RAIL

*MOVING AMERICA FORWARD*

# FRA/Volpe Grade Crossing Safety Research Update



U.S. Department of Transportation
Federal Railroad Administration

April 13, 2026

# Crossing Safety and Trespass Prevention Research

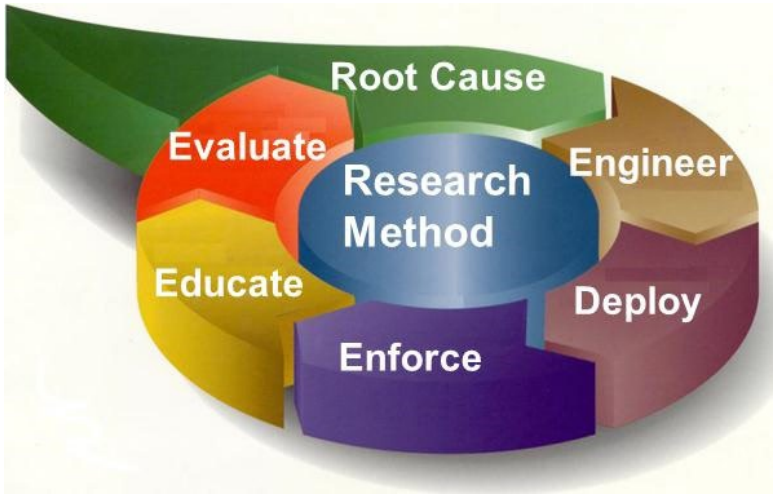
FRA conducts research to improve grade crossing safety and trespass prevention by developing and evaluating human factors and engineering solutions, funding research, and working in partnership with railroads, universities, vendors, and local governments.

## Goal

- Analyze crash causation and develop safety countermeasures, programs, and guidance to reduce the number of casualties at grade crossings and along railroad rights-of-way (ROW)

## Research Method

- Research the root cause of incidents and fatalities
- Identify corrective actions
  - Engineering, Enforcement, Education
- Engage stakeholders/deploy and evaluate solutions



# Crossing Safety and Trespass Prevention Research

- Grade Crossing Flashers
- ENS Signage
- Pedestrian Grade Crossing Violation Detection and Warning
- FRA Resources
  - Grade Crossing Toolkit

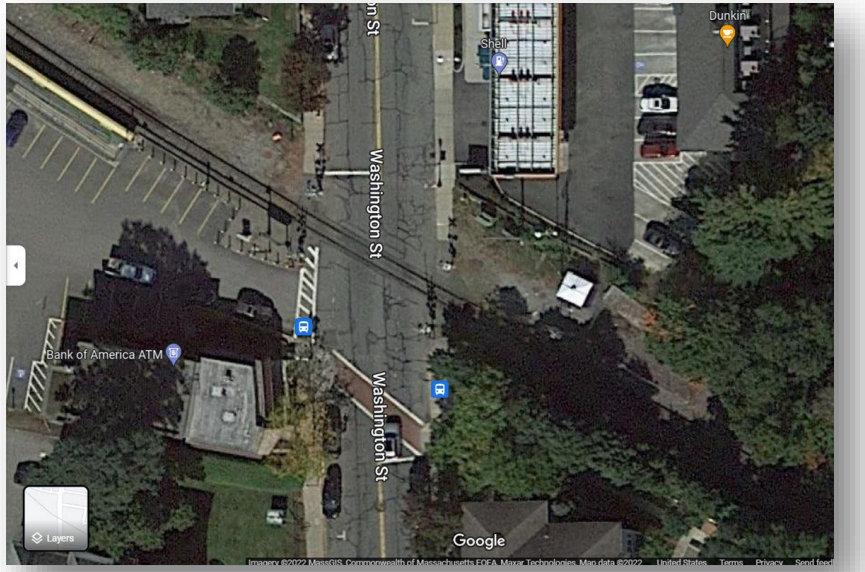
# Grade Crossing Flashers Research

- Problem: Drivers violating activated crossing
- Technology
  - Rapid flashing crossing gate lights (strobe effect)
  - 4.5Hz (vs. 1 Hz)
- Field testing in progress
  - Washington St (Canton, MA)
- Research Results:
  - 85% descending gate violation rate decrease

# Grade Crossing Flashers Research

- Proposed Technology
  - Rapid flashing crossing gate lights (12” LED)

- Crossing ID 546729P
  - 700 Washington St, Canton, MA
  - MBTA Commuter Rail Providence/Stoughton Line
  - 2-quad gates, 8” incandescent flashers
  - Average of 36 commuter trains per day
  - Annual Average Daily Traffic = 18,900 (2002)
  - https://goo.gl/maps/3UfeqwduVYzwTGQf8



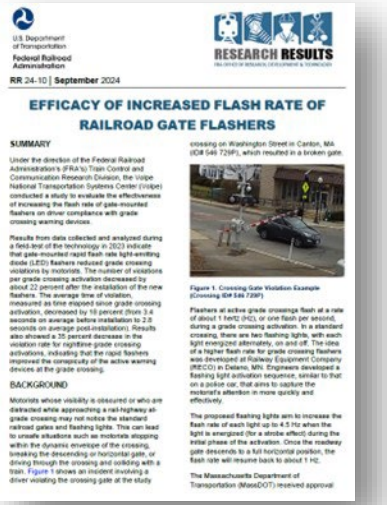

# Grade Crossing Flashers Research

- Phase I (Pre): Data collection/analysis under current conditions present at the grade crossing.
  - Period: May 30, 2023 – June 26, 2023

- Phase II (Post 1): Data collection/analysis under conditions present at the grade crossing after installation of the 4” gate-mounted rapid flashers.
  - Period: November 27, 2023 – December 22, 2023
  - Research Results

- Phase III (Post 2): Data collection/analysis under conditions present at the grade crossing after upgrading the flashers from 8-inch incandescent to 12-inch LED rapid flashers.
  - Period 3: January 6, 2025 – February 3, 2025
  - Research Results (Draft under FRA review)

- Phase IV (Post 3): Data collection/analysis under conditions present at the grade crossing one year after the activation of the enhanced flashing feature of the 12-inch LEDs (long-term evaluation).
  - Period 4: January 5, 2026 – February 2, 2026
  - Data analysis in progress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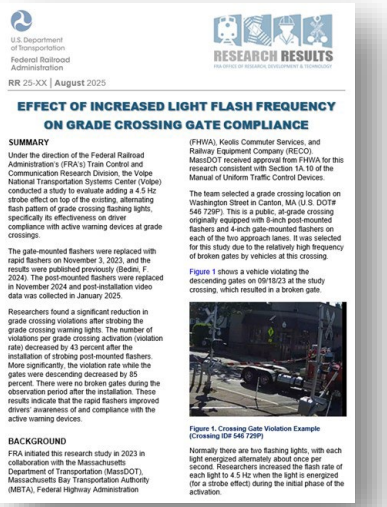
RESEARCH RESULTS

RR 24-10 | September 2024

EFFICACY OF INCREASED FLASH RATE OF RAILROAD GATE FLASHERS

SUMMARY

BACKGROUND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RESEARCH RESULTS

RR 25-XX | August 2025

EFFECT OF INCREASED LIGHT FLASH FREQUENCY ON GRADE CROSSING GATE COMPLIANCE

SUMMARY

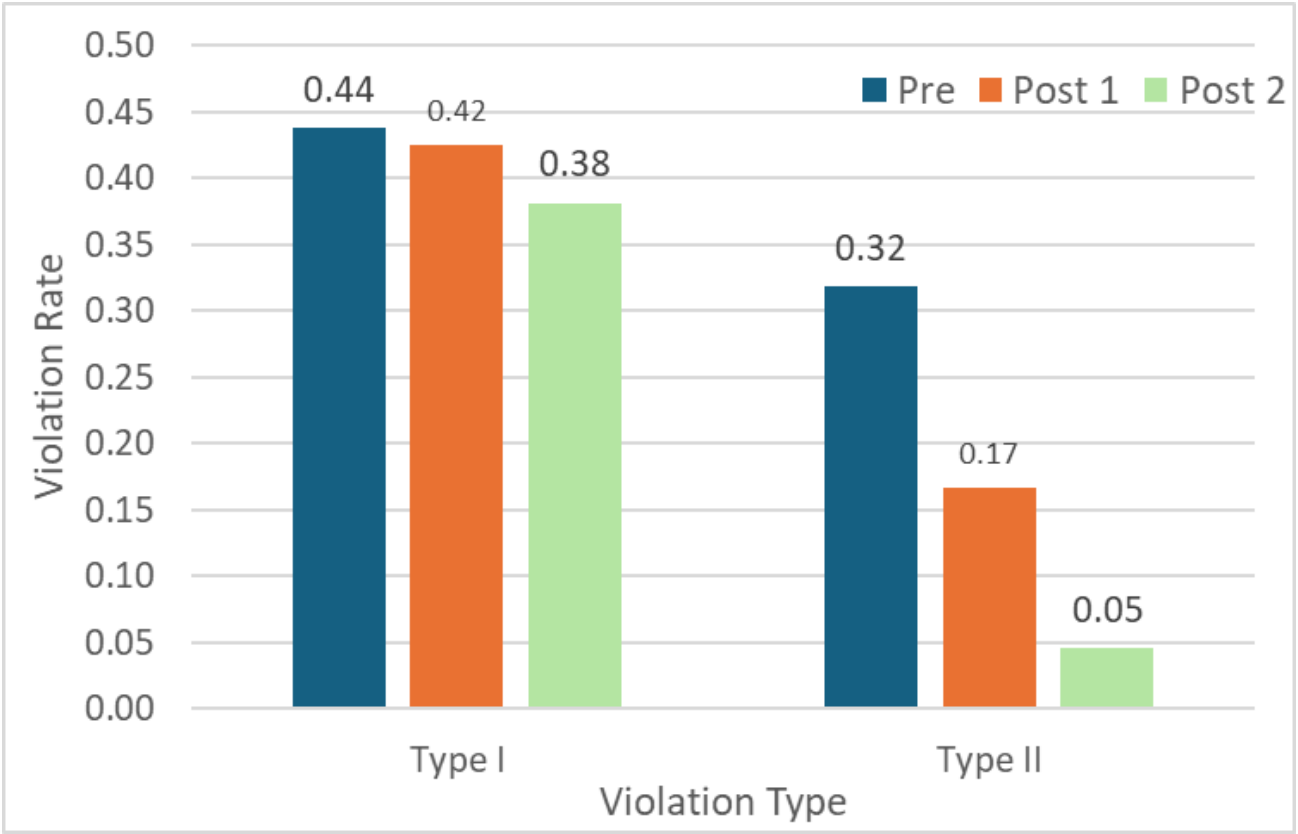
BACKGROUND

# Grade Crossing Flashers Research

## ❑ Results (Phase I vs. Phase III)

- **45%** overall violation rate decrease
- **85%** descending gate violation decrease (Type II)

| | Count | | Violation Rate |
|---|---|---|---|
| **Period** | Activations | Violations | |
| **Pre** | 720 | 544 | 0.76 |
| **Post 1** | 702 | 415 | 0.59 |
| **Post 2** | 700 | 299 | 0.43 |

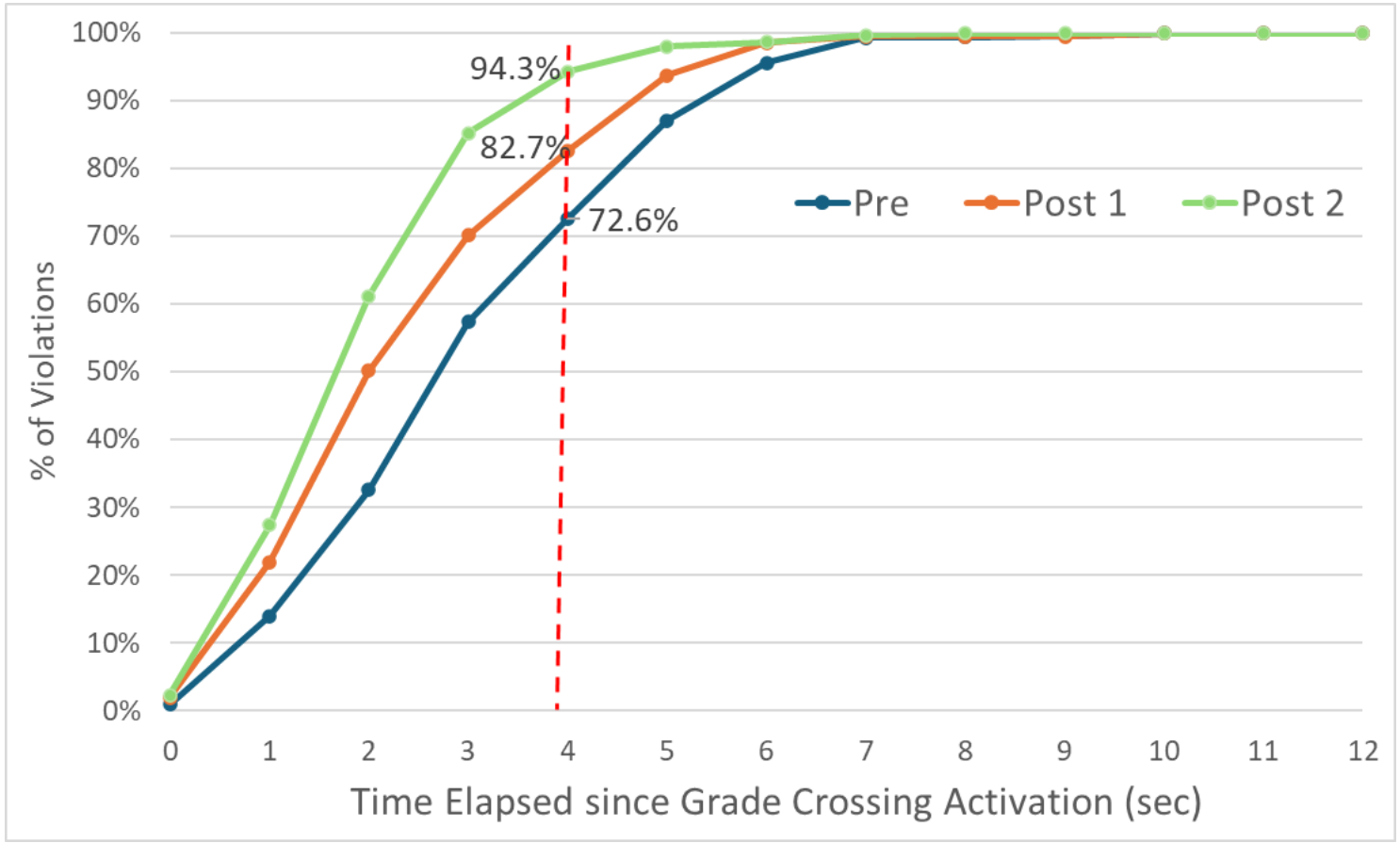



- *Type I: Vehicle traversed the crossing while lights were flashing but before gates started descending (first four seconds of the activation).*
- ***Type II: Vehicle traversed the crossing while gates were descending (subsequent 8 seconds of activation).***

# Grade Crossing Flashers Research

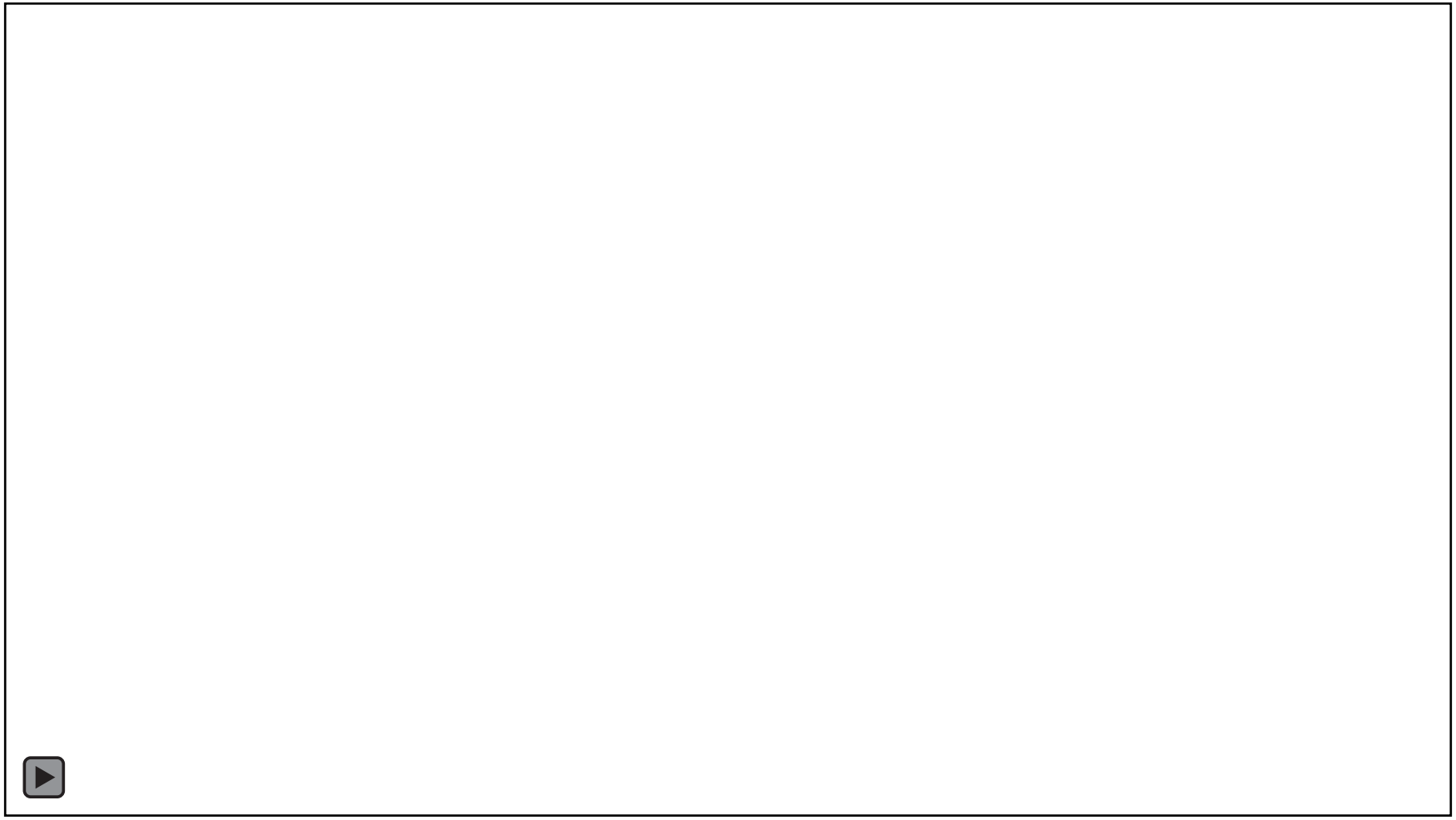
## ❑ Results (Phase II: replacing 4” gate-mounted flashers)

- Less violations occurred later into the activation after the installation of the rapid flashers in Phase II.
  - **32% decrease** in average time of violation (time elapsed since start of the grade crossing activation)
    - Pre: 27% of violations were Type II
    - Post 2: 6% of violations were Type II




- *Type II: Vehicle traversed the crossing while gates were descending (subsequent 8 seconds of activation).*

# Grade Crossing Flashers Research



# Grade Crossing Flashers Research

# ENS Signage Research

- Problem: Lack of public awareness of Emergency Notification System (ENS) signage at crossings.
- Research: Evaluate the effectiveness of increasing the size of the ENS sign and adding a “NOTICE” sign (MUTCD W16-18P).
- Field testing in progress
  - 7 crossings on MBTA (installed in Fall 2024)
    - Comparison of before/after call data for those crossings
  - Installation on 15 CN crossing in IL, 27 Amtrak crossings in Michigan (2025-2026)


*Project Partners: FRA, FHWA, Massachusetts Bay Transportation Authority, Amtrak, Canadian National Railway*

# ENS Signage Research

49 CFR 234.301
Emergency Notification System is a *system* in place by which a railroad receives, processes, and responds to telephonic reports of an unsafe condition at a highway-rail or pathway grade crossing.

# ENS Signage Research

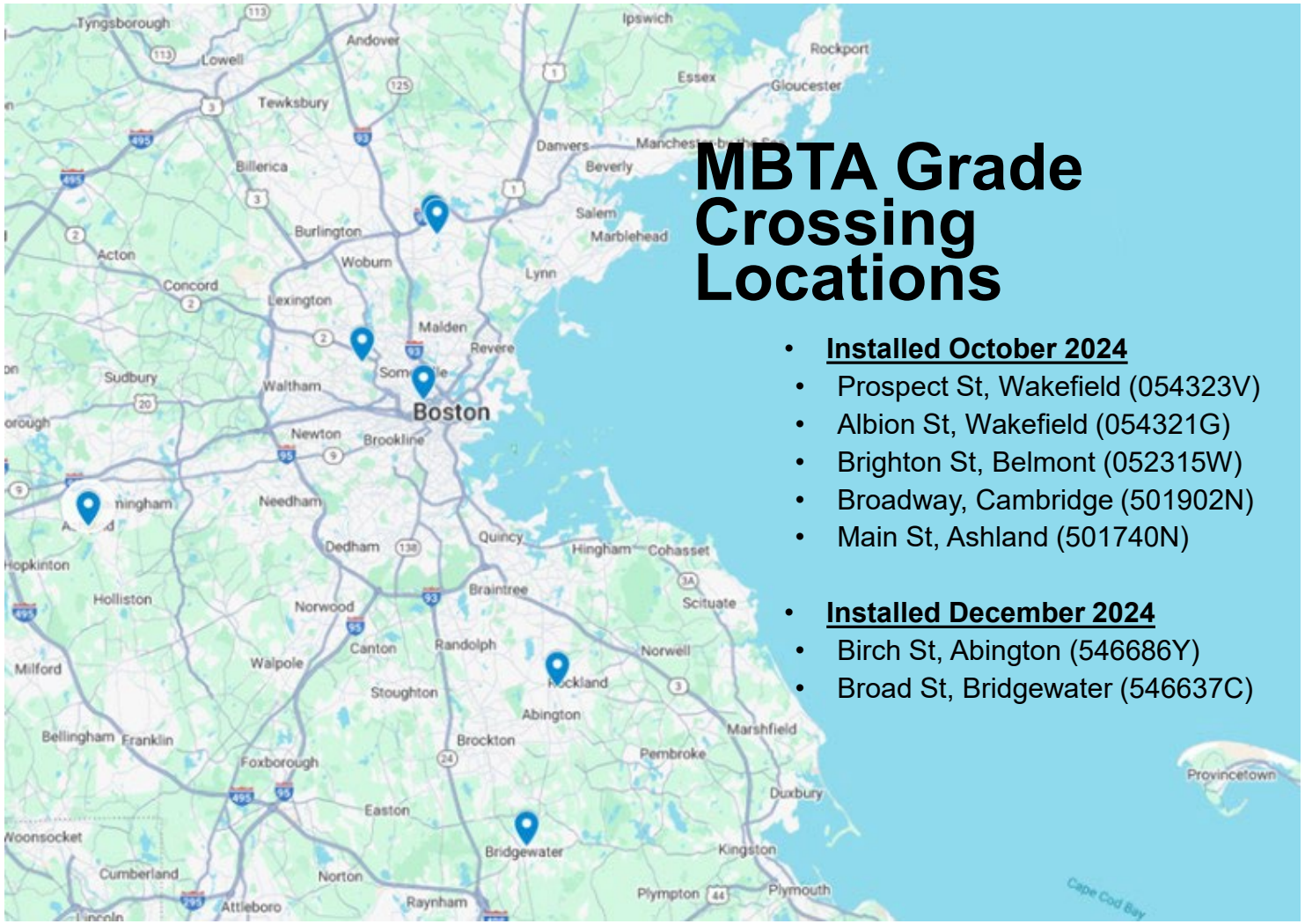
To evaluate the effectiveness of increasing the size of the sign and adding a “NOTICE” sign (MUTCD W16-18P).

- 11th Edition of the MUTCD updated (8B.27 paragraph 13); NOTICE plaque W16-18P can be added to the ENS sign
- Addition of the NOTICE sign may increase ENS sign visibility to the public. To this end, Volpe is supporting FRA in partnering with the MBTA, Amtrak, and CN to evaluate the impact of adding these signs on ENS sign visibility.
- Study center on analyzing before and after call rates from the public to the emergency numbers to determine effectiveness


12" x 9" ENS sign


24" x 18" ENS sign with NOTICE plaque

# ENS Signage Research




## MBTA Grade Crossing Locations

- **Installed October 2024**
  - Prospect St, Wakefield (054323V)
  - Albion St, Wakefield (054321G)
  - Brighton St, Belmont (052315W)
  - Broadway, Cambridge (501902N)
  - Main St, Ashland (501740N)
- **Installed December 2024**
  - Birch St, Abington (546686Y)
  - Broad St, Bridgewater (546637C)

# ENS Signage Research

Before


After


**Birch St, Abington MA (546686Y)**

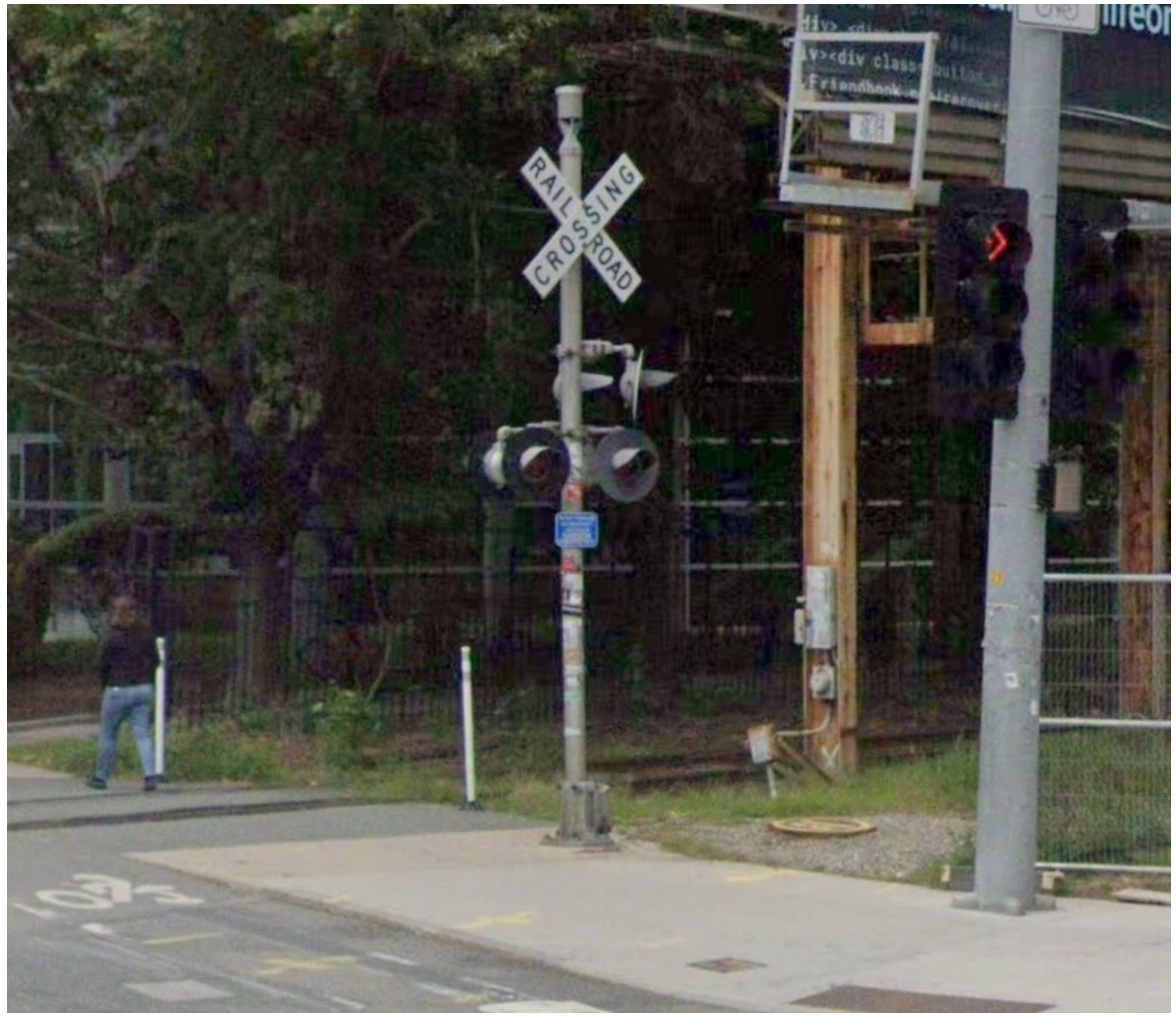
Before


After


**Prospect St, Wakefield MA (054323V)**

# ENS Signage Research

Before

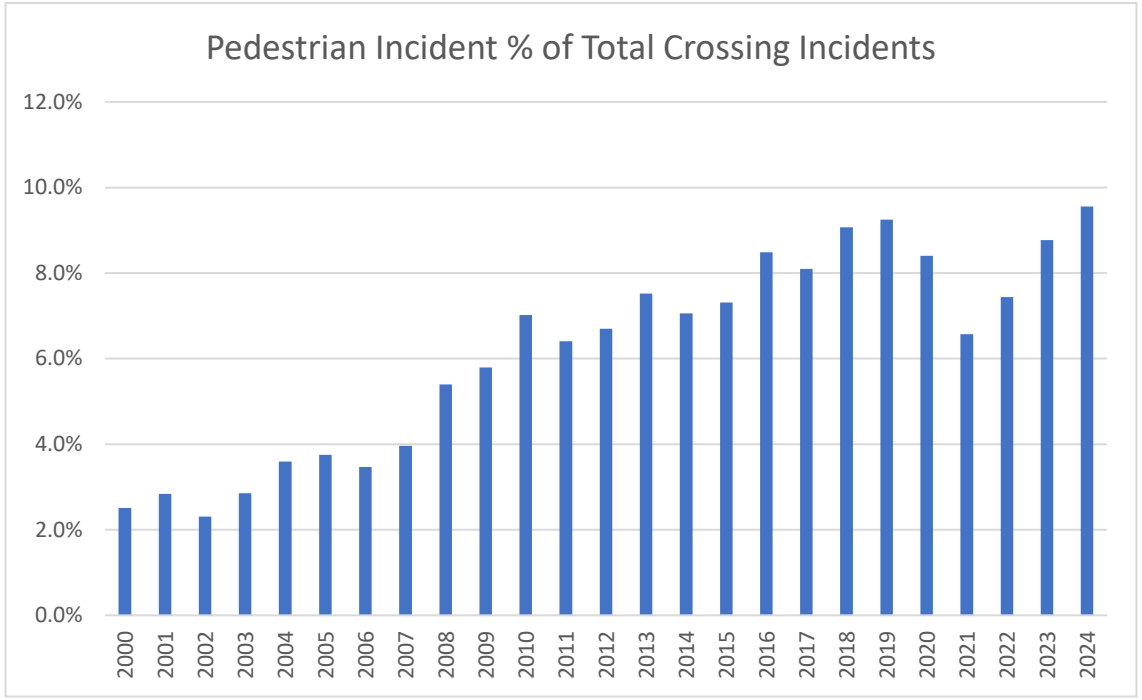



After


**Broadway, Cambridge MA (501902N)**

# Pedestrian Grade Crossing Violation Detection and Warning

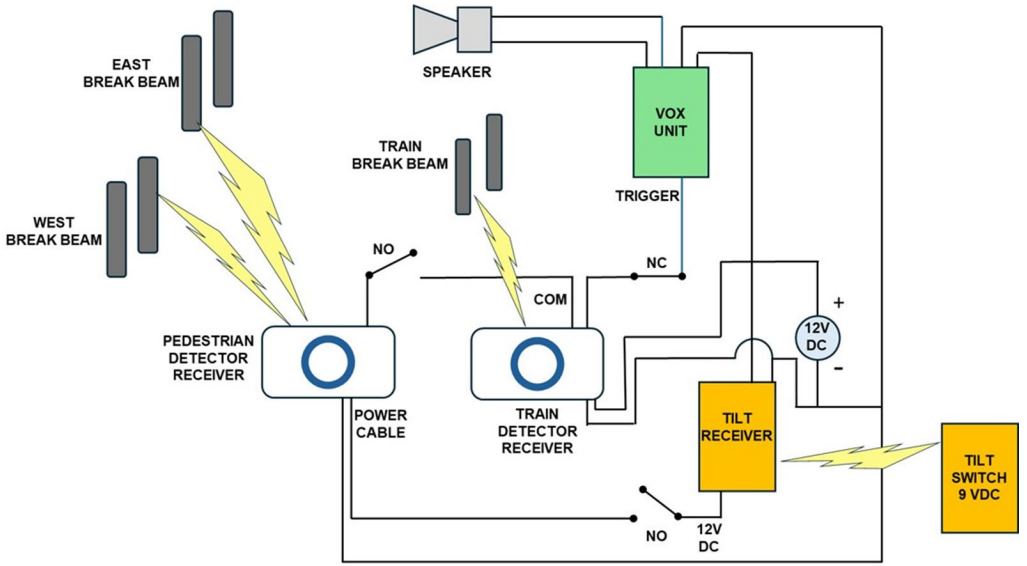
- Risky pedestrian behavior at actively protected at-grade crossings is a significant safety problem.
- Fatalities at crossings have increased by almost 75% over the most recent 10-year period (2015-2024), registering 66 fatalities in 2015 versus 115 fatalities in 2024.
- In 2024, about 44% of fatalities at highway-rail grade crossings involved pedestrians. In 2015, this figure was about 28%.



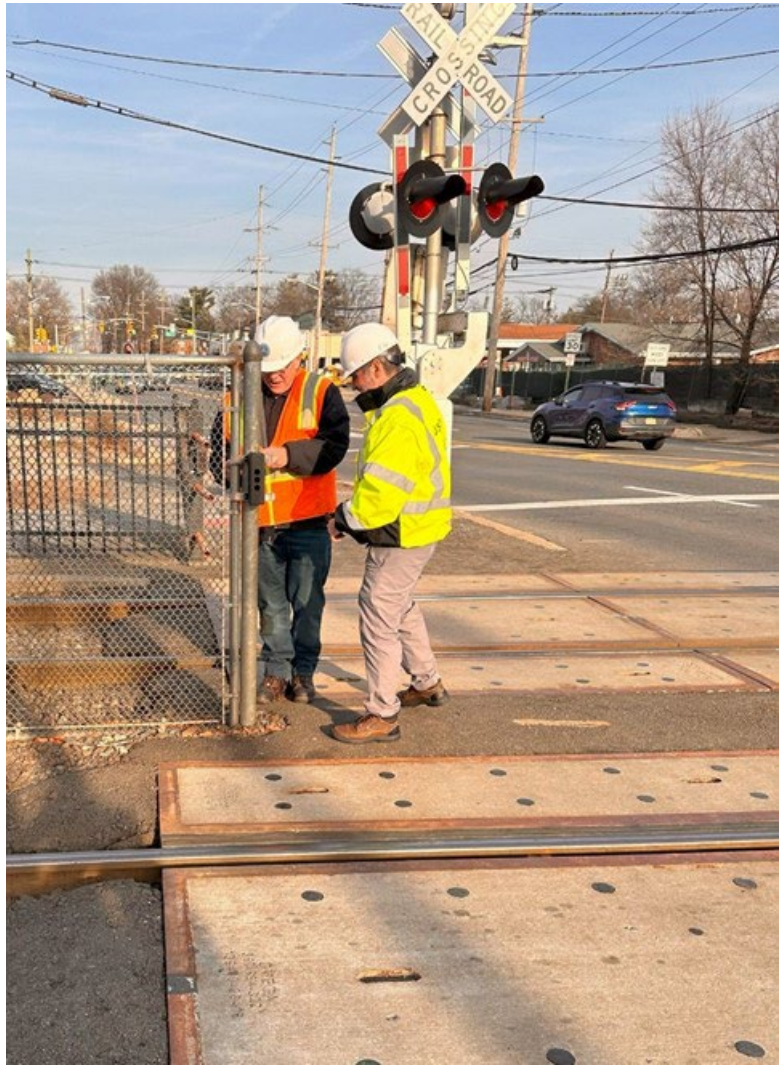

# Pedestrian Grade Crossing Violation Detection and Warning

## Objective:

- Develop and demonstrate a portable, low-cost, stand-alone (not tied into grade crossing circuitry), pedestrian detection and warning system using Commercial off-the-shelf (COTS) technology.
  - Evaluate the ability of a wireless tilt switch mechanism attached to a gate arm to detect grade crossing activations.
  - Test the effectiveness of a break beam sensor to detect pedestrian grade crossing violations.
  - Test the operation of an automated verbal warning component.



# Pedestrian Grade Crossing Violation Detection and Warning





# Pedestrian Grade Crossing Violation Detection and Warning

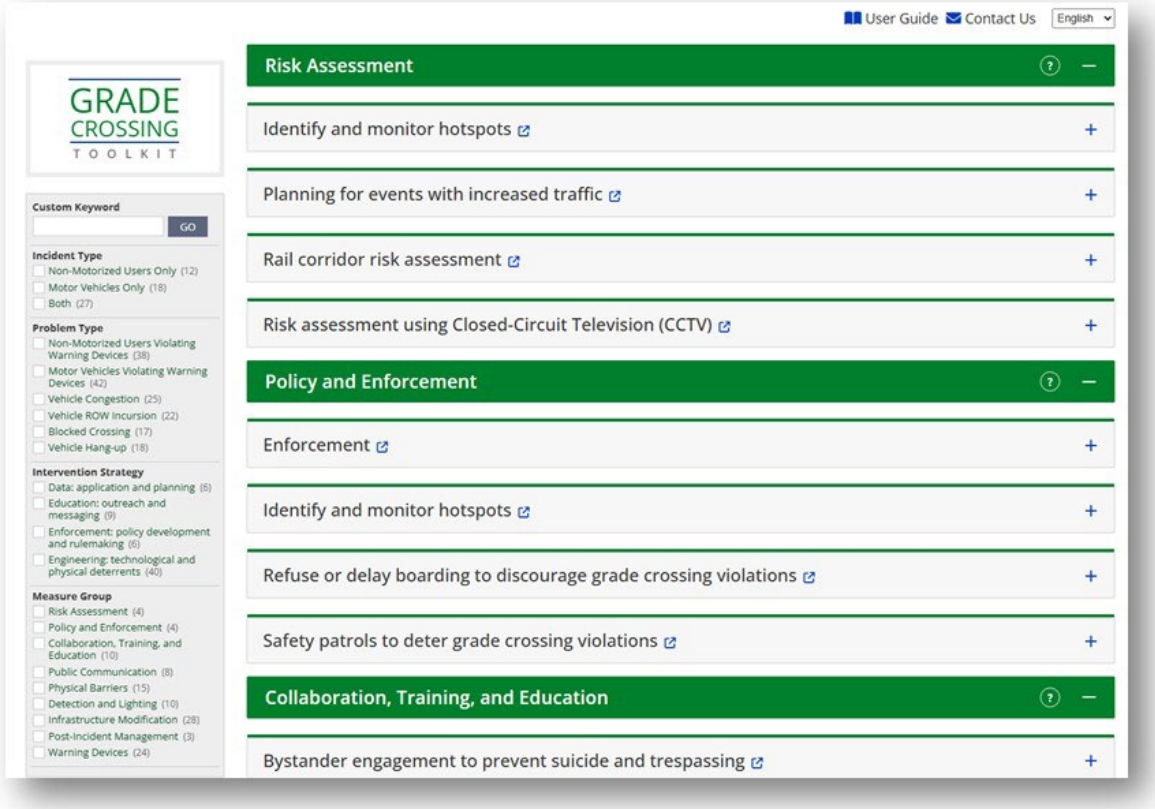
Results:

- Tilt switch mechanism was able to detect all grade crossing activations.
- The system broadcast a verbal warning message every time a violation was detected.
  - The system latency (time between beam break and message broadcast) was observed to be one second.
- Removing events that the system was not designed to capture (violators in the rail ROW or traversing the crossing when train was blocking the train sensor), the system had a **detection rate of about 95 percent**.

# Pedestrian Grade Crossing Violation Detection and Warning

# FRA Resource: Grade Crossing Toolkit

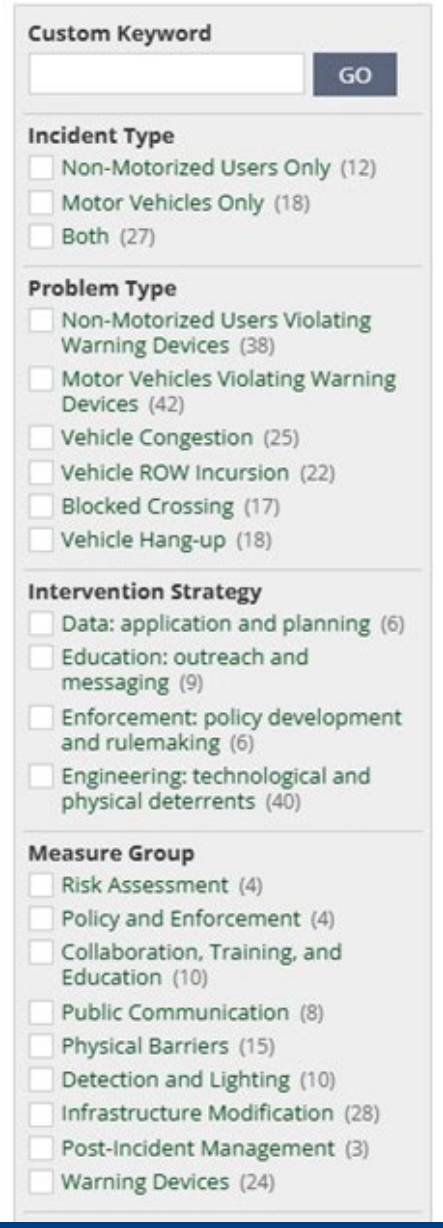
- Interactive resource to help identify relevant and effective strategies and measures (57 measures to date).
- Provides summarized information about potential strategies and measures and evidence of effectiveness and examples of lessons learned.
- Contains guides, noteworthy practices, and research results on implementation of a wide range of grade crossing safety treatments.




https://gradecrossingtoolkit.fra.dot.gov/

# FRA Resource: Grade Crossing Toolkit

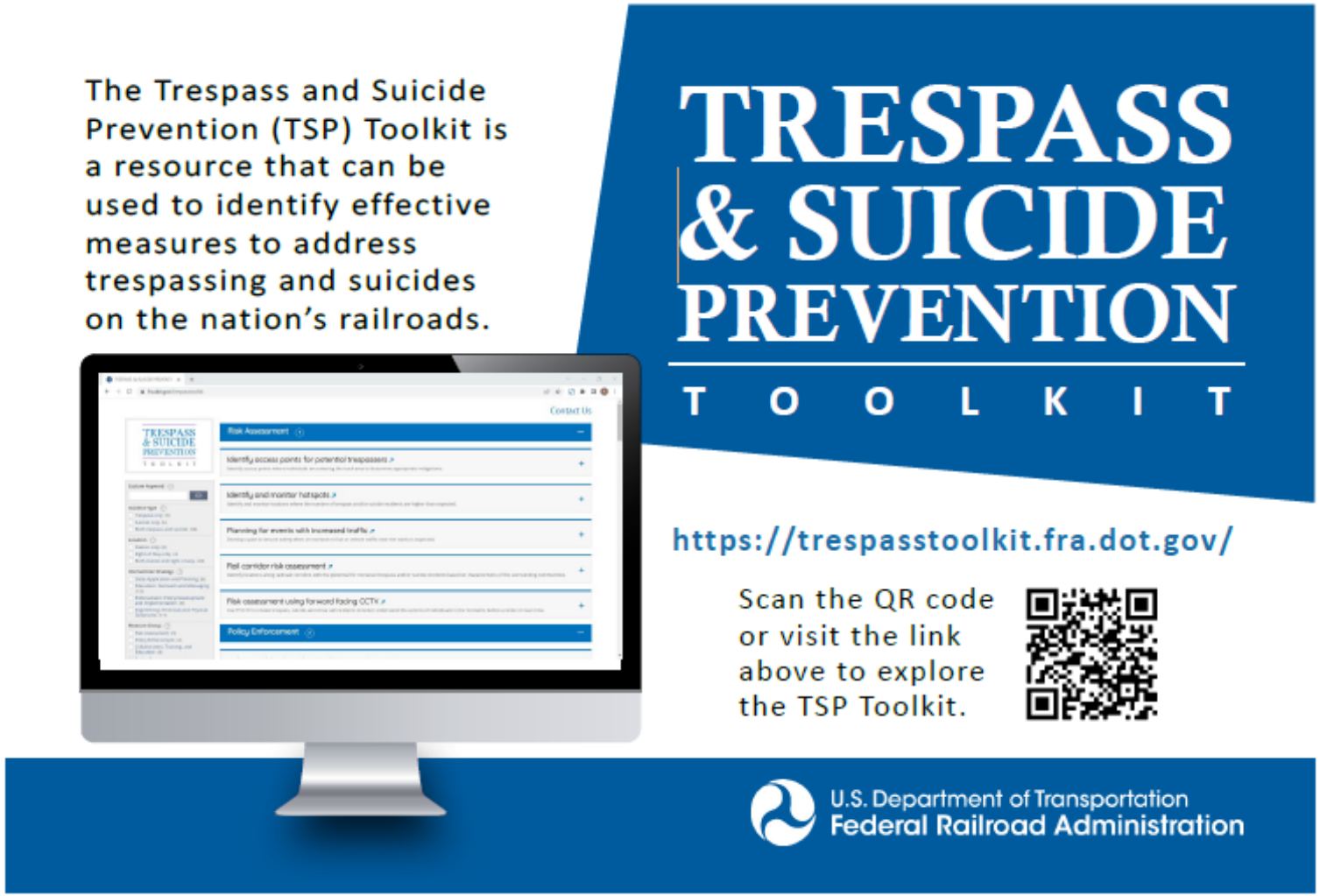
- 57 measures to date
- Navigation with filters and custom search
- Summarized insights with links to more detailed information and documents such as guides, noteworthy practices and research results




GRADE CROSSING TOOLKIT

https://gradecrossingtoolkit.fra.dot.gov/

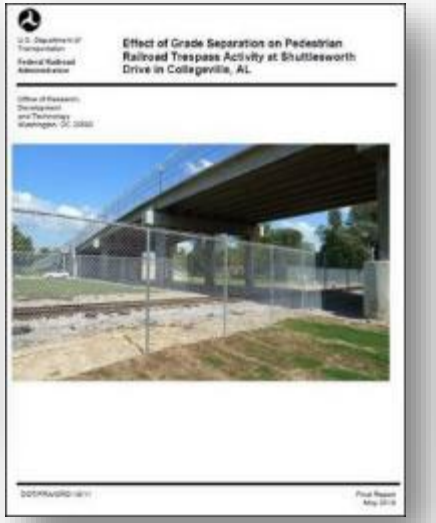
# FRA Resource: Trespass and Suicide Prevention Toolkit

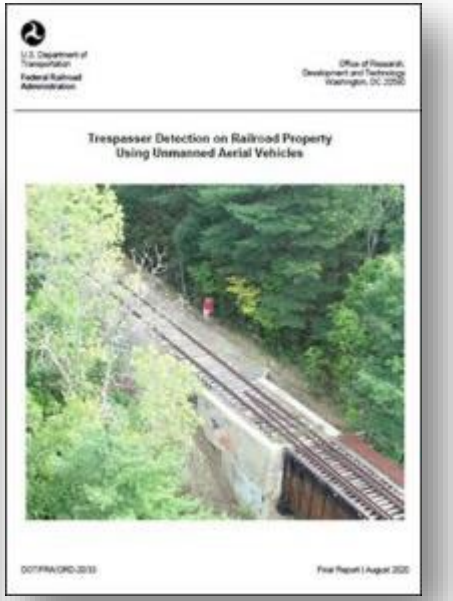



https://trespasstoolkit.fra.dot.gov/

# FRA Resource: Crossing and Trespass Prevention Research

- FRA Research Repository: https://railroads.dot.gov/elibrary-search
- RosaP: https://rosap.ntl.bts.gov/



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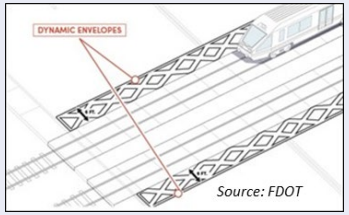
# Sample Products and Impact: research-driven implementation

| Research Topic | Product | | Impact | Partners | Implementation |
|---|---|---|---|---|---|
| **Vehicle ROW Incursion Prevention** | **Pavement markings** through the crossing and reflective markers and flexible delineators on both sides and in between the tracks |  | **85% reduction** in frequency of vehicles turning onto the tracks in initial FRA/Volpe study (2016-2018)<br><br>**86% train delay reduction** in FRA/Volpe study of LIRR implementation (2018-2019) | SunRail, LIRR, Volpe | Systemwide implementation by LIRR (296 crossings) upon initial study (2018)<br><br>Brightline installation 2022-2023<br><br>MBTA (2023), CT DOT (2027), others… |
| **Vehicles Stopping on Tracks** | Pavement markings on the **dynamic envelope zone** and signage on approach |  | **15% decrease** in vehicles stopping on tracks in FRA/Volpe study (2012-2014) | Florida DOT, Volpe | Florida DOT: 620 crossings (2020); CRISI funding<br><br>Brightline: 333 crossings (2022-2023, RAISE funding)<br><br>MBTA, others… |
| **ROW Trespassing** | Development and implementation of a dedicated **Railroad Trespassing Enforcement Grant Program** (law enforcement grants for railroad trespassing). |  | Pilot project allowed law enforcement agencies to dedicate resources to rail trespassing enforcement in four communities. Most communities saw a decrease in the number of trespassers encountered per patrol, indicating a positive reduction in the number of trespassers along the ROW. FRA/Volpe study (2017-2020)<br><br>Efforts through the implemented grants program since the pilot study have **saved 12+ lives** since 2020. | Pilot study: Palm Beach County Sheriff's Office (FL), Worcester (MA), North Tonawanda (NY), Brighton (NY) | Establishment of a dedicated Railroad Trespassing Enforcement Grant Program<br><br>2020 Law Enforcement Grant Program: 11 grants, 8 States, 3K+ trespasser encounters, **3+ LIVES SAVED**<br><br>2022 Law Enforcement Grant Program: 25 grants, 15 States, 2.5K trespasser encounters (as of Jan 2024), **12+ LIVES SAVED** (ongoing program) |