



Pedestrian and Bicycle Information Center

Global Benchmarking Webinar Series:
Improving Pedestrian Safety on Urban Arterials (Part 3)

Safe System Approach to Road Safety Audits

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Housekeeping

- ⇒ **Submit your questions**
- ⇒ **Webinar archive: www.pedbikeinfo.org/webinars**
- ⇒ **Certificates and professional development hours**
- ⇒ **Follow-up email later today**
- ⇒ **Review previous episodes and sign up for upcoming sessions**

Improving Pedestrian Safety on Urban Arterials

Part 1 Sept 25, 2023
**Introduction and Overview
of Study Findings**

Part 2 Oct 2, 2023
**The Movement and Place
Framework**

Part 3 Oct 23, 2023
**Safe System Approach to
Road Safety Audits**

Part 4 Nov 7, 2023
**Speed Management
Policies and Practices**

PBIC Webinar Series #3: Road Safety Audits

International Study Findings Pedestrian Safety on Urban Arterials

U.S. DOT Federal Highway Administration
Office of International Programs
October 2023



Source: USDOT/Getty



U.S. Department of Transportation
Federal Highway Administration
Office of International Programs

Recap: Study Team Overview



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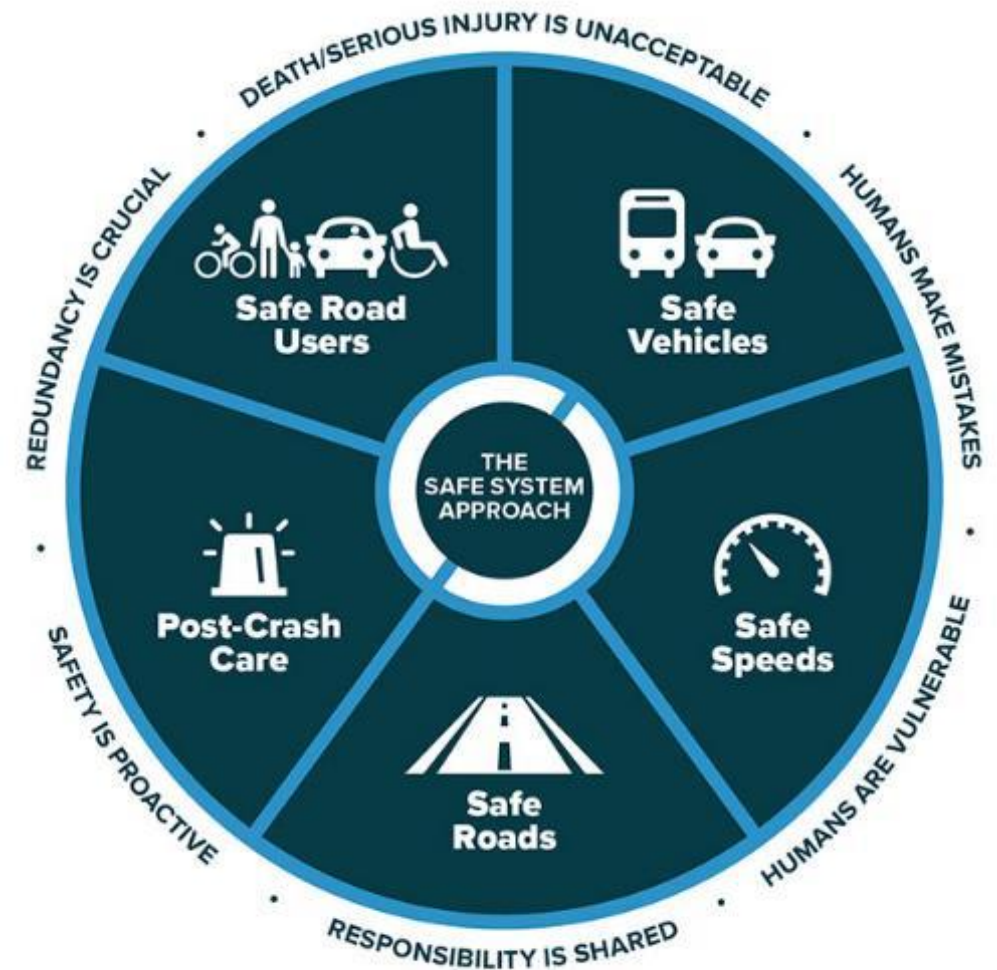
Jonah Chiarenza
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Recap: Core Factors to Improve Safety



- **Reduce vehicle speed to mitigate kinetic energy**
using geometric design and operational strategies, including emerging technologies like camera enforcement
- **Separate vulnerable road users from motorized vehicles in time and space**
when vehicle speeds exceed survivable levels
- **Design roads and streets to suit their desired context**
considering future land use, as well as economic, climate, public health, and equity goals



Source: FHWA.



U.S. Department of Transportation
Federal Highway Administration

Office of International Programs

Recap: Design & Implementation Takeaway



Pedestrian Safety Challenges Require Proactive and Interdisciplinary Solutions

- ***Designing roads and streets that are safe for pedestrians and other vulnerable road users requires proactive and intentional solutions.*** The design and implementation of projects at all scales – network, corridor, and block – must contribute to a holistic vision that recalibrates modal priorities and is rooted in the Safe System approach. This means designing a transportation system that recognizes humans will make mistakes and mitigates negative outcomes by managing speed, changing roadway designs, and influencing user behavior.
- Communities cannot effectively address discrete transportation issues – safety, equity, public health, congestion, freight – in isolation. ***Sustainable solutions to these issues require analytical tools and multidisciplinary practitioners who can work outside of their silos to analyze the tradeoffs*** between different modal emphases through a rational, systemic approach.



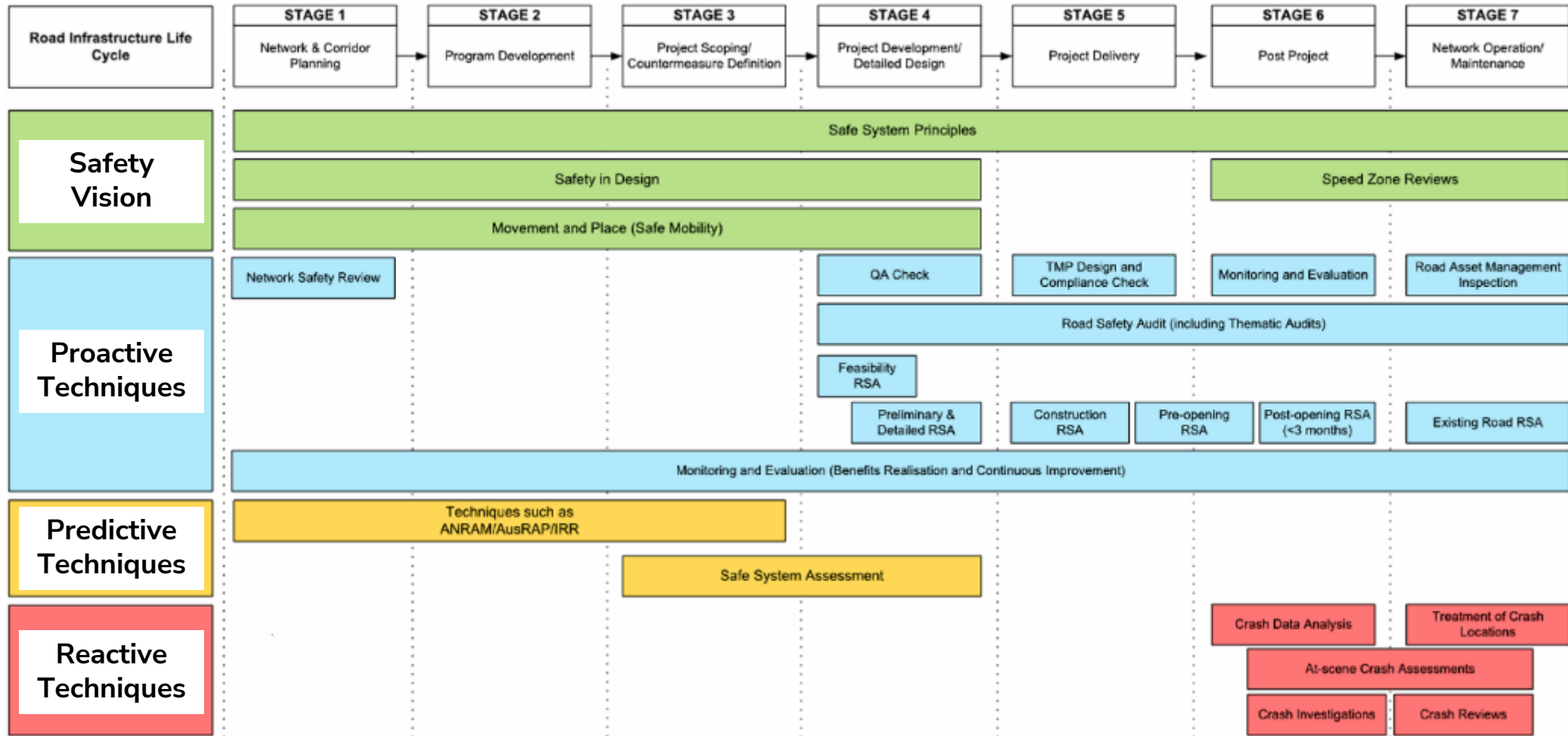
Recap: Bake in Safety through Road Safety Audits



Systemic Approach

Span all stages of the project lifecycle:

1. Network / corridor-scale planning
2. Programming
3. Scoping / developing countermeasures
4. Project development / detailed design
5. Project delivery
6. Post project
7. Network operation / maintenance



Back to Basics: What is a Road Safety Audit?



“A Road Safety Audit is a **systematic** method of checking the safety aspects of new road improvement schemes. The term is generally considered to refer to a formal **independent and multi-disciplinary** detailed assessment of the safety performance of all new highway and traffic management schemes, including modifications to existing layouts, and are **undertaken at different stages** during the design, planning and construction process.”



NZ Approach: Institutionalizing RSAs

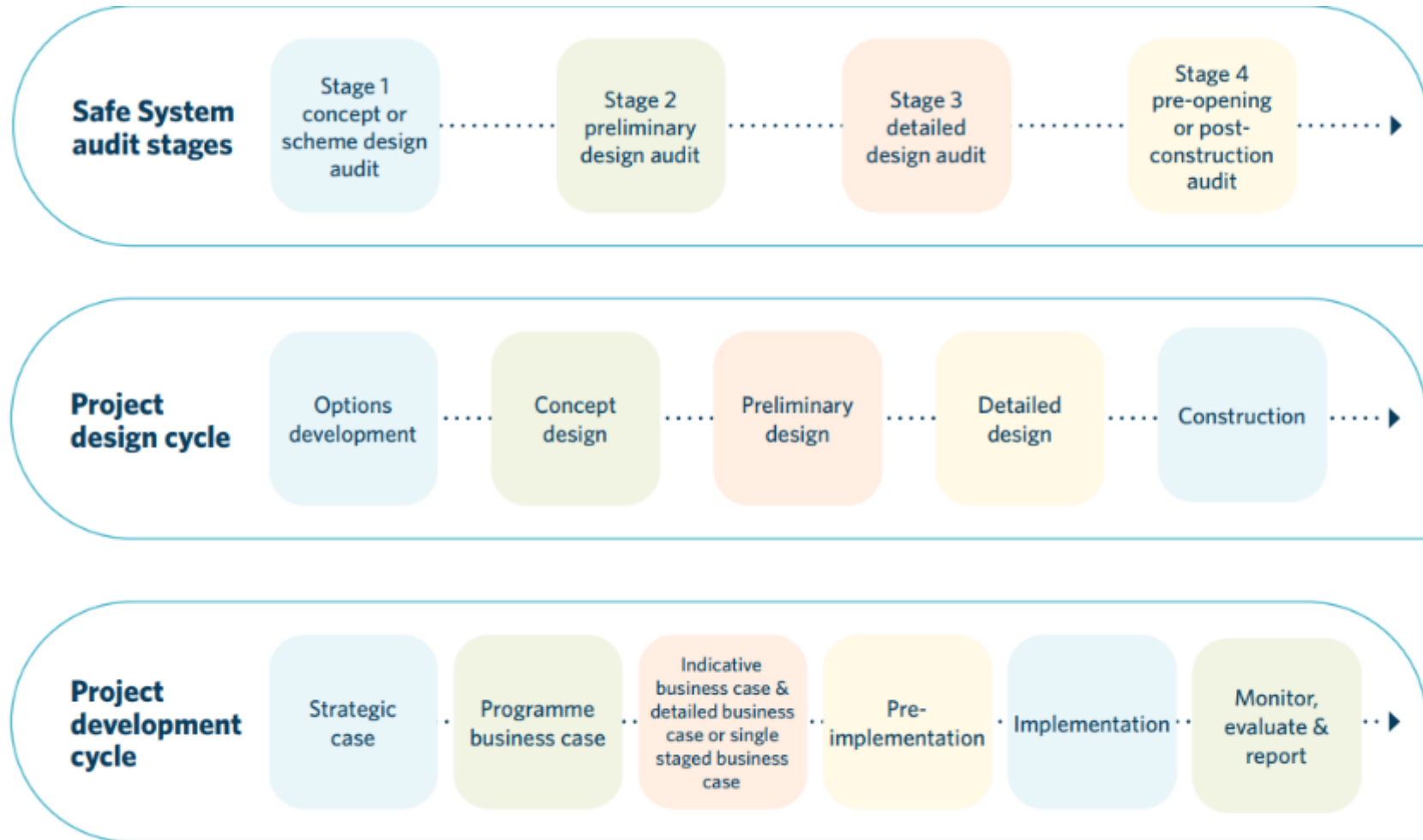


Figure 3: Safe System audit stages within project development



NZ Approach, cont'd

- Specific process
- Well-defined roles
- Multidisciplinary team
- Training/certification support

Safe System audit process steps		Role responsible
Confirm audit stage	Identify project audit stage required or complete exception form	Client
Audit team selection	Select the Safe System audit Team Leader and team members including observers	Client/Safe System audit team leader
Safe System audit brief	Provide the Safe System audit team a brief including all relevant project information	Client/designer
Commencement meeting	Hold	Client/designer/Safe System audit team
Review of project background documents	Assess all necessary documents	Safe System audit team
Project site inspection	Identify project audit stages requires or complete exception form	Safe System audit team
Debrief meeting	Identify project audit stages requires or complete exception form	Client/designer/Safe System audit team
Report writing	Complete audit report and forward to client	Safe System audit team
Designer response to report	Designer provides responses to safety concerns raised within report	Designer
Road safety engineer response to report	Road safety engineer provides responses to safety concerns	Road safety engineer
Client decision	Client reviews comments, responses and make decisions	Client
Complete report with decisions	Complete audit tracking within report and feedback response to designer and Safe System audit team	Client
Implement client decision	Document final actions and finalise audit tracking	Client

Figure 4: The steps in a road safety audit



Austrads Example

- Pre-construction assessment
- Articulates the potential for **exposure** to risk, **likelihood** of a crash or crash type, and **severity** of injury
- References standards/guidelines

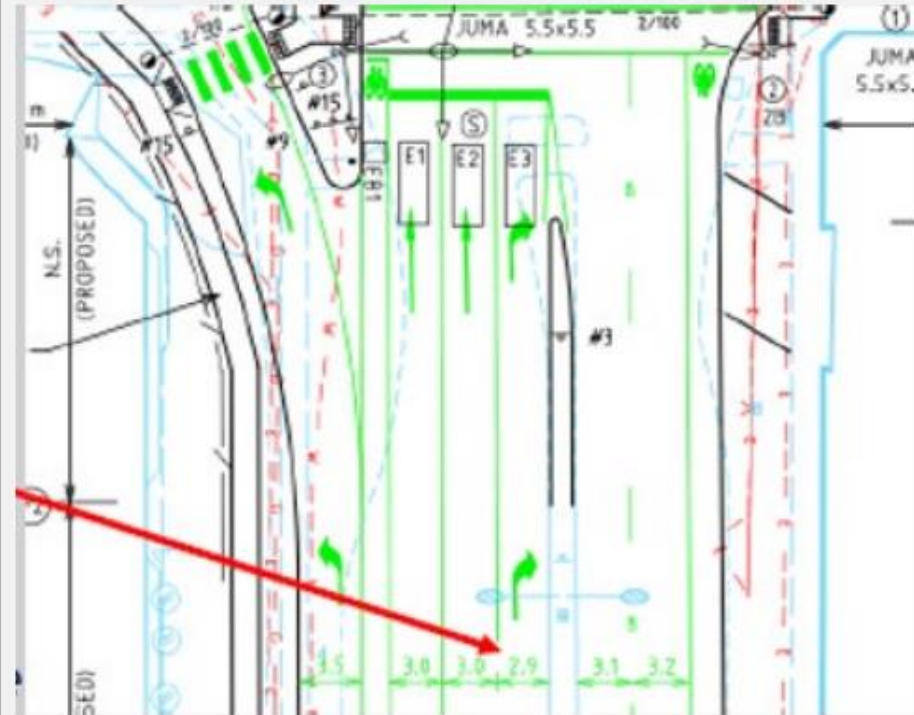
Getting it right! (a good practice example – expressing risks and hazards identified during an RSA)

Poor example – ‘the right-turn bay is too narrow’

Reasonable example – ‘the right-turn bay from Main Road to Side Road is too narrow, which increases the potential for side-swipe or rear-end type crashes. The Austrads design Guide states that the minimum traffic lane width should be 3.3 m’.

Good/preferred example – ‘the right-turn lane from Main Road into Side Road is not wide enough to adequately store right turning vehicles, which could result in vehicles encroaching into the same-direction traffic lane while either performing the turning manoeuvre or waiting in the lane, especially if more than one vehicle is queuing. This will increase potential for sideswipe or rear-end crashes, particularly in wet weather and at night. Austrads road design Guide also states that the minimum traffic lane width should be 3.3 m. The traffic volumes are high, it is in a 60 km/h speed zone and the concern is likely to occur occasionally with likely minor injuries resulting.

The area of concern is shown here:



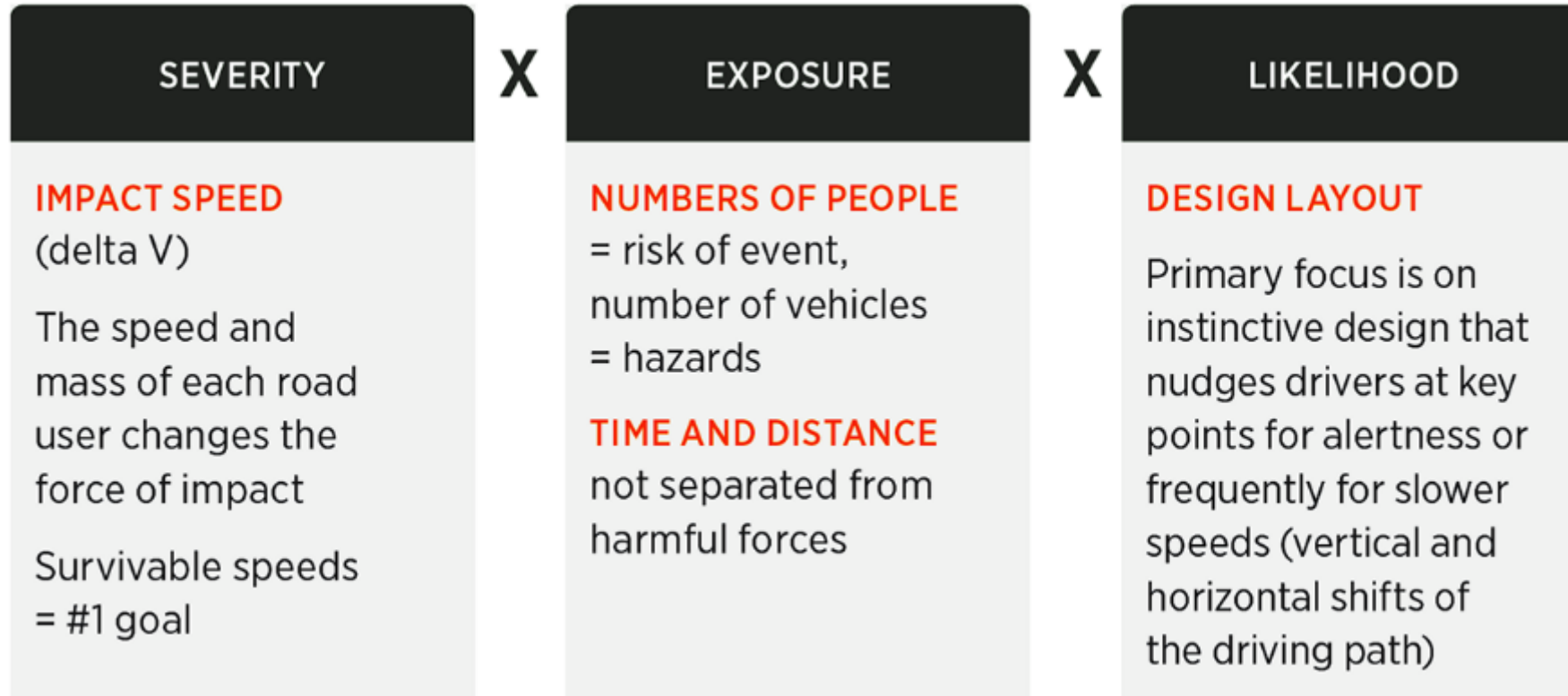
The example given is preferred as it clearly states the:

ISSUE, CRASH TYPE, RISK FACTORS and REFERS TO STANDARDS/GUIDELINES

Source: acknowledgement Safe System Solutions Pty Ltd



Key RSA Safety Considerations



Linking Problems to Treatments



Table 3.1: Examples of pedestrian treatments based on treatment hierarchy

Hierarchy	Treatment	Influence (E = exposure, L = likelihood, S = severity)
Safe System options (primary treatments)	<ul style="list-style-type: none"> • Separation (footpath) • Separation (crossing point) • Very low speed environment, especially at intersections or crossing points 	E L L, S
Supporting treatments (compatible with future implementation of Safe System options)	<ul style="list-style-type: none"> • Reduce speed environment/speed limit • Pedestrian refuge • Reduce traffic volume 	L, S L E, L
Supporting treatments (does not affect future implementation of Safe System options)	<ul style="list-style-type: none"> • Pedestrian signals • Skid resistance improvement • Improved sight distance to pedestrians • Improved lighting • Rest-on-red signals 	L L L L L, S
Other considerations	<ul style="list-style-type: none"> • Speed enforcement 	L, S

Source: Austroads, *Guide to Road Safety Part 6: Managing Road Safety Audits*

Note: The objective of the treatment hierarchy is to apply the primary treatments in a systematic, targeted way. Where it is not possible to apply these, or in the short term, other solutions should be used, working down through the options.





Road Safety Audits in CA



Road Safety Audit (RSA) – formal and independent safety performance review



Pilot Program to be released in June 2024



Develop Uniform Statewide Practice



Explore Project Screening and Funding Mechanisms



Train and Certify Auditors



Partner with Headquarters Divisions and District Offices



Safety Benefits:
10-60%
reduction in total crashes.¹



CA Road Safety Audit Example



District 3, Colusa County, Route 20, Postmile 0.00 – 22.10



Completed a Road Safety Audit in April 2022



Developed short-term, mid-term, and long-term safety enhancements



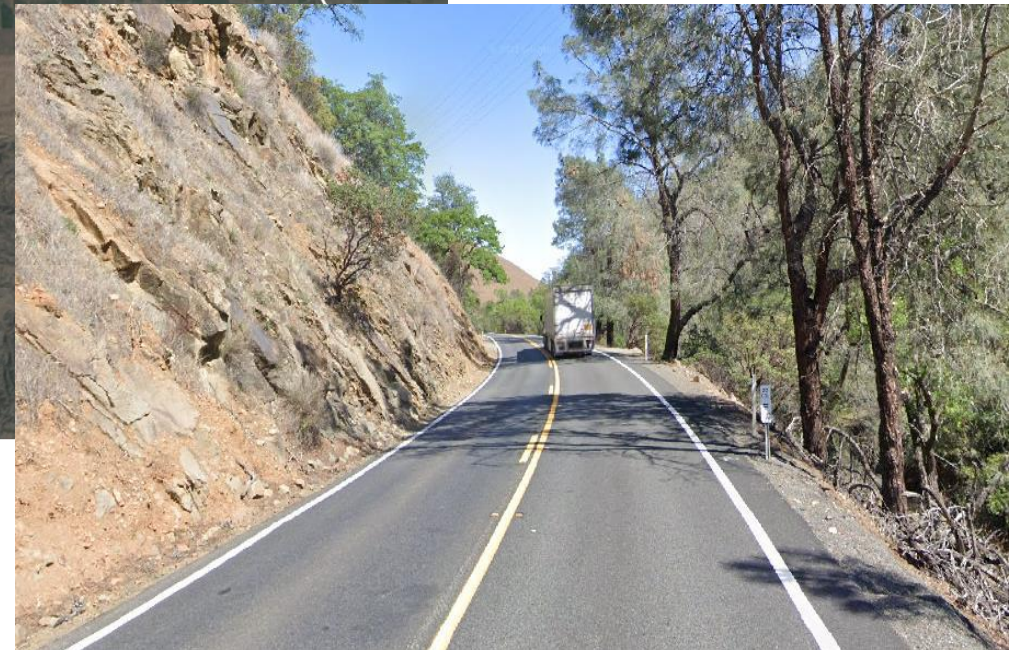
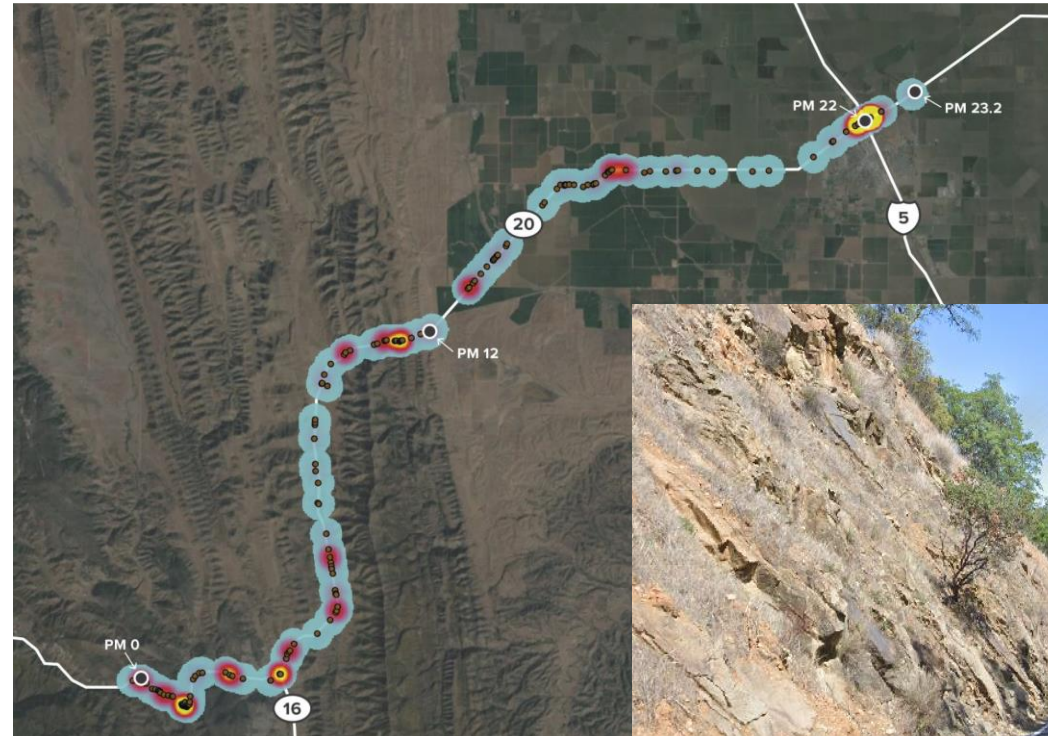
Scoped Safety Project



Approved for HSIP Reactive Program, Cost \$30,000,000



Construction Begins Fall 2026



Road Safety Audits in the U.S

Where are we?



Source: USDOT/Getty



U.S. Department of Transportation
Federal Highway Administration
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US Road Safety Audit State of the Practice



- RSAs were adopted in the U.S. because of a previous Global Benchmarking Scan.
- FHWA Proven Safety Countermeasure.
- NCHRP Synthesis Project 20-05, Topic 54-03, “DOT Practices on Road Safety Audits.”
- NCHRP Project 17-125, “Incorporating the Safe System Approach into Road Safety Audits.”



Safety Benefits:

10-60%

reduction in total crashes.¹



Multi-disciplinary team performs field review during an RSA.

Source: FHWA

Source: FHWA



U.S. Department of Transportation
Federal Highway Administration

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FHWA Goal from Global Benchmarking Study Tour



Advance the integration of modern, multimodal Road Safety Audit (RSA) processes into new projects.

- Develop a “Roadmap” and other resources to advance RSAs
- Undertake a synthesis of current practices. (NCHRP Synthesis)

GOAL: RSAs conducted through the lifecycle of a project



Source: FHWA

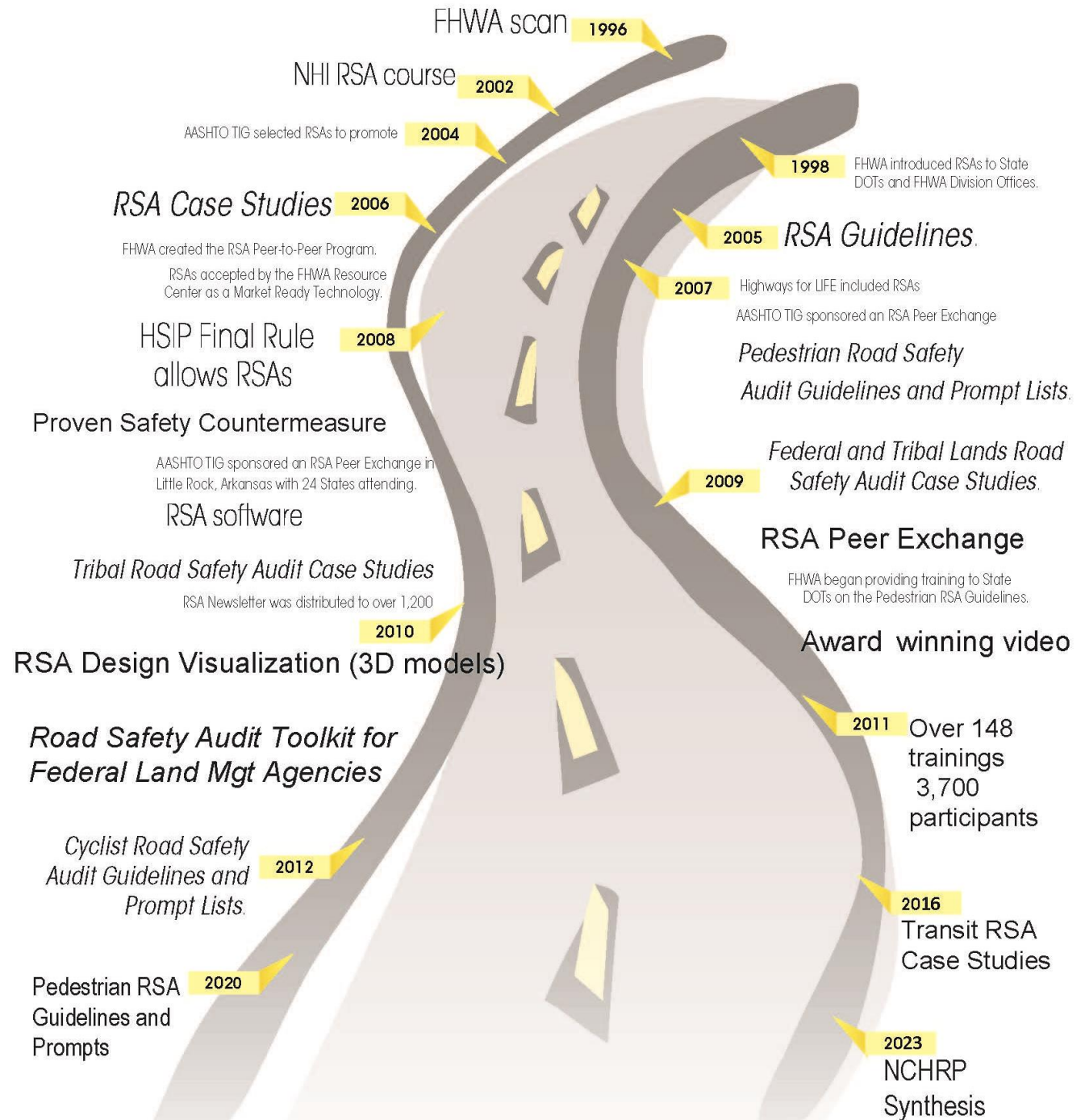


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RSA History in US



Resources:

<https://highways.dot.gov/safety/data-analysis-tools/rsa/rsa-resources>



- RSA Guidelines
- RSA Case Studies
- Pedestrian and Bicyclist RSA Guide and Prompt List
- RSA Toolkit for Federal and Tribal Lands
- An Evaluation of RSA Programs and Projects
- Using 3D Design Visualization in the RSA Process
- Road Safety Audits/Assessments Training (FHWA-NHI-380069) available through National Highway Institute

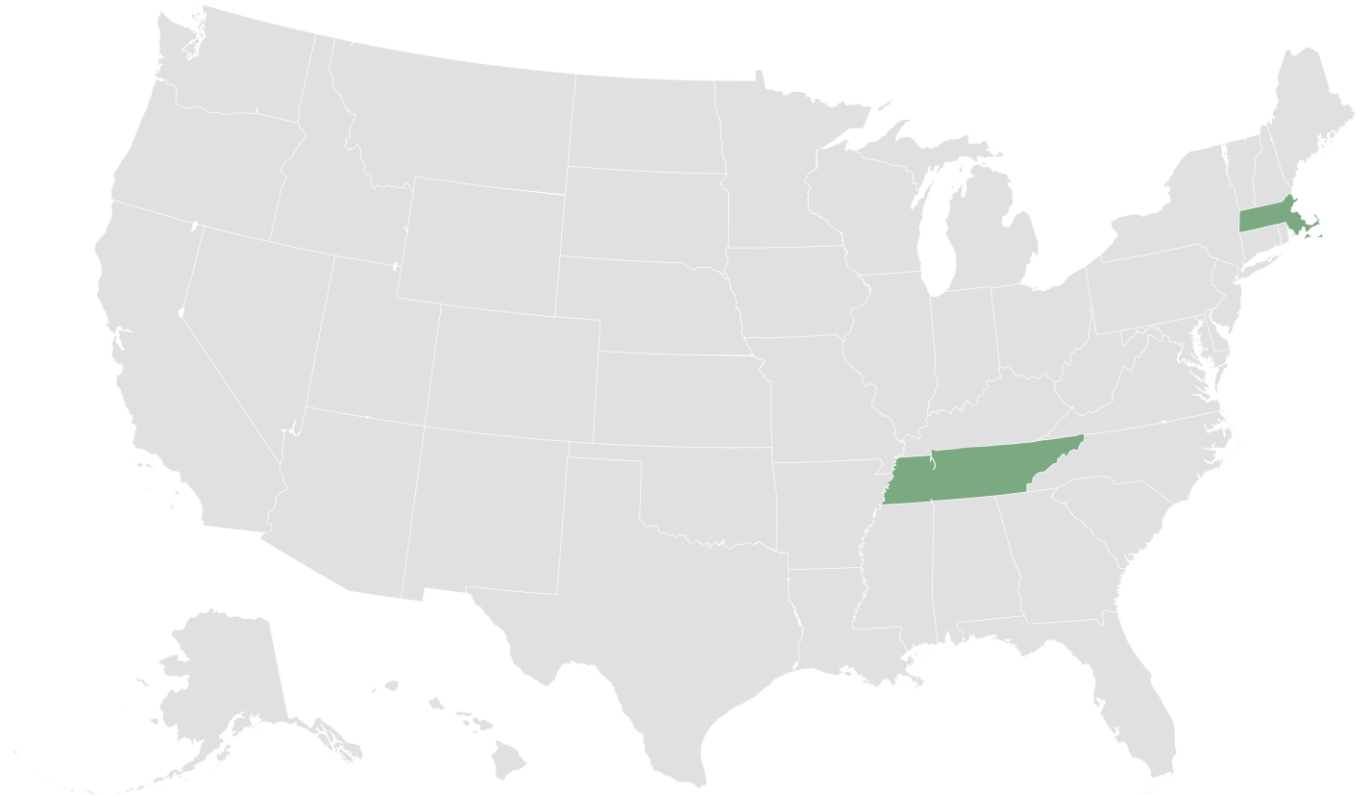


State Spotlight on Road Safety Audits



Chart Title

- Tennessee
- Massachusetts



U.S. Department of Transportation
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Thank you!



Source: USDOT/Getty

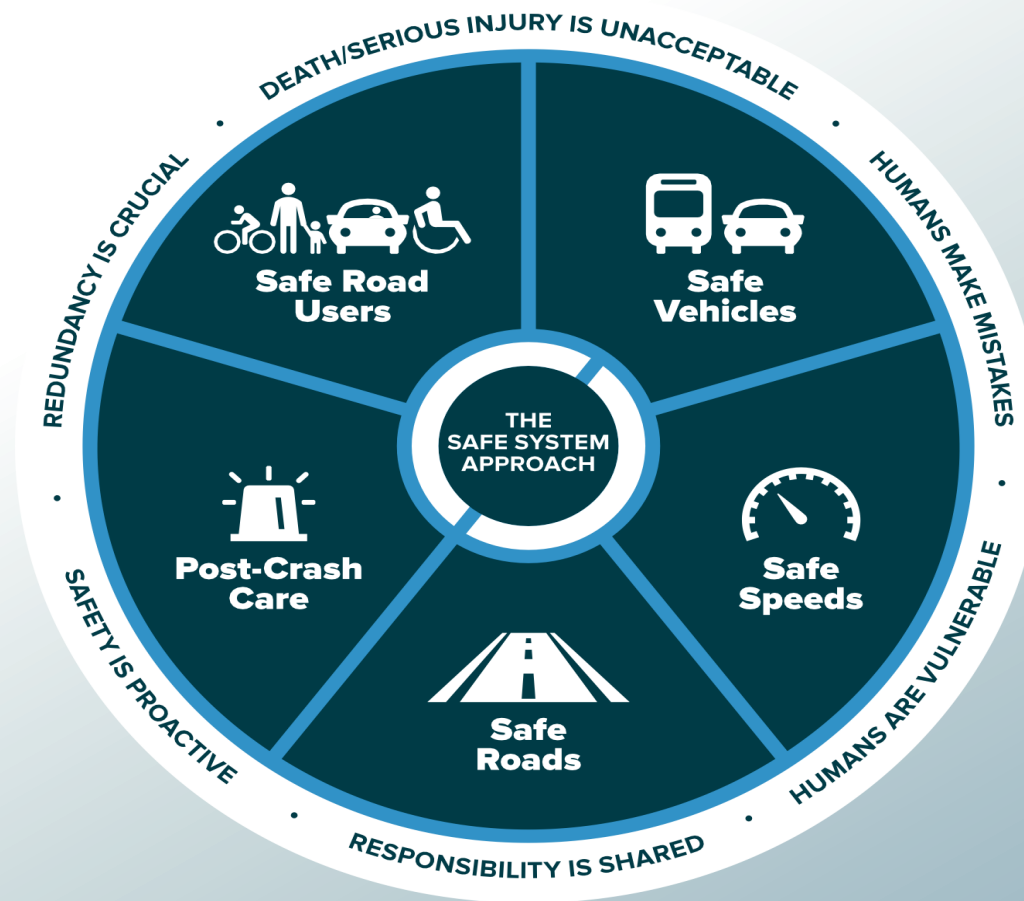


Tennessee (TDOT) Roadway Safety Audit Program (RSA)

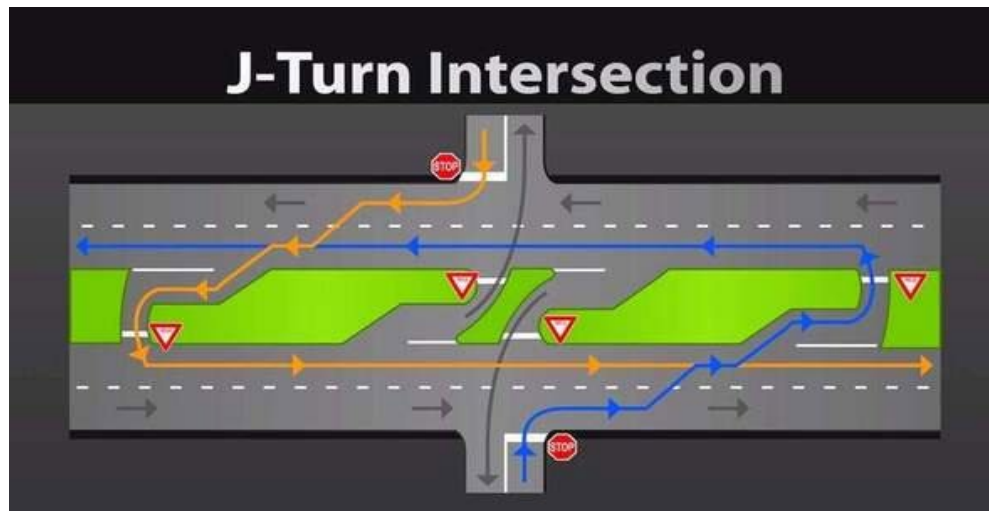


*Brandon Darks, Manager
Project Safety Office*

THE SAFE SYSTEM APPROACH



Innovative Design



Example: Roundabouts vs Signalized Intersections

		
Lower Speeds	✓	
Lower Impact Angles	✓	
Fewer Conflict Points	✓	

Is this why roundabouts are so effective at reducing severe crashes?
YES !!!



Source: Fehr & Peers

Manage speed



Source: City of Carmel, IN

Manage impact angles



Source: Fehr & Peers

Manage impact energy distribution

Focus on Vulnerable Road Users (VRU)



In addition to making East Boulevard in Charlotte, N.C., more attractive, a road diet reduced travel speeds, bicycle and pedestrian injury rates and the number of rear-end and left-turn collisions. Photo courtesy city of Charlotte



Separating users
in space



Separating
users in time



Increasing
attentiveness and
awareness

Safe System Applications

ROADWAY DEPARTURE



Wider Edge Lines



Longitudinal Rumble Strips and Stripes on Two-Lane Roads



Enhanced Delineation for Horizontal Curves

INTERSECTIONS



Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections



Backplates with Retroreflective Borders



Lighting

PEDESTRIANS/BICYCLES



Rectangular Rapid Flashing Beacons (RRFB)



Crosswalk Visibility Enhancements

TDOT –SHSP Emphasis Areas

Emphasis Area	Safe System Element
Crash Data and Analysis	Post-Crash Care
Infrastructure Improvements	Safe Roads, Safe Speeds
Operations Improvements	Safe Roads, Safe Road Users, Safe Speeds
Vulnerable Road Users	Safe Road Users
Commercial Vehicles	Safe Road Users
Driver Behavior	Safe Road Users, Safe Speeds

Highway Safety Improvement Program (HSIP)

- **Section 148 of Title 23, United States Code (23 USC 148)**

Achieving a significant reduction in traffic fatalities and serious injuries on all public roads, including non-State-owned public roads.

- **Strategic Highway Safety Plan (SHSP)**
- **All safety programs to use a data-driven process with set qualification criteria.**

Safety Data

HSIP Annual Report- submitted to FHWA

E-TRIMS: Tennessee Roadway Information Management System
TDOT Statewide database housing all roadway elements

AASHTO Safetyware- Numetric:

Early implementation:

Crash analysis
Network screening
Training

Tennessee Integrated Traffic Analysis Network (TITAN)

Collecting/analyzing crash data/crash rates for HSIP eligibility

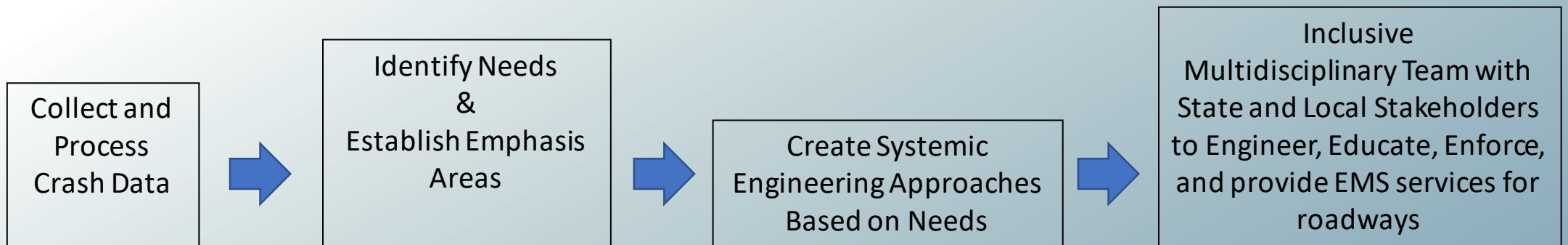
Strategic Highway Safety Plan (SHSP)



Highway Safety Improvement Program (HSIP)

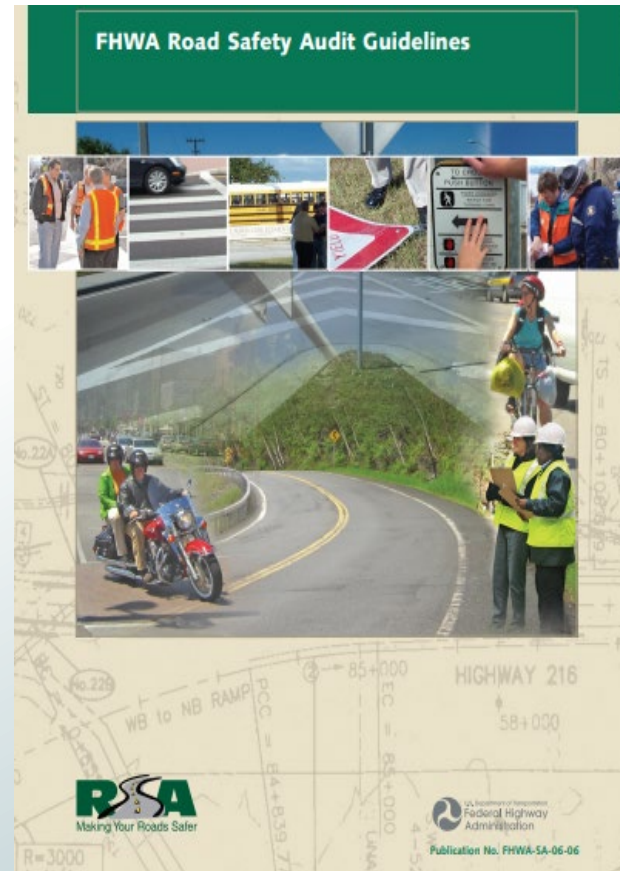


RSA / Initiative



RSA Process

- *Pre-Brief Meeting*
 - Site Identification
 - Crash Rates
 - Crash Diagrams
- *Site Visit*
 - Photo Inventory
 - Recommendations
- *RSA Packet*
 - Guidance Figures
 - Cost Estimate
 - Review Report



SHSP/HSIP Road Safety Audits / Initiatives

- Ramp Queue
- Spot Safety
- Wrong Way Initiative
- Local Road Safety Initiative
- Pedestrian Safety Initiative



HSIP Programs/Initiatives

Local Road Safety Initiative):

Identify and address safety concerns on local, non-state route segments located outside an urban boundary and NOT represented by a Metropolitan Planning Organization (MPO). (82 Counties - \$ 22.5 MIL)

Typical countermeasures:

- Signs and pavement markings
- Edge line / shoulder rumbles
- Snowplow-able pavement markers
- Guardrail/barrier wall delineation
- Upgrade of guardrail/end terminals



HSIP Programs/Initiatives

Ramp Queue Program:

Identify and address Ramp safety concerns on Interstate and control access facilities: Ramp traffic queuing back to mainline traffic.

Typical countermeasures:

- Geometric Design
- Improve length of ramp storage
- Signalization of Ramp
- Improve shoulder for turn lane
- Signs and pavement markings
- Snowplow-able pavement markers
- Guardrail/barrier wall delineation
- Upgrade of guardrail/end terminals



HSIP Programs/Initiatives

Wrong Way Safety Initiative:

Address vehicles making wrong way movements onto ramps of access-controlled facilities.

Typical countermeasures:

- Signs and pavement markings (direction arrow)
- Snowplow able pavement markers
- Flexible Delineators
- Concrete curb/raised islands
- Bi-directional guardrail delineation
- Reflective signpost delineation
- Modular curbing



HSIP Programs/Initiatives

Pedestrian Safety Initiative:

Typical countermeasures:

- Pedestrian countdown signal heads
- Cross walks/Pedestrian crossing
- Concrete curb/raised islands
- Signs, pavement markings
- Reflective signpost delineation
- Modular curbing
- Pedestrian signal (PHD) HAWK
- Rapid flashing beacon (RRFB)



Project Delivery Method

“No-Plans Contract” - Projects calling only for improvements that have no in-depth design considerations and require no acquisition of right-of-way

“Design” – More in-depth design of improvements (i.e. drainage, earthwork, signalization, survey, etc.) or the acquisition of right-of-way is required... the project will undergo a formal design

Project schedules

- Project Safety Office (PSO)- request all phases of funding
 - Funding request to FHWA
 - Request NEPA /Environmental Doc.
 - Conduct/prepare RSA program
 - Let to construction – completion notice

TDOT HSIP Annual Funding

- Highway Safety Improvement Program (HSIP)
- Road Safety Audit (RSA) (~\$25-35 mil/year)
 - STID-Project Safety Office
 - Local Road Safety Initiative (LRSI) (~\$5.5 mil/year)
 - Operations Division
 - Multi-modal Division (~\$6-7 mil/year)
- Statewide resurfacing program (~\$8-10 mil/year)
- Spot Safety (NON-HSIP) (~\$4.0 mil/year)
- Tennessee Highway Safety Office

TDOT HSIP Project/Funding History

- 2019 – 50 let- to-contract Cost: \$ 49.5 Million
- 2020 – 85 let- to-contract Cost: \$ 38.5 Million
- 2021 – 63 let- to-contract Cost: \$ 35.6 Million
- 2022 – 44 let- to-contract Cost: \$ 52.9 Million
- 2023 – 57 let- to-contract Cost: \$ 62.4 Million

Thank you....

Quest?ons & Comments !!



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Road Safety Audits in Massachusetts

Ana Fill, PE., MassDOT



Why RSAs?

- FHWA proven safety countermeasure - 10% to 60% reduction in total crashes.
- Helps prioritize projects and clarify issues for politicians and decision makers.
- Strengthens connections between participants (different areas maintenance, enforcement, design also different agencies local, state, advocacy, etc.)
- Helps incorporation of safety enhancements into project (ideally before conceptual and preliminary design).

MASSDOT PROJECT SCOPING CHECKLIST

IV. SAFETY

A. Top Crash Locations [Top Crash Locations](#)

Intersections: [Top 200 Intersection Crash Cluster](#)

Top 5% Clusters: Crash Bicycle Crash Pedestrian Crash [IMPACT Screening Tools](#)

Primary MPO/RPA Risk Site for Intersections based on the Network Screening - Risk Based Tool

Describe High Crash and Risk Locations in Project Area:

Corridors: [IMPACT Screening Tools](#)

Top 5% Crash MPO/RPA for Fatal & Injury based on the Network Screening - Crash Based Tool

Primary MPO/RPA Risk Site based on the Network Screening - Risk Based Tool, select all:

Lane Departure Bicyclist Related Pedestrian Speeding Other, describe below

Describe Network Screening Locations and potential proposed countermeasures:

B. Safety Analysis Required/Completed

All Intersections Entire Length of Corridor

Crash Diagrams Required *If completed, for what years?*

Corridor Crash Mapping Required *If completed, for what years?*

Road Safety Audit Required (prior to 25%) *If completed, date?*

[RSA Template & Guidelines](#)

Safety Alternative Analysis Required (If Top-5% Crash Location; also required for ICE Stage 2)

[HSIP Eligibility & Alternative Safety Analysis Guide](#)

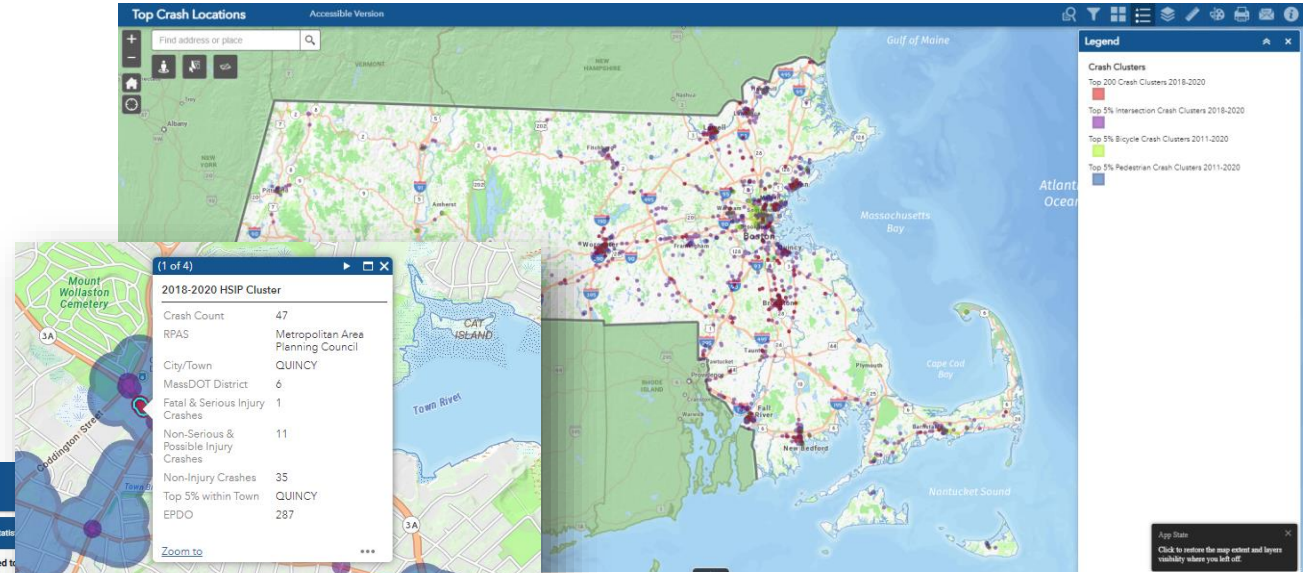
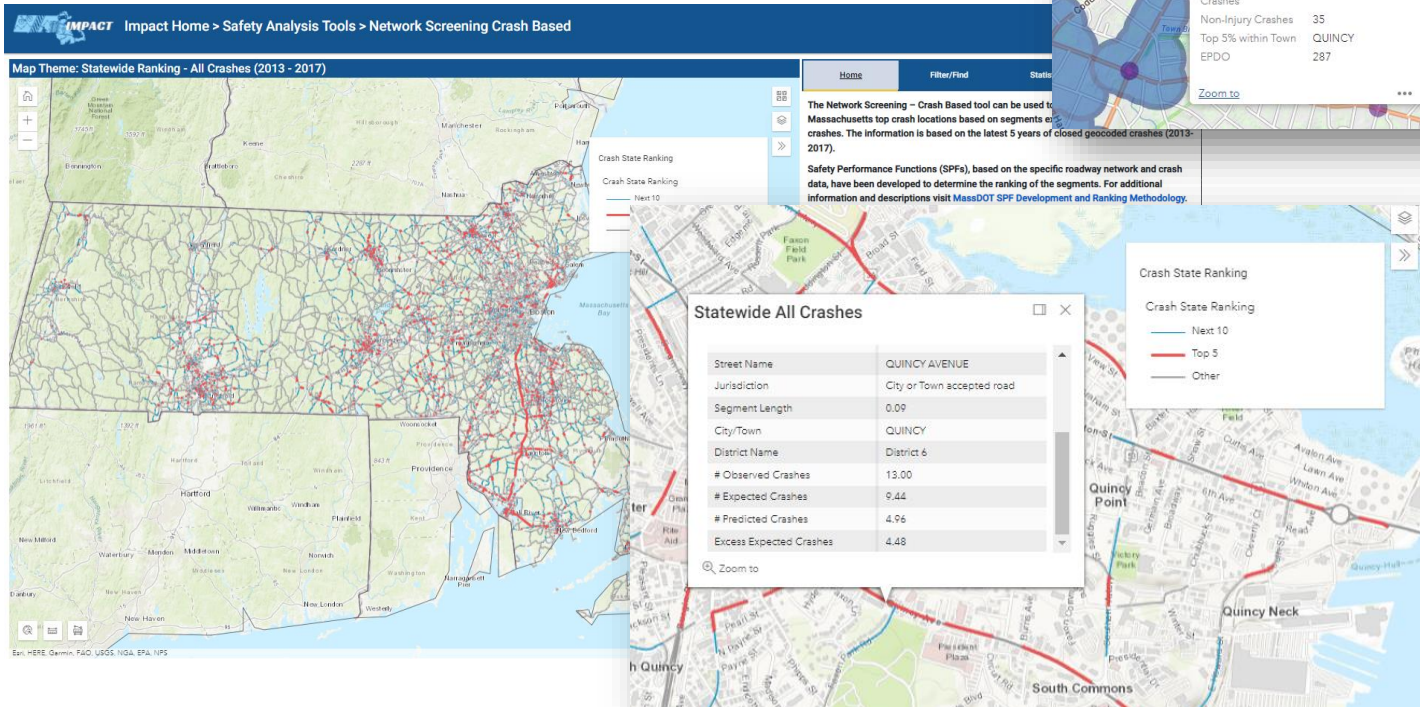


Safety Benefits:
10-60%
 reduction in total crashes¹.

When is RSA required in MA?

- When project area includes high crash locations (Top 5% Vehicle, Bicycle, or Pedestrian Intersections or Segments) of the most recent available years.

Network Screening - Crash Based Map

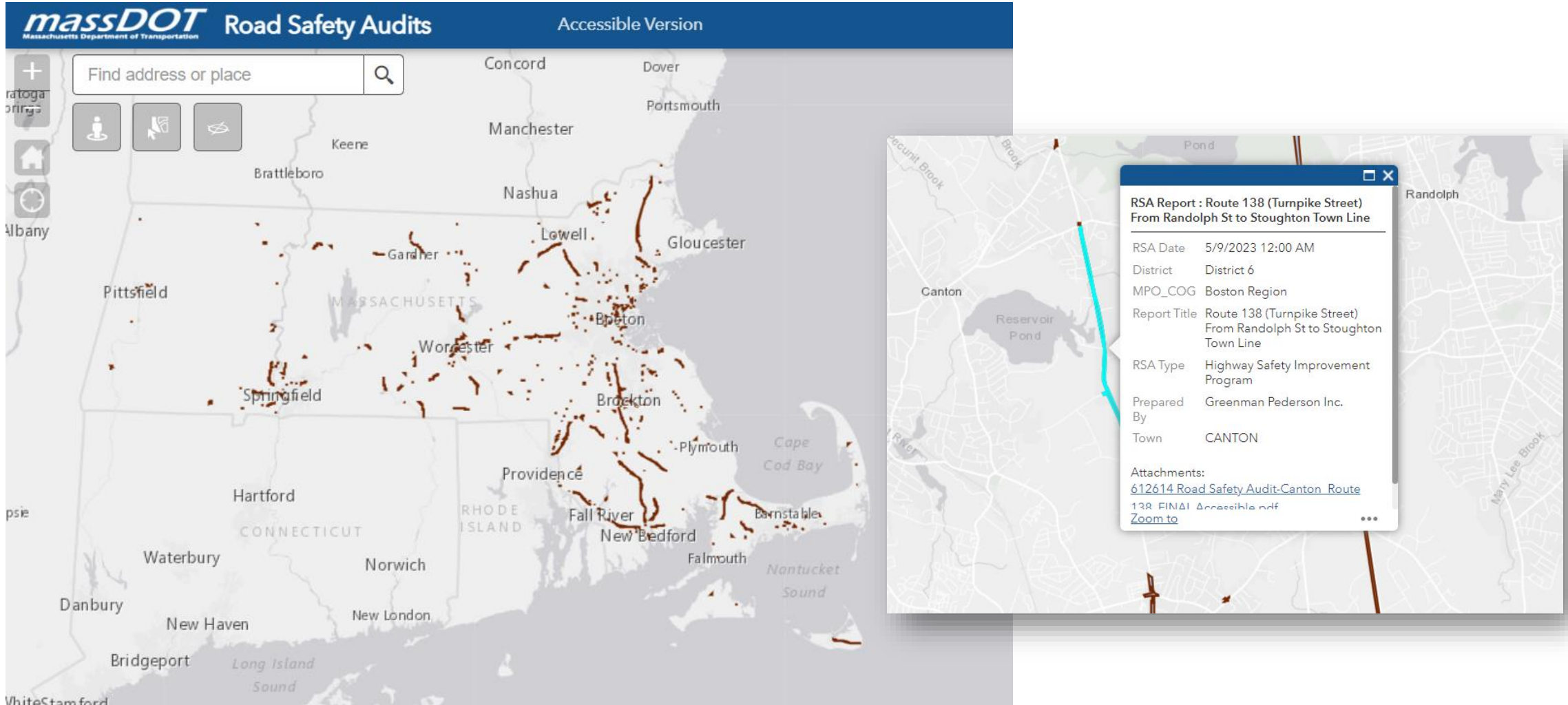


Statewide High Crash (HSIP-Eligible) Cluster Map

- When projects are looking to securing federal funding through the Highway Safety Improvement Program (HSIP) or are anticipated to utilize HSIP funding.

MassDOT Road Safety Audits Interactive Map

<https://gis.massdot.state.ma.us/RoadSafetyAudits/>



massDOT Road Safety Audits Accessible Version

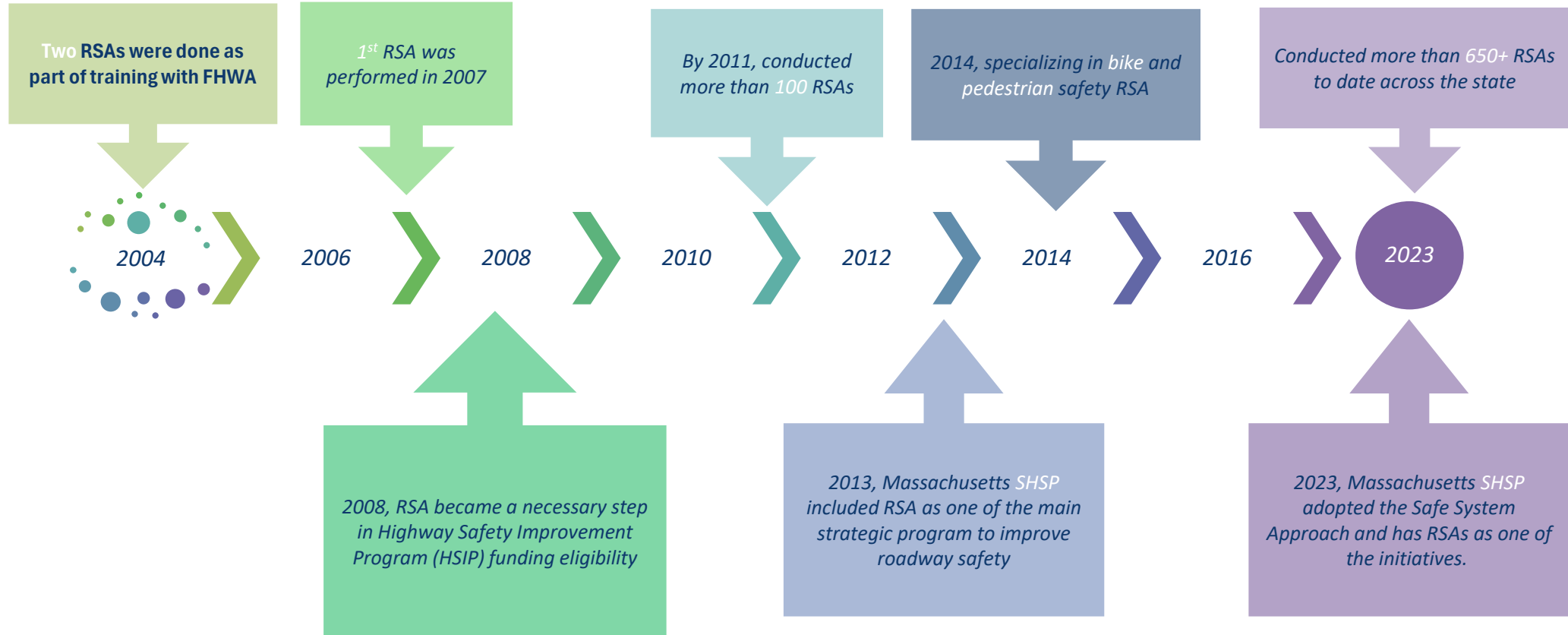
Find address or place

RSA Report : Route 138 (Turnpike Street) From Randolph St to Stoughton Town Line

RSA Date	5/9/2023 12:00 AM
District	District 6
MPO_COG	Boston Region
Report Title	Route 138 (Turnpike Street) From Randolph St to Stoughton Town Line
RSA Type	Highway Safety Improvement Program
Prepared By	Greenman Pederson Inc.
Town	CANTON

Attachments:
[612614 Road Safety Audit-Canton_Route 138_FINAL_Accessible.pdf](#)
[Zoom to](#)

History of RSA in MA



2023 MA SHSP Initiative #5 – Double Down on What Works

“The Commonwealth will maintain existing initiatives that have proven effective, while also expanding them in new ways using the Safe System Approach.”

- MA SHSP



5.10 Increase Road Safety Audits

A Road Safety Audit (RSA) is a formal safety review of an existing or planned roadway or intersection. The use of RSAs to inform projects has been shown to reduce crashes by between 10 - 60%. The Commonwealth’s RSA program is an important part of the HSIP and has expanded to include additional high-crash locations and individual crash types, such as pedestrian and bicycle hot spots. **The RSA program should be emphasized, particularly in areas where equity concerns are present.** These expansions can assist the Commonwealth in better identifying and improving problem areas on Massachusetts roadways.

Enhancing Massachusetts RSA Program

- Update MassDOT Road Safety Audit Guidance document (<https://www.mass.gov/info-details/road-safety-audits>).
- Incorporate CMFs in the RSA Process
- Evaluate Countermeasures through a Safe System Approach Lens
- Adopt relevant findings from NCHRP projects:
 - NCHRP Synthesis 20-05/Topic 54-03: **DOT Practices on Road Safety Audits**
 - NCHRP 17-125: **Incorporating the Safe System Approach into Road Safety Audits**
- Create mechanism to implement RSA recommendations



Impacts of RSAs



Low-Cost, Short-Term Enhancement

After RSA: Installed flexible delineator post



After RSA: Convert two-way stop control to signalized intersection



Impacts of RSAs



After RSA: Convert two-way stop control to modern roundabout

Lessons Learned



Positive feedback from local communities and MPOs



Need to think about short and long term/ low and high cost countermeasures.



Need to think broadly – consider VRU, human factors, vehicle design, etc.



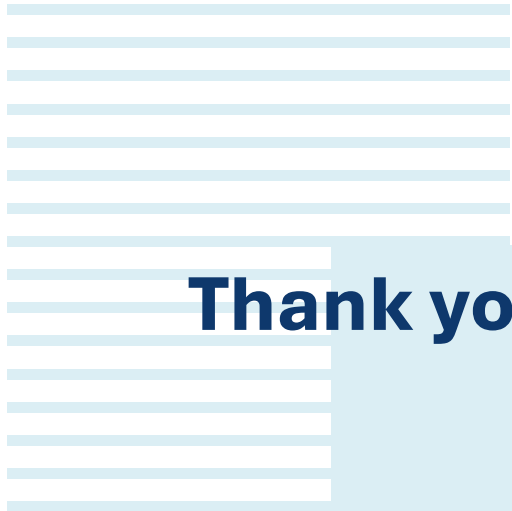
Need to incorporate engineering and other (education, emergency response, etc.) countermeasures.



RSAs help designers consider safety as part of project improvements.



Goal is to truly integrate safety into all we do.



Thank you!



Ana.Fill@dot.state.ma.us

Discussion

⇒ **Send us your questions**

⇒ **Follow up with us:**

⇒ **General Inquiries pbic@pedbikeinfo.org**

⇒ **Archive at www.pedbikeinfo.org/webinars**