Module 9:

Road Safety Audit

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Good morning!

Agenda

- ✓ List of Acronyms and Abbreviations
- ✓ Fundamentals
  - ✓ What is a Road Safety Audit (RSA)?
  - ✓ Benefits of Performing an RSA
  - ✓ RSAs as part of the highway project's full process
  - ✓ RSAs do not…
  - ✓ Recommended Resources for RSA Program
  - ✓ Concerns involving legal liability of government agencies and the State
- ✓ Implementation of RSAs
  - ✓ RSAs as part of transportation policy
  - ✓ Recommended Resources of RSA programs
  - ✓ Available RSA guidelines published by the FHWA
  - ✓ Example case studies published by the FHWA
  - ✓ Other valuable documentation for Road Safety Audits

Agenda

- ✓The RSA Process
  - ✓Identification of project or existing infrastructure component to audit
  - ✓Selection of RSA Team
  - ✓Pre-Audit meeting and project documentation revision
  - ✓Field observations under various conditions
  - ✓Audit analysis and findings report
  - ✓Presentation of findings to project owner and/or design team
  - ✓Formal response from project owner and/or design team
  - ✓Incorporation of findings as appropriate

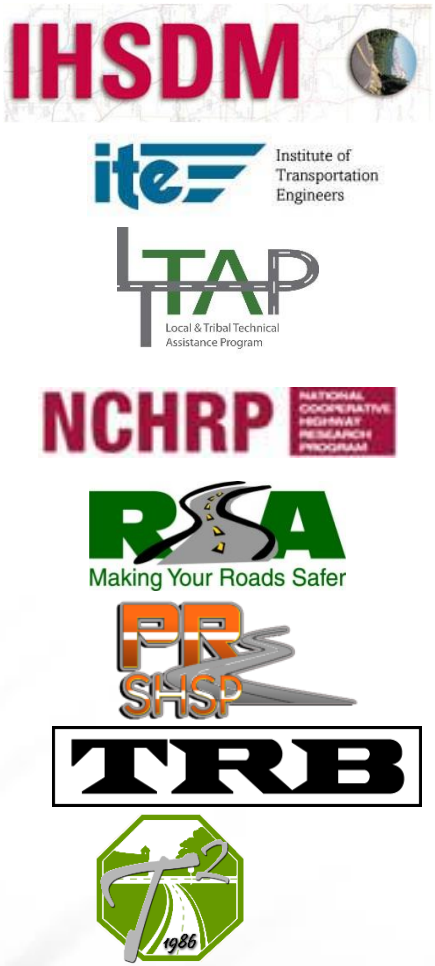
Agenda

- ✓RSAs During Different Stages of Highway Projects
  - ✓Pre-construction
  - ✓Construction
  - ✓Post-construction
  - ✓Land Development
- ✓Questions and Answers

List of Acronyms and Abbreviations

- ✓ **AASHTO:** American Association of State Highway and Transportation Officials
- ✓ **ACT:** Autoridad de Carreteras y Transportación
- ✓ **CMF:** Crash Modification Factors
- ✓ **CIAPR:** Colegio de Ingenieros y Agrimensores de Puerto Rico
- ✓ **CSP:** Comisión para la Seguridad en el Tránsito
- ✓ **DOT:** Department of Transportation
- ✓ **DTOP:** Departamento de Transportación y Obras Públicas
- ✓ **FHWA:** Federal Highway Administration

List of Acronyms and Abbreviations



- ✓ **IHSDM:** Interactive Highway Safety Design Model
- ✓ **ITE:** Institute of Transportation Engineers
- ✓ LTAP: Local and Tribal Technical Assistance Program
- ✓ **NHCRP:** National Cooperative Highway Research Program
- ✓ **RSA:** Road Safety Audit
- ✓ **SHSP:** Strategic Highway Safety Plan
- ✓ **TRB:** Transportation Research Board
- ✓ T^2: Transportation Technology Transfer Center

Fundamentals

What is a Road Safety Audit (RSA)?

- ✓ *Formal safety performance examination* for road projects
- ✓ *Proactive* procedure
  - ✓ Assess safety needs
  - ✓ Compliance of highway projects
  - ✓ Multidisciplinary
  - ✓ External auditing
- ✓ Considers multiple project aspects concerning safety
- ✓ Can be performed at various stages of the project's progress—the earlier, the better!

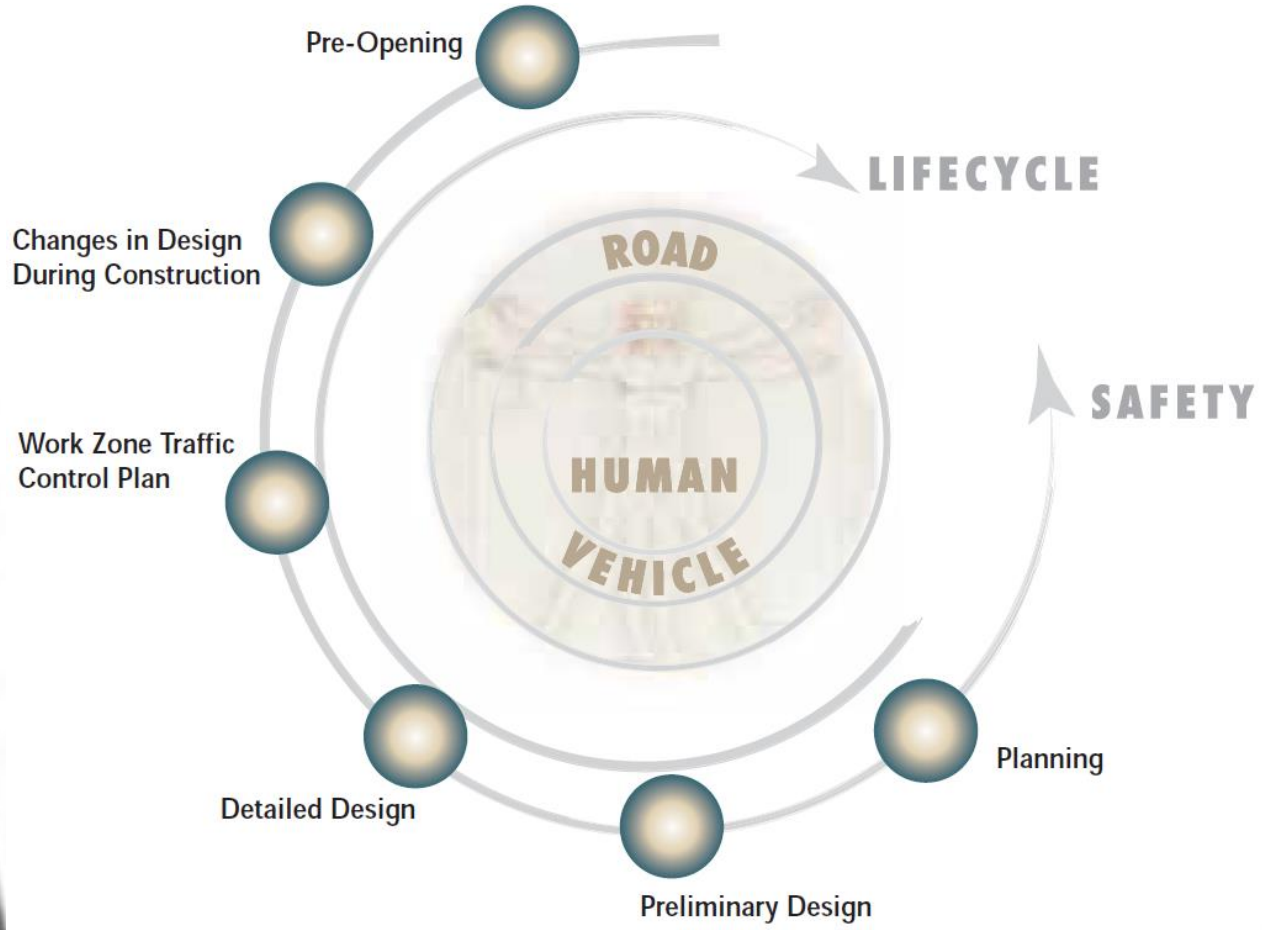
RSA
Making Your Roads Safer

¿?

Benefits of performing an RSA

- ✓ Identifies *otherwise neglected aspects* of traffic safety
- ✓ *Early intervention* reduces needs for costly/difficult corrective measures during construction and operation
- ✓ Process is low cost ($1,000-$10,000 per audit) and requires small amount of time (typically 1-2 weeks), per audit
- ✓ Can be incorporated to all road infrastructure projects
- ✓ Can recommend highly effective, low-cost measures
- ✓ *Considers full spectrum of users*

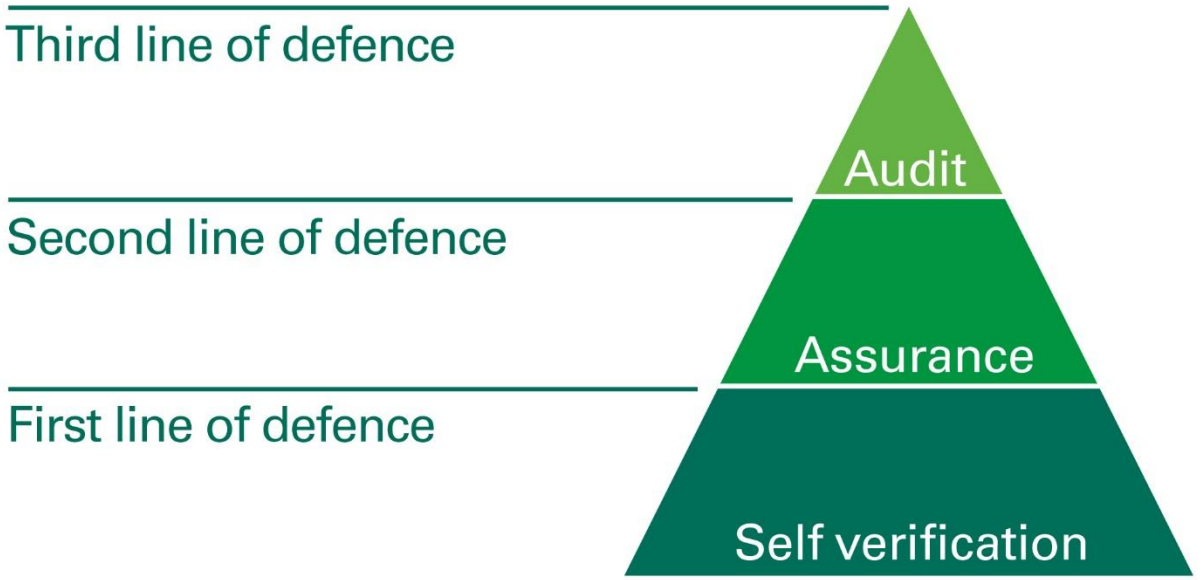
RSAs as part of the highway project's full process



- ✓ Earlier intervention allows for more effective measures
- ✓ RSAs include auditing report from the audit team
- ✓ RSAs require a response report from the project authors (design team, construction team, agency owning/operating facility)
- ✓ RSAs can bring financial and logistical benefits to projects
- ✓ *Best option: perform RSAs at different project progress stages*

RSAs do *not*...

- ✓ *Replace other safety evaluation procedures*
- ✓ Follow a rigid recipe to use in all projects, regardless of circumstances
- ✓ Appraise or criticize non-safety related aspects of projects
- ✓ Rank highway projects for priority purposes → projects instead are ranked for RSA implementation



- ✓ Check for compliance with standards
- ✓ Constitute a single time activity
- ✓ Call for a ground-up re-design of a project

Critical questions RSAs answer

- ✓What *elements* of the road may present a *safety concern*: to what extent, to which road users, and under what circumstances?
- ✓What *opportunities* exist to *eliminate or mitigate* identified *safety concerns*?

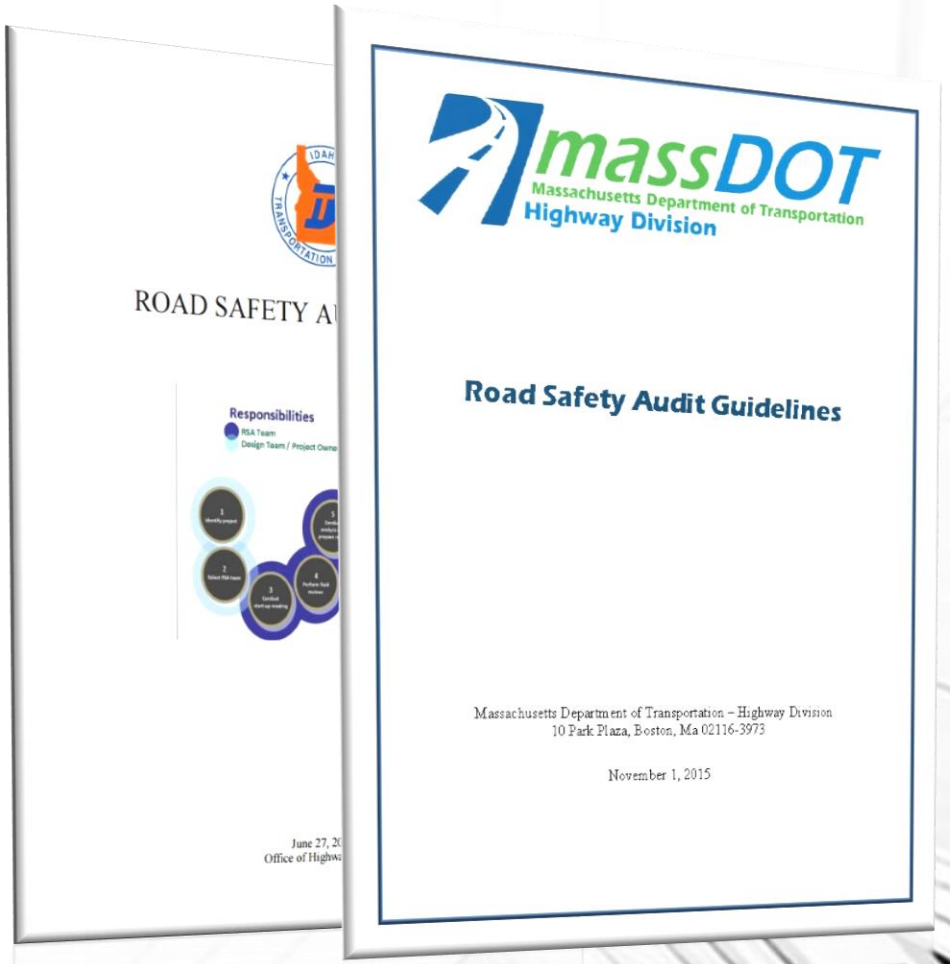
Implementation of RSAs

RSAs as part of transportation policy

- ✓ High flexibility allows adaptation to local and regional needs
- ✓ State, territory, tribal and local DOTs can develop standardized methodologies compatible with their other policies
- ✓ Main members of Audit teams can be defined in accordance to the public agency system of the jurisdiction
- ✓ Developing criteria to determine eligibility of projects for RSA implementation

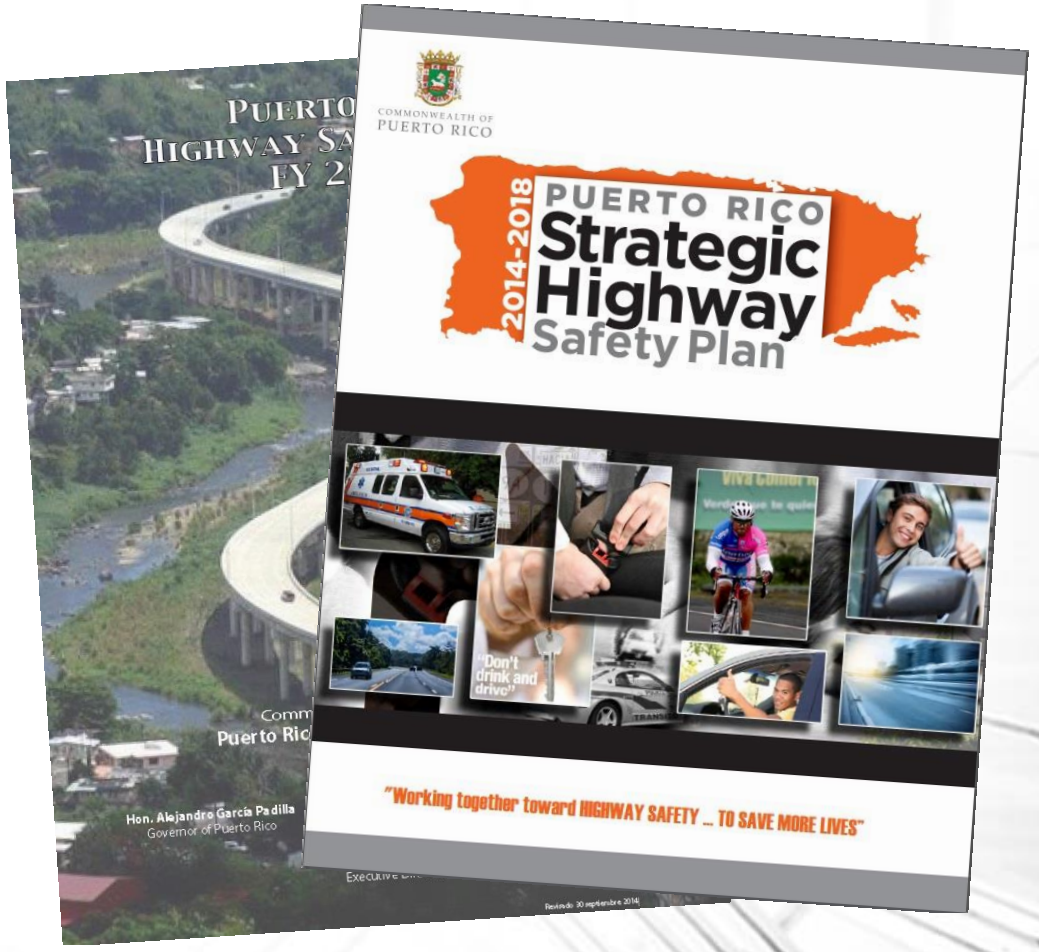
Recommended resources for RSA program

- ✓ Manual or guidebook for the RSA process specifically made for the jurisdiction using it
  - ✓ Project selection criteria
  - ✓ RSA team membership
  - ✓ Auditing protocol for different project stages
  - ✓ Auditing protocol for different categories of roadway facilities
  - ✓ Auditing protocol for different categories of users
  - ✓ RSA guidelines and prompt lists
  - ✓ RSA documentation format

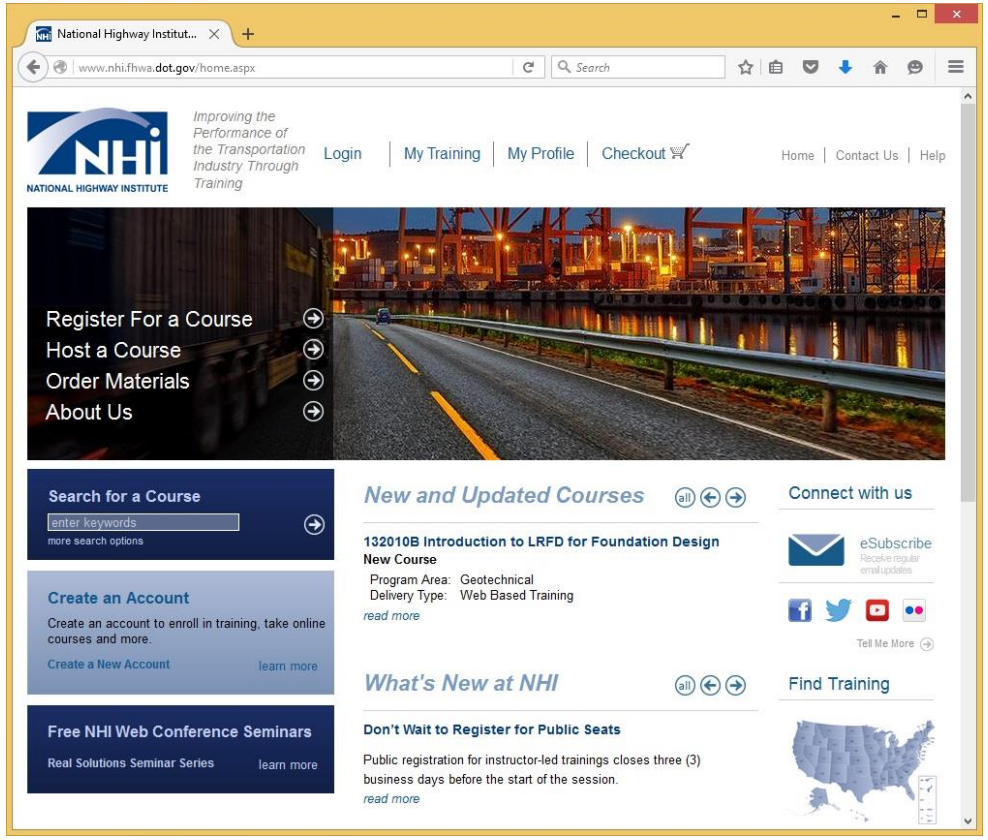


Recommended resources for RSA program

- ✓ Assign DOT personnel to administer the RSA program
  - ✓ Infrastructure design (ACT)
  - ✓ Traffic Safety (CSP)
- ✓ Detailed and timely traffic safety data
  - ✓ Identify most dangerous locations in the road network
  - ✓ Identify most pressing traffic safety issues
  - ✓ Follow-up data to determine effectiveness of RSAs
- ✓ Coordinate with *Strategic Highway Safety Plan*

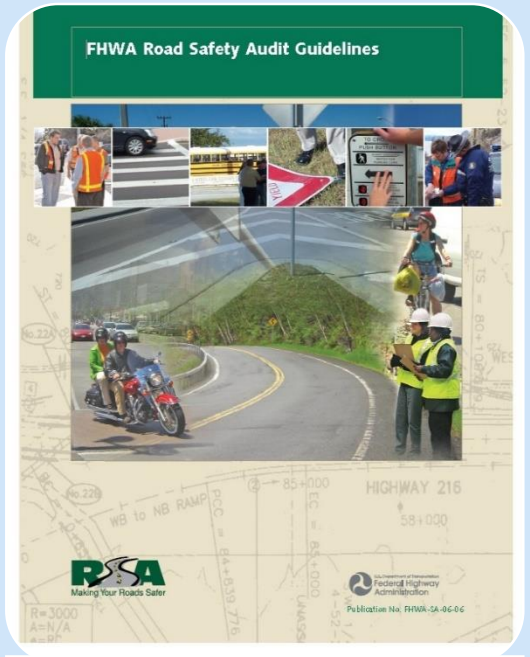


Recommended resources for RSA programs

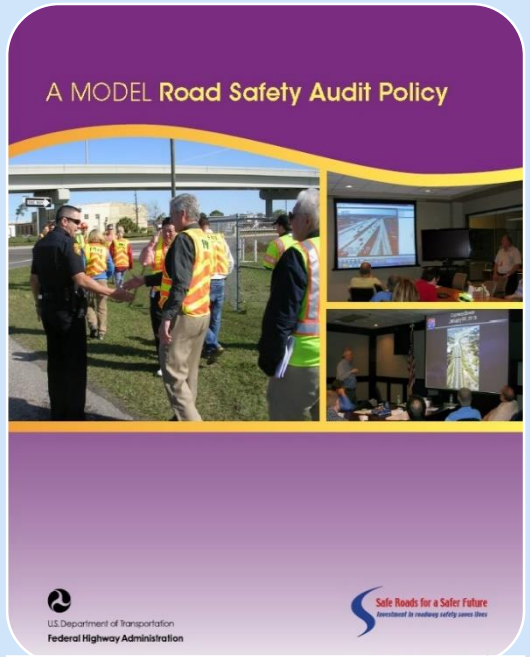


- ✓ Professional training for public officials performing RSAs
- ✓ Great resource: *National Highway Institute* training programs (on-site, webinars)—visit http://www.nhi.fhwa.dot.gov/home.aspx
- ✓ Pilot programs to introduce the RSA to regional and municipal DTOP offices
- ✓ Mechanisms to ensure the monitoring of implementation and effectiveness of RSAs
- ✓ Archives for RSA-generated documentation
- ✓ Funding protocol

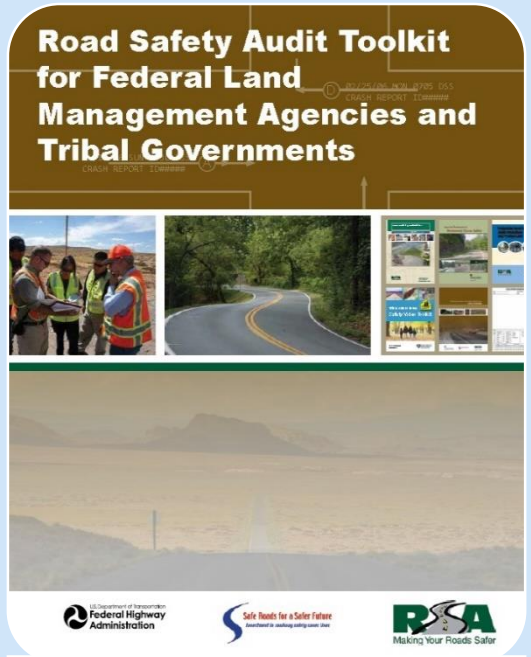
Available RSA guidelines published by the FHWA



FHWA Road Safety Audit Guidelines

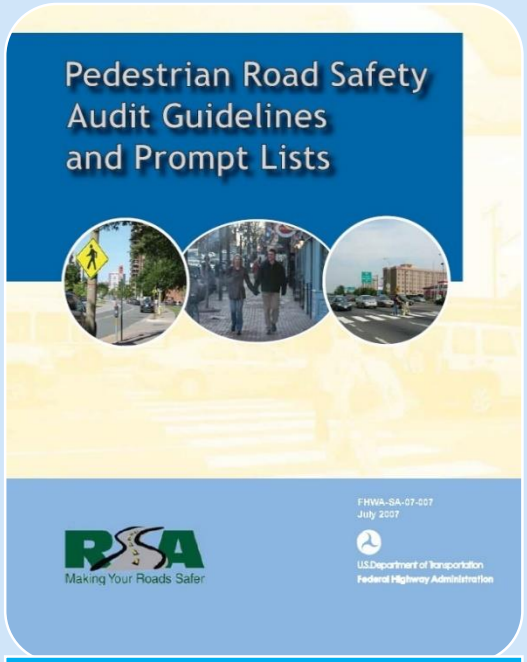


A Model Road Safety Audit Policy

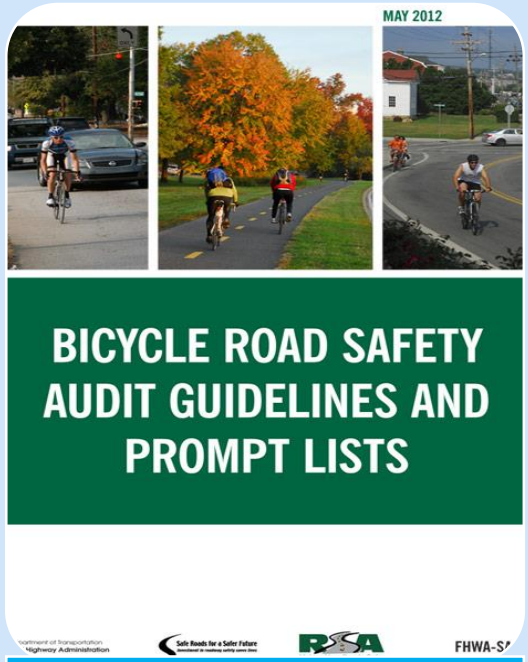


Road Safety Audit Toolkit for Federal Land Management Agencies and Tribal Governments

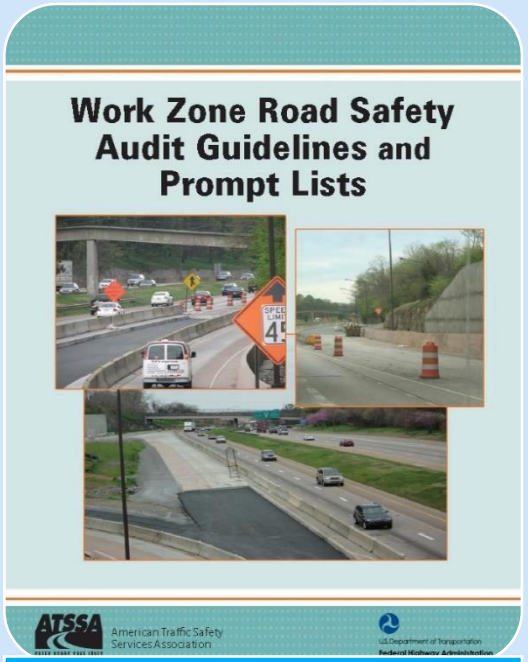
Available RSA guidelines published by the FHWA



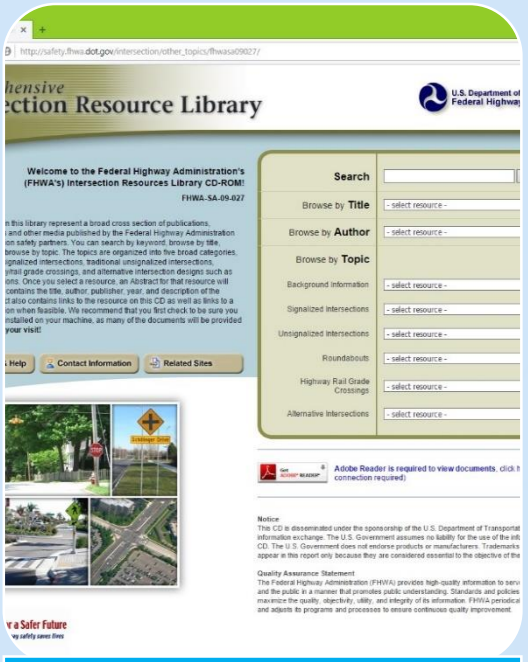
Pedestrian Road Safety Audit Guidelines and Prompt Lists



Bicycle Road Safety Audit Guidelines and Prompt Lists

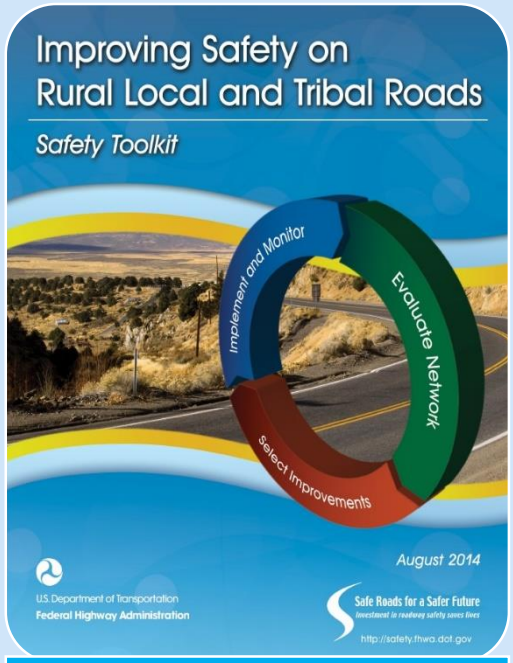


Work Zone Road Safety Audit Guidelines and Prompt Lists

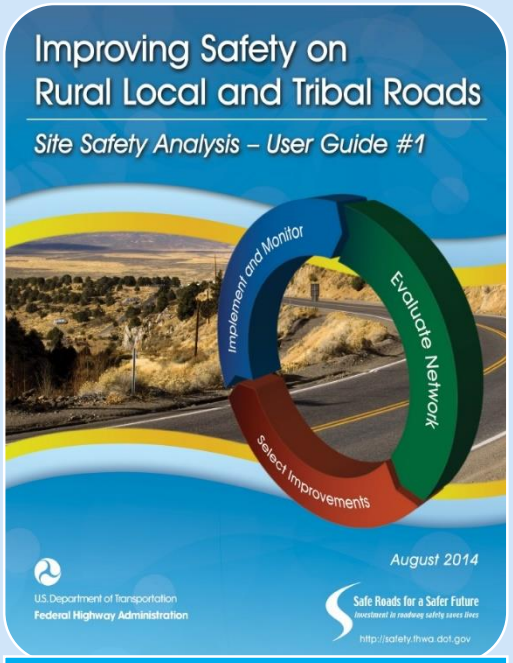


Comprehensive Intersection Resource Library

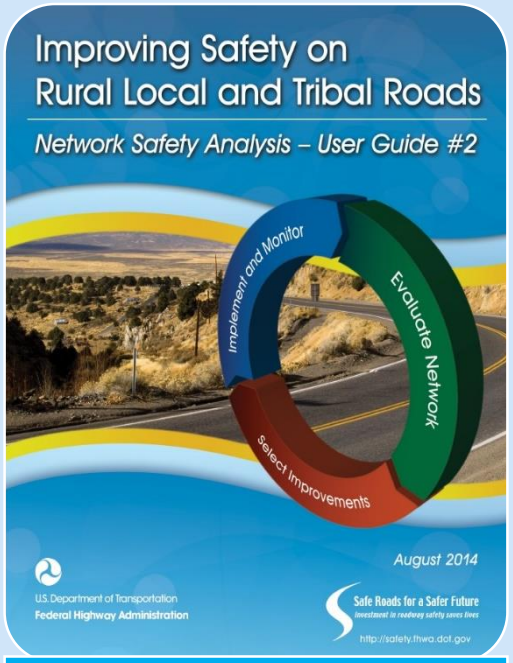
Available RSA guidelines published by the FHWA



Improving Safety on Rural Local and Tribal Roads: Safety Toolkit

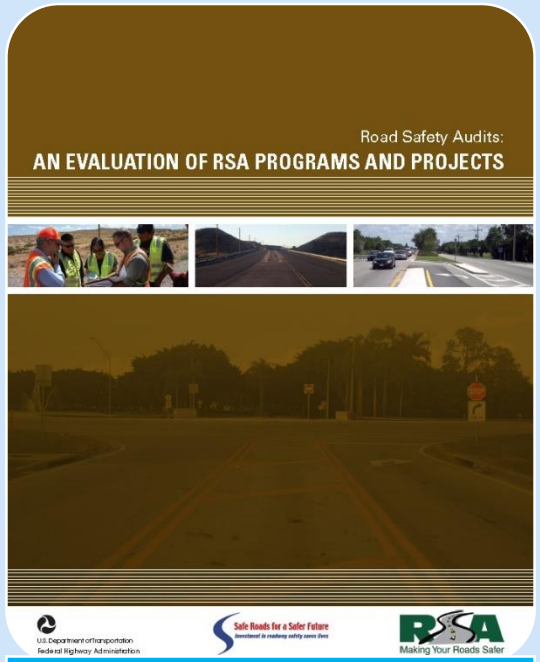


Improving Safety on Rural Local and Tribal Roads: Site Safety Analysis

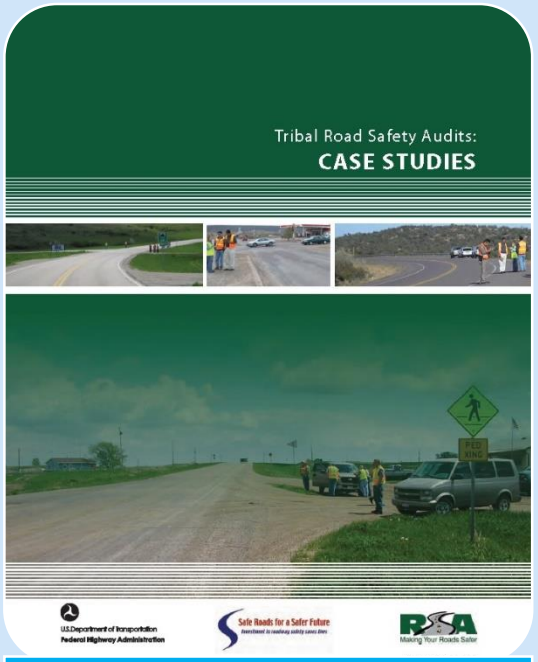


Improving Safety on Rural Local and Tribal Roads: Network Safety Analysis

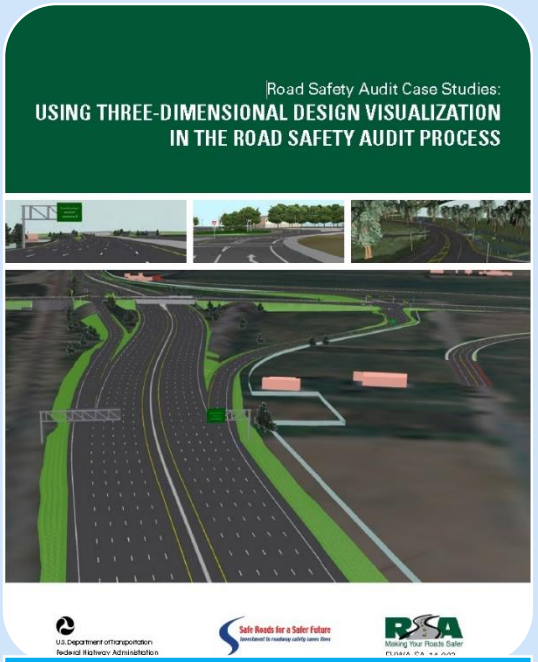
Example case studies published by the FHWA



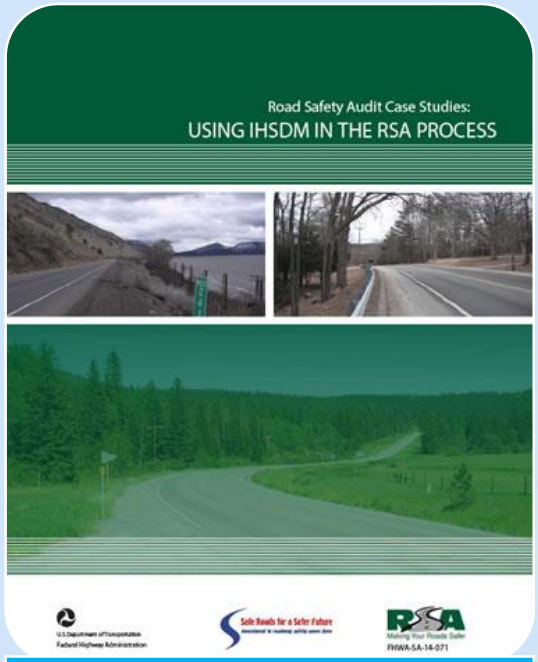
Road Safety Audits: An Evaluation of RSA Programs and Projects



Tribal Road Safety Audits: Case Studies

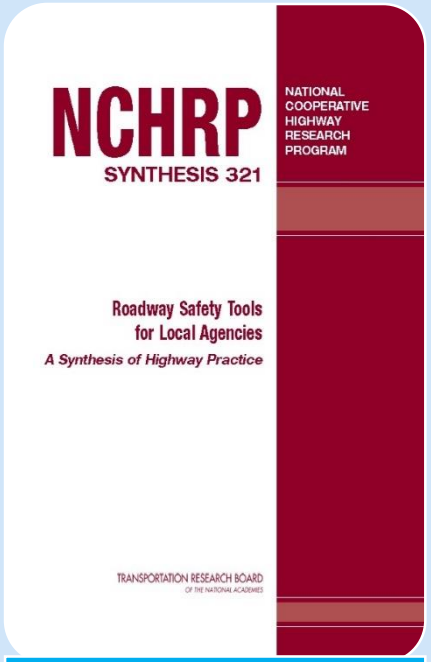


Road Safety Audit Case Studies: Using Three-Dimensional Design Visualization in the RSA Process

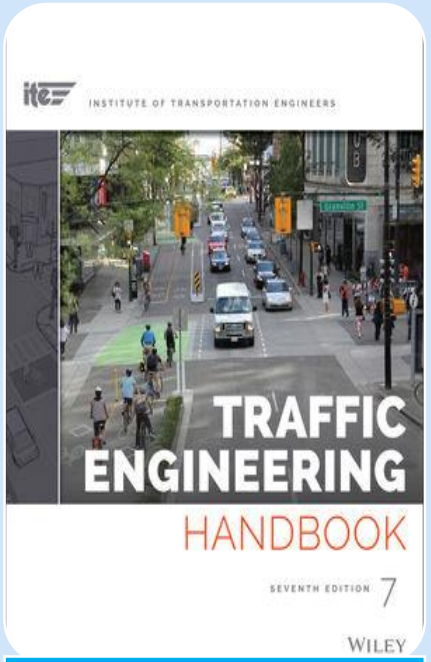


Road Safety Audit Case Studies: Using the Interactive Highway Safety Design Model in the RSA Process

Other valuable documentation for Road Safety Audits

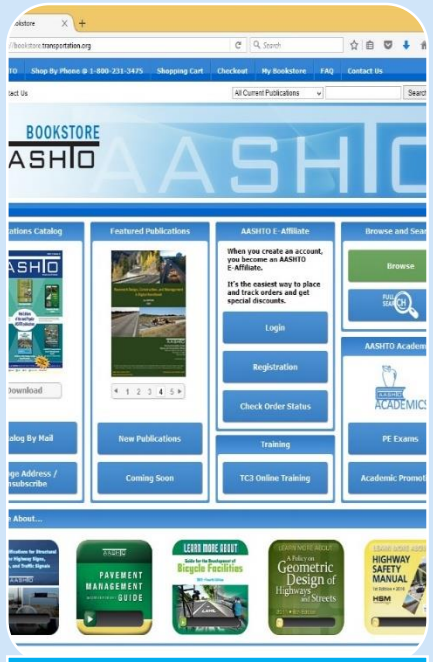


National Cooperative Highway Research Program publications

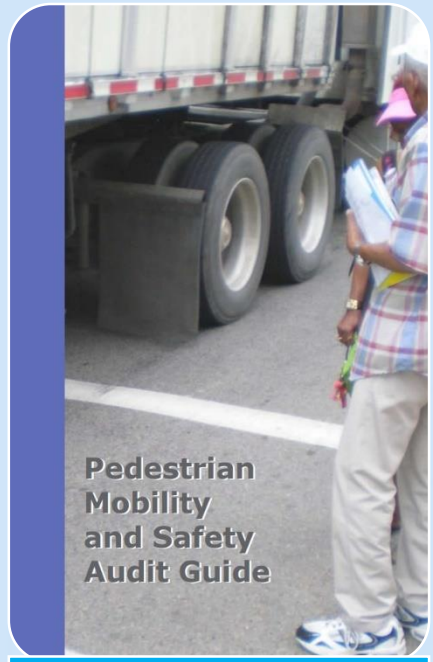


Institute of Transportation Engineers' publications: Traffic Engineering Handbook

Crash Modification Factors Clearinghouse: database with data for crash reduction analysis



AASHTO bookstore: books, guides and manuals for design of all roadway components



ITE and AARP: Pedestrian and Mobility Safety Audit Guide

Concerns involving legal liability of government agencies and the State

- ✓ The RSA process generates documentation identifying safety issues of road facilities
  - ✓ RSA findings report and presentation (RSA team)
    - ✓ Safety issues identified
    - ✓ Recommendations to address issues
  - ✓ RSA response report (Project owner or Design team)
    - ✓ Safety issues to address
    - ✓ How to address said issues
    - ✓ Safety Issues not to be addressed
    - ✓ Justification not to address said issues

Concerns involving legal liability of government agencies and the State

- ✓ *Extensive legislation and federal case law* dictates that any documentation identifying safety issues and generated by transportation agencies or by individuals or institutions hired or consulted for such purpose *cannot be used in demands against the State or government agency* (immunity against tort liability)
  - ✓ Safety documentation can be used by State or government agency as a *defense*
  - ✓ *Litigants must generate their own documentation and studies* to prove a safety problem if he/she/it wishes to file a lawsuit against the State or Agency

Concerns involving legal liability of government agencies and the State

- ✓ Said legislation does not necessarily mean the RSA documentation is to be withheld from the public
  - ✓ States with public disclosure law are required to make information available
  - ✓ Freedom of Information Act
  - ✓ Case law rejecting requests to prevent disclosure
  - ✓ States may require specific legislation in order to prevent disclosure

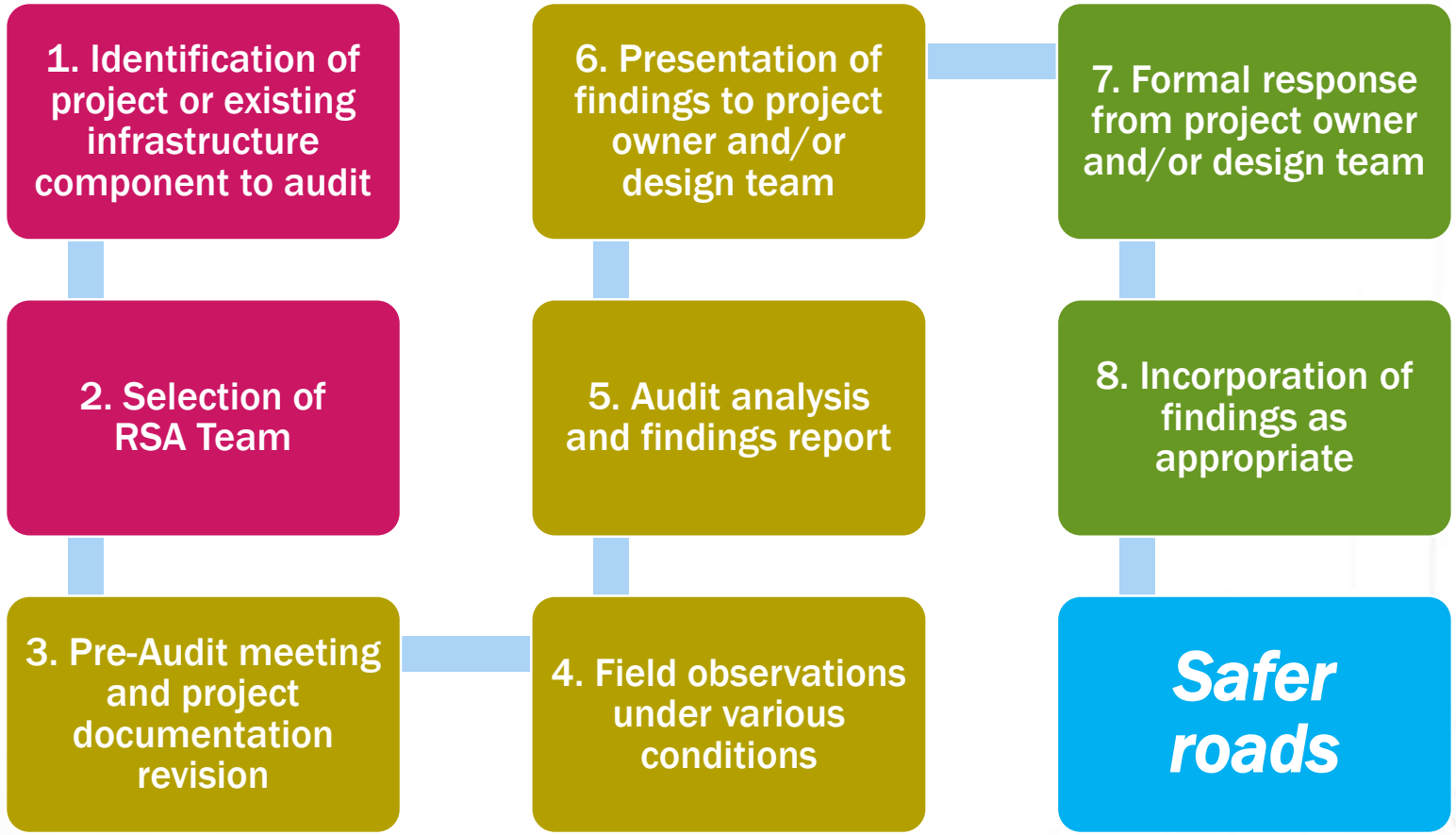
- ✓ States *must incorporate legal liability issues* as part of their RSA policy
- ✓ Option: use RSA documentation for internal agency purposes only

One last reminder…

Engineering judgement: just because a design is in compliance of regulations does not necessarily mean it's the safest or more practical choice → recommend something better when the situation warrants it!

The RSA Process

Steps for typical Road Safety Audits

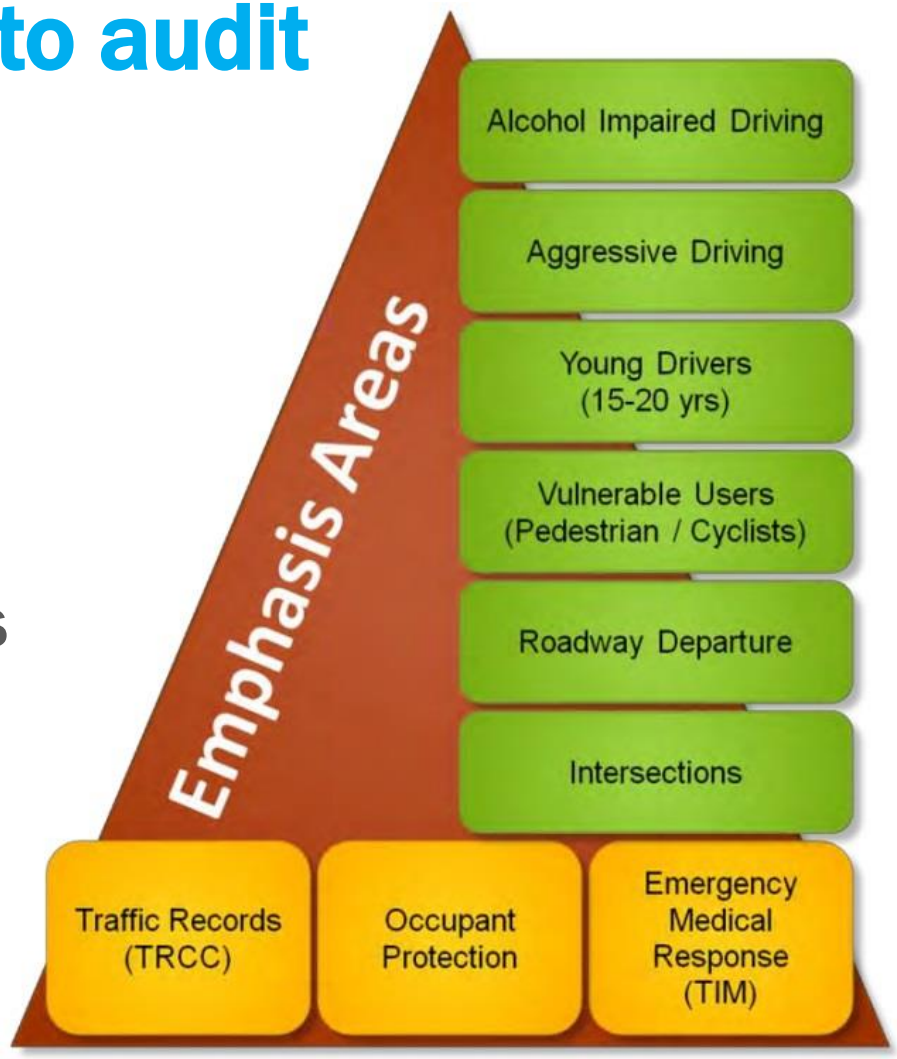


1. Identification of project or existing infrastructure component to audit

- ✓ DOTs have limited resources to fulfill their missions → define priorities
- ✓ Projects may be in greater need of an RSA due to
  - ✓ Major traffic safety problems
  - ✓ Higher traffic volume
  - ✓ Traffic safety problems are priority in DOT's SHSP
  - ✓ Major changes in prevailing conditions
  - ✓ Existing facility is outdated from a safety standpoint

1. Identification of project or existing infrastructure component to audit

- ✓Tools that can aid selection of projects
  - ✓Traffic volume studies
  - ✓Crash rate statistics
  - ✓Land use planning documents
  - ✓Community insight
  - ✓Strategic Highway Safety Plan's Emphasis Areas



2. Selection of RSA Team

- ✓Team members must be *independent* from the project
  - ✓*Controversial findings* are more likely to be voiced → critical safety problems *can be confronted* rather than overlooked or dismissed due to conflict of interests
  - ✓They must not have involvement with the design team to minimize bias favoring design decisions

2. Selection of RSA Team

- ✓Team members can come from *different origins*
  - ✓Other groups within agency
  - ✓Hired from consulting company
  - ✓Other agencies with relevant roles in traffic safety
  - ✓Representatives from project stakeholders

2. Selection of RSA Team

- ✓Team members must be *qualified*
  - ✓ Knowledge must be relevant to the project
  - ✓ Diverse expertise and experience allows for detection of multiple issues with the project
  - ✓ Professional qualifications ensure team members bring the proper tools for an effective work

2. Selection of RSA Team

- ✓Can consist of *core members* and *niche members*
  - ✓Core members have broader knowledge and should form part of the RSA team throughout the whole process
  - ✓Niche members have specific technical knowledge useful to confront more complicated or specific issues, only required to be present when reviewing said issues

2. Selection of RSA Team

- ✓ Examples of relevant and beneficial backgrounds
  - ✓ **Road Safety Specialist:** ideally expert in safety studies and evaluations, qualifications can include enforcement, engineering and/or emergency response
  - ✓ **Traffic Operations Engineer:** certified/licensed professional knowledgeable in the different aspects of traffic operations and related design components
  - ✓ **Road Design Engineer:** certified/licensed professional knowledgeable of standards, legislation, design process and needs of different users

2. Selection of RSA Team

- ✓ Examples of relevant and beneficial backgrounds
  - ✓ **Local Contact Person:** familiar with area being audited and problems experienced. Best options include law enforcement and community members
  - ✓ **Human factors:** individuals with knowledge concerning legislation, policies and needs of different classes of users of the road network

2. Selection of RSA Team

- ✓ **Other specialists:** experts in particular aspects of the project that can contribute to safety within these. Examples include:
  - ✓ Intelligent Transportation Systems
  - ✓ Planning
  - ✓ Designers for special facilities (bridges, tunnels, cycling, toll plazas, bus facilities, freight…)
  - ✓ Construction
  - ✓ Maintenance
  - ✓ Emergency response personnel

2. Selection of RSA Team

- ✓Team members must have knowledge relevant to the project's stage
  - ✓ **Pre-construction:** focus on members with design, planning and existing conditions expertise
  - ✓ **Construction:** focus on members with temporary traffic control, construction protocol and 'as-built' expertise
  - ✓ **Post-construction:** focus on members with traffic safety data, operations and enforcement expertise

2. Selection of RSA Team

- ✓ Ensure diversity is maintained and stakeholder concerns are addressed
- ✓ Avoid extreme team sizes
  - ✓ Smallest but still effective size (3-7 members as rule of thumb)
  - ✓ Team size should be reasonable for project magnitude and scope
  - ✓ Inappropriately sized teams can make the RSA process excessively long

2. Selection of RSA Team

- ✓Team members must have great communication skills
  - ✓The RSA generates documentation about needs and recommendations to address them
  - ✓Skillful at communicating amongst themselves, with stakeholders and project owners and/or designers

2. Selection of RSA Team

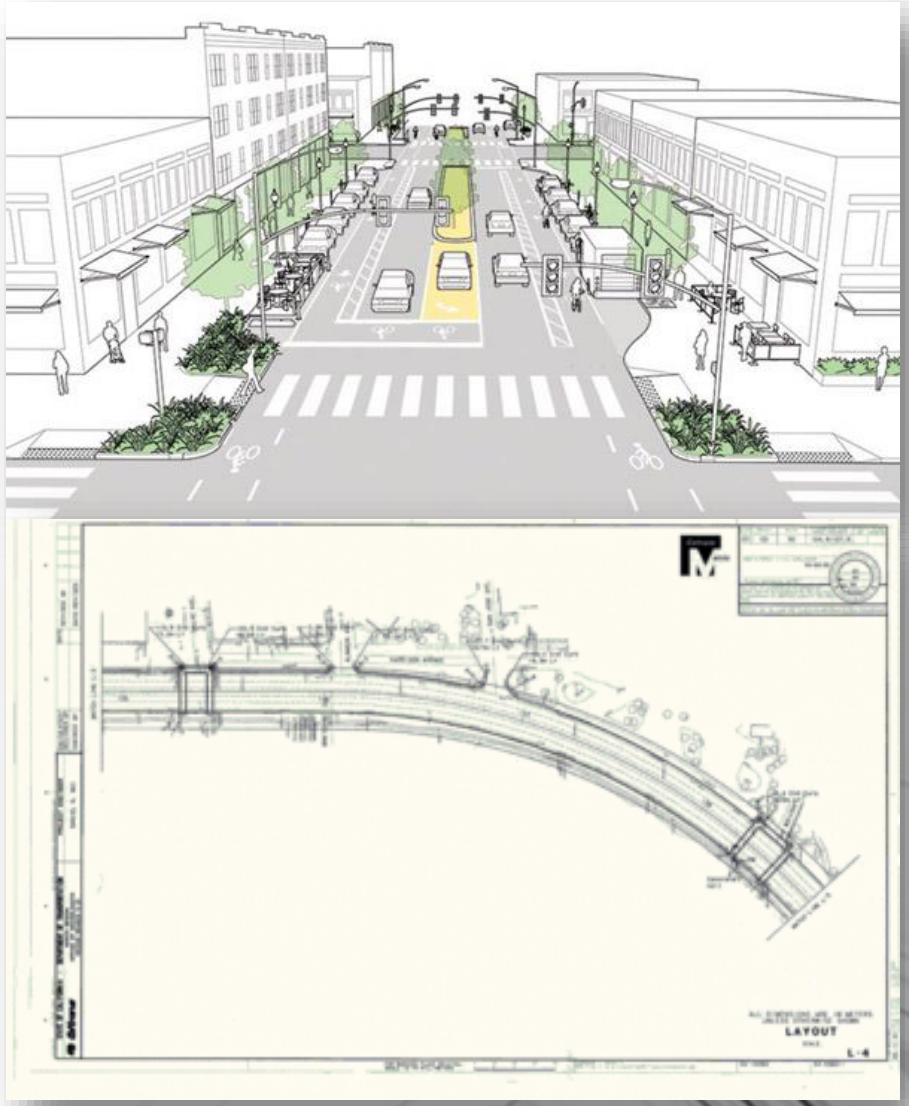
- ✓Team members must have great communication skills
  - ✓The RSA can trigger unexpected changes in design based on critical issues, communication must extend to the project management team
  - ✓Critical safety issues must be conveyed appropriately and with support/concensus

3. Pre-Audit meeting and project documentation revision

- ✓ The RSA team needs *detailed documentation* about the project and the factors *relevant to* the safety audit and to the *project's progress level*
  - ✓ Geometric drawings/plans
  - ✓ Traffic control devices drawings/plans
  - ✓ Aerial photography
  - ✓ Crash/safety data of affected locations
  - ✓ Digital models for proposed designs
- ✓ Prepare a schedule or calendar of the auditing process

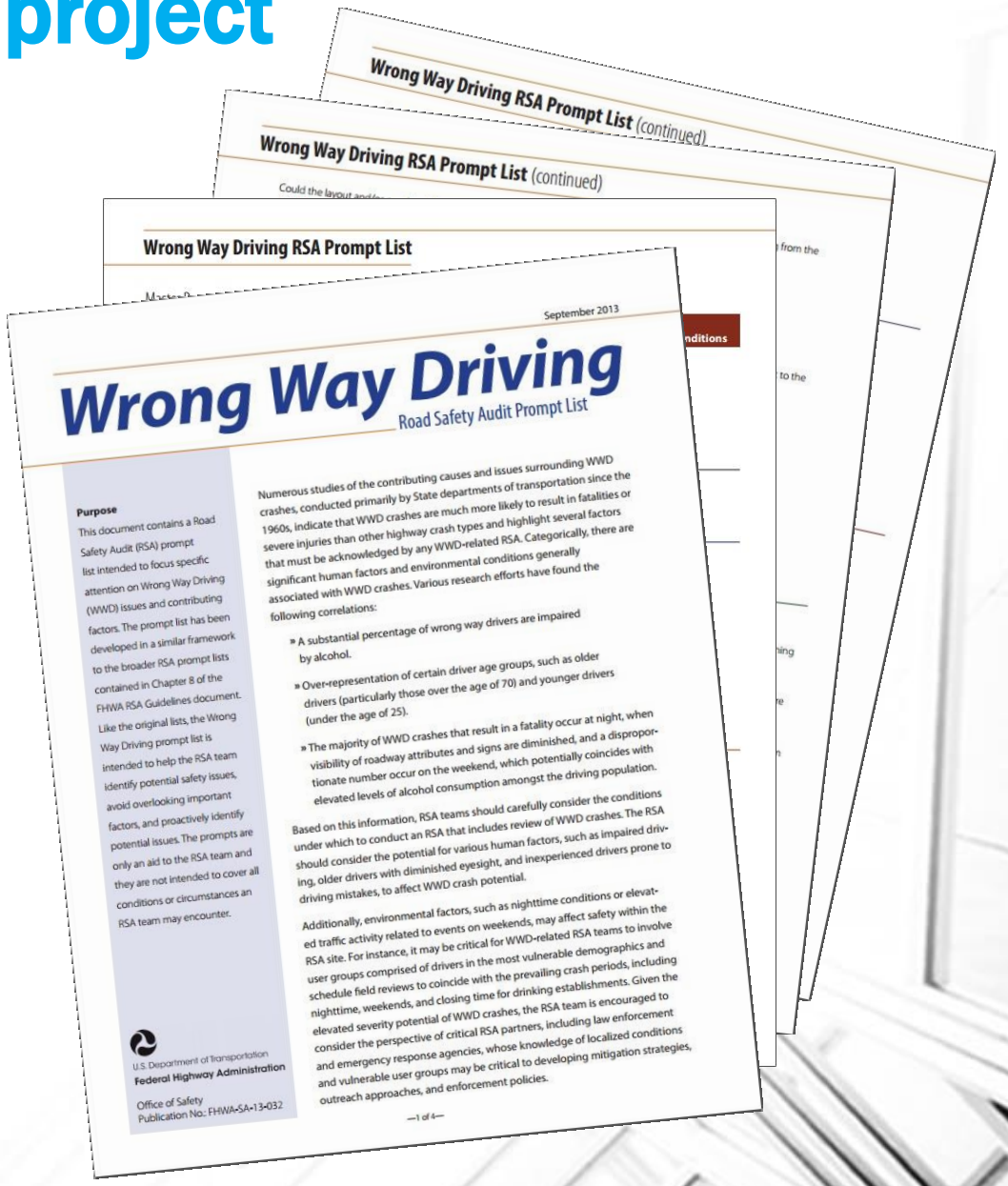
3. Pre-Audit meeting and project documentation revision

- ✓ The RSA team must review the documentation carefully, considering how the proposed design affects:
  - ✓ Different categories of road users
  - ✓ Various road use behaviors
  - ✓ Interactions between design components and environmental factors (topography, weather, day/night, adjacent land uses…)
  - ✓ Existing infrastructure
- ✓ Revision of documentation should be done both individually and as a team in a brainstorming session → allows for group feedback on individual findings



3. Pre-Audit meeting and project documentation revision

- ✓ Usage of an *RSA checklists and prompt lists* can be extremely useful
  - ✓ Different issues listed may not be apparent during the pre-audit meeting or later field observation
  - ✓ Initial safety concerns can be listed for further investigation during the field review
- ✓ *Annotations* during pre-audit meeting can help the upcoming field observations
- ✓ Pre-audit meeting must include project owners/designers to *define scope and purpose*
- ✓ Highlight issues with *missing data*



4. Field observations under various conditions

- ✓ Field observation should be thorough and done under various conditions
- ✓ Emphasize contrasts between conditions and users → safety problems can happen under different conditions and affect different users!
  - ✓ Day/night
  - ✓ Peak/non-peak hour operations
  - ✓ Good/bad weather
  - ✓ Drivers/vulnerable users
  - ✓ Light/heavy vehicles/bicycles/pedestrians
  - ✓ Opposing traffic directions in corridors

4. Field observations under various conditions

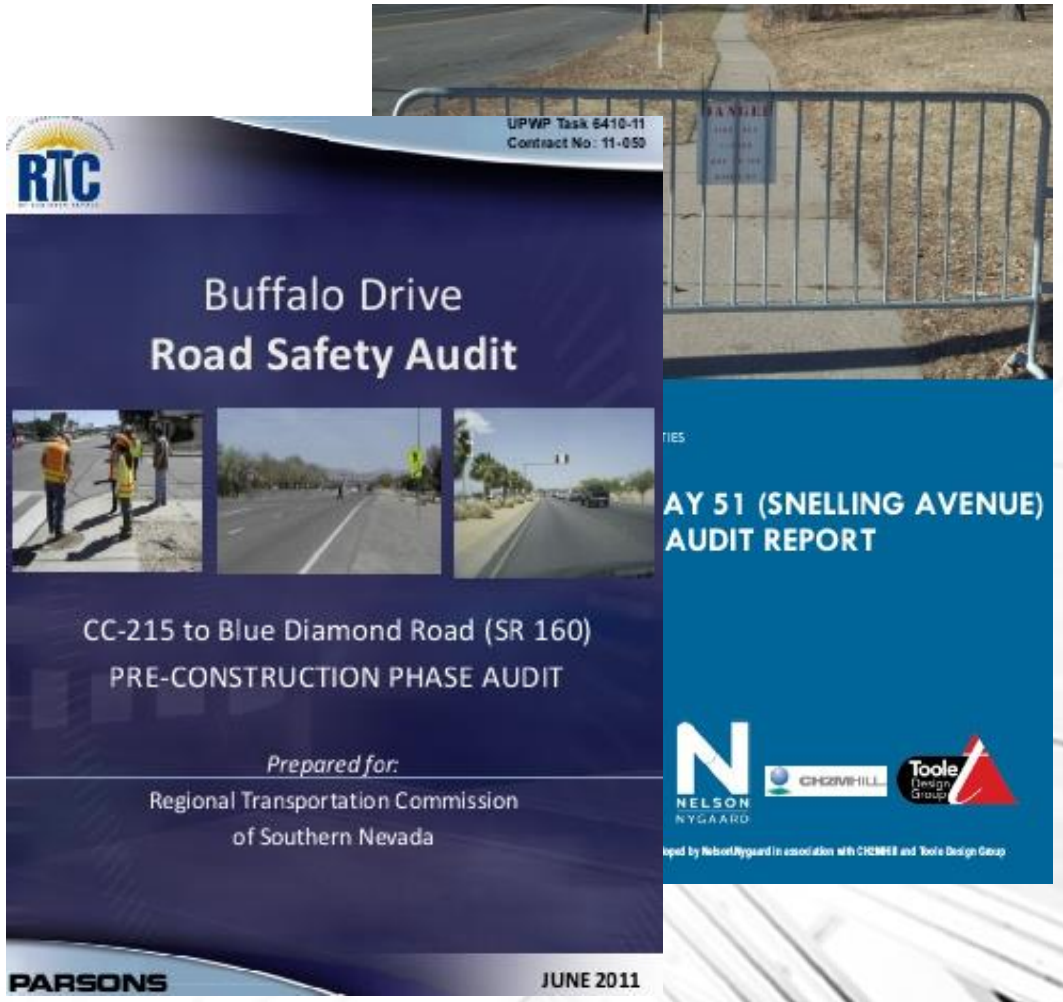
- ✓ First individual and then team observations by the RSA members helps reduce bias
  - ✓ Diversity of opinions and insights maintained
  - ✓ Members less likely to defer to the RSA team leader
  - ✓ Can cover more ground faster in larger project sites
- ✓ Ensure observation methods are appropriate for the project stage

4. Field observations under various conditions

- ✓ Identify additional issues not apparent through project documentation
  - ✓ Documentation about existing conditions *doesn't necessarily match the actual conditions!!*
- ✓ Provide detailed documentation of safety issues found
  - ✓ Photography
  - ✓ Video
  - ✓ Written annotations
  - ✓ Simple measurements (ex. measuring tape)
  - ✓ Readings from special devises if used
  - ✓ Maps and plans showing location of issue

5. Audit analysis and findings report

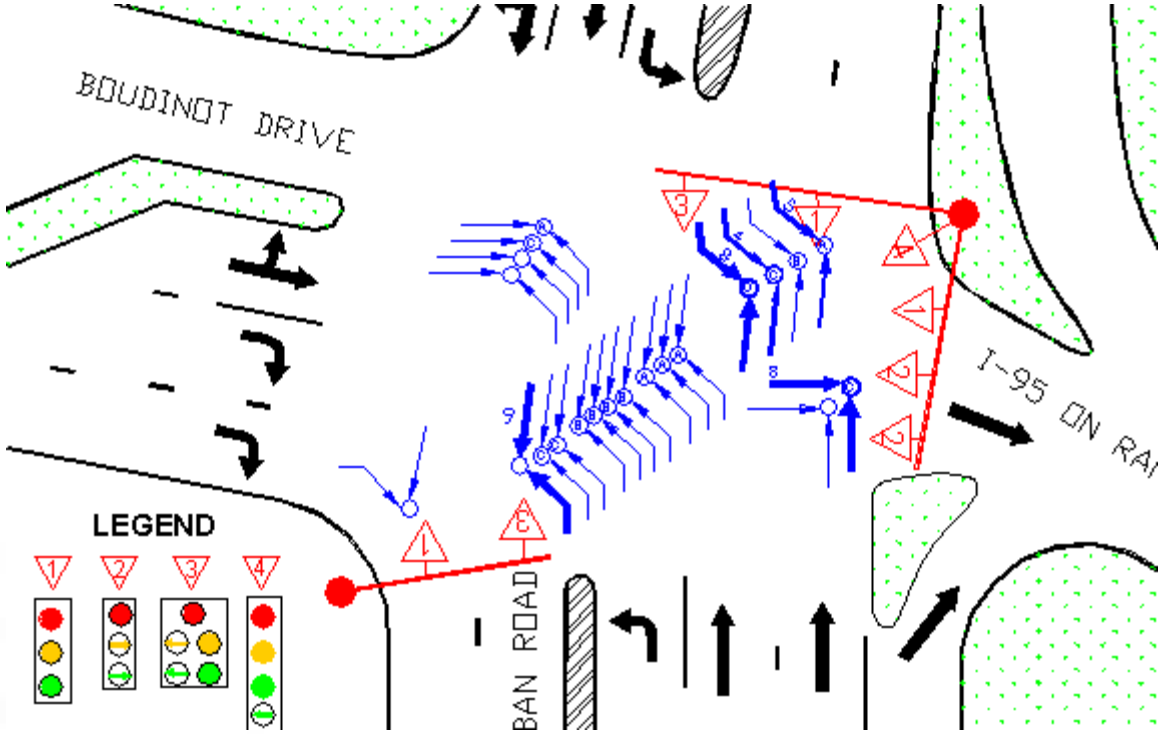
- ✓ RSA team must hold a *post-inspection meeting*
- ✓ Discuss findings
  - ✓ Some members might notice things others didn't classify as safety issues
  - ✓ Expertise of members should be used to propose safety countermeasures
  - ✓ Review field documentation and compare to design documentation and traffic safety data if available
- ✓ Define and sort each safety issue; ascribe a severity rating for the safety issues identified
- ✓ If a previous RSA has been conducted for the project, include information about fulfillment of previous recommendations and their effect



5. Audit analysis and findings report

Priority Matrix of Crash Countermeasure Implementation				
Crash Frequency	Crash Severity			
	Highest	High	Medium	Low
Pervasive	Greatest	Greatest	Great	Medium
Common	Greatest	Great	Medium	Moderate
Uncommon	Great	Medium	Moderate	Low
Rare	Medium	Moderate	Low	Lowest

5. Audit analysis and findings report



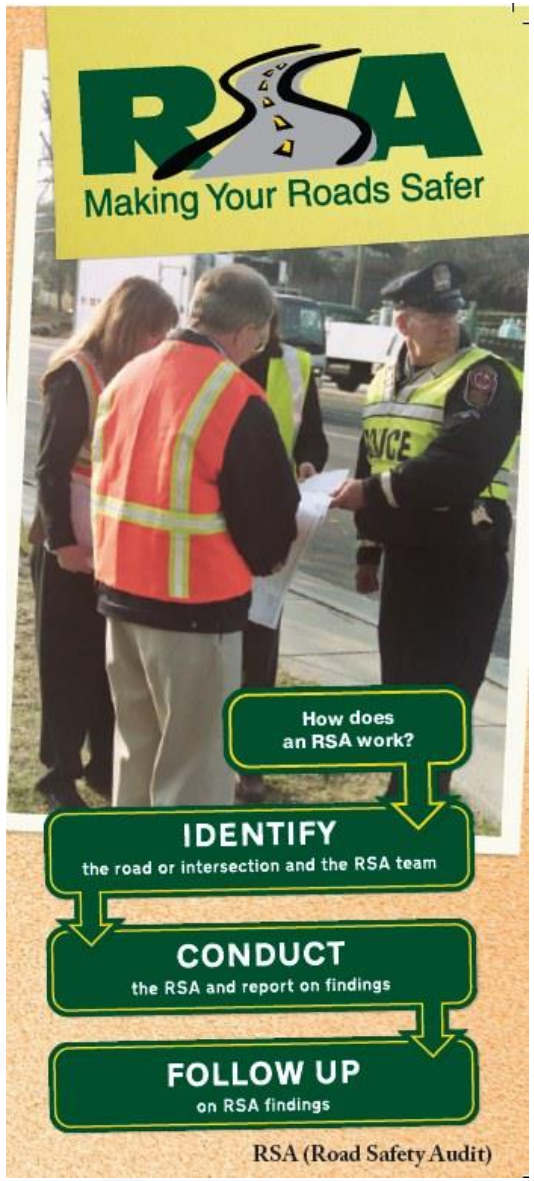
- ✓ Write a concise report addressing each safety issue
  - ✓ Problem
  - ✓ Adverse Impacts
  - ✓ Proposed countermeasure(s)
  - ✓ Field documentation evidencing issues (location in map, photographs)
  - ✓ Supporting standards and policies related to issues found
- ✓ Ensure each and all members contribute
  - ✓ Document with sections detailing feedback from each auditor is recommended

6. Presentation of findings to project owner and/or design team

- The RSA team must communicate its findings in a concise, organized and well-documented manner, both oral and written
  - Praise highlighting positive safety aspects of project or existing facility, or fulfillment of previously adopted measures
  - Pictures
  - Video
  - Measurements
  - Reasons justifying safety issues and corresponding recommendations

6. Presentation of findings to project owner and/or design team

- Beneficial to conduct a pre-meeting between RSA team and owner/designer for preliminary overview
  - Minimize redundant content
  - Owner or designer can provide additional information about action being taken to address issues found
  - Reminder about audit's scope
- Caution is advised with the use of a pre-meeting
  - Maintain independence between RSA team and owner/designer
  - Avoid imposing of points of view



7. Formal response from project owner and/or design team

- ✓ The project owner or designer must reply in written form (response report) to the RSA team
- ✓ Must specify which recommendations will be incorporated into the design, with justification
- ✓ Rejected recommendations must also be specified and justified
- ✓ Project owner or designer may dismiss specific findings if they go outside the scope and purpose of the audit
- ✓ Owner or designer must do its cost-benefits analysis to select countermeasures and include it in the formal response

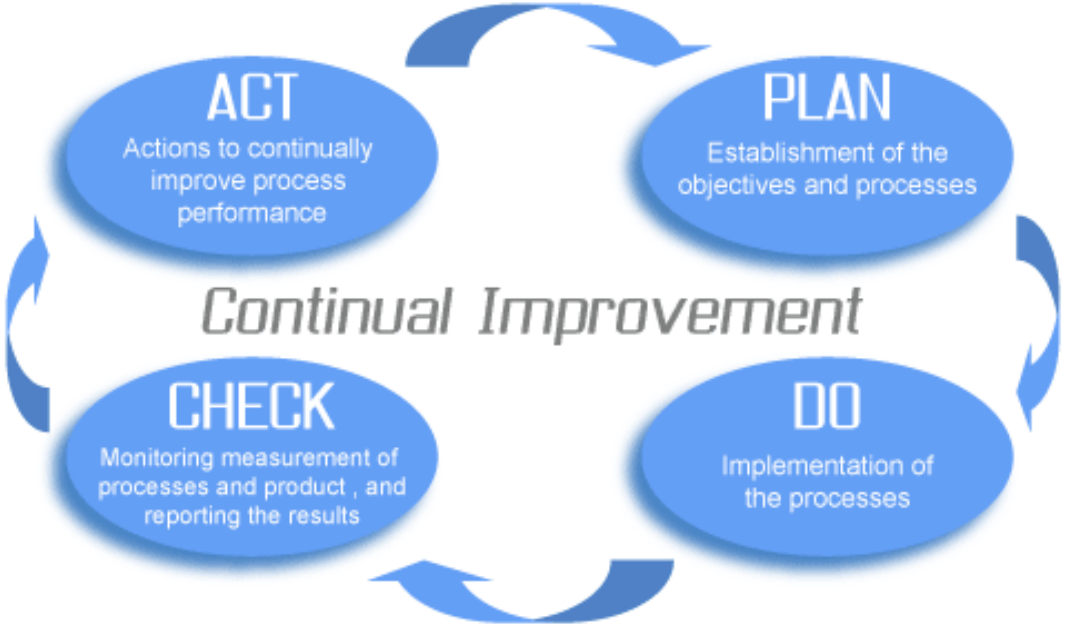
7. Formal response from project owner and/or design team

- ✓ Reasons to reject recommendations may include
  - ✓ Unfavorable cost-benefits analysis → *include alternative countermeasures* that may be cost-effective in its place
  - ✓ Recommendations do not belong to the project itself → may lead to new RSA if otherwise considered important
  - ✓ Recommended countermeasure would cause other unacceptable problems if adopted
  - ✓ Proposed countermeasure isn't effective at addressing its corresponding problem

8. Incorporation of findings as appropriate

- ✓ The project owner and/or designer must consider the feedback received and act upon it
- ✓ Depending of the kinds of safety issues and corresponding recommendations, project components are to be changed
  - ✓ Design plans
  - ✓ Project schedule
  - ✓ Materials, equipment and workers required to build/remove components affecting safety
- ✓ Second costliest part of the RSA
  → *not addressing safety needs is more costly*

8. Incorporation of findings as appropriate



- ✓ Project owner or designer can revise its RSA protocol and modify it for future implementations
  - ✓ Timing of RSA
  - ✓ Including important documents
  - ✓ Excluding irrelevant documents
  - ✓ Change RSA membership criteria if previous composition not optimal
  - ✓ Determine effectiveness of adopted recommendations

8. Incorporation of findings as appropriate

- ✓ The RSA team might recommend a future audit if substantial changes are adopted
  - ✓ Team composition may be different
  - ✓ Following RSA can happen at different project stage
- ✓ The owner must ensure the hired design and/or construction teams actually add the adopted countermeasures to the project
  - ✓ Emphasis on construction's inspector and as-built reviews

RSAs During Different Stages of Highway Projects

Pre-Construction Phase

- Planning
- Preliminary Design
- Detailed design

Construction Phase

- Work Zones
- Change orders
- Pre-Opening

Post-Construction Phase

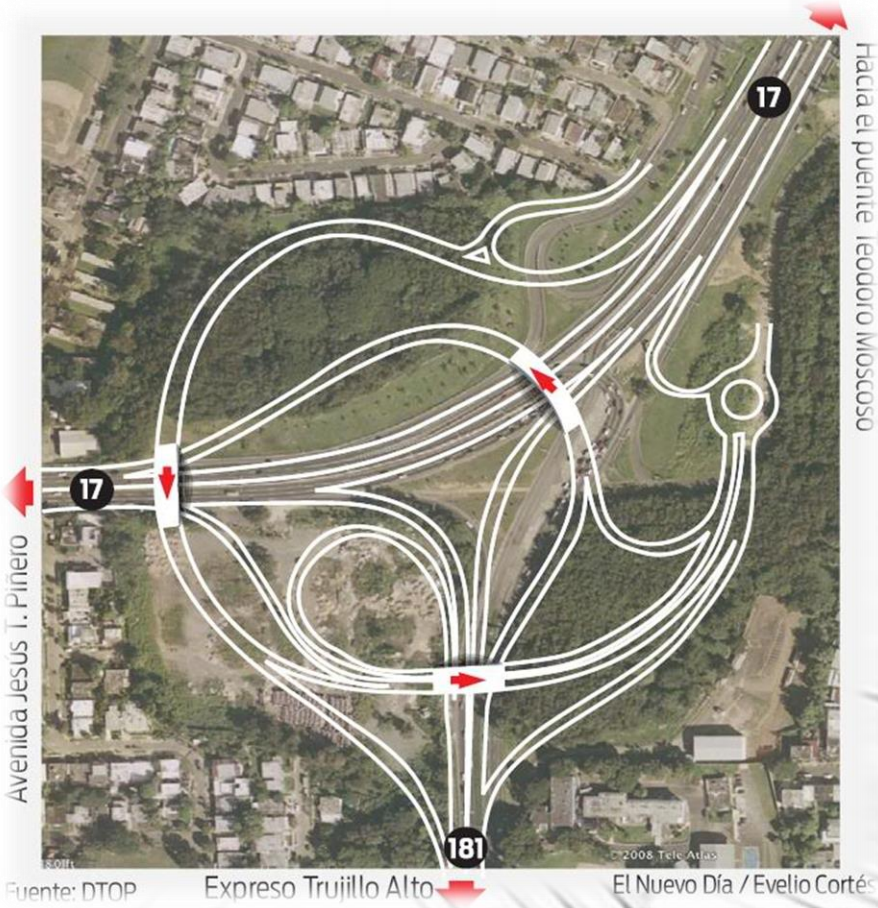
- Particular design components
- Existing road facilities
- Notorious safety problems
- New safety features

Land use

- Long term changes in existing projects
- Preparation in anticipation of demographic or economic shifts

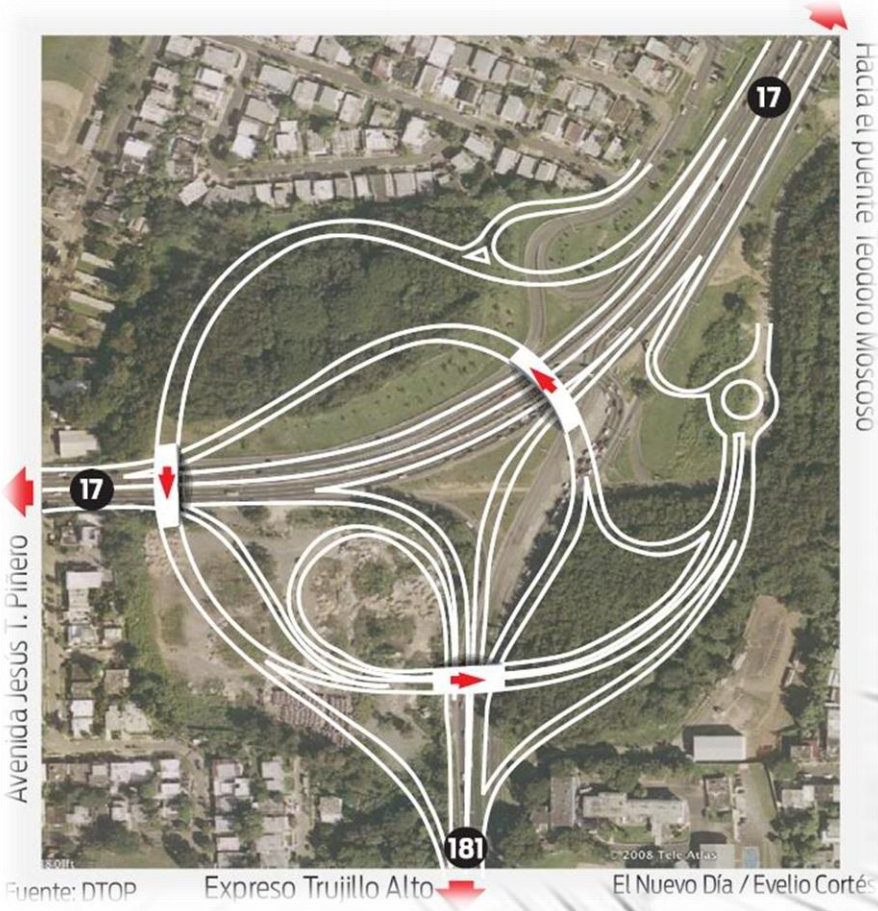
Pre-Construction

- Most effective stage for RSA impacts
  - Design issues can be addressed before they become a reality
  - Most economic benefits
  - Additional benefits for construction process
  - Most flexibility for major changes
  - Field inspection of the *before* condition can provide valuable insight about safety needs
- Can be difficult
  - Project design isn't materialized
  - Limited input from operating or environmental conditions of the site being considered
  - Great tool: Roadway simulation (SaferSim, IHSDM)



Pre-Construction

- Safety aspects considered at the pre-construction phase will depend on the completion level of designs. Focus on:
  - *Concept design:* at-large geometry, alignment, interaction with surrounding features, type of improvement or new project to build
  - *Preliminary design:* details of geometry, road furnishings (signs, safety barriers, traffic signals)
  - *Final design:* materials, temporary traffic control for future work zone, markings
- Consider interaction between different phases



Construction

- ✓ Highly dangerous road project stage → can benefit greatly from addressed safety concerns
- ✓ Last chance to address critical but overlooked safety issues
- ✓ *Pre-opening:* Road project becomes materialized
  - ✓ First opportunity to examine real site conditions of the new project in-person
- ✓ *Work zones:* bring their own set of safety issues that need dedicated attention
- ✓ *Change orders:* unexpected design change during construction, these may need their own inspection

Post-Construction

- Benefit of hindsight
  - Can consider actual operational conditions of facilities
  - Can consider input and behavior of road users
  - Addresses maintenance concerns
  - Study new safety features
- Can recommend new projects for improvement or replacement of road components

Land Development

- ✓ Long term or dramatic changes in land use can change safety needs of highway facilities
  - ✓ Increased presence of heavy vehicles → *economic growth*
  - ✓ Increased volume from new residential, commercial, industrial or institutional facilities → *population growth*
  - ✓ Different demographics (children and the elderly, gentrification, local vs non-local users) → *demographic shifts*
  - ✓ Rural facilities remain but serve urban use and activities → *urbanization process*
- ✓ Ensure critical facilities are up to par to the new uses they experience

Questions and Answers

References

- *FHWA Road Safety Audit Guidelines*. Washington, DC, 2016. *FHWA Road Safety Guidelines*. Federal Highway Administration, 2016. Web. <http://safety.fhwa.dot.gov/rsa/guidelines/documents/fhwa_sa_06_06.pdf>.
- *Road Safety Audits: An Evaluation of RSA Programs and Projects*. Washington, DC, 2012. *Road Safety Audits (RSA)*. Federal Highway Administration, Oct. 2012. Web. 18 Mar. 2016. <http://safety.fhwa.dot.gov/rsa/case_studies/fhwasa12037/fhwasa12037.pdf>.
- *Road Safety Audit Toolkit for Federal Land Management Agencies and Tribal Governments*. Washington, DC, 2010. *Road Safety Audits (RSA)*. Federal Highway Administration, Sept. 2010. Web. 14 Mar. 2016. <http://safety.fhwa.dot.gov/rsa/resources/toolkitflh/toolkitflh.pdf>.

Thank you for your attention!

And may your trip back home be safe!