2011, through December 31, 2020.

4.2 Existing Conditions

The Massachusetts railroad network is made up of approximately 1,000 miles of active track, which is operated on by 14 freight railroads, two passenger railroads, and four tourist railroads. The freight rail network originated or terminated 12.2 million tons of freight in over 328,000 carloads with numerous additional carloads traveling through the state.[5] The passenger rail network carried approximately 35.8 million passengers in 2019.

As of July 2021, there were 1,272 open public and private grade crossings within Massachusetts; approximately 59% are public and 41% are private crossings.[6] Massachusetts has a similar proportion of public versus private crossings as found nationally. **Table 2** summarizes crossings by control type in Massachusetts and the United States.

[3] FRA Office of Railway Safety, Highway-Rail Grade Crossing Accident Data: https://data.transportation.gov/Railroads/Highway-Rail-Grade-Crossing-Accident-Data/7wn6-i5b9

[4] FRA Office of Safety Analysis, State Highway-Rail Crossing Database Files and Reports: https://railroads.dot.gov/crossing-and-inventory-data/grade-crossing-inventory/highwayrail-crossing-database-files

[5] Association of American Railroads (AAR). Freight Railroads in Massachusetts Fact Sheet 2019. January 2021. https://www.aar.org/wp-content/uploads/2021/02/AAR-Massachusetts-State-Fact-Sheet.pdf

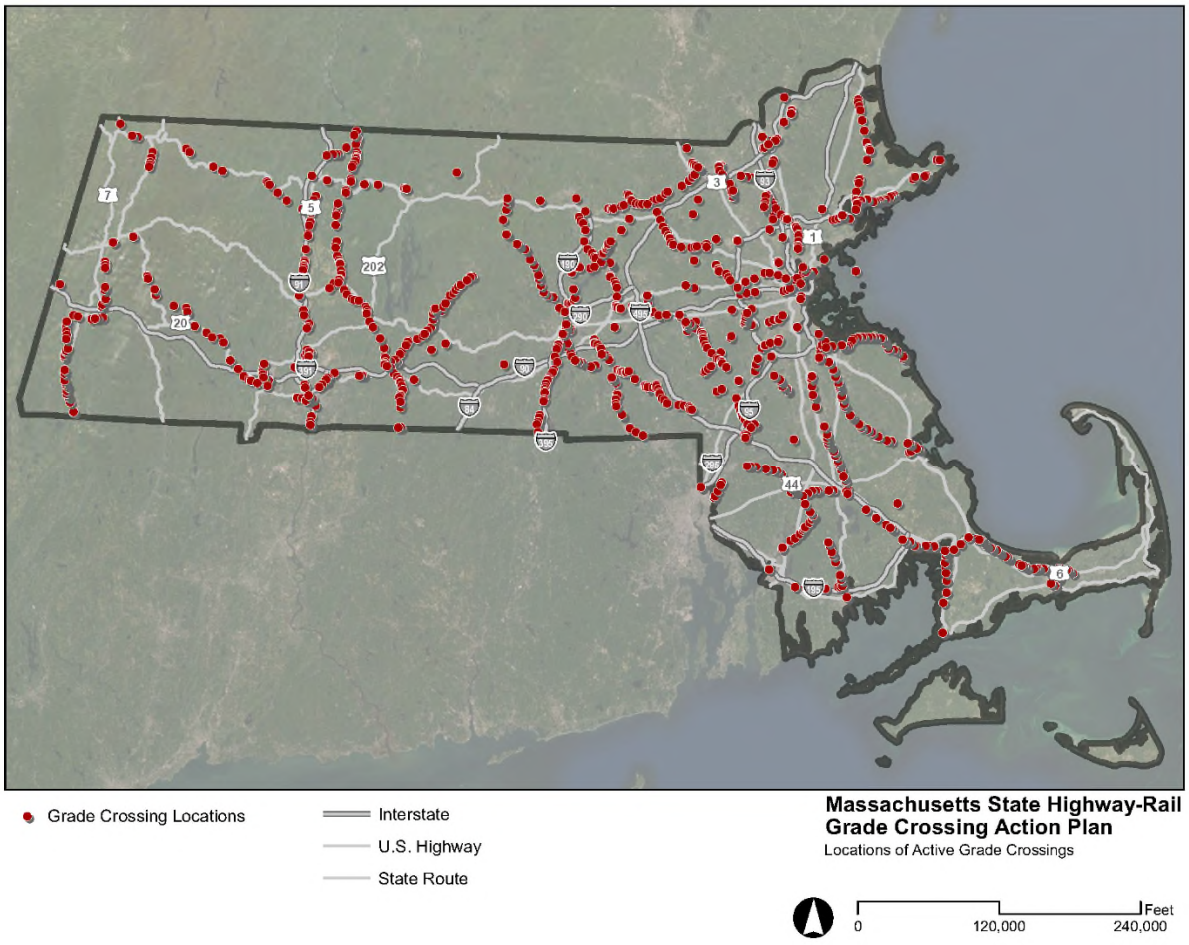
[6] 49 CFR § 234.401 - Definitions. *Private crossing* means a highway-rail or pathway crossing that is not a public crossing. *Public crossing* means a highway-rail or pathway crossing where the approaches are under the jurisdiction of and maintained by a public authority and open to public travel. All approaches must be under the jurisdiction of the public authority and no approach may be on private property, unless State law or regulation provides otherwise.

Table 2. Massachusetts and U.S. Number of Crossings by Control Type

	Public	Private	Total
Massachusetts Count	746	524	1,272
Massachusetts Percentage	59%	41%	100%
U.S. Count	129,500	79,500	209,000
U.S. Percentage	62%	38%	100%

Figure 3 shows the location of grade crossings in Massachusetts.

Figure 3. Location of Massachusetts Grade Crossings



Massachusetts has focused on reducing the number of passive crossings over the past decade. As summarized in

Table 3, as of 2021, only 18% of public crossings are passive and do not include any form of active warning device. FRA reports that nationally 45% of all crossings are passive.

Table 3. Massachusetts Public Crossing by Protection

	Passive	Flashing Lights	Two Quadrant Gates	Four Quadrant Gates
Count	135	205	398	5
Percentage	18%	27%	53%	1%

4.3 Highway-Rail Grade Crossings with at least 1 Incident within the Last 3 Years (2018-2020)

As part of the Action Plan, FRA requires states to identify crossings where: 1) At least one incident has occurred within the last three years. According to the FRA grade crossing collision reports, a total of 31 grade crossings have reported one incident within the last three years (January 1, 2018 – December 31, 2020) and are listed within **Table 4**. Out of these 31 grade crossings, only one had experienced greater than one incident. **Figure 4** shows the locations of grade crossings that have experienced incidents within the past 3, 5, and 10 years.

Table 4. Crossings that Experienced at Least One Incident in Last Three Years, 2018-2020

No.	Grade Crossing Identification	Roadway Name	City	Number of Incidents
1	053026Y	Andover Street	Lawrence	2
2	536876A	West Yarmouth Road	Yarmouth	1
3	546731R	Pine Street	Canton	1
4	537278P	Newman Avenue	Seekonk	1
5	052338D	Wayland Road	Lincoln	1
6	052334B	Viles Street	Weston	1
7	052363L	Foster Street	Littleton	1
8	536892J	South Street	Randolph	1
9	052381J	Main Street	Shirley	1
10	546678G	Pond Street	Weymouth	1
11	052673F	Route 5	Northampton	1
12	547119K	Main Street	Southborough	1
13	967752W	Private	Walpole	1
14	052315W	Brighton Street	Belmont	2

No.	Grade Crossing Identification	Roadway Name	City	Number of Incidents
15	536713R	Hyannis-Barnstable Road	Barnstable	1
16	053848K	W Third Street	Chelsea	1
17	536887M	Plain Street	Braintree	1
18	053906D	W Thissell Street	Beverly	1
19	536917C	East Street	Bridgewater	1
20	053933A	Cedar Street	Gloucester	1
21	546637C	Route 18	Bridgewater	1
22	053938J	Poole's Lane	Rockport	1
23	546686Y	Birch Street	Abington	1
24	054151P	Cabot Street	Beverly	1
25	546736A	Porter Street	Stoughton	1
26	247431C	Route 32	Monson	1
27	926105Y	Beverly Depot Station (Pedestrian Crossing)	Beverly	1
28	501902N	Broadway	Cambridge	1
29	970901Y	Concord Station (Pedestrian Crossing)	Concord	1
30	525877B	Memorial Drive	Springfield	1
31	525878H	Robbins Road	Springfield	1

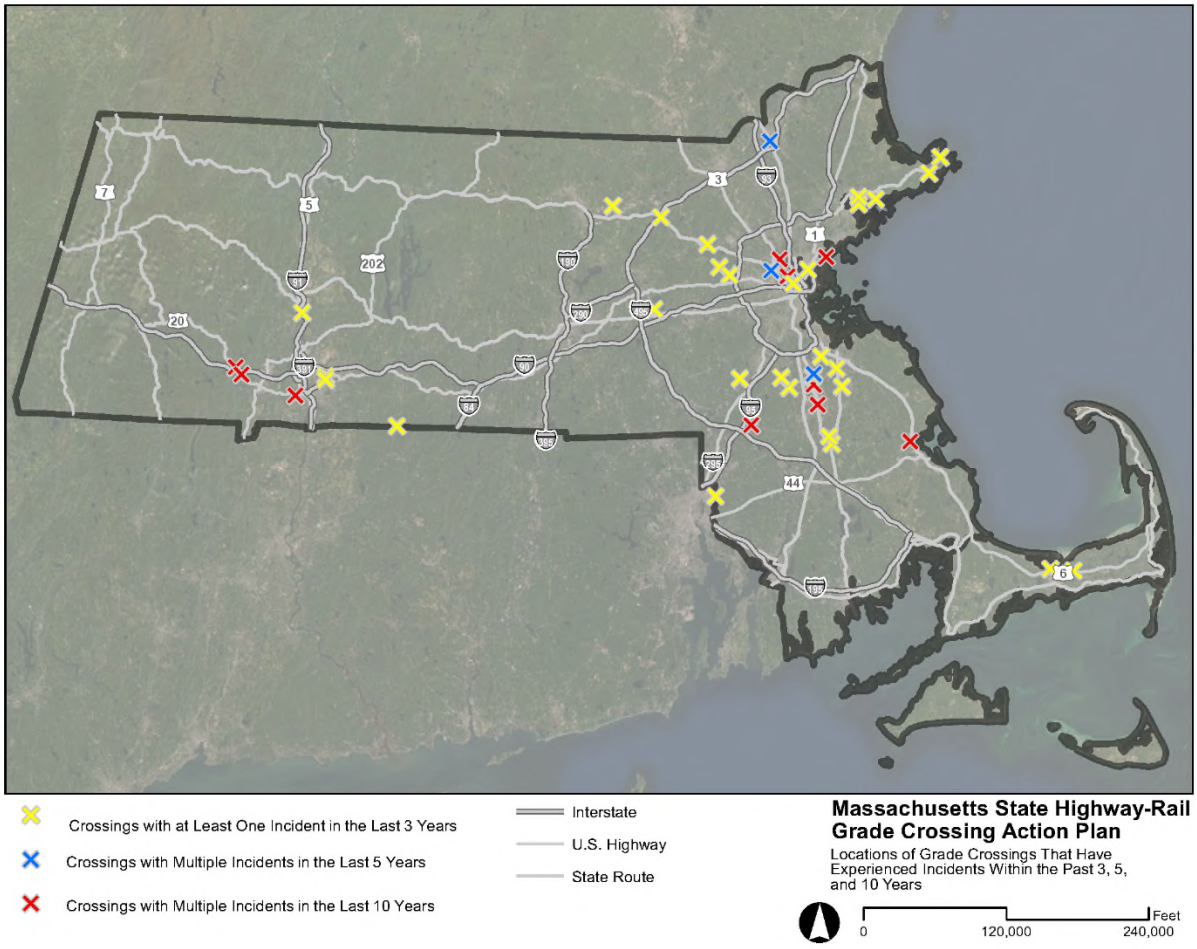


Figure 4. Locations of Grade Crossings that have Experiences Incidents within the past 3, 5, and 10 Years

4.4 Highway-Rail Grade Crossings with Multiple Incidents within the Last 5 Years (2016-2020)

As part of the Action Plan, FRA requires states to identify crossings where multiple (greater than one) incidents have occurred within the last 5 years. Within the past five years (January 1, 2016 – December 31, 2020), three grade crossings have reported greater than one incident. These grade crossings have each experienced two incidents during this time frame. **Table 5** summarizes information related to these three crossings. **Figure 4** shows the locations of grade crossings that have experienced incidents within the past 3, 5, and 10 years.

Table 5. Summary of Crossings with Multiple Incidents in Last 5 Years, 2016-2020

Crossing Location	Brighton Street, Belmont	Andover Street, Lawrence	Route 139, Holbrook
Crossing Identification	052315W	053026Y	536891C
Total Trains per Day	32	68	26
Incidents with Motor Vehicles	2	2	1
Incidents with Pedestrians/Other	0	0	1
Total Number of Railroad Tracks Through Crossing	2	5	1
Total Number of Roadway Lanes Through Crossing	2	2	3
Type of Warning Device at Crossing	o Gates o Cantilever FLS o Crossbucks o Pavement markings	o Gates o Standard FLS o Crossbucks	o Gates o Cantilever FLS o Crossbucks o Pavement markings
Summary of Incident	Incident #1: Vehicle stuck on crossing Incident #2: Vehicle stuck on crossing	Incident #1: Vehicle went around gate Incident #2: Vehicle stuck on crossing	Incident #1: Vehicle moving across crossing and struck by train Incident #2: Trespasser struck by train

4.5 Evaluation of "High Risk" Crossings

The following sections evaluate the factors identified by FRA that each state should consider when determining which crossings would be considered "High-Risk." The factors that FRA required that each state consider include:

- Average annual daily traffic (AADT)
- Total number of trains per day that travel through each crossing
- Total number of motor vehicle collisions at each crossing during the previous five-year period
- Number of main tracks at each crossing
- Number of roadway lanes at each crossing
- Sight distance (stopping, corner and clearing) at each crossing
- Roadway geometry (vertical and horizontal) at each crossing
- Maximum timetable speed

Each of the following sections includes an evaluation of how influential each factor has appeared to contribute to an incident occurring at a particular location with Massachusetts during the past ten years. Only a few of the identified factors appear to correlate with a higher level of crossing incidents in the Commonwealth of Massachusetts during the past 10 years.

4.5.1 Average Annual Daily Traffic (AADT)

Incident rates for public grade crossings over a 10-year period (2011-2020) were calculated for ranges of AADT in **Table 6**. The total incidents include both private and public crossings, whereas the total crossings only include public crossings. Additionally, 29 crossings were not included within the dataset due to having reported AADTs below of the ranges where incidents occurred.

As shown in **Table 6**, almost 80% of grade crossings are located at roadways with a reported AADT between 100 and 10,000 vehicles. However, only about 60% of incidents were located at those crossings. Crossing locations with average daily highway volumes over 10,000 were more likely to experience an incident, although the incident rate did not continue to increase as traffic levels increased. The highest rate of incidents occurred at crossings with AADT between 35,000 and 40,000. Based on this data, AADT rate appears to be a factor in identifying high-risk crossings in Massachusetts.

Table 6. Incident Rate by AADT for Public Grade Crossings, 2011-2020

AADT Range	Total Incidents	Total Crossings	Incident Rate
N/A[1]	1	20	3%
100 – 5000	32	436	7%
5000 – 10000	9	133	7%
10000 – 15000	14	56	25%
15000 – 20000	9	41	22%
20000 – 25000	5	18	28%
25000 – 30000	1	10	10%
30000 – 35000	0	1	0%
35000 – 40000	1	2	50%

Notes:
1. Crossings in this row had a reported AADT of 0 or blanks in incident reports and crossing inventory.

4.5.2 Total Number of Trains per Day that Travel Through Each Crossing

Incident rates for public grade crossings over a ten-year period (2011-2020) were calculated based on the average volume of trains per day, as shown in **Table 7**. The table includes incident data comprised of both private and public crossings, whereas the total crossings only include public crossings. Additionally, a total of 132 crossings within the grade crossing inventory did not report any train volumes.

As identified from the data included in **Table 7**, almost 63% of grade crossings are located on lines with a volume of fewer than 10 trains per day. However, only about 7% of incidents were located at those crossings. The crossing locations with higher daily train volumes were more likely to experience an incident; the incident rate did not continue to increase as daily train volume increased. The highest rate of incident occurred at crossings with the highest volume of trains, but the rate of accident frequency did not appear to correlate directly as daily train volumes increased if the volume was over 10 trains per day. Based on this data, the total number of trains per day appears to be a factor in the identification of high-risk crossings in Massachusetts.

Table 7. Incident Rate by Trains per Day for Public Grade Crossings, 2011-2020

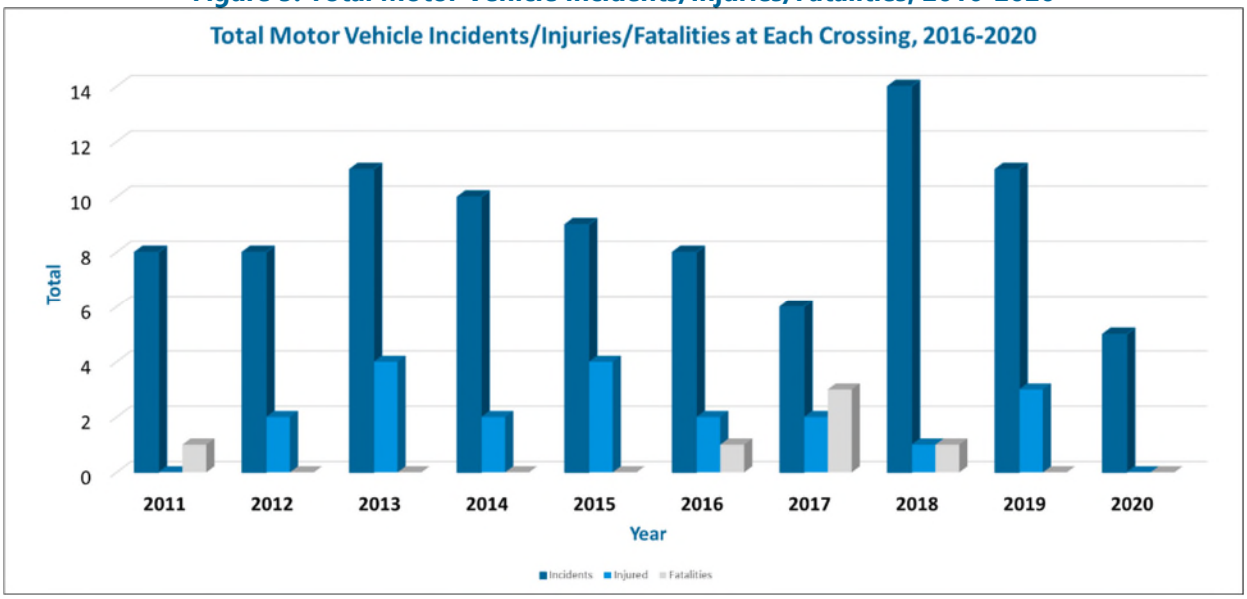
Average Trains per Day	Total Incidents	Total Crossings	Incident Rate
1-10	28	388	7%
11-20	5	14	36%
21-30	38	120	32%
31-40	14	59	24%
41-50	5	13	38%
51-68	14	20	70%

4.5.3 Total Number of Motor Vehicle Collisions at Each Crossing During the Previous 5-Year Period

Incidents involving a motor vehicle were analyzed using incident data over a five-year period (January 1, 2016, through December 31, 2020). The data includes both private and public crossings. During this period, a total of 44 incidents involved a motor vehicle at the time of collision. The incidents occurred at 42 crossings, with two of the crossings experiencing two incidents each. Since there are so few incidents reported in Massachusetts, data over a 10-year period was analyzed (2011-2020) to determine if trends exist or if locations where past accidents occurred are specifically indicative of a high-risk location. As shown in **Figure 5**, total incidents involving motor vehicles have ranged between five and 14 per year, and the highest number occurred in 2018.

Injuries from these incidents range between zero and four per year, and fatalities range between zero and three per year. There have not been any specific trends over the past decade regarding motor vehicle incidents. The frequency of grade crossing accidents across Massachusetts in any individual year, or even over a five-year period, is relatively limited. Incidents at particular locations are randomized, also making it difficult to identify trends resulting from any particular two- or three-year period.

Figure 5. Total Motor Vehicle Incidents/Injuries/Fatalities, 2016-2020



In addition, since the number of crossing locations in Massachusetts that have had more than one incident has been limited to three within the past five years, the occurrence of a recent previous incident does not appear to be predictive of a future incident.

4.5.4 Number of Railroad Tracks Through Crossing

To determine the risk associated with the number of railroad tracks through a given crossing, incident and grade crossing inventory data for public crossings from January 1, 2011, through December 31, 2020, was analyzed. The total number of tracks at a crossing was compared to the total number of incidents reported at the crossing during the 10-year timeframe. This data is summarized in **Table 8**. A total of 70% of crossings within Massachusetts have a single track through the crossing, which is also where most incidents occurred during the period. However, when comparing the total number of incidents with the total crossings based on the number of through-traffics, the highest rate of incident occurs at crossings where there are two or three tracks through the crossing. There was a single incident with a reported number of zero tracks that occurred at a private yard crossing. It is also worth noting that within Massachusetts, most of the crossings that have two or three tracks at the crossing are also locations with high volumes of daily train traffic. The number of tracks could contribute to the identification of a high-risk crossing in Massachusetts.

Table 8. Summary of Number of Tracks Through Crossing, 2011-2020

Number of Tracks	Total Crossings that Experienced Incidents	Total Crossings in Massachusetts	Rate of Incidents
1	38	547	7%
2	30	157	19%
3	3	22	14%
> 3	1	19	5%

4.5.5 Number of Roadway Lanes Through Crossing

The total number of roadway lanes intersecting each crossing were reviewed to determine if trends exist for incidents in Massachusetts; data is summarized in **Table 9**. This data includes only active and public grade crossings and incidents from January 1, 2011, through December 31, 2020. The number of roadway lanes was not reported at three grade crossings. **Table 9** shows that most crossings in Massachusetts have either one or two lanes of traffic through them. However, when comparing incidents with the total number of crossings, the highest rate of incidents occurs at crossings with three or more lanes of traffic through them. Therefore it is assumed that at crossings with a greater number of roadway lanes there is a higher potential for an incident to occur. However, in Massachusetts, the existence of more than two lanes at a crossing is highly correlated with high annual average daily traffic volumes. Therefore it is more appropriate to focus on the correlation between average daily traffic volume and incidents and not the existence of a 3rd or 4th lane at a crossing.

Table 9. Summary of Number of Roadway Lanes Through Crossing, 2011-2020

Number of Lanes	Total Crossings that Experienced Incidents	Total Crossings in Massachusetts	Rate of Incidents
1	2	25	8%
2	55	666	8%
3	4	15	27%
>3	11	37	30%

4.5.6 Sight Distance and Roadway Geometry at Crossing

Sight distance limitations are a significant concern at passive crossings where drivers (or pedestrians/bicyclists) must rely on visual cues, in combination with auditory cues, to determine the existence of an on-coming train. Whereas at active crossings, the sight distance that drivers must maintain is between the travel lane and the active warning device. One of the primary design considerations in the development of an active warning system is the sight distance for approaching drivers to the flashing lights. Due to the intentional design, there are few active crossings where sight distances and roadway geometry are a substantial concern. Any existing active crossing with sight distance and roadway geometry concerns would require a detailed diagnostic team review to clearly identify the shortcomings of the existing system and the risk associated with the existing design.

As noted previously, Massachusetts has made a concerted effort over the past decade to install active warning devices at formerly passive crossings. As a result, only 18% of public crossings in the state are passive. With such a small percentage of passive crossings, most of which have limited traffic, sight distance, and roadway geometry concerns do not contribute to the identification of a high-risk crossing in Massachusetts. Although, MassDOT would facilitate a diagnostic team review to assist in identifying any safety concerns at a crossing should a deficiency be identified.

4.5.7 Maximum Timetable Speed at the Crossing

Maximum timetable speeds and train speeds reported at the time of an incident were analyzed, including incident and grade crossing inventory data for public grade crossings in Massachusetts. **Table 10** summarizes train timetable speeds for incidents between 2011 and 2020. Timetable speeds assigned for each crossing were analyzed to determine if a higher timetable speed resulted in more incidents. Most incidents occurred at crossings with timetable speeds of greater than 30 miles per hour. However**,** when considering the actual train speed at the time of the incident, the data in **Table 11** shows that in 86% of incidents, trains were operating below the maximum timetable speed. Most incidents occurred while trains were operating under 30 miles per hour and may be a result of other factors, such as trains approaching or departing a station, speed limits through specific areas, or changes in track geometry or operations. Maximum timetable speed does not appear to be a contributing factor in the occurrence of incidents at crossings in Massachusetts and therefore is not a factor included in identifying high-risk crossings in Massachusetts.

Table 10. Summary of Incident Rates Based on Timetable Speeds, 2011-2020

Speed Range (miles per hour)	Crossings with Incidents	Total Crossings in MA	Rate of Incidents
0-5	1	133	1%
6-10	13	335	4%
11-15	4	28	14%
16-20	1	39	3%
21-25	2	158	1%
26-30	8	147	5%
31-35	2	11	18%
36-40	11	109	10%
41-45	1	15	7%
46-50	3	23	13%
51-55	0	17	0%
56-60	13	100	13%
61-65	5	29	17%
66-70	19	91	21%
71-75	0	2	0%
76-80	4	32	13%

Table 11. Summary of Incident Rates Based on Train Operating Speed, 2011-2020

Speed Range (miles per hour)	Number of Incidents	Percent of Total Incidents
0-5	9	8%
6-10	15	14%
11-15	5	5%
16-20	1	1%
21-25	16	15%
26-30	9	8%
31-35	9	8%
36-40	12	11%
41-45	2	2%
46-50	2	2%
51-55	9	8%
56-60	11	10%
61-65	1	1%
66-70	4	4%
71-75	1	1%
76-80	0	0%

4.6 Accident/Incident Data

MassDOT examined the conditions related to the incidents from the past 10-year period to determine if any additional factors should be considered in the identification of high-risk crossings. MassDOT reviewed these as a supplement to the factors required by FRA to be considered in the identification of high-risk crossings.

4.6.1 Incident Data for 10-Year Period (2011-2020)

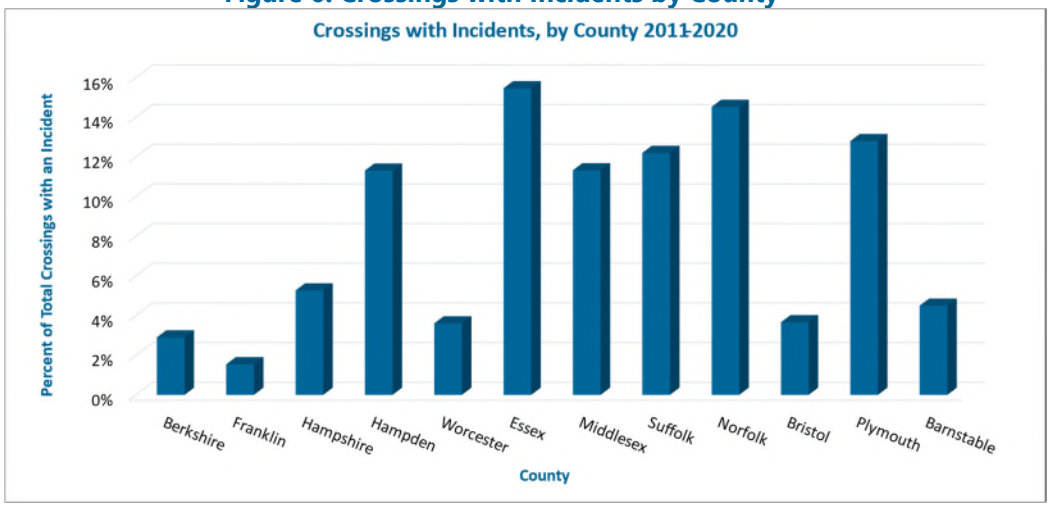
Table 12 summarizes the total incidents, injuries, and fatalities for each year over the 10-year period from 2011 to 2020. Within the period, a total of 109 incidents occurred at grade crossings within Massachusetts. Of those incidents, 33 resulted in an injury and 19 resulted in a fatality. Motor vehicles were involved in 90 (83%) of the incidents, while 19 incidents (17%) involved pedestrians and cyclists. For reference, **Figure 4** shows the locations of grade crossings that have experienced incidents within the past three, five, and 10 years

Table 12. Summary of Incidents/Injuries/Fatalities, 2011-2020

Year	Total Incidents	Total Injuries	Total Fatalities
2011	8	0	1
2012	8	2	0
2013	16	6	3
2014	13	4	1
2015	12	6	2
2016	10	2	3
2017	10	3	6
2018	14	3	1
2019	13	7	2
2020	5	0	0
Total	**109**	**33**	**19**

Figure 6 shows the percentage of crossings experiencing incidents by county. The counties are generally presented by geographic location within the state from west to east. For this analysis, the total number of incidents for each county was divided by the total number of grade crossings within the specific county to determine the percentage of crossings that experienced incidents over the 10-year period. The analysis concluded that Essex County experienced the highest percentage of incidents at its grade crossings (15.5%), followed by Norfolk (14.5%), and Plymouth Counties (12.8%). This is consistent with the typical crossing exposure index at the crossings in those counties, where the exposure index is the cross product of the AADT and the daily train volume.

Figure 6. Crossings with Incidents by County



Another significant factor when reviewing grade crossing incidents is determining what warning device was implemented at the crossing at the time of the incident. Incidents at crossings were separated by primary warning device based on information reported in the incident's FRA incident report. The total number of incidents associated with each primary warning device was then divided by the total number of public crossings with that specific warning device to determine the rate at which crossings experience incidents. Over the 10-year period, 65 incidents occurred at crossings equipped with gates, accounting for 60% of all incidents. The grade crossing inventory identified that a total of 400 Massachusetts public grade crossings have gates, making gates the most common warning device in the state. When considering the rate of incidents, as shown in **Figure 7**, even though only 10 crossings are reported to be equipped with stop signs, five of those crossings have experienced at least one incident within the last 10 years, which equates to an incident rate of 50 percent (50%). The second highest rate of incidents occurred at crossings with no safety device installed, which accounted for fourteen percent (14%) of grade crossings incidents over the 10-year period. This data supports MassDOT's continued focus on improvements at passive crossings and should be considered in the identification of high-risk crossings in Massachusetts.

Figure 7. Incidents by Primary Warning Device

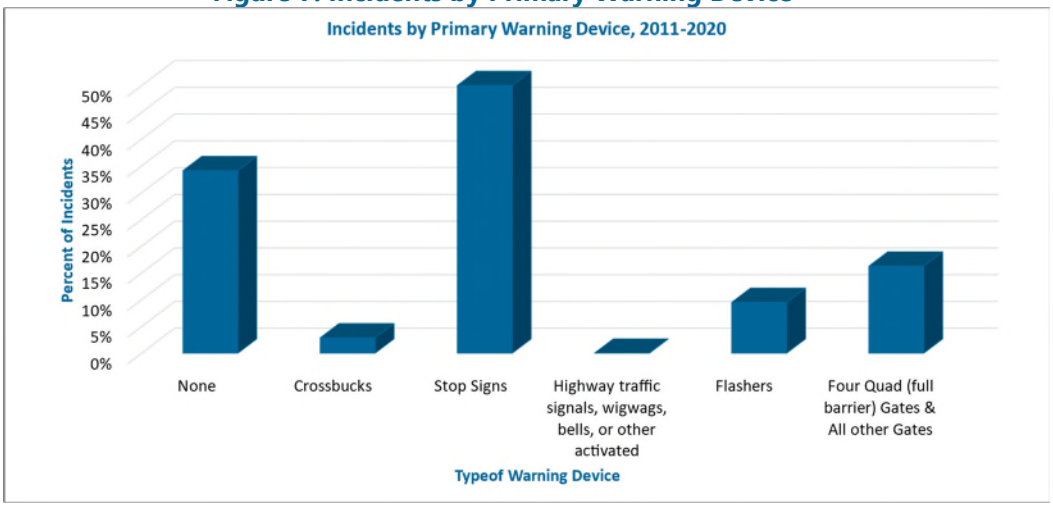
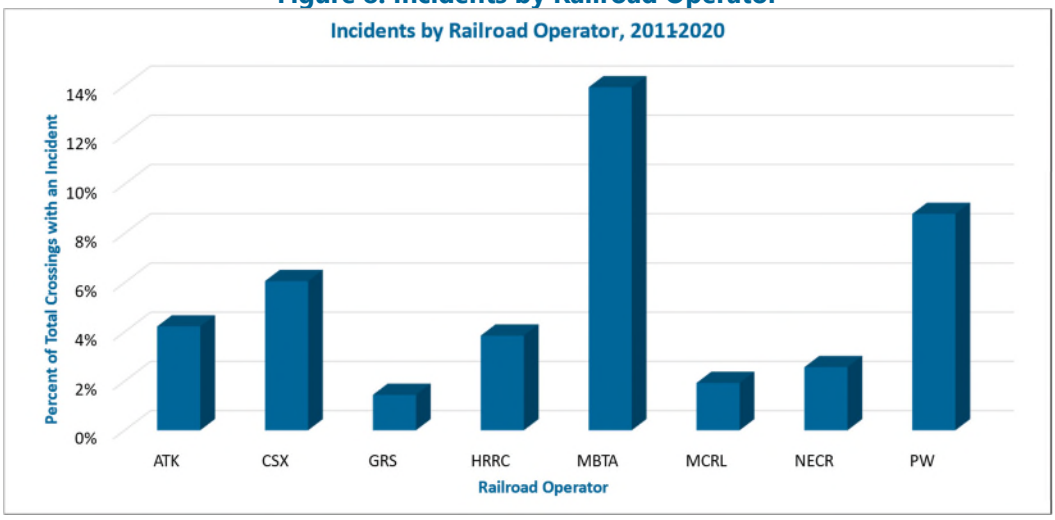


Figure 8 summarizes the percentage of incidents at public grade crossings by railroad operator between 2011 and 2020. Using the FRA incident reports, the operating railroad at the time of the incident was identified to determine the total number of incidents that each railroad was involved with over the 10-year period. This total was then divided by the total crossings each railroad operates at to determine the percent of crossings each railroad operator had incidents at. Of all the railroad operators within Massachusetts, the Massachusetts Bay Transportation Authority (MBTA) operates both the greatest number of train and at the greatest number of grade crossings. MBTA also experiences the highest rate of incidents at its crossings (14%). Providence and Worcester Railroad (PW) experienced incidents at 9% of its crossings, followed by CSX, which experienced incidents at 6% of its crossings between 2011 and 2020.

Figure 8. Incidents by Railroad Operator

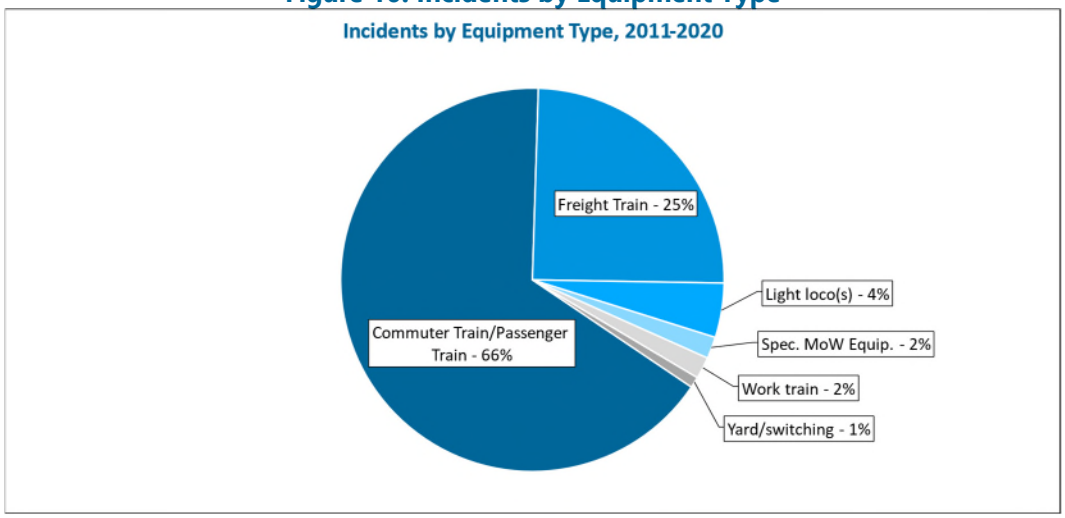


Incidents that occurred at public crossings within Massachusetts were also analyzed based on reported roadway classification, as summarized in '**Figure 9**. Of the grade crossings with a roadway classification reported, most are located along local roadways (54%). However, grade crossings located along Minor Arterials experienced the highest rate of incidents between 2011 and 2020 (25%), followed by Minor Collectors (20%).

Figure 9. Incidents by Roadway Classification

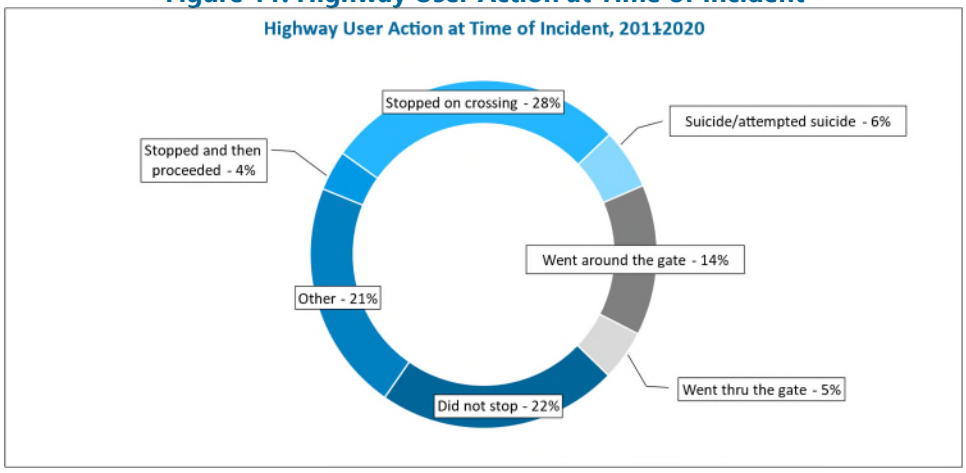
Figure 10 presents all incident data between 2011 and 2020 by reported railroad equipment type. Of the 109 incidents, commuter and passenger trains were involved in 72, accounting for 66% of the total incidents. Freight trains were also involved in a high percentage of incidents, accounting for a total of 27 incidents (25%) over the 10-year period. According to incident report data, train equipment was documented to be traveling less than 25 miles per hour for 46 of the 109 reported incidents (43%).

Figure 10. Incidents by Equipment Type



To help identify potential causes of incidents at grade crossings in Massachusetts, incident data was investigated and analyzed by the highway user's action at the time of the incident, refer to **Figure 11**. A highway user includes individuals operating a motor vehicle, a pedestrian, or a cyclist. The greatest reported action at the time of the incident was the highway user stopping on the crossing (28%), followed by the highway user not stopping at the crossing (22%). "Other" was also a highly reported action (21%), which includes unique situations that do not fit into the other categories.

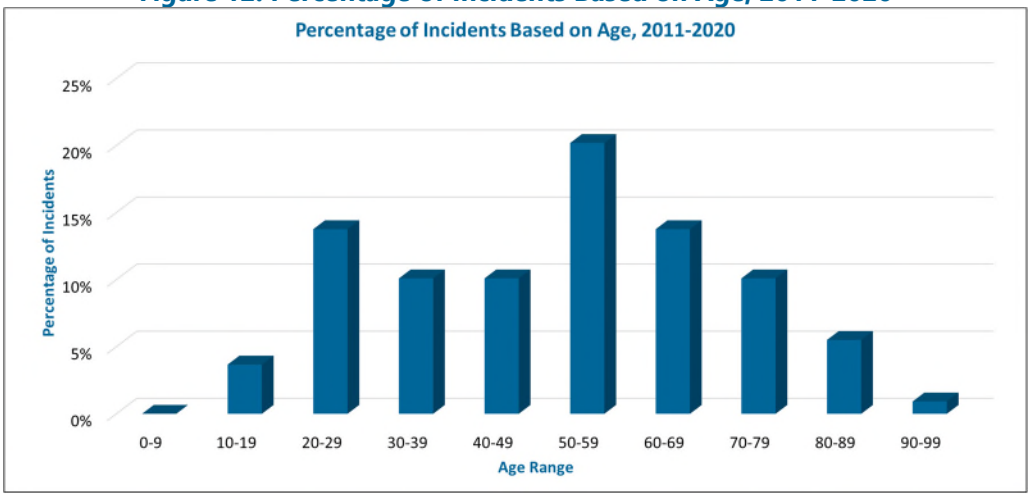
Figure 11. Highway User Action at Time of Incident



The reported age of the highway user at the time of an incident was also investigated using incident data from 2011 through 2020. Out of the 109 total incidents reported during this period, 96 included the highway users' age in the incident report. Therefore, the 13 incidents with missing age information were not included in this analysis.

As seen in **Figure 12**, out of the 96 incidents, highway users over the age of 50 accounted for 55 of the 109 total reported incidents or 57% of incidents. The greatest number of incidents occurred within the 50–59-year-old age range during this period, equaling to 22 incidents. The total number of incidents with a reported highway user age between 20-29 years old is also notable and accounts for 12 incidents between 2011 and 2020.

Figure 12. Percentage of Incidents Based on Age, 2011-2020



To further investigate a potential cause of incidents, additional analysis of the incident data related to highway user action was completed. Narratives of each incident were individually reviewed and categorized by type of incident; this information is summarized in **Table 13**. Most incidents involved individuals operating motor vehicles and were related to driver inattention or behavior (37%), such as not stopping at a crossing or going around gates, followed by crossing area incursions (28%), which includes vehicles stopping on tracks and vehicles fouling the tracks while stopped at the crossing. However, 66% of these incidents did not result in an injury or fatality. Although pedestrian/cyclist incidents only make up 17% of the total incidents, data revealed that the highest rate of injuries and fatalities occurred during these incidents (79%). For comparison, incidents that involved motor vehicles resulted in an injury or fatality 36% of the time.

Table 13. Summary of Incidents, Categorized by Cause, 2011-2020

Type of Incident		Total Incidents	Total Uninjured	Total Injured	Total Fatalities
Pedestrian/Cyclist Stopped in Crossing	Pedestrian in crossing	12	2	4	6
	Cyclist in crossing	2	0	0	2
	Pedestrian in crossing. Rain.	2	1	0	1
	Total	**16**	**3**	**4**	**9**
Pedestrian/Cyclist Went Around Gate	Cyclist went around gate	1	1	0	0
	Pedestrian went around gate	2	0	1	1
	Total	**3**	**1**	**1**	**1**
Vehicle Drove Down Tracks	Driver drove down tracks and got stuck	4	3	1	0
	Driver drove down tracks and got stuck. Fog.	1	1	0	0
	Driver drove down tracks and got stuck. Rain.	2	2	0	0
	Total	**7**	**6**	**1**	**0**
Crossing Area Incursion	Vehicle in crossing, stopped on crossing. Vehicle fouling the tracks	6	3	2	1
	Vehicle in crossing, stopped on crossing. Stuck between gates.	1	1	0	0
	Vehicle in crossing, stopped on crossing	20	15	5	0
	Vehicle in crossing, stopped on crossing. Unable to clear crossing due to vehicle in front of them	2	2	0	0
	Vehicle in crossing, stopped on crossing. Vehicle was rear ended and pushed into crossing.	1	1	0	0
	Total	**30**	**22**	**7**	**1**
Driver Inattention/Action	Vehicle in crossing. Vehicle stopped at crossing, then went into crossing.	6	5	1	0
	Vehicle in crossing, did not stop	21	15	3	3
	Vehicle in crossing, stopped on crossing. Suicide Attempt	1	0	1	0
	Vehicle in crossing, stopped on crossing. DUI	2	0	2	0
	Vehicle went around gates	10	3	6	1
	Total	**40**	**23**	**13**	**4**
Weather Related	Vehicle in crossing, did not stop. Vehicle slid into crossing. Snow.	4	3	0	1
	Vehicle in crossing, did not stop. Rain.	1	1	1	0
	Vehicle in crossing, stopped on crossing. Snow.	8	4	3	1
	Total	**13**	**8**	**4**	**2**
TOTAL		**109**	**63**	**30**	**17**

5 Risk Assessment

Incidents and fatalities associated with grade crossings have remained limited over the past several decades in Massachusetts. However, until there are zero incidents, there is always room for improvement to reduce risk. The following sections summarize the results of the data analysis included in Section 4 and highlight the state-level safety challenges and considerations that will be made in establishing the strategic actions.

5.1 High-Risk Crossings

Based on the data analyzed, there are several factors to consider when identifying high-risk crossings. They include:

- Average annual daily traffic
- Total number of trains per day that travel through each crossing
- Number of main tracks at each crossing
- Number of roadway lanes at each crossing
- Crossing primary warning device

Considering that the number of main tracks and the number of roadway lanes at each crossing is already reflected in the average annual daily traffic and the total number of trains per day, MassDOT concluded that the focus should be on the first two factors, as well as the crossing primary warning device.

Several states (including Massachusetts) already use prioritization formulas that focus on these three attributes, called a Hazard Index (HI). In Massachusetts, existing use of the HI in project prioritization provides a method to evaluate projects already identified as candidate projects, but it is not used in the evaluation of crossings statewide.

An analysis calculating the HI was performed to determine potential trends in incident data during the ten-year period from 2011 to 2020. The HI was calculated by multiplying the AADT, daily train volume, and warning device. Warning devices were weighted and given a protection factor value (stop signs and crossbucks = 1.0; flashing lights = 0.33; gates = 0.13).

Table 14 summarizes incident rates based on the calculated HI. The table identifies the incident rate at crossings in Massachusetts with a range of HI values. As the data shows, the HI provides a good indication of the incident rate, where increasing incident rates occurred at crossings that are within the higher HI ranges.

Table 14. Incident Rate by Hazard Index for Public Grade Crossings, 2011-2020

Hazard Index Range	Total Incidents	Total Crossings	Incident Rate
N/A	0	148	0%
1-5,000	17	324	5.25%
5,000-10,000	10	80	12.50%
10,000-40,000	23	133	17.29%
40,000-80,000	13	46	28.26%
80,000-120,000	3	8	37.50%
120,000-220,000	5	7	71.43%

Using the HI as the designation of high-risk crossings in the Commonwealth of Massachusetts, there are 15 crossings that have an HI above 80,000. These crossings have been identified as the high-risk crossings in Massachusetts. **Table 15** lists the crossings in Massachusetts with the highest calculated HI.

Table 15. Massachusetts Crossings with Highest Calculated Hazard Index (HI)

Crossing Number	Location	Roadway	Hazard Index (HI)
501736Y	FRAMINGHAM	Concord Street	218,400
053849S	CHELSEA	Everett Avenue	169,624
054041E	MEDFORD	High Street	158,600
053049F	NORTH ANDOVER	Sutton Street	143,468
052326J	WALTHAM	Moody Street	124,800
053855V	CHELSEA	Eastern Avenue	124,488
053026Y	LAWRENCE	Andover Street	123,760
053847D	EVERETT	Second Street	108,086
536871R	BARNSTABLE	Iyannough Road	106,920
054310U	MELROSE	West Wyoming Avenue	106,080
053900M	BEVERLY	Cabot Street	100,464
546736A	STOUGHTON	Porter Street	99,792
536891C	HOLBROOK	Union Street	92,950
053850L	CHELSEA	Spruce Street	88,088
053014E	ANDOVER	Essex Street	86,690
501736Y	FRAMINGHAM	Concord Street	218,400
053849S	CHELSEA	Everett Avenue	169,624
054041E	MEDFORD	High Street	158,600

5.2 Crossings and corridors challenges

The Massachusetts rail system is made up of a dense network of very active rail lines located in Eastern Massachusetts that host primarily passenger rail but also include some freight services, while in Central and Western Massachusetts, the network is dominated by low-density freight lines. The most active freight lines, the CSX Boston to Albany Line and the Pan Am Mainline, which both traverse the Commonwealth from East to West, have fewer at-grade crossings per mile than most other rail lines in the state. Most grade crossings outside of the MBTA commuter rail district are on rail lines that have relatively fewer daily trains and less highway traffic than those in metropolitan Boston and therefore pose less risk.

However, risk at less frequently used crossings is not zero and therefore it is important to also consider conditions on less frequently used lines. Historically, rail lines beyond the metropolitan Boston region have experienced less investment and less frequent maintenance. Over the past decade, a concerted effort was made in Massachusetts to improve equity in the level of grade crossing safety systems regardless of whether the crossing was in a rural area or in a more urban location. Considerable progress has been made in improving safety systems, as evidenced by the fact that only 18% of public crossings in the Commonwealth are passively protected. Most of the remaining passive crossings are on exceptionally low volume local roadways.

5.3 State-level safety challenges/ considerations

Based on the data analysis and risk assessment, the following are the highest-priority highway-railway crossing safety challenges facing the Commonwealth.

- Improve/maintain safety at the most highly-used crossings – As identified in the data analysis, Crossings with the highest exposure (daily trains x average daily traffic) are those that are experiencing the highest rate of incident.
- Minimize pedestrian risk at crossings – As identified in the data analysis, the preponderance of fatalities was in incidents with pedestrians.
- Reduce incidents that involve grade crossing area incursions – A high percentage of incidents occurred when vehicles were within the dynamic envelope of the train.
- Reduce incidents that involve drivers on the tracks – Several incidents occurred from drivers turning onto the tracks and becoming immobilized.
- Reduce risk for older drivers at grade crossings – As identified in the data analysis, older drivers were more highly represented in accidents than younger drivers.
- Reduce the total number of grade crossings and/or the risk exposure from grade crossings across the Commonwealth.
- Reduce the total number of passive crossings across the Commonwealth regardless of the level of risk identified through the Hazard Index at any individual crossing.

6 Action Plan

6.1 Goals

As introduced in Section 2, the latest version of the Massachusetts Strategic Highway Safety Plan (SHSP) was completed in 2018. That plan identified the Commonwealth's long-term goal of zero roadway fatalities and serious injuries. The Commonwealth's goal for grade crossing is also to have zero fatalities and incidents.

As stated in the SHSP, the Commonwealth's five-year goal is to reduce highway fatalities by 12 percent and serious injuries by 21 percent. Although specific goals were not identified for each Emphasis Area of the SHSP, including grade crossings, it was anticipated that each Emphasis Area would contribute to the reduction goal.

As identified previously in this plan, incidents at grade crossings are not always highway-related, but a reduction goal for highway and non-highway-based fatalities and incidents has been established. The current five-year average of fatalities is 2.2 and incidents is 10.51. A 12 percent reduction in fatalities in the next five years would equal a five-year average of 1.9, while a 21 percent reduction in incidents would equal a five-year average of 8.3.[7] Therefore, these are the goals for the reduction in grade crossing fatalities and incidents by 2025.

Specific strategies, objectives, and actions to achieve the goal of reducing crossing fatalities and incidents are detailed in the following sections.

6.2 Strategies

This section presents the specific strategies that the Commonwealth will take to improve safety at grade crossings.

6.2.1 High-Risk Crossings

Strategy:
Improve and/or maintain safety at the most highly-used crossings. As identified in the data analysis, crossings with the highest exposure (daily trains x average daily traffic x protection) are those that are experiencing the highest rate of incident.

Objective:
Conduct diagnostic reviews of all high-risk crossings. By 2025, complete diagnostic team recommended improvements at all crossings with a Hazard Index greater than 120,000 and develop a priority schedule for improvements to remaining high-risk crossings.

[7] Grade crossing incidents are not the same as incidents with "serious injury", however since highway accident data is collected differently than grade crossing accident data, it was concluded that at goal of 21% reduction of incidents is reasonable.

Action:
The top 15 high-risk grade crossings in Massachusetts based on Hazard Index rank are summarized in **Table 16.**

Table 16. Massachusetts High-Risk Crossings with Highest Calculated Hazard Index (HI)

Crossing Number	Location	Roadway	Hazard Index (HI)
501736Y	Framingham	Concord Street	218,400
053849S	Chelsea	Everett Avenue	169,624
054041E	Medford	High Street	158,600
053049F	North Andover	Sutton Street	143,468
052326J	Waltham	Moody Street	124,800
053855V	Chelsea	Eastern Avenue	124,488
053026Y	Lawrence	Andover Street	123,760
053847D	Everett	Second Street	108,086
536871R	Barnstable	Iyannough Road	106,920
054310U	Melrose	West Wyoming Avenue	106,080
053900M	Beverly	Cabot Street	100,464
546736A	Stoughton	Porter Street	99,792
536891C	Holbrook	Union Street	92,950
053850L	Chelsea	Spruce Street	88,088
053014E	Andover	Essex Street	86,690

Consistent with the MassDOT Section 130 prioritization and project development process, MassDOT Rail and Transit Division will coordinate diagnostic team reviews at each of the high-risk crossings. After recommendations are made, MassDOT Rail and Transit Division will work with the operating railroad, municipality and MassDPU to complete the recommended improvements.

The priority of crossing improvements will follow the most up-to-date Hazard Index rating. It is understood that many of the high-risk crossings have recently been improved, and although they have high levels of vehicular and train traffic, the warning and safety systems are consistent with diagnostic team expectations. Therefore, improvements will not be recommended at all high-risk crossings.

As part of assessing recommendations for the high-risk crossings, grade separation and highway closure will be considered. (See Grade Crossing Elimination Strategy in Section 6.2.6) Although most of the crossings are in densely developed urban areas that make crossing separation difficult, there are a couple where grade separation or closure has been considered in the past and will be considered as part of a safety improvement strategy, especially if federal funding could be secured through the newly enacted Railroad Crossing Elimination Program.

The areas for evaluation are downtown Framingham, which includes the Concord Street and Bishop Street crossings considered for grade separation, and the area within and near the Fannie Stebbins Wildlife Refuge in Longmeadow, where there are several public and private crossings that could be considered for closure/consolidation.

6.2.2 Pedestrian Crossings

Strategy:
Minimize pedestrian risk at crossings. As identified in the data analysis, the preponderance of grade crossing related fatalities in Massachusetts over the past 10 years involved incidents with pedestrians.

Objective:
Develop a program to identify, assess and make improvement to pedestrian crossings and/or the pedestrian use of highway crossings. Incorporate pedestrian safety into the crossing improvement prioritization process. The objective is that by 2025, pedestrian use of crossings will be fully integrated into the Section 130 program's prioritization process and the five crossings with the most pedestrian use are identified and improved to provide appropriate warning systems.

Action:
As noted, 17 percent of fatalities at crossings over the past 10 years have been pedestrians/bicyclists. A preliminary assessment of the 746 public crossings has been conducted to identify those locations with the highest level of pedestrian/bicyclist activity. The top 14 high-risk grade crossings in Massachusetts based on Pedestrian Hazard Index rank are summarized in **Table 17**. StreetLight Data[8] was used to calculate the average daily pedestrian volumes within 200 feet of the grade crossing location. Average daily pedestrian volumes are based on data from September 2019 through November 2019.

Table 17. Massachusetts High-Risk Crossings with Highest Calculated Hazard Index (HI) Based on Average Daily Pedestrian Volume

Crossing Number	Location	Roadway	Hazard Index (HI)
053849S	Chelsea	Everett Avenue	358,456
501736Y	Framingham	Concord Street	305,424
501735S	Framingham	Bishop Street	242,496
052326J	Waltham	Moody Street	214,240
053852A	Chelsea	Arlington/Sixth Streets	186,704
053850L	Chelsea	Spruce Street	157,136
054041E	Medford	High Street	106,445
501898B	Cambridge	Massachusetts Ave	103,064
053932T	Gloucester	Maplewood Avenue	99,596
053899V	Beverly	Elliot Street	93,156
053026Y	Lawrence	Andover Street	90,508
054148G	Beverly	Elliot Street	89,343
053855V	Chelsea	Eastern Avenue	84,392
052304J	Somerville	Park Street	81,952

Source: StreetLight Data

[8] StreetLight Data is a source of data made available to MassDOT through a data broker that collects and interprets anonymized location data from cellphones.

MassDOT will facilitate a diagnostic review at each of the top 10 pedestrian/bicyclist crossing locations. Improvements will be made that decrease risk at the crossings. Improvements may include active or passive warning devices and/or other approaches to decrease risk, such as channelization systems.

In addition, MassDOT will identify available data on pedestrian/bicyclist use of the Commonwealth's crossings and develop a methodology to identify high-risk locations, evaluate types and levels of pedestrian/bicyclist risk, and develop an improvement prioritization methodology. Since grade crossing evaluation and prioritization is a new use of the data, additional verification will be necessary to assess the prioritization of the pedestrian/bicycle crossings. The objective is that pedestrian/bicyclist risk will be fully incorporated into the Section 130 prioritization process by 2025.

6.2.3 Crossing Incursions

Strategy:
Reduce incidents that involve grade crossing area incursions. As identified in the data analysis, a high percentage of crossing incidents occurred during the past decade when vehicles were within the dynamic envelope of the train.

Objective:
Develop a statewide program to improve the visibility of the train dynamic envelope at crossings. The program will review the results of past studies to identify the most beneficial way to make the train dynamic envelope more visible in a manner that will reduce the number of incursion accidents. On average, there have been three incidents annually over the past decade. The objective of the program is to reduce the average annual occurrence of these types of incidents by 2025.

Action:
There have been several studies and pilot programs that have evaluated the effectiveness of improved dynamic envelope pavement markings. Dynamic envelope markings are roadway markings used to increase the visibility of the dynamic envelope in the hope to change driver stopping and pedestrian behavior at crossings. The dynamic envelope pavement markings indicate the area needed for trains to safely pass.

By keeping vehicles outside of the dynamic envelopes, fewer vehicles will stop too close to or actually on the tracks, thereby reducing the danger to drivers, train crews and passengers, and pedestrians/ bicyclists.

The Florida Department of Transportation (FDOT) reported that they conducted dynamic envelope pilot programs in 2014 and 2017, which showed that the number of vehicles that stopped on or too close to rail crossings was reduced by at least 15%. The FDOT results are similar to a research study conducted in 2012 by the Volpe National Transportation Systems Center.[9]

Following the successful pilot program, FDOT issued a bulletin in February 2020 that introduced new requirements for Railroad Dynamic Envelope (RDE) pavement markings into the FDOT design manual and standard plans. The bulletin included a directive to install the RDE pavement markings at crossings

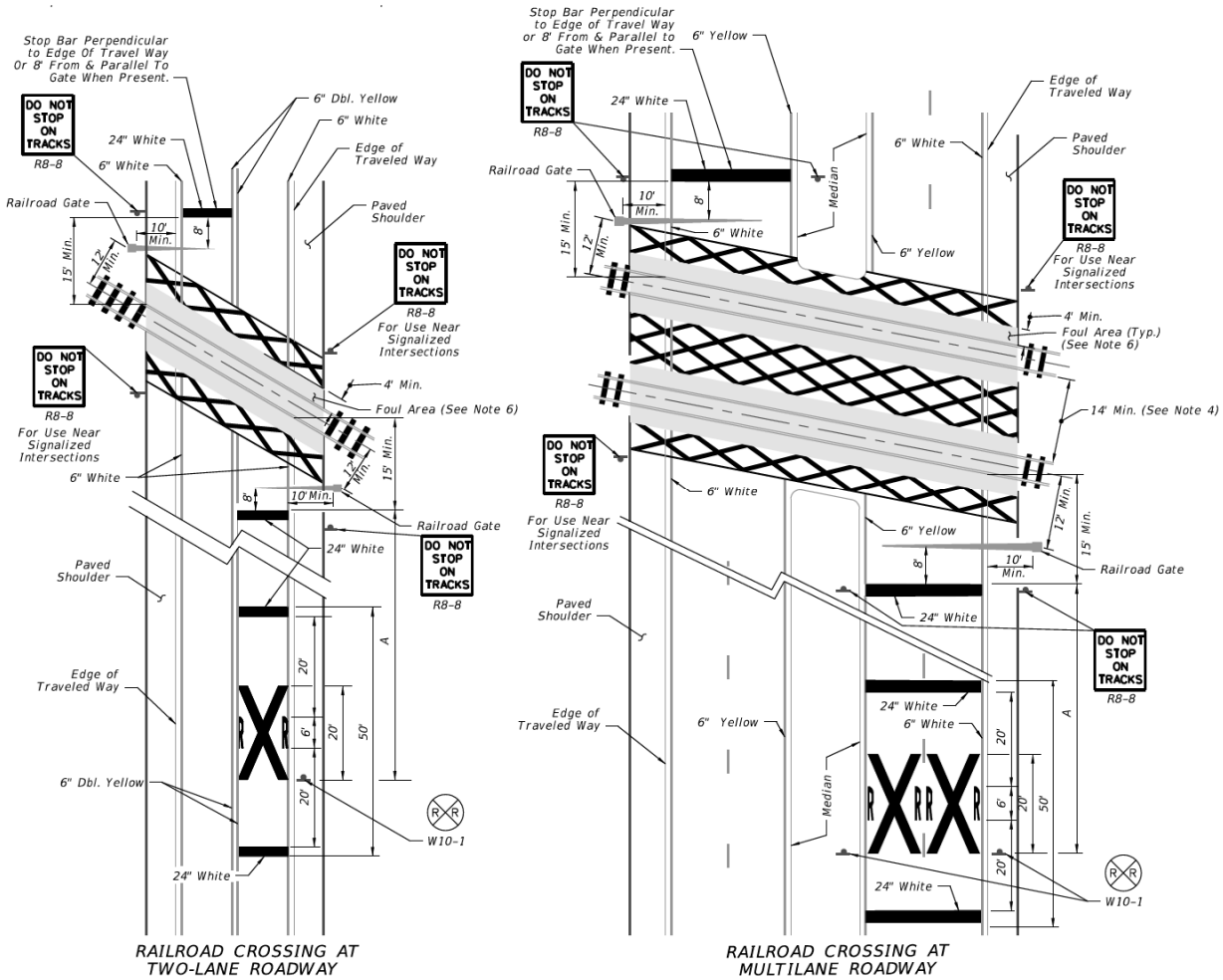
[9] Effect of Dynamic Envelope Pavement Markings on Vehicle Driver Behavior at a Highway Rail Grade Crossing, (DOT-VNTSC-FRA-13-05), Volpe National Transportation Systems Center, April 2014.

on state roads, state-owned railroads, and state-owned property. An example of the FDOT standard RDE pavement markings are included in **Figure 13**.

Since there are on average three incidents in Massachusetts annually involving drivers stopped in the dynamic envelope, representing over 27% of crossing incidents, MassDOT will advance a program to incorporate dynamic envelope pavement markings and associated signage into crossing standards used in the Commonwealth. MassDOT will work with federal, state, and local partners to identify the most appropriate standard to utilize. Although it is anticipated the standard would be similar to the one incorporated in Florida, there may be some alternative approaches or standards that are more applicable for the Commonwealth.

Upon identification of the preferred standard, MassDOT will initiate a state-wide installation program, identifying priority crossings, corridors or locations to focus the initial efforts. It is anticipated that the installation program will be initiated by 2024, but will require several years to complete installation at the priority crossing locations.

Figure 13. Florida Department of Transportation Draft Railroad Dynamic Envelope Pavement Marking Standard



Source: FDOT Traffic Engineering and Operations Bulletin 20-01, February 11, 2020.

6.2.4 Drivers on the track

Strategy:
Reduce incidents that involve drivers accessing the railroad right of way from grade crossings. As identified in the data analysis, several incidents occurred during the past decade when drivers turned onto the tracks at a crossing and then became immobilized, leading to an incident at the crossing.

Objective:
Develop a statewide program to improve signage, pavement markings, and other appropriate measures to minimize driver confusion regarding the use of railroad right of way for travel. The strategy will include identifying appropriate standard treatments for installation and identifying appropriate and prioritized conditions for installation. The objective of the program is to reduce the average annual occurrence of drivers on the tracks by 2025.

Action:
It is common for drivers to mistakenly turn onto the tracks, thinking they are a roadway, and then becoming immobile or unable to turn off the tracks before being struck by a train. Drivers stuck on the tracks have resulted in seven incidents over the past decade in the Commonwealth. Although this represents less than 7% of the annual crossing incidents, possible measures to eliminate any of the incidents are fairly low cost and easily implementable.

The Volpe National Transportation Systems Center completed a study in 2019 to evaluate the effectiveness of engineering treatments to deter vehicles from turning onto a rail right-of-way (ROW) at highway-rail grade crossings. Working with the Long Island Railroad (LIRR), pavement markings and high-visibility safety delineators were installed along the roadway edge through crossings. After installing the improvements, the LIRR experienced an 85% reduction in reports of vehicles on tracks. Examples of the roadway edge pavement markings and high-visibility safety delineators are shown in **Figure 14**.

Figure 14. ROW Incursion Treatments Installed at the LIRR Crossing on 5th Ave in Bay Shore, NY

Source: Google Maps (Streetview) - Image capture October 2021.

MassDOT will advance a program to incorporate railroad ROW incursion treatments into crossing standards used in the Commonwealth. MassDOT will determine the appropriate combination of treatments for Massachusetts. Consideration will be given to the treatments tested in other locations. These included extending white edge and yellow centerline pavement markings through the crossing, adding reflective markers on the pavement markings through the crossing, and adding flexible delineators on both sides and in-between the tracks.

After defining the appropriate standard for Massachusetts, a program will be initiated by MassDOT to identify crossing conditions appropriate for priority implementation and install treatments at priority locations. It is anticipated that ROW incursion treatments will be installed at priority locations by 2025, where installation of incursion treatments at non-priority locations will be conducted in conjunction with other roadway or railway improvements at the crossings.

6.2.5 Older Drivers

Strategy:
Reduce risk for older drivers at Commonwealth crossings. As identified in the data analysis, older drivers were more highly represented in accidents in the Commonwealth than younger drivers during the past 10 years.

Objective:
Consistent with the strategies identified in the Massachusetts Strategic Highway Safety Plan, MassDOT will initiate a program to increase visibility of public passive crossings in Massachusetts. The program will include a review of all public passive crossings with at least one daily train to either provide illumination, where there is none, or install the reflectorized signage recommended in the Handbook. The objective is to improve conditions at all passive crossings, as necessary, by 2025.

Action:
FHWA published the *Handbook for Designing Roadways for the Aging Population* in 2014[10] , which identifies several studies concluding that as a result of sensory losses, many older drivers may have difficulties detecting crossings. Difficulties related to sensory losses are especially compounded at crossings with only passive warning devices, leading to slower reaction times when a train is approaching a passively protected crossing.

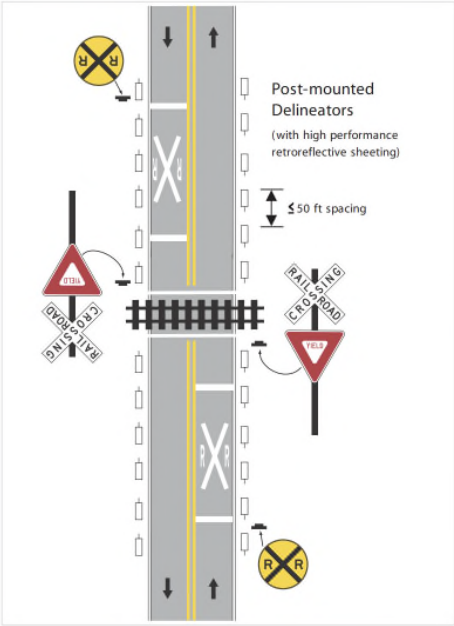
One of the strategies identified in the Massachusetts Strategic Highway Safety Plan was to "Implement measures recommended in the Highway Design Handbook for Older Drivers and Pedestrians regarding visual improvements at at-grade crossings that will enhance support for older drivers and alternative road users." The Handbook includes the following recommendations for crossings:

1. Installation of Post-Mounted Delineators: For rural passive grade crossings that are not illuminated, it is recommended that the approach be delineated with post-mounted delineators spaced 50 feet or closer together on the right shoulder, from the location of the Railroad

[10] FHWA. *Handbook for Designing Roadways for the Aging Population.* June 2014. https://safety.fhwa.dot.gov/older_users/handbook/

Advance Warning sign (W10-1) to the crossbuck, and extending an equal distance beyond the crossbuck (Refer to **Figure 15**).

Figure 15. Recommended placement of post-mounted delineators at unlighted passive crossings



Source: Handbook for Designing Roadways for the Aging Population

2. Illumination of Passive Crossings: Add illumination at passive crossings. Illumination at a crossing may be effective in reducing nighttime collisions. Illuminating most crossings is technically feasible because more than 90 percent of all crossings have commercial power available. The report additionally identifies conditions where illumination is recommended; however, the conditions identified in the report include attributes consistent with all passive crossings in Massachusetts.

6.2.6 Grade Crossing Elimination

Strategy:
Reduce the total number of grade crossings and/or the risk exposure from grade crossings across the Commonwealth.

Objective:
The objective is to evaluate the opportunity for crossing elimination at each of the high-risk crossing locations by identifying if closure, consolidation, track relocation, or grade separation is a feasible option. The evaluation will be completed by 2023 to allow for the continued advancement of any identified crossing closure through the FRA Railroad Crossing Elimination Grant Program, if possible.

Action:
Elimination of crossings is a goal of the Commonwealth. It is often noted that the best improvement to at-grade crossing is to eliminate a grade crossing altogether. Crossing elimination can occur either

through grade separation or crossing closure. Both elimination and closure will be considered to reduce risk at any and all crossings. Grade separations will be considered at crossings where standard safety improvements are not sufficient or where the HI is high.

The closure or consolidation of crossings may also be used to improve safety throughout the Commonwealth. Potential closures should be thoroughly reviewed to determine the potential impact on traffic and pedestrian circulation as well as the impact to emergency services response times.

MassDOT will conduct an evaluation of the opportunity for crossing elimination at each of the high-risk crossing locations. Additional crossings may be considered for crossing elimination, especially where crossing elimination would provide substantial additional benefits, such as environmental or community benefits.

Crossing elimination considered may include:

- Grade separation, through the use of a bridge, embankment, tunnel, or combination thereof
- Crossing closure
- Crossing consolidation, or
- Track relocation

6.2.7 Grade Crossing Safety Education

Strategy:
Continue raising public awareness of the dangers associated with trains, railroad tracks, and crossings.

Objective:
The objective is to continue to raise public awareness of risks associated with grade crossings through the ongoing support of media and in-person awareness campaigns.

Action:
Consistent with the Massachusetts Strategic Highway Safety Plan, several stakeholders have the responsibility for improving grade crossing safety education. The planned actions related to education include the following:

- MassDOT (Rail and Transit & Highway Divisions) and the MBTA to develop a campaign that will educate the public and increase awareness about safety precautions needed at railroad crossings.

- MassDOT Rail and Transit Division and the MBTA to continue implementing “Operation Lifesaver,” a public awareness campaign that includes safety blitzes, press conferences, and other community awareness events with the goal of reducing rail tragedies. In addition, expand outreach to areas surrounding new or modified Commuter Rail services such as the Foxborough Pilot program.

- Several grade crossing stakeholders across the Commonwealth (MassDOT, MBTA, Transit Police, and Keolis) to implement Rail Safety Week activities each year.

6.2.8 Grade Crossing Incident Evaluation

Strategy:
Improve understanding and/or collection of information related to root causes of incidents that occur at grade crossings.

Objective:
Establish a coordinated process to improve the knowledge and understanding of the underlying causes of grade crossing incidents across the Commonwealth. By 2025, establish a process and procedure that facilitates incident evaluation and cooperation among DPU, MassDOT, railroads, or stakeholders identified as appropriate.

Action:
Since grade crossing incident response can include multiple federal, state, and local government agencies in addition to one of the many railroads that operate in the Commonwealth, the evaluation and collection of data collection to clearly understand the conditions leading to an incident can be a challenge. For this Action Plan, FRA incident data was utilized to understand the location and conditions at the time of an incident, but many times additional information is being collected and/or assessed by other entities (i.e., the MBTA, local/transit police, or the other operating railroads).

It is recommended that a coordinated effort be established with railroad stakeholders to ensure that a clear understanding of the root causes leading to each incident in the Commonwealth can be understood and documented. This information will lead to a more effective prioritization of safety funding and resources.

MassDOT will facilitate coordination among parties that are currently involved in incident response and evaluation for stakeholders to determine the most appropriate and effective process that leverages existing responsibilities to improve the collection and evaluation of grade crossing incident conditions and causes that could be used in future updates to the Grade Crossing Safety Action Plan.

6.2.9 Grade Crossing Safety Collaboration

Strategy:
Improve collaboration among entities involved in grade crossing safety efforts in the Commonwealth by establishing regular meetings focused specifically on grade crossing safety.

Objective:
Establish an annual meeting that involves grade crossing safety stakeholders to discuss progress being made on the Massachusetts State Grade Crossing Action Plan Strategies as well as new or evolving issues related to grade crossing safety in the Commonwealth.

Action:
MassDOT will facilitate an annual meeting that includes the members of the Massachusetts Grade Crossing Action Plan Working Group plus other applicable stakeholders to advance strategies to reduce

collisions, accidents, or incidents between trains or on-track equipment and vehicles, pedestrians, or bicyclists at grade crossings. The goal of the meeting will be to review and collectively identify approaches to overcome any challenges in progressing the Action Plan Strategies. In addition, the meeting can be a forum to discuss other statewide grade crossing issues and/or strategies that may lead to reduced crossing incidents.

6.3 Implementation of Strategies

As previously stated, the goal of this Action Plan is to identify specific strategies that will reduce collisions, accidents, or incidents between trains or on-track equipment and vehicles, pedestrians, or bicyclists at grade crossings. The Action Plan identifies specific goals and strategies to prioritize and address the specific locations and attributes that have been identified as the highest risk.

The following is a summary of the planned actions along with the necessary resources and planned schedules.

Strategies	Planned Actions	Planned Resources	Schedule
Reduce incidents that involve grade crossing area incursions.	Develop a statewide program to improve visibility of the train dynamic envelope at crossings.	MassDOT will review the results of past studies to identify the most beneficial way to make the train dynamic envelope more visible	Fiscal Year 2023
		MassDOT will identify preferred crossing locations for installation and statewide prioritization listing	Fiscal Year 2023
		MassDOT will work with railroads and municipalities as appropriate to initiate installation of improvements to priority crossing locations	Fiscal Year 2024
Reduce the total number of grade crossings and/or the risk exposure at crossings	Evaluate opportunities for crossing elimination across the Commonwealth	MassDOT will conduct an evaluation of the opportunity for crossing elimination at each of the high-risk crossing locations.	Fiscal Year 2023
		MassDOT will evaluate opportunities to advance feasible crossing eliminations through state of federal funding programs including the FRA Railroad Crossing Elimination Grant Program.	Fiscal Year 2024
Improve and/or maintain safety at the most highly-used and high-risk crossings.	Assess and improve crossings with highest levels of risk – 15 with the highest Hazard Index	Conduct diagnostic reviews of all high-risk crossings with a Hazard Index greater than 120,000.	Fiscal Year 2023
		Develop a priority schedule for improvements of reviewed crossings; Develop a priority schedule for diagnostic reviews of remaining high-risk crossings	Fiscal Year 2024
		Complete diagnostic team recommended improvements at all crossing	Fiscal Year 2025

Strategies	Planned Actions	Planned Resources	Schedule
Reduce risk for older drivers at Commonwealth crossings.	Increase visibility of public passive crossings	MassDOT will review of all public passive crossings with at least 1 daily train to identify locations where improvements are necessary.	Fiscal Year 2023
		MassDOT will initiate a program to either provide illumination, where there is none, or install the recommended reflectorized signage.	Fiscal Year 2024
Minimize pedestrian risk at crossings.	Develop a program to identify, assess and make improvements to pedestrian crossings and/or the pedestrian use of highway crossings.	Conduct diagnostic reviews at six crossings with a Pedestrian Hazard Index greater than 150,000; identify preferred pedestrian safety improvements for Massachusetts;	Fiscal Year 2023
		Initiate improvements to crossings with highest Pedestrian Hazard Index; Conduct diagnostic review of remaining eight crossings with Pedestrian Hazard Index greater than 80,000 to determine recommended improvements and future priorities	Fiscal Year 2024
		Complete recommended improvements to the six crossings with a Pedestrian Hazard Index greater than 150,000.	Fiscal Year 2025
Reduce incidents that involve drivers accessing the railroad right of way from grade crossings.	MassDOT will advance a program to incorporate railroad ROW incursion treatments into crossing standards used in the Commonwealth.	MassDOT will determine the appropriate combination of treatments for Massachusetts and identify locations for priority installation of treatments	Fiscal Year 2023
		MassDOT will initiate a program in combination with railroads and municipalities to install recommended treatments at priority locations.	Fiscal Year 2025
Grade Crossing Safety Education		MassDOT (Rail and Transit & Highway Divisions) and the MBTA to develop a campaign that will educate the public and increase awareness about safety precautions needed at railroad crossings.	Annually
		MassDOT Rail and Transit Division and the MBTA to continue implementing “Operation Lifesaver,” a public awareness campaign that includes safety blitzes, press conferences, and other community awareness events with the goal of reducing rail tragedies. In addition, expand outreach to areas surrounding new or modified Commuter Rail services such as the Foxborough Pilot program.	Annually
		Several grade crossing stakeholders across the Commonwealth (MassDOT, MBTA, Transit Police, and Keolis) to implement Rail Safety Week activities each year.	Annually
Improve collaboration among entities involved in grade crossing safety	MassDOT will facilitate an annual meeting to discuss grade crossing safety	MassDOT will convene an annual meeting of the Action Plan Working Group and other stakeholders to discuss strategy progress and other issues related to reducing grade crossing incidents.	Annually

Strategies	Planned Actions	Planned Resources	Schedule
Improve data related to grade crossing incident root causes	Establish process to coordinate information collected from incident analysis to better understand root causes.	MassDOT will convent a meeting and communication among stakeholders to identify a coordinated process to improve the knowledge and understanding of the underlying causes of grade crossing incidents across the Commonwealth.	Fiscal Year 2024

6.4 Challenges

While Massachusetts is committed to implementing these actions to improve safety at highway-rail grade crossings throughout the Commonwealth, there are considerations that may challenge the ability to meet all the goals and objectives outlined in this SAP. A short description of the primary anticipated challenges is provided below.

6.4.1 Changing Railroad Network

Railroad activity in the Commonwealth is poised to go through a period of substantial change over the next few years. It is likely that high-risk crossing locations will change as rail traffic shifts. It will be a challenge for MassDOT and railroad staff to keep up with changes to ensure improvement and investment at crossings that will have long term benefits.

MassDOT will continue to track changes in railroad and traffic volumes to assess and evaluate changing risk levels. Changes could lead to a shift in crossing location priorities before the end of the SAP planning horizon.

6.4.2 Funding Limitations

Federal funding for highway-rail grade crossing improvements is limited and not sufficient to fund all likely highway-rail grade crossing project needs in the Commonwealth of Massachusetts.

Currently, the Commonwealth of Massachusetts receives approximately $2.5 million each year to support the FHWA Rail-Highway Crossing Program (Section 130). MassDOT often provides state funding to augment that amount to advance safety improvements across the state. Sometimes those funds are to support improved safety at particular highway projects, while other times it is to address safety conditions that could not be accommodated by the annual federal funding. In addition, most of the railroads make safety improvements utilizing their own financial resources.

The priorities included in this Massachusetts Grade Crossing Action Plan totals approximately $7.5 to $ 8 million equal to the amount of federal funding available to Massachusetts for the three fiscal years included in this plan. Depending on the improvements recommended by the diagnostic teams for each crossing and the increased costs of improvements due to inflation, some actions may need to be delayed to address funding constraints.

6.4.3 Complex Responsibilities

Due the organization of Massachusetts governmental entities, which includes 351 municipalities that are responsible for the maintenance and improvements of the highway approaches, coordinating statewide improvement programs can often be a challenge.

In the development of statewide programs, MassDOT will establish expectations commensurate with the responsibilities and resources available to different governmental entities.

6.5 Implementation Responsibility

Each state developing an SAP is mandated under Section 11401 of the FAST Act to designate a state official responsible for managing the implementation of the SAP. This mandate was echoed by the FRA in its Final Rule issued on December 14, 2020. The state official responsible for managing the implementation of the 2022 Massachusetts SAP is identified below:

James Eng
Deputy Administrator
Massachusetts Department of Transportation Rail and Transit Division
10 Park Plaza
Boston, MA 02116

Appendix A State Highway-rail Grade Crossing Action Plan Regulation (49 CFR 234.11)

49 CFR § 234.11 State highway-rail grade crossing action plans.

(a) ***Purpose.*** The purpose of this section is to reduce accident/incidents at highway-rail and pathway grade crossings nationwide by requiring States and the District of Columbia to develop or update highway-rail grade crossing action plans and implement them. This section does not restrict any other entity from adopting a highway-rail grade crossing action plan. This section also does not restrict any State or the District of Columbia from adopting a highway-rail grade crossing action plan with additional or more stringent requirements not inconsistent with this section.

(b) ***New Action Plans.***

(1) Except for the 10 States identified in paragraph (c)(3) of this section, each State and the District of Columbia shall develop a State highway-rail grade crossing action plan that addresses each of the required elements listed in paragraph (e) of this section and submit such plan to FRA for review and approval not later than February 14, 2022.

(2) Each State and the District of Columbia shall submit its highway-rail grade crossing action plan electronically through FRA's website in Portable Document Format (PDF).

(c) ***Updated Action Plan and implementation report.***

(1) Each of the 10 States listed in paragraph (c)(3) of this section shall develop and submit to FRA for review and approval an updated State highway-rail grade crossing action plan that addresses each of the required elements listed in paragraph (e) of this section, not later than February 14, 2022.

(2) Each of the 10 States listed in paragraph (c)(3) of this section shall also develop and submit to FRA, not later than February 14, 2022, a report describing:

(i) How the State implemented the State highway-rail grade crossing action plan that it previously submitted to FRA for review and approval; and

(ii) How the State will continue to reduce highway-rail and pathway grade crossing safety risks.

(3) The requirements of this paragraph (c) apply to the following States: Alabama, California, Florida, Georgia, Illinois, Indiana, Iowa, Louisiana, Ohio, and Texas.

(d) ***Electronic submission of updated Action Plan and implementation report.*** Each of the 10 States listed in paragraph (c)(3) of this section shall submit its updated highway-rail grade crossing action plan and implementation report electronically through FRA's website in PDF form.

(e) ***Required elements for State highway-rail grade crossing action plans.*** Each State highway-rail grade crossing action plan described in paragraphs (b) and (c) of this section shall:

(1) Identify highway-rail and pathway grade crossings that:

(i) Have experienced at least one accident/incident within the previous 3 years;

(ii) Have experienced more than one accident/incident within the previous 5 years; or

(iii) Are at high-risk for accidents/incidents as defined in the Action Plan. Each State or the District of Columbia that identifies highway-rail and pathway grade crossings that are at high-risk for accidents/incidents in its Action Plan shall provide a list of the factors that were considered when making this determination. At a minimum, these factors shall include:

(A) Average annual daily traffic;

(B) Total number of trains per day that travel through each crossing;

(C) Total number of motor vehicle collisions at each crossing during the previous 5-year period;

(D) Number of main tracks at each crossing;

(E) Number of roadway lanes at each crossing;

(F) Sight distance (stopping, corner and clearing) at each crossing;

(G) Roadway geometry (vertical and horizontal) at each crossing; and

(H) Maximum timetable speed;

(2) Identify data sources used to categorize the highway-rail and pathway grade crossings in paragraph (e)(1) of this section;

(3) Discuss specific strategies, including highway-rail grade crossing closures or grade separations, to improve safety at those crossings over a period of at least four years;

(4) Provide an implementation timeline for the strategies discussed in paragraph (e)(3) of this section; and

(5) Designate an official responsible for managing implementation of the State highway-rail grade crossing action plan.

(f) ***Point of contact for State highway-rail grade crossing action plans.***

(1) When the State or the District of Columbia submits its highway-rail grade crossing action plan or updated Action Plan and implementation report electronically through FRA's website, the following information shall be provided to FRA for the designated official described in paragraph (e)(5) of this section:

(i) The name and title of the designated official;

(ii) The business mailing address for the designated official;

(iii) The email address for the designated official; and

(iv) The daytime business telephone number for the designated official.

(2) If the State or the District of Columbia designates another official to assume the responsibilities described in paragraph (e)(5) of this section before December 16, 2024, the State or the District of Columbia shall contact FRA and provide the information listed in paragraph (f)(1) of this section for the new designated official.

(g) ***Review and approval.***

(1) FRA will update its website to reflect receipt of each new, updated, or corrected highway-rail grade crossing action plan submitted pursuant to this section.

(2)

(i) Within 60 days of receipt of each new, updated, or corrected highway-rail grade crossing action plan, FRA will conduct a preliminary review of the Action Plan to ascertain whether the elements prescribed in paragraph (e) of this section are adequately addressed in the plan.

(ii) Each new, updated, or corrected State highway-rail grade crossing action plan shall be considered conditionally approved for purposes of this section sixty (60) days after receipt by FRA unless FRA notifies the designated official described in paragraph (e)(5) of this section that the highway-rail grade crossing action plan is incomplete or deficient.

(iii) FRA reserves the right to conduct a more comprehensive review of each new, updated, or corrected State highway-rail grade crossing action plan within 120 days of receipt.

(3)

If FRA determines that the new, updated, or corrected highway-rail grade crossing action plan is incomplete or deficient:

(i) FRA will provide email notification to the designated official described in paragraph (e)(5) of this section of the specific areas in which the Action Plan is deficient or incomplete and allow the State or the District of Columbia to complete the plan and correct the deficiencies identified.

(ii) Within 60 days of the date of FRA's email notification identifying the specific areas in which the highway-rail grade crossing action plan is incomplete or deficient, the State or District of Columbia shall correct all deficiencies and submit the corrected State highway-rail grade crossing action plan to FRA for approval. The corrected highway-rail grade crossing action plan shall be submitted electronically through FRA's website in PDF format.

(4)

(i) When a new, updated, or corrected State highway-rail grade crossing action plan is fully approved, FRA will provide email notification to the designated official described in paragraph (e)(5) of this section.

(ii) FRA will make each fully-approved State highway-rail grade crossing action plan publicly available for online viewing.

(iii) Each State and the District of Columbia shall implement its fully-approved highway-rail grade crossing action plan.

(h) ***Condition for grants.*** The Secretary of Transportation may condition the awarding of any grants under 49 U.S.C. ch. 244 on the State's or District of Columbia's submission of an FRA-approved State highway-rail grade crossing action plan under this section.

[85 FR 80659, Dec. 14, 2020; 86 FR 10857, Feb. 23, 2021]

Appendix B Coordination of SHSP Strategies with Grade Crossing Action Plan Strategies

SHSP Strategies	SHSP Actions and Implementing Agencies	GX Action Plan Strategies	Planned Actions/Strategies
Enhance at-grade rail crossing safety	Continue implementing Section 130 of the Rail-Highway Crossing Safety Program (MassDOT Rail and Transit).	Reduce incidents that involve grade crossing area incursions.	Develop a statewide program to improve visibility of the train dynamic envelope at crossings. The program will review the results of past studies to identify the most beneficial way to make the train dynamic envelope more visible in a manner that will reduce the number of incursion accidents. On average there have been 3 incidents annually over the past decade. The objective of the program is to reduce the average annual occurrence of these types of incidents by 2025.
		Reduce the total number of grade crossings and/or the risk exposure from grade crossings across the Commonwealth.	MassDOT will conduct an evaluation of the opportunity for crossing elimination at each of the high-risk crossing locations. The crossing elimination evaluation will be completed by 2023 to allow for the continued advancement of any identified crossing closure through the FRA Railroad Crossing Elimination Grant Program.
	Prioritize and select projects utilizing data-driven processes, including crash data analysis, site visits (similar to road safety audits), and surveys of crossings that may require improvements (MassDOT Rail and Transit, MBTA).	Improve and/or maintain safety at the most highly-used and high-risk crossings.	Conduct diagnostic reviews of all high-risk crossings. By 2025, complete diagnostic team recommended improvements at all crossings with a Hazard Index greater than 120,000 and develop a priority schedule for improvements to remaining high-risk crossings.
	Implement measures recommended in the Highway Design Handbook for Older Drivers and Pedestrians regarding visual improvements at at-grade crossings that will enhance support for older drivers and alternative road users (MassDOT Rail and Transit, MBTA).	Reduce risk for older drivers at Commonwealth crossings.	MassDOT will initiate a program to increase visibility of public passive crossings in Massachusetts. The program will include a review of all public passive crossings with at least 1 daily train to either provide illumination, where there is none, or install the reflectorized signage recommended in the Handbook. It is planned that improvements will be made at all passive crossings, where necessary, by 2025.

SHSP Strategies	SHSP Actions and Implementing Agencies	GX Action Plan Strategies	Planned Actions/Strategies
	Conduct pedestrian and motor vehicle enforcement near at-grade rail crossings (Local Law Enforcement).	Minimize pedestrian risk at crossings.	Develop a program to identify, assess and make improvement to pedestrian crossings and/or the pedestrian use of highway crossings. Incorporate pedestrian safety into the crossing improvement prioritization process. The objective is that by 2025, pedestrian use of crossings will be fully integrated into the Section 130 program' s prioritization process and the five crossings with the most pedestrian use are identified and improved to provide appropriate warning systems.
	Utilize proven crash prevention methods at grade crossings, including the increase of signage and pavement markings and changing from passive to active devices (MassDOT Rail and Transit, MBTA).	Reduce incidents that involve drivers accessing the railroad right of way from grade crossings.	MassDOT will advance a program to incorporate railroad ROW incursion treatments into crossing standards used in the Commonwealth. MassDOT will determine the appropriate combination of treatments for Massachusetts. A program will then be initiated by MassDOT to identify crossing conditions appropriate for priority implementation and install treatments at priority locations. It is anticipated that ROW incursion treatments will be installed at priority locations by 2025, where installation of incursion treatments at non-priority locations will be conducted in conjunction with other roadway or railway improvements at the crossings.
Educate general public about safe crossing practices	Develop a campaign that will educate the public and increase awareness about safety precautions needed at railroad crossings (MassDOT Rail and Transit, MassDOT Highway, MBTA).	Grade Crossing Safety Education	MassDOT (Rail and Transit & Highway Divisions) and the MBTA to develop a campaign that will educate the public and increase awareness about safety precautions needed at railroad crossings.
	Continue implementing "Operation Lifesaver," a public awareness campaign that includes safety blitzes, press conferences, and other community awareness events with the goal of reducing rail tragedies. In addition, expand outreach to areas surrounding new or modified Commuter Rail services such as the Foxborough Pilot program. (MBTA, MassDOT Rail and Transit).		MassDOT Rail and Transit Division and the MBTA to continue implementing "Operation Lifesaver," a public awareness campaign that includes safety blitzes, press conferences, and other community awareness events with the goal of reducing rail tragedies. In addition, expand outreach to areas surrounding new or modified Commuter Rail services such as the Foxborough Pilot program.
	Implement Rail Safety Week activities each year (MassDOT, MBTA, Transit Police, Keolis).		Several grade crossing stakeholders across the Commonwealth (MassDOT, MBTA, Transit Police, and Keolis) to implement Rail Safety Week activities each year.

SHSP Strategies	SHSP Actions and Implementing Agencies	GX Action Plan Strategies	Planned Actions/Strategies
Improve data collection and analysis capabilities	Collaborate with local and railroad police departments, the MBTA, and the Federal Railroad Administration to improve data collection for at-grade crossing incidents involving fatalities and serious injuries (MassDOT Highway).		
Improve communication and collaboration among those responsible for at-grade rail crossing safety	Continue collaborating with entities responsible for at-grade crossing safety (MassDOT Rail and Transit, MBTA, and DPH).		

Appendix C References and Endnotes

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