

Work Zone Road Safety Audit Guidelines and Prompt Lists



Form DOT F 1700.7 (8-72)

1. Report No. FHWA-XX-12-XXX	2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle Work Zone Road Safety Audit Guidelines and Prompt Lists			5. Report Date September 2013	
			6. Performing Organization Code	
7. Authors Jennifer Atkinson; Brian Chandler; Heather Rigdon; Kelly Donoughe			8. Performing Organization Report No.	
9. Performing Organization Name and Address American Traffic Safety Services Association 15 Riverside Parkway, Suite 100 Fredericksburg, Virginia 22406-1022 Science Applications International Corporation (SAIC) Transportation Solutions Division 11251 Roger Bacon Drive Suite: 3rd Floor Reston, VA 201902			10. Work Unit No. (TRAIS)	
			11. Contract or Grant No.	
12. Sponsoring Agency Name and Address Federal Highway Administration U.S. Department of Transportation			13. Type of Report and Period Covered	
			14. Sponsoring Agency Code	
15. Supplementary Notes Mr. Jawad Paracha, FHWA COTM				
16. Abstract The Work Zone Road Safety Audit Guidelines and Prompt Lists provides a process to individuals or agencies for performing formal work zone safety examinations to improve the safety of workers and all roadway users. This document includes guidance on conducting Road Safety Audits (RSA) at all phases of work zone planning, design and deployment, and considerations for each project phase. The guidelines and prompt lists explain the importance of the Work Zone RSA and navigate the practitioner through the RSA process. Material presented here is for informational purposes only. Users should check local standards and guidelines for additional information. Any opinions or recommendations expressed in this guidance document are those of the authors and do not necessarily reflect the views of the FHWA or ATSSA.				
17. Key Words Work zone, road safety audit, RSA, safety, work zone inspection, work zone process review, prompt list		18. Distribution Statement No restrictions. This document is available to the public from: The National Technical Information Service, Springfield, VA 22161.		
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No of Pages 56	22. Price N/A	

Table of Contents

List of Tables	ii
List of Figures	iii
List of Acronyms	iii
Glossary	iv
Executive Summary	1
1. Introduction	2
1.1 Purpose	4
1.2 Scope	4
1.3 Organization	4
2. Work Zone Basics	5
2.1 Work Zone Characteristics	5
2.1.1 Work Zones in the Planning and Design Phases	5
2.1.2 Active Work Zones	6
2.2 Mobility Considerations that Affect Safety	6
2.3 Crash Analysis Considerations	7
2.4 Factors Contributing to Work Zone Crashes	7
2.5 Tools, Methods, and Processes Used to Identify Work Zone Safety Improvements	8
2.6 Solutions to Improve Work Zone Safety	9
3. Overview of Work Zone RSAs	11
3.1 Work Zone RSA versus Work Zone Inspection	11
3.1.1 Conceptual Difference between Work Zone RSAs and Work Zone Inspections	12
3.1.2 Procedural Differences between the Work Zone RSA and the Work Zone Inspection	12
3.2 How to Choose the Right Project and Phase to Conduct a Work Zone RSA	12
3.3 Anticipated Challenges in Conducting a Work Zone RSA	13
3.3.1 Costs and Benefits	13
3.3.2 Impact on Project Schedule	13
3.3.3 Resource Constraints	14
3.3.4 Risk	14
4. Conducting a Work Zone RSA	16
4.1 STEP 1: Identify Project or Active Work Zone to be Audited	16
4.2 STEP 2: Select an WZRSA Team	16
Planning Phase	18
Preliminary Design Phase	18
Final Design Phase	18
Active Work Zone	18
4.3 STEP 3: Conduct a Pre-audit Meeting to Review Project Information and Drawings	18
4.3.1 Conduct Project Overview Meeting with Road Owner	18
4.3.2 Review Project Information	19

Planning Phase	19
Preliminary Design and Final Design Phases	19
Active Work Zone Phase	20
4.4 STEP 4: Conduct Review of Project Data and Field Review	20
4.4.1 Review Project Data	21
Planning Phase	22
Preliminary Design and Final Design Phases	22
Active Work Zone Phase	23
4.4.2 Field Review	23
4.5 STEP 5: Conduct Audit Analysis and Prepare Report of Findings	25
4.6 STEP 6: Present Audit Findings to Road Owner	27
4.7 STEP 7: Road Owner Prepares Formal Response	27
4.8 STEP 8: Incorporate Findings into the Project and Evaluate Results	28
5. Work Zone RSA Prompt Lists	29
5.1 Purpose of Prompt Lists	29
5.2 Organization of Prompt Lists	29
5.3 Team Development of Prompt Lists	29
5.4 When to Use the Prompt Lists	30
5.5 How to Use the Prompt Lists	31
6. Conclusion	39
Appendices – Work Zone RSA Additional Materials	40
Appendix A – Work Zone RSA Pilot Event - Design Phase: Case Study	41
Appendix B – Work Zone RSA Pilot Event - Active Work Zone: Case Study	45
Appendix C - Additional RSA Products	51
Appendix D – Road Owner Briefing Packet Example	52
Appendix E – Work Zone RSA Report Template	55
Appendix F – Work Zone RSA Response Letter from Road Owner Template	56
List of Tables	
Table 1. Differences between WZRSA and Work Zone Inspections	11
Table 2. Work Zone RSA Team	42
Table 3. Design Phase Work Zone RSA Team Observations and Recommended Improvements	44
Table 4. Work Zone RSA Team	46
Table 5. Active Work Zone RSA Team Observations and Recommended Improvements	50

List of Figures

Figure 1. Opportunity for Change to Project and Associated Potential Cost Savings.	2
Figure 2. Examination Types to Improve Safety for Road Users and Workers, and Mobility for All Users	3
Figure 3. Types of Work Zone Safety Examinations Shown by Project Phase.. . . .	4
Figure 4. Basic Work Zone Design	5
Figure 5. Work Zone RSA Eight-Step Process.	14
Figure 6. Work Zone RSA Eight-Step Process.	16
Figure 7. Prompt List Development Method	30
Figure 8. Example: Work Zone Enforcement Prompt List Development	30
Figure 9. 118th Ave. Project Location	41
Figure 10. 118th Avenue as viewed from Google Maps.	43
Figure 11. 118th Avenue Planned Detour Routes	43
Figure 12. Firefighters Provide Input on 118th Ave. Project.	44
Figure 13. I-275 Project Limits.. . . .	45
Figure 14. I-275 Work Zone RSA Team at the TMC.	47
Figure 15. Ashley/Kay Interchange on I-275.. . . .	47
Figure 16. Howard/Armenia Interchanges on I-275.	48
Figure 17. Field review of I-275 at Ashley/Kay.	48
Figure 18. Drivers Encroach the Pedestrian Crosswalks on Howard and Armenia Avenues	49
Figure 19. Inconsistent Signal Head Alignment on Howard and Armenia Avenues.	49
Figure 20. Sign Height on the Left-hand Merge was Too High.	49
Figure 21. The Left-hand Merge Condition Could Violate Driver Expectation.	49

List of Acronyms

ADA	Americans with Disabilities Act
ATSSA	American Traffic Safety Services Association
DMS	Dynamic Message Sign
DOT	Department of Transportation
FARS	Fatality Analysis Reporting System
FHWA	Federal Highway Administration
EMS	Emergency Medical Services
ITS	Intelligent Transportation Systems
MUTCD	Manual on Uniform Traffic Control Devices
NCHRP	National Cooperative Highway Research Program
RSA	Road Safety Audit
TMP	Transportation Management Plan
TTC	Temporary Traffic Control
TTCD	Temporary Traffic Control Device
TTCP	Temporary Traffic Control Plan
WZRSA	Work Zone Road Safety Audit

Glossary

Active Work Zone: Roadway area in which work is actively being performed, having either a short- or long-term duration, which can include a stationary or moving operation.

Emergency or First Responder: Medically trained responder, such as emergency medical service providers, law enforcement, or fire, who is among those responsible for going immediately to the scene of an accident or emergency to provide assistance.

Project Overview Meeting: The initial opportunity for a road owner to formally meet the WZRSA team and kick off the WZRSA.

Temporary Traffic Control Device (TTCD): A sign, signal, marking, or other device used to regulate, warn, or guide traffic; placed on, over, or adjacent to a street, highway, pedestrian facility, or shared-use path by authority of a public agency having jurisdiction. TTCDs promote highway safety and efficiency by providing for the orderly movement of all road users on streets and highways.¹

Temporary Traffic Control Plan (TTCP): A plan or set of plans detailing the contracting/construction techniques, strategies, and use and location of all temporary traffic control devices that will facilitate traffic flow and safety through and around work zones.²

Road Safety Audit (RSA): A formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team. It qualitatively estimates and reports on potential road safety issues, identifies opportunities for improvements in safety for all road users, and culminates in the development and presentation of a final report citing safety enhancement recommendations.³

Transportation Management Plan (TMP): A formal plan defining project-specific strategies to minimize the safety and mobility impacts from the work zone on roadway users. For all projects, a TMP requires a temporary traffic control plan that addresses traffic safety and control through the work zone. For significant projects, the TMP must also contain both transportation operations and public information components. The transportation operations (TO) component addresses operations and management of the transportation system in the work zone impact area. The public information (PI) component addresses public and stakeholder communications before and during the project. It provides general information about the project, what to expect in and around the work zone, and available travel alternatives.⁴

Work Zone: A segment of roadway where activity takes place, including maintenance to existing roadways, construction of new elements, or other non-roadway work (e.g., utility installations).

Work Zone Impacts Assessment: The process of understanding the safety and mobility impacts of a road construction, rehabilitation, or maintenance project.⁵ This assessment occurs most commonly during the preliminary or final design stages.

Work Zone Inspection: A work zone inspection is a review of temporary traffic control devices and safety/mobility strategies that have been deployed per an approved plan, standards, and specifications in an active work zone. Specific project inspections are typically performed by a member of the agency responsible for the road work. Compliance and deficiencies are documented formally using a work zone inspection sheet, or informally, using visual judgment. Work zone inspection sheets can vary in complexity and categories, but typically identify criteria deemed most critical to the work zone (e.g., signing quality/location, whether the work zone set-up matches design plans, presence of flaggers, safety/mobility concerns, etc.).

Work Zone Process Review: Periodic evaluation of work zone policies, processes, procedures, and work zone impacts that aids in the process of addressing and managing the safety and mobility impacts of work zones.⁶

1 Federal Highway Administration, *Manual on Uniform Traffic Control Devices (MUTCD)*, 2009.

2 Federal Highway Administration, *Developing and Implementing Transportation Management Plans for Work Zones*. http://ops.fhwa.dot.gov/wz/resources/publications/trans_mgmt_plans/sec4.htm#four1

3 Federal Highway Administration, Road Safety Audits website. <http://safety.fhwa.dot.gov/rsa/>

4 Federal Highway Administration, *Transportation Management Plans for Work Zones*. http://ops.fhwa.dot.gov/wz/resources/tmp_factsheet.htm

5 Federal Highway Administration. *Work Zone Impacts Assessment: An Approach to Assess and Manage Work Zone Safety and Mobility Impacts of Road Projects*. August 2006.

6 Federal Highway Administration. *Implementing the Rule on Work Zone Safety and Mobility*. http://ops.fhwa.dot.gov/wz/rule_guide/index.htm

Work Zone Road Safety Audit (WZRSA): A formal safety performance evaluation that can be performed at any stage of a planned or existing work zone (project planning and design, or in active work zones) by an independent, multidisciplinary team. It qualitatively estimates and reports on potential work zone safety issues, identifies opportunities for improvements in work zone safety for all road users and workers, and culminates in the development and presentation of a final report citing work zone safety enhancement recommendations.⁷

Work Zone Road Safety Audit Prompt List: A list of potential safety issues to be used by the Work Zone RSA team to help ensure that they do not overlook important work zone safety concepts. It may also be used by planners and designers to help identify potential work zone safety concepts proactively as the design progresses.

Work Zone Road Safety Audit Report: A report that succinctly presents the audit team findings through identification and prioritization of safety issues and presents suggestions for reducing the degree of risk.

⁷ A Work Zone RSA does not address industrial safety concerns.



Executive Summary

The *Work Zone Road Safety Audit Guidelines and Prompt Lists* provides a process to individuals or agencies for performing formal work zone safety examinations to improve the safety of workers and all roadway users. This document includes guidance on conducting Road Safety Audits (RSA) at all phases of work zone planning, design and deployment, and considerations for each project phase. The guidelines and prompt lists explain the importance of the Work Zone RSA and navigate the practitioner through the RSA process.

A Work Zone RSA (WZRSA) employs the process of an RSA combined with characteristics of a typical work zone inspection or process review. The difference between an RSA and a WZRSA is in the tailored RSA approach incorporated into the unique challenges of work zones. Note that a WZRSA assesses a project's *temporary* elements that will eventually be removed once the active work zone phase is completed. For example, a WZRSA team should focus on work zone safety, design, and operations; it should not focus on *permanent* geometric design elements. Due to the temporary nature of work zones, the WZRSA team must record its findings and submit recommendations to the road owner in a timely fashion.

The eight-step RSA process qualitatively estimates and reports on potential road safety issues and identifies safety improvement opportunities for workers and all road users. One of the key features of a WZRSA is that it is performed by a multidisciplinary team focused on safety issues. A team comprised of members with various backgrounds and experiences can identify issues that may otherwise be overlooked. Recommendations from a WZRSA can potentially affect roadway users and workers immediately, improve the safety on the work zone being audited, and improve the agency's overall work zone development and deployment process.

Agencies using the RSA process realize a number of benefits. Conducting an RSA early in the project development process can reduce overall project costs. Executing an RSA can make a roadway safer, mitigating the potential for risk claims, reducing the societal cost of crashes, reducing project costs, mitigating congestion, and lessening crash severity levels.

Impacts on safety and mobility are not limited to the actual work zone limits. Impacts can reach beyond the immediate affected area to adversely impact businesses, communities, other roadway networks, and adjacent work zones. Impacts can even affect other geographic areas if the work zone is located at critical segments on the road network. Unresolved impacts can cause traffic delays, increase costs, create safety and mobility issues, and affect project delivery.⁸ Performing a WZRSA in the planning, design, and/or active work zone phases can mitigate these impacts by addressing potential safety and mobility problems before they occur or as a result of a defined need to improve safety.

The WZRSA's impact on a project's schedule depends on several issues:

- The complexity of the project;
- How the WZRSA program is organized;
- When in the project life cycle is the audit performed;
- The scope and implications of WZRSA recommendations; and
- How those suggestions are addressed.

Public agencies should consider these scheduling issues when beginning a WZRSA. Generally, the WZRSA process may be conducted in as little as a week covering the project identification through preparing the formal report of findings. Incorporating the findings into the report is dependent upon the road owner's response to the conclusions and the detailed nature of the findings.

Florida DOT used the *Work Zone Road Safety Audit Guidelines and Prompt Lists* to conduct pilot WZRSA for two projects in January 2013. As a result of two WZRSA Pilot Studies – one in the Design Phase and one in the Active Work Zone Phase – the WZRSA Team recommended several opportunities to improve safety. See Appendix A for a detailed account of the Design Phase Work Zone RSA Pilot Study and Appendix B for the Active Work Zone RSA Pilot Study.

In the nation's quest toward zero roadway deaths, these guidelines outline another tool designed to help reach that goal. Recommendations from a WZRSA can affect roadway users and workers immediately, improve the safety on the work zone being audited, and improve the agency's overall work zone development and deployment process.

Additional information on the RSA process may be found on the Federal Highway Administration (FHWA) RSA website - <http://safety.fhwa.dot.gov/rsa/> and the National Work Zone Safety Information Clearinghouse website – <http://www.workzonesafety.org>.

⁸ Li, Arditi, Snyder. *Guidelines for Highway Work Zone Safety Audits*. 2009.

1. Introduction

Multidisciplinary collaboration on RSA teams provides:

- Experience from multiple viewpoints.
- Opportunities to develop relationships with stakeholders and partners.
- An understanding of how stakeholder input varies with respect to the roadway functionality and user needs.

The practice of Road Safety Audits (RSA) helps to proactively identify safety issues and recommend treatments. It is a formal safety performance examination of an existing or future road or intersection conducted by independent, multidisciplinary team members who bring their individual experiences and expertise to the process. It qualitatively estimates and reports on potential road safety issues and identifies opportunities for safety improvements safety for all road users.

RSA teams may review the potential for safety enhancements to roadway elements, human factor considerations, enforcement and emergency services issues, and facility operations, whether they currently exist or are planned. In some cases, the formal safety performance examination may occur during a specific project phase, but it may also take place over the course of the project's life.

Agencies implementing RSAs have realized several benefits that can be categorized in the following areas:

- Avoid or substantially reduce throwaway costs and reconstruction costs to correct safety deficiencies identified once roads are in-service. Figure 1 illustrates how conducting RSAs early in the project development process can reduce overall project costs.⁹
- Lessen the societal costs of collisions with safer roads and fewer, less-severe crashes.
 - Five locations in Arizona, Tennessee, New Jersey and Florida exhibited an overall reduction in crashes ranging from 10 percent to 50 percent as a result of improvements implemented from the RSAs. In addition, the study determined that the benefits of these safety treatments exceeded the total RSA and implementation costs combined.¹⁰
- Mitigate risk claims, a component of both agency and societal costs.

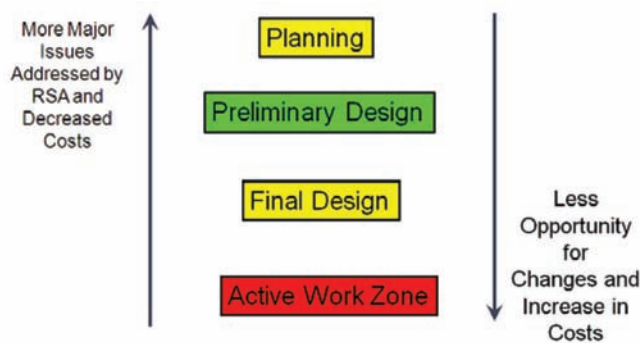


Figure 1. Opportunity for Changes to Project and Associated Potential Cost Savings

Applying RSAs to work zones can result in a unique set of safety and operational benefits. Temporary traffic control (TTC) devices and construction or work zone staging often represent 5-10 percent of project costs.¹¹ By identifying improvements to work zone elements and staging early, agencies may realize substantial savings.

Recommendations from a WZRSA can affect roadway users immediately and broadly when applied to active work zones. In addition to identifying opportunities to improve safety for roadway users and workers, WZRSAs can lead to other benefits. For example, WZRSAs can make it possible to improve travel times and travel time reliability. Though operational and mobility enhancements are not necessarily the primary goal of the WZRSA process, it is important to consider the relationship and balance that should occur between safety and operational matters during the roadway planning, design, and active work zone phases. In addition to the work zone projects being reviewed, observations from the WZRSA team may provide recommendations that benefit future work zones and design.

⁹ Throwaway costs refer to a project design or project element (such as infrastructure or traffic control elements) that are ultimately removed or modified due to deficiencies that are recognized after the project is significantly completed or concluded.

¹⁰ Federal Highway Administration. *Road Safety Audits: An Evaluation of RSA Programs and Projects*. October 2012. Report Number FHWA-SA-12-037.

¹¹ Utah Department of Transportation. *Roadway Design Manual of Instruction*. September 26, 2011 Edition.

Throughout these guidelines, several terms will be used frequently to introduce or compare the types of safety examinations performed for work zones. The relationships are shown in Figure 2 and their definitions follow:

- **RSA** – A Road Safety Audit is the formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team. It qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users.¹² An RSA culminates in the development and presentation of a final report citing safety enhancement recommendations. RSAs may also be conducted that are geared toward specific user groups, such as pedestrians and bicyclists.
- **Work Zone Inspection** – A work zone inspection is a review of temporary traffic control devices (TTC) and safety/mobility strategies deployed per an approved plan, standards and specifications in an active work zone. Member(s) of the agency responsible for the road work typically perform the specific project inspections. Compliance and deficiencies are documented formally, using a work zone inspection sheet, or informally, using visual judgment. Work zone inspection sheets can vary in complexity and categories, but typically identify criteria deemed most critical to the work zone (e.g., signing quality/location, whether the work zone set-up matches design plans, presence of flaggers, safety/mobility concerns, etc.).
- **Work Zone Process Review** – A work zone process review is a periodic evaluation of work zone policies, processes, procedures, and work zone impacts that aids in the process of addressing and managing the safety and mobility impacts of work zones. The process review helps assess the effectiveness of a program or a set of processes and procedures.
- **WZRSA** – A Work Zone Road Safety Audit is a formal safety performance evaluation performed at any stage of a planned or existing work zone (project planning and design, or in active work zones) by an independent, multidisciplinary team, and considers methods of improving safety in a work zone. A WZRSA assesses the temporary elements of a project that will eventually be removed once the active work zone phase is completed. Due to the temporary nature of work zones, WZRSA recommendations must be provided to the road owner in a timely fashion.

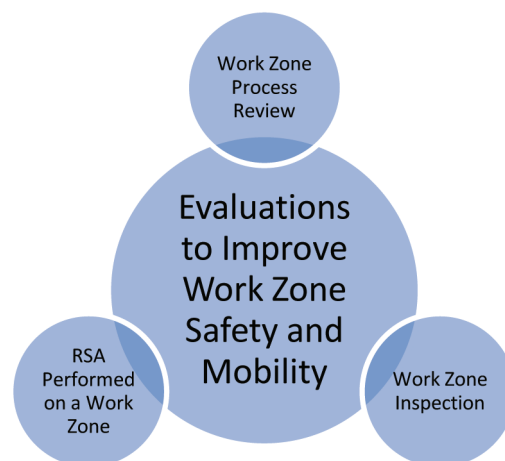


Figure 2. Examination Types to Improve Safety for Road Users and Workers, and Mobility for All Users

¹² Federal Highway Administration, Road Safety Audits website. <http://safety.fhwa.dot.gov/rsa/>

These safety examinations may be performed at various project phases, as shown in Figure 3. Drafting and implementing policy happens as a continuous process, as does a work zone policy review. This type of review can happen at any time. Agencies may conduct RSAs, Pedestrian RSAs, and Bicycle RSAs during project planning, preliminary and final design, and on existing roads. Work zones inspections occur during the active work zone phase. WZRSAs can occur during all project phases – from planning through an active work zone.

Additional RSA resources are found in Appendix C.

1.1 Purpose

The *Work Zone Road Safety Audit Guidelines and Prompt Lists* provide a process to individuals or agencies for performing a formal safety examination of a work zone in order to improve the safety of workers and all roadway users in active work zones. These guidelines expand on the current RSA guidance to include details on how the eight-step RSA process and prompt lists can apply specifically to work zones.

1.2 Scope

This document includes guidance on conducting WZRSAs at various phases of work zone planning, preliminary design, final design, and active work zones. The guidelines and prompt lists will explain the importance of WZRSAs and navigate the WZRSA process. The guidelines will also help answer the questions “Why should I perform a Work Zone RSA?” and “What are the benefits?”

1.3 Organization

The guidelines are organized in the following manner:

- Chapter 2 discusses basic work zone safety concepts and introduces factors that lead to work zone crashes. It includes methods used to identify work zone safety improvements and solutions to improve work zone safety issues.
- Chapter 3 presents an overview of Work Zone RSAs and denotes the differences and similarities between WZRSA and work zone inspections. This chapter provides suggestions for projects and the most appropriate project phase in which to conduct a WZRSA and mentions challenges that may be anticipated while conducting a WZRSA.
- Chapter 4 organizes the eight-step WZRSA process and gives specific considerations for each step. This chapter discusses who to include on the WZRSA team, how to conduct the WZRSA most effectively, how to develop and present the WZRSA final report, and how to respond to the report’s findings and recommendations.
- Chapter 5 details the use of prompt lists when conducting a WZRSA. It provides the practitioner with an overview of the importance and application of prompt lists.



Prompt lists are available for use in the WZRSA process during any project phase. Appropriate instances for use of the prompt lists are denoted with this clipboard icon.

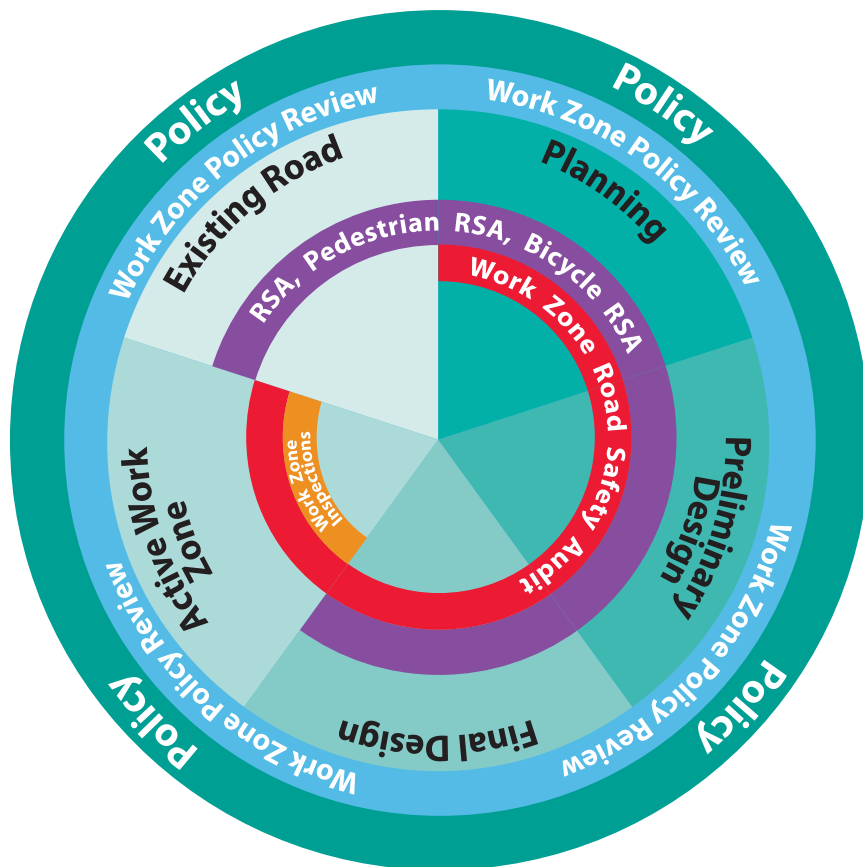


Figure 3. Types of Work Zone Safety Examinations Shown by Project Phase

2. Work Zone Basics

According to the Fatality Analysis Reporting System (FARS), 561 people were killed in motor vehicle traffic crashes in work zones in 2011. Roadway workers represented 119 fatalities (91 were related to transportation incidents), while motorists, pedestrians, and other roadway users accounted for the rest.¹³ Work zones vary in traffic volume, work duration, user types, and impact on traffic; safety and mobility issues should be addressed using a combination of methods available to the agency. The temporary and unique nature of each work zone dictates the consistent application of work zone safety considerations and practices.



Agencies can incorporate elements of WZRSAs into their current practices by considering work zone safety and mobility at each stage of a project's life. The following sections offer safety and mobility considerations for work zones in the planning, design, and active work zone phases. For more detailed considerations, see Sections 4.3 and 4.4 and the prompt lists in Section 5.3.

2.1 Work Zone Characteristics

A work zone is commonly identified as a segment of roadway where work activity takes place, including maintenance to existing roadways, construction of new elements, or non-roadway work (e.g., utility installations or repair). In many cases, road users recognize active work zones by specific highway signing, a reduction in speed, change in traffic patterns, use of specialized traffic control methods, and/or the presence of materials, equipment, and workers. Work zones also exist on paper during the planning and design phases prior to the physical characteristics described above.

Consistency is Key

Drivers must be able to recognize work zone traffic control elements and construction practices without learning “new rules” each time.

2.1.1 Work Zones in the Planning and Design Phases

For large-scale projects, work zones are planned and designed over a span of many years and involves a team comprised of diverse backgrounds and interests. During the planning phase, work zones may be conceptual and may only exist through discussions of those responsible for assigning a proposed budget and timeline to the project.

During design, there are usually several modifications to the work zone design to ensure the inclusion of various traffic control components, operational and safety considerations for each roadway user type, and strategies to mitigate potential negative impacts to operational safety and mobility.

During these phases, specific considerations are given to:

- Whether work zone safety and mobility goals are complementary;
- Geometric design of the work zone;
- Work zone staging;
- Construction techniques;
- Construction duration;
- The impacts the work zone will have on roadway users, workers, transit, railroads, airports, schools, businesses, parking, detours, pedestrians, emergency response, special events, seasonal travel, and surrounding communities;
- Environmental conditions where the work zone will be located;
- Identification of the type and placement of temporary traffic control and safety devices;
- Identification of transportation management strategies;
- Project costs;
- Involving the public and other stakeholders; and
- Communication channels for use during the active work zone phase.

¹³ The worker fatalities were obtained from (pg. 1 (total fatalities) and pg. 11(transportation-related)): http://www.workzonesafety.org/files/documents/crash_data/2003-2011_worker_fatalities.pdf

Early in the planning and design phases, work zones begin to appear in elementary form, often consisting of basic work areas, as shown in Figure 4, and becoming more complete as project and work zone details are decided. During the latter part of this phase, designers assess work zone impacts to determine the safety and operational effects of work zones on roadway users and workers and strategies to mitigate these effects.

2.1.2 Active Work Zones

Construction, utility, operations, and maintenance activities in an active work zone can have an impact on roadway users. Active work zones may include work being performed during a short- or long-term duration, in addition to a moving operation. Active work zones may consist of installed TTCDs, safety and mobility strategies that have been deployed, and the presence of construction equipment and workers. Chronological phases of a work zone include set-up, active work zone, non-active work zone (e.g., overnight in between working days), and take-down/removal.

During the active work zone phase, specific considerations should be given to:

- Safety and mobility performance goals; and
- If the transportation management plan (TMP) is performing as needed.¹⁴

2.2 Mobility Considerations that Affect Safety

Factors that improve mobility in work zones can also positively impact work zone safety. Attempts to mitigate and reduce congestion and queuing can significantly reduce work zone fatalities and serious injuries. Studies have indicated crashes secondary to other incidents range from 14 to 30 percent of all crashes. The United States Department of Transportation (USDOT) estimates that 18% of fatalities on freeways were due to secondary crashes.¹⁵

The following mobility considerations in work zones can also affect safety:

- **Queuing.** After analyzing their work zone crash data, the California Department of Transportation (Caltrans) learned that 26 percent of their work zone fatalities occurred at the back of a queue.¹⁶ Efforts to reduce or eliminate queuing in work zones help to alleviate unexpected speed reductions and better conform to drivers' expectations. In some cases, queuing may be inevitable; in this case, advanced notification to road users can help mitigate safety concerns.
- **Congestion.** Significant congestion can lead to risky behaviors and aggressive driving, especially when road users are subjected to the congestion on a daily basis. Repeated exposure to congested work zones can lead to frustrated, desperate drivers who make impulsive and often dangerous driving decisions.

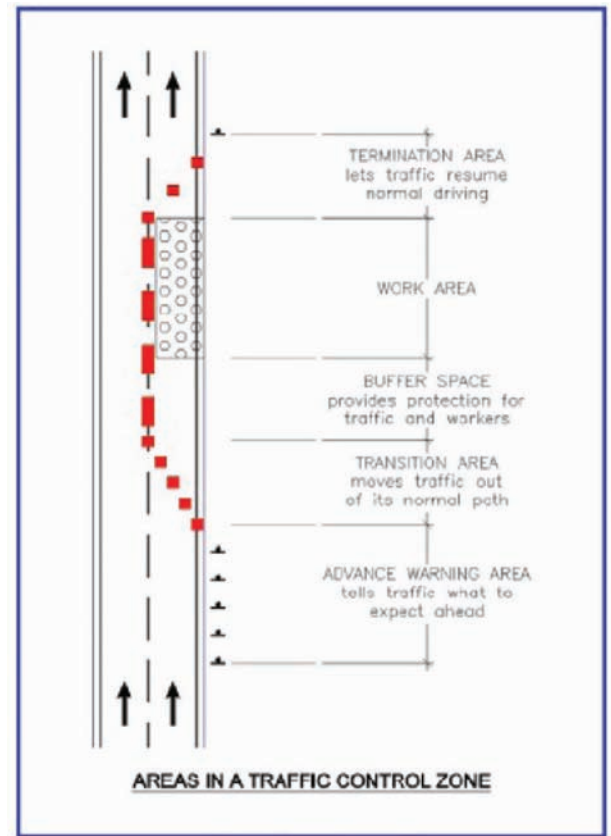


Figure 4. Basic Work Zone Design



¹⁴ Federal Highway Administration, *Transportation Management Plans for Work Zones*. http://ops.fhwa.dot.gov/wz/resources/tmp_factsheet.htm

¹⁵ O'Laughlin, J. and A. Smith. Operational Issues Discussion Paper on "Incident Management 4 Operations: Top Five Issues". In *Proceedings of the National Conference on Traffic Incident 5 Management: A Road Map to the Future*. June 2002, pp. C-2.

¹⁶ Presentation by Joe Jeffrey, Road-Tech Safety Services during a webinar on Work Zone Fatality Reduction Strategies - Held on May 23, 2012 by FHWA.

2.3 Crash Analysis Considerations

Crashes occurring within work zones have both similarities and disparities to those occurring outside work zone limits. Likewise, work zone crash analyses should consider the elements within a work zone that may contribute to the crash. This analysis may differ from similar studies conducted outside of a work zone area. Elements of the work zone may change on a daily basis: TTCDs may be relocated, work activity staging may require motorists to navigate a different path, and lanes may be temporarily closed, whereas roadways without active work zones remain familiar and unchanged to roadway users. The issues below illustrate how crash analyses within work zones differ from crash analyses in other locations:

- **Real-time Safety Needs during Active Work Zones.** The temporary nature of work zones often leaves little time to assess crashes and determine the contributing/causal factors and the most appropriate remediation within the project's duration, whereas long-term safety treatments can be applied to road sections experiencing on-going safety concerns. Given the need for immediate solutions to field-level work zone safety issues, receiving work zone crash data in a timely manner is very important, while the depth of analysis – compared to non-work zone crashes – is typically less robust.
- **Potential for Cost Savings.** During the review process of preliminary design plans, practitioners can analyze work zones for potential safety issues and include work zone safety strategies as plan development progresses. Early incorporation of safety and mobility elements provide the potential for considerable cost savings, as compared to a reactive solution during an active work zone. When identified early in the project life cycle, safety and/or mobility strategies may be combined or streamlined. These early adjustments offer the opportunity for:
 - reduced project duration;
 - efficiencies gained by deploying fewer TTCD;
 - reduced interruption of roadways users; and
 - lowered mobilization costs.

Planning should allow for adequate ingress and egress into the work zone area for emergency vehicles tow-trucks, and special equipment. This equipment needs the ability to access the scene of a crash, tend to the victims, and protect the scene from further incidents. Proper planning for a quick response significantly impacts mobility, safety, and the ability to clear the scene in a timely manner.

2.4 Factors Contributing to Work Zone Crashes

Work zones crashes may result from a variety of causes and contributing factors.

Driver Expectations. Crashes may occur when a road user does not anticipate a work zone, or if traffic control warnings do not match the road user's expectations. This may result from improper use of traffic control, inconsistent use of traffic control from one work zone to another or the use of experimental or not-widely-used traffic control devices.

Roadside Hazards. In some cases, work zone traffic control elements (and workers themselves) are placed close to the lane of travel and may be struck in a crash. This is sometimes seen with the use of concrete traffic barrier, deployment of changeable message signs, work activities occurring close to motorists' wheel paths, and placement of equipment.

Driver Behavior. In most cases, driver behavior plays a role in work zone crashes. Crashes associated with unexpected conditions, unfamiliarity, speed, aggressive driving, driver inattention, impaired driving, and other causes may occur anywhere and at any time.

Unsuccessful Mitigation Strategies/TTC Deployment. Despite attempts to identify and mitigate potential sources of safety and mobility concerns, strategies can still fail. It is also possible to mismatch potential impacts and strategies.

Roadway Characteristics. Existing or changed pavement conditions, uneven pavement or edges, steel plates, horizontal or vertical geometry, clear zones, and impacts to interchange merge areas may contribute to a work zone crash.

Environmental Conditions. The presence of wet, snow-covered, or ice-covered roadways may contribute to drivers' control of their vehicles or pedestrians' ability to traverse the work zone. Limited visibility from dark conditions or sun glare may also affect their abilities (e.g., new asphalt pavement can be difficult to see during night conditions).

Secondary Crashes Caused by Roadway Incidents. Crashes occurring within the work zone may contribute to congestion and aggressive driving, leaving the upstream roadway susceptible to additional incidents. These same characteristics may occur as a result of a disabled vehicle in the roadway and the need for a tow service to remove it.

Combined Effects. In certain situations, deployed work zone TTCD can appear to provide roadway users with the guidance needed to direct them through an active work zone. However, when conditions at the work zone location change, the once-helpful guidance may actually contribute to crashes. For example, pavement markings that have been milled or covered with black paint may appear as positive guidance under certain sunny, wet, or dark conditions.



2.5 Tools, Methods, and Processes Used to Identify Work Zone Safety Improvements

Many strategies exist to help identify work zone safety improvements. The following methods are the most common tools and processes:

Work Zone Road Safety Audits. A WZRSA is a formal safety performance evaluation that can be performed at any stage of a planned or existing work zone (project planning and design, or in active work zones) by an independent, multidisciplinary team. It reports on potential work zone safety issues, identifies opportunities for improvements in work zone safety for all road users and workers, and culminates in the development and presentation of a final report citing work zone safety enhancement recommendations.



Active Work Zone Inspections. A work zone inspection is a review of temporary traffic control devices and safety/mobility strategies that have been deployed per an approved plan, standards, and specifications in an active work zone. The agency responsible for the road work typically performs project inspections. Inspections are typically frequent (e.g., daily or weekly) and brief. Compliance and deficiencies are documented formally using a work zone inspection sheet, or informally, using visual judgment. Work zone inspection sheets can vary in complexity and categories, but typically identify criteria deemed most critical to the work zone (e.g., signing quality/location, whether the work zone set-up matches design plans, presence of flaggers, safety/mobility concerns, etc.).

Collaboration between Stakeholders and Safety Partners. Discussions between those who affect and are affected by work zones can and should occur during all project lifecycle phases. Specific stakeholders and partners may include:

- Agency staff (including those responsible for planning, design, construction, maintenance, traffic, safety, work zones, bicycles and pedestrians, and policy);
- Cities, counties, or other local agencies;
- Regional or metropolitan planning agencies;
- Law enforcement and first responders;
- Community advocacy groups;
- The motor carrier industry;
- Public utility companies;
- Fire and emergency medical services (EMS);
- Public Transportation Agencies, such as transit authorities;
- Railroads;



- School representatives;
- Private businesses;
- Media/public relations; and
- Civic groups.

Modeling Work Zone Conditions. Representing the environment that may exist during the active work zone can help design and construction staffs anticipate site-specific solutions for safety and mobility.

Work Zone Impacts Assessment. Agencies typically conduct a work zone impact assessment to determine the conditions that will be present during the active work zone. This study helps identify complementary strategies to mitigate the expected impacts. Generally, the assessment occurs during preliminary or final design phase. The impacts may be evaluated with respect to anticipated crash rates, expected queues, road user travel time or delay, and other considerations.

2.6 Solutions to Improve Work Zone Safety

Agencies may use one or more solutions in combination to improve work zone safety. Agencies typically plan these solutions during the design phase and apply them during the active work zone phase. The following solutions represent the most common techniques:

Transportation Management Plan (TMP). A TMP is a formal plan defining project-specific strategies to be employed during the active work zone phase to lessen the effects of the work zone on roadway users. If major impacts are anticipated, projects will have a TMP comprised of three components:

- *Temporary Traffic Control strategies;*
- *Public Information strategies; and*
- *Transportation Operations strategies.*¹⁷

Intelligent Transportation Systems (ITS). ITS use can provide the means to collect both safety and mobility data and relay messages to road users about upcoming incidents, congestion, and delay, in addition to suggesting alternate routes.¹⁸

Positive Protection. Several types of positive protection devices are available to enhance worker and motorist safety. These include several types of rigid traffic barriers, shadow vehicles with truck-mounted attenuators, and vehicle arresting systems that prevent road users from entering a closed section of roadway.¹⁹

Proactive and Reactive Solutions. Variable speed limits (VSL) may be used to proactively address potential or existing safety issues prior to work zones. For example, a VSL may be used to reduce the speed of road users upstream of an active work zone to mimic the speed limit conditions at the site. Making changes to the existing work zone layout or TTCDS may be a reactive solution necessary to address safety issues that occurred near the active work zone.

Performance Measures. Agencies may establish performance measures to quantify safety or operational goals or limits. For example, an agency may set a goal of zero work zone fatalities or establish a limit of fewer than 10 minutes for delays through a work zone.



¹⁷ For more information, see the Federal Highway Administration website for Transportation Management Plan Examples. http://www.ops.fhwa.dot.gov/wz/resources/final_rule/tmp_examples.htm

¹⁸ For more information, see the United States Department of Transportation Intelligent Transportation Systems Joint Program Office website. <http://www.its.dot.gov/>

¹⁹ For more information, see the Work Zone Positive Protection Toolbox that is available through ATSSA. <http://www.atssa.com/galleries/default-file/WZ%20Positive%20Protection%20Toolbox%20LL%20-%20FINAL.pdf>

Coordination between an Agency's Construction and Safety Offices. An agency's construction office should coordinate with the agency's safety office in real-time during the active work zone phase. An agency's safety office can assist with crash type identification and remediation in an active work zone as long as those responsible for construction activities document the incidents and circumstances surrounding work zone crashes in a timely fashion.

Communication with the Public. The use of intelligent transportation systems (ITS), news media, social media, and other means of data collection and public notification may assist road users in selecting other routes before or during their commute. Arizona Department of Transportation (DOT) uses a combination of 511, Twitter, Facebook, and RSS feeds to provide work zone information to road users.²⁰

Kansas DOT estimates that roughly 80 percent of media-based communication between their DOT and the public is work zone-related.

²⁰ Federal Highway Administration, Work Zone Best Practices Guidebook, 2012.

3. Overview of Work Zone RSAs

In 2008, the FHWA Office of Safety included RSAs in its first list of Proven Safety Countermeasures to reduce the frequency and severity of traffic crashes nationwide.²¹ When WZRSAs are applied during planning, design, and active work zone phases, both safety and operational benefits can be recognized and potential safety and mobility impacts may be mitigated before they occur. Though operational and mobility enhancements are not necessarily the primary goal of the WZRSA process, it is important to consider the relationship and tradeoffs that occur between safety and operational matters during the roadway planning, design, and active work zone phases.

A key differentiator of a WZRSA is that it assesses the temporary elements of a project that will eventually be removed once the active work zone phase is completed. For example, a WZRSA team should focus on work zone design, operations, and safety. A WZRSA team should not focus on the permanent geometric design elements. Due to the temporary nature of work zones, it is essential that WZRSA recommendations are provided to the road owner in a timely fashion.

As a result of implementing WZRSA findings on planned or active work zones, substantial cost savings may be realized, as TTCDs and construction or work zone staging often represent a large percentage of project costs. WZRSAs may be introduced during planning, design, and active work zone phases and the WZRSA may be conducted over a span of a few weeks covering the initial meeting through the presentation of the findings and recommendations to the road owner.

3.1 Work Zone RSA versus Work Zone Inspection

The basic principles of a RSA are used to conduct a WZRSA. The difference between the two can be found in the tailored approach and considerations toward work zones that takes place during a specific project phase.

By definition, a WZRSA is a formal safety performance evaluation at any stage of a planned or existing work zone (project planning and design, or in active work zones) by an independent, multidisciplinary team. Table 1 shows the differences between the review types used to evaluate work zone safety.

Table 1. Differences between WZRSA and Work Zone Inspections

Review Type	WZRSA	Work Zone Inspection
Project Delivery Stage:		
• Planning	√	
• Preliminary Design	√	
• Final Design	√	
• Active Work Zone	√	√
Focuses on work zone safety issues and respective solutions	√	√
Focuses on work zone mobility issues and respective solutions		√
Potential for cost savings	√	√
Use of multidisciplinary team	√	
Includes driver behavior and human factors as part of the review	√	
Is typically a proactive safety measure	√	
Formalized step-by-step process	√	
Formal report on findings	√	

²¹ <http://safety.fhwa.dot.gov/policy/memo071008/>

3.1.1 Conceptual Difference between Work Zone RSAs and Work Zone Inspections

Typical inspections in active work zones examine compliance to basic requirements set forth in standards established in the Manual on Uniform Traffic Control Devices (MUTCD) or State-specific policies, as well as analyzing conformance to the design plans (i.e., nominal safety). A WZRSA, in contrast, focuses on substantive safety such as assessing the crash frequency, type, and severity and identifying safety treatments to improve the safety of the workers and road users. A WZRSA provides a comprehensive overview of all aspects of the work zone and its impact on safety.

3.1.2 Procedural Differences between the Work Zone RSA and the Work Zone Inspection

- While a work zone compliance inspection is performed by a limited number of inspectors who are intimately familiar with the project, a WZRSA is performed by a multidisciplinary team, independent of the project.
- Due to their limited time commitment, a work zone inspection may be performed on a daily or weekly basis, but a WZRSA may only be conducted once during a project/activity.
- A traditional work zone inspector follows a checklist focused on complying with standards and results are displayed as a score or rating. A WZRSA report identifies potential safety risks through the use of prompt lists.
- A WZRSA recommends solutions and a call to action in a final report, whereas a formal report is not developed when a work zone inspection is concluded.

3.2 How to Choose the Right Project and Phase to Conduct a Work Zone RSA

In 2007, researchers conducted a survey to aid in the development of national highway work zone safety audit guidelines. The survey responders included FHWA experts on highway work zone safety and mobility concepts, State transportation agencies, local government agencies, private consultants, equipment vendors, general contractors, universities/research institutions, unions, and professional associations. The survey asked respondents to identify:

- Leading causes of work zone safety problems and effective countermeasures;
- Types of projects suitable for auditing and audit frequencies;
- Suitable project delivery stage, lead party and composition of auditing team, and funding sources for performing work zone safety audits; and
- Expected audit tasks, approach, and useful tools.

Respondents recommended that a WZRSA be conducted at the project design, pre-construction, and construction stages. The survey indicated that the primary WZRSA tasks should include:

- 1) Checking the work zone activity area configuration, examining the implementation of TTCDs, and assessing driver behavior
- 2) Reviewing project design, construction, and TMPs.

Performing a WZRSA benefits a project when the following situations exist:

- The project location is in proximity to another work zone, and either may have overlapping effects on the other;
- The project is high-profile in nature;
- The proposed project location has a history of safety and mobility issues;
- The project has a complex traffic control plan;
- Multiple construction stages exist;
- The contractor proposes changes to the traffic control plan; and/or
- The active work zone has not met performance goals or is not performing as expected in safety and mobility categories.



3.3 Anticipated Challenges in Conducting a Work Zone RSA

This section provides a level of understanding of the challenges to expect when preparing to conduct a WZRSA. Those individuals tasked with moving a project forward may be resistant to an additional level of review, posing questions such as:

- What is the WZRSA anticipated cost?
- Will the findings of the safety examination increase our risk?
- Will the WZRSA delay the project completion date?
- Will the WZRSA require extra staff and training?

3.3.1 Costs and Benefits

Several reports suggest the RSA process is cost-effective, although most reference qualitative rather than quantitative benefits. Establishing and meeting a target benefit/cost ratio for a RSA is not the motivating factor behind the support for the process. The State DOT in Kansas, Iowa, and Pennsylvania suggest that the benefits of the RSA are substantial, but largely immeasurable. Nonetheless, the major quantifiable benefits of the RSA can be identified in the following areas:

- Avoiding or reducing throwaway costs and work zone reconfiguration costs to correct safety deficiencies identified once work zones are in-service.
- Reduced societal costs of collisions through safer roads and fewer, less-severe crashes.
- Reduced risk claims, a component of both agency and societal costs.

An RSA conducted in Surrey County, United Kingdom, compared fatal and injury crash reductions at 19 audited highway projects to those at 19 highway projects for which audits were not conducted. It found that while the average yearly fatal and injury crash frequency at the audited sites had dropped by 1.25 crashes per year (an average reduction from 2.08 to 0.83 crashes per year), the average yearly fatal and injury crash frequency at the sites that were not audited had dropped by only 0.26 crashes per year (an average reduction from 2.6 to 2.34 crashes per year). This suggests that audits of highway projects make them more effective in reducing fatal and injury crashes.

The cost of an RSA may vary based upon project size, scope and complexity; the composition of the RSA team; and the level of detail of the audit. The cost of human resources to conduct RSAs may range from a one-day field review by an in-house audit team to maintaining full-time auditors working on a statewide basis. Costs may also be affected if agencies retain consultants to conduct the audit or to supplement staff expertise on audit teams. Overall, the cost of RSA programs depend upon an agency's creativity in integrating audit activities within existing project tasks, policies, practices, resources, and the decision-making methodology used to evaluate and implement audit suggestions.

The Pennsylvania Department of Transportation (PennDOT) indicates that their average cost of conducting an RSA ranges from \$2,000 to \$5,000. This aligns with United Kingdom and Australian estimates and is, according to PennDOT, "very little for the amount of success." The results of PennDOT's own RSA pilot program concluded that RSA teams identified safety concerns that would not otherwise have been discovered as part of a standard safety review. As a result, the safety value of projects where the RSA process was applied was significantly enhanced.²²

3.3.2 Impact on Project Schedule

WZRSAs impact on a project's schedule depends on several issues such as:

- Project complexity;
- Program organization;
- When in the project lifecycle the audit is undertaken;
- The scope and implications of suggestions which result from the findings and recommendations; and
- How the findings and recommendations are addressed.

Public agencies should understand these scheduling considerations before beginning a WZRSA program.

²² Federal Highway Administration. *FHWA Road Safety Guidelines*. Publication No. FHWA-SA-06-06. 2006.

Generally, the WZRSA requires only a few weeks to conduct, from project identification to preparing a formal response to the findings. Incorporating the findings depend upon the owner's response to the findings, as well as the detailed nature of the findings themselves. Figure 5 shows each of the steps in the WZRSA process.

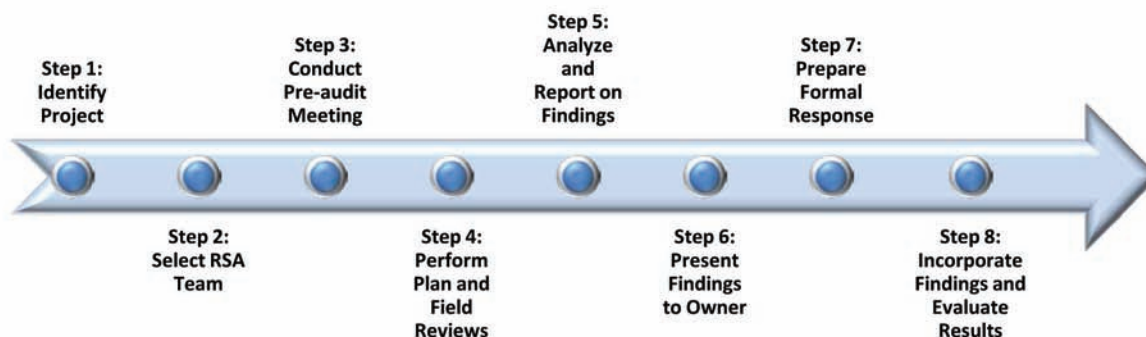


Figure 5. Work Zone RSA Eight-Step Process

If, while conducting a WZRSA, the team discovers an issue in an active work zone requiring immediate attention, the team can accelerate the WZRSA process. In instances where the safety of workers and road users presents an immediate threat, the WZRSA team leader should expeditiously bring the concern to the attention of the work zone manager or proper authority for immediate follow-up action. These instances may include issues such as the improper use or absence of TTCDs, extremely poor visibility and conspicuity of TTCDs, especially if it involves regulatory or warning devices, foreign objects in the traffic lane, etc.

The relationship between WZRSA tasks and other project activities is an important consideration, and any potential impact to the work zone should be identified and planned for at the outset. In general, the earlier a WZRSA is performed in the project life cycle, the easier it is to implement suggestions without disruption to the project schedule. Lead times for changes in project scope, right-of-way acquisition, design revisions, and subsequent reviews are more easily accommodated if they are identified early in the project lifecycle.

Due to the temporary nature of work zones, WZRSA recommendations must be provided to the road owner in a timely fashion. Whenever possible, the road owner should begin implementing WZRSA recommendations immediately following the WZRSA team presentation of findings.

3.3.3 Resource Constraints

Agencies with resource constraints such as limited funding, a tight project schedule, or limited staff can still utilize principles inherent to the WZRSA process to increase safety. The prompt lists in Section 5.5 and considerations in Sections 4.3 and 4.4 can be used on high-profile or complex projects, in development of a TMP, or during the review of an active work zone.

3.3.4 Risk

**Note: The information provided here is not legal advice, but is meant to assist public agencies in discussions with their legal staff on developing a policy for the implementation of WZRSA program.*

Some State and local agencies have hesitated to conduct RSAs because the RSA reports may be used against them in court. The concern is that RSA documents could be cited as proof that a State or local agency oversaw implementation of a work zone design that was unsafe or that somehow contributed to an individual's injury. Safety information gathered pursuant to a Federal Highway safety program may be protected by Federal statute (23U.S.C.409).

In general, if a State follows applicable standards for TTC, that can go a long way toward reducing risk. A WZRSA goes above and beyond the applicable standards to make the work zone safer and more operationally efficient for users, indicating a desire by the public agency to be proactive in safety, which can also reduce risk.

"...Once safety issues are identified, we have financial limitations on how much and how fast we can correct the issues. The audit will help us in defense of liability." – Survey respondent

A survey of State DOTs was conducted as part of National Cooperative Highway Research Program (NCHRP) Synthesis project #336, Road Safety Audits. The survey asked questions about States' sovereign immunity, the doctrine that considers government agencies (Federal, State, city, county) immune to lawsuits unless they give their consent to the lawsuit. A summary of the information in the synthesis follows:

There appeared to be no specific correlation in the application of RSAs and whether or not the State had sovereign immunity. Two States implementing RSAs indicated full immunity and three indicated partial immunity. For States that use RSAs (in the design stage or on existing roads but not both), two indicated full immunity, four had partial immunity, and four had no immunity. The same survey also received this response related to risk: "Liability is one of the major driving factors in performing a good audit; it demonstrates a proactive approach to identifying and mitigating safety concerns. When findings cannot be implemented, an exception report is developed to address liability and mitigating measures. Our attorneys say that once safety issues are identified, and we have financial limitations on how much and how fast we can correct the issues, then the audit will help us in defense of liability..."

Kansas DOT (KDOT) implemented their RSA program to proactively identify and correct safety issues. KDOT reports that RSA results are for internal staff use only and are not available to the public or to lawyers representing claims against the State. There have been instances where these records were requested by outside legal counsel, but to date the information has remained at KDOT.

4. Conducting a Work Zone RSA

The WZRSA process includes eight steps, regardless of the project stage in which the RSA is conducted. The eight steps are illustrated in Figure 6.

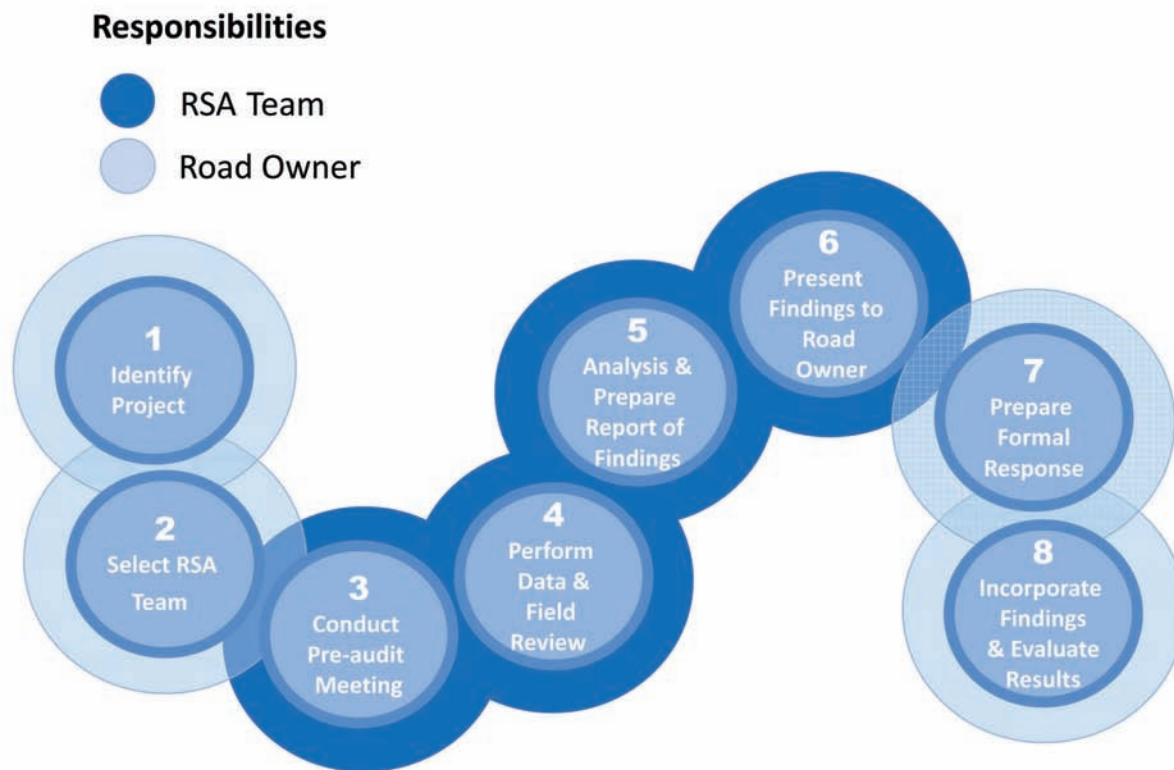


Figure 6. Work Zone RSA Eight-Step Process

4.1 STEP 1: Identify Project or Active Work Zone to be Audited

As mentioned in the introduction, a WZRSA may lead to the selection of more effective traffic control strategies during the planning and design phases. The WZRSA may also provide a modification suggestion for construction or work zone staging efforts before or during an active work zone, which contributes to the potential for project cost savings while being less intrusive to motorists. These tangible results show how recommendations from a WZRSA may translate into project time and cost savings and provide for enhanced safety and mobility aspects within the work zone.

Criteria and considerations for selecting a WZRSA project may be found in Section 3.2.

4.2 STEP 2: Select an WZRSA Team

Objective of the WZRSA Team. The objective for selecting an audit team is to choose an independent, qualified, and multidisciplinary group of experts who can successfully conduct a WZRSA. It is important to assemble a WZRSA team that has sufficient competency to contribute to the objective of the WZRSA, while providing a “birds-eye” view and fresh perspective. By building a team that spans many disciplinary fields and extends past engineering lines, well-rounded insights can contribute to out-of-the-box solutions. Team members should share insights on all aspects of the safety examination as they are not only safety professionals, but road users as well. While it is desirable for team members to have previous WZRSA training or experience, it is not required, and specific subject matter expertise should be the most important factor for team selection.

WZRSA Team Leader. The road owner is responsible for selecting the WZRSA team leader. The team leader should have a thorough understanding of the WZRSA process and possess excellent communications and leadership skills. He or she will have the ultimate say on the WZRSA final report and will serve as the primary point of contact between the road owner and the audit team. The road owner and the WZRSA team leader should select a set of qualified individuals from a variety of organizations including representatives from within the agency, from another public agency, or from other outside sources. It is recommended that the team's composition be composed of members independent of those involved in development of the project during any phase.

Needed Skills of the WZRSA Team. Should the road owner choose to use individuals from within the agency, these individuals must be impartial and must not have been involved in the project development process. The key element to consider when deciding if the team is truly independent is whether the auditors can act independently of the road owner/project development team, and not whether they are drawn from internal or external resources. The freedom, ability, and comfort of auditors to comment frankly on potentially controversial safety issues are crucial to the success of the WZRSA. Individuals with no prior input or participation in the project may also be able to provide a fresh viewpoint from an unbiased perspective not impacted by previous conversations, decisions, or directions established at any point during project development.

The road owner and WZRSA team leader should also ensure that the audit team represents a group of individuals that possess a set of skills that will ensure the most critical aspects of the project are addressed. Generally, WZRSA teams have five to eight members. One person may possess a combination of skills in a number of different areas, but the audit team should consist of at least three individuals to ensure that no aspect of the WZRSA is overlooked. On projects of a more complex nature, agencies should consider a larger team to be inclusive of project needs.

Team Composition. Depending on the nature of the project and the phase in which the WZRSA is to be conducted, those to consider serving on a WZRSA team may include:

- DOT staff, including Planning, Design, Construction, Work Zone, Traffic, Safety, Pedestrian and Bicycle specialists, and Maintenance personnel;
- Human factors;
- Law enforcement;
- Metropolitan Planning Organizations;
- Local agencies, such as cities and counties;
- First responders (e.g., fire, EMS, road assistance patrols);
- Tow truck operators;
- Local business and hospitals;
- Public Utility companies;
- Motor carriers industry; and
- Those with specialized expertise, such as transit operations, commercial vehicle operations, ITS, or the design of special facilities (e.g., toll plazas, bridges, tunnels, complex freeway structures, roundabouts, traffic calming, etc.).

Illinois DOT includes central office staff from the offices of design, standards/specifications, operations, safety, and construction during their work zone review process, in addition to members from the district where the work zone is located.

Illinois DOT identified inclusion of staff members from other districts on their review teams as a best practice.

Consider including a member of the community in which the work zone will be or is taking place. Community members may have insights that contribute to a more robust review. Their participation on the team may assist in gaining public support for the project or work zone.

In addition to those listed above, WZRSA team members should be added and considered based on the specific phases of a project being assessed. Areas of specialty that would further supplement the core skills will vary depending on the WZRSA phase (planning, design, or active work zone). At a minimum, the core team members should include DOT staff versed in work zone and safety concepts and law enforcement personnel.

Planning Phase

In the planning phase, the WZRSA team discusses high-level concepts and may not rely on drawings or formalized plans. In addition to the WZRSA team members listed previously, additional members should include a representative who is familiar with the local road network and affected communities, and someone who is familiar with other planned projects in the vicinity of the work zone being examined.

Preliminary Design Phase

In the preliminary design phase, members of the WZRSA team must rely on drawings to determine what the project will include and how traffic flow, accessibility, and safety will be maintained during the project. The team needs to visualize the road in three dimensions with all its appurtenances. A field investigation of the site of a proposed road will help in conceptualizing the design and will assist the audit team in a better understanding of the new project's transition into the existing roads. In addition to the WZRSA team members listed above, a preliminary design phase WZRSA should have a road design engineer skilled in horizontal and vertical road alignment, cross-section elements, and intersection layout.

Final Design Phase

A final design phase WZRSA team should have a traffic operations engineer skilled in traffic signal control; traffic signs; delineation; pavement markings; pedestrian, bicycle, and transit facilities; and a road design engineer skilled in roadside protection and work zone TTC. Consideration should also be given to individuals with experience in road maintenance, enforcement, first response, schools, highway-rail grade crossings, and other areas.

Active Work Zone

In addition to the WZRSA team members listed above, the active work zone phase RSA, should include experts in human factors/positive guidance, maintenance, and law enforcement. During this phase, the team should have sufficient expertise to also consider ingress and egress to/from the work zone, work space and activity area issues, and work zone TTCD setup and removal.

4.3 STEP 3: Conduct a Pre-audit Meeting to Review Project Information and Drawings

The pre-audit meeting is comprised of two parts:

1. The project overview meeting with the road owner, and
2. The project information review.

4.3.1 Conduct Project Overview Meeting with Road Owner

The project overview meeting provides an opportunity for the road owner to formally meet the WZRSA team and kick off the WZRSA. The road owner should introduce the WZRSA team leader and give details related to the following topics:

- Specific WZRSA goals and objectives;
- Define the scope of the WZRSA, including the specific project locations that the WZRSA should focus on for the safety assessment;
- Concerns with the roadway section where the work zone will take place;
- Safety concerns with similar projects;
- Work zone schedule and duration;
- State laws and agency policies related to work zone activities (e.g., no texting and driving, how speed limits are established);
- Constraints and limitations associated with the project, including guidelines by which the WZRSA will be conducted and the types and extent of recommendations that can be made by the team; and
- Guidance on the level of risk associated with the various safety issues identified (e.g., low, medium, or high).

When performing a WZRSA for a complex project, the WZRSA team should define a smaller scope using input from the road owner. The WZRSA team should still assess the entire project, but put more emphasis on reviewing locations identified by the road owner.

The WZRSA team leader should be prepared to discuss the following:

- Identification of individual team members' roles;
- Reviewing the WZRSA process; and
- Summarizing the contact information of the road owner, all relevant project contacts, and all team members.

Prior to the pre-audit meeting, the WZRSA team leader should consider providing the road owner with a briefing packet. This packet defines the road owner's role and details the project information (i.e., plans, data, etc.) to bring to the pre-audit meeting with the WZRSA team. Providing detailed information prior to the pre-audit meeting helps orient the road owner to the WZRSA process, allows him or her to see where they fit into the process, and understand how their information aids the WZRSA team in their review. Appendix D provides an example of a road owner briefing packet that can be tailored to suit the needs of the individual agency.



4.3.2 Review Project Information

During the initial meeting with the road owner, it is important for the road owner to convey an overview of pertinent basic information related to the WZRSA location and design criteria. Depending on the project phase, the road owner should, as a minimum, provide a summary of the following items:

Planning Phase

- Project description and type of work to be conducted;
- Geographical area information and maps;
- Environmental conditions;
- Roadway classification, speed limit and design speed;
- Availability of adjacent road networks;
- Potential impacts to and from emergency service provider locations;
- Historical crash and volume data near the planned work zone, including variations by days of the week and seasonally;
- Statewide work zone crash data trends;
- Detailed information on crashes that have occurred in the project's planned location and any complaints received in the vicinity of the planned work zone;
- Findings from previous corridor studies conducted within the area of the planned work zone;
- A summary of any meeting with stakeholders or communities; and
- The number and types of road users within the planned work zone.

Preliminary Design and Final Design Phases

- Project description and type of work to be conducted;
- Geographical area information and maps;
- Environmental conditions;
- Roadway classification, speed limit and design speed;
- Availability of adjacent road networks;
- Potential impacts to and from emergency service provider locations;
- Historical crash and volume data near the planned work zone, including variations by days of the week and seasonally;
- Statewide work zone crash data trends;
- Detailed information on crashes that have occurred in the project's planned location and any complaints that have been

received in the vicinity of the planned work zone;

- Findings from previous corridor studies conducted within the area of the planned work zone;
- A summary of any meeting with stakeholders or communities;
- How the limits of the work zone were decided; and
- The number and types of road users within the planned work zone.

Active Work Zone Phase

- Project description and type of work being conducted;
- Geographical area information and maps;
- Environmental conditions;
- Roadway classification, speed limit and design speed;
- Availability of adjacent road networks;
- Impacts to and from emergency service provider locations;
- Historical crash and volume data near the planned work zone, including variations by days of the week and seasonally;
- Statewide work zone crash data trends;
- Detailed information on crashes that are occurring in the work zone and any complaints that have been received in the vicinity of the work zone;
- A summary of any meeting with stakeholders or communities;
- Number, severity, and cause of crashes that have occurred within the active work zone;
- Hours/days of work zone operation; and
- The number and types of road users present within the limits of the work zone and how they are being accommodated.

Having detailed crash information provides insight to the WZRSA team on what types of crashes are occurring, which can hint at possible contributing factors that the team should review in the field.

The road owner should consider guiding the WZRSA team through the planned or existing work zone using an internet mapping service, such as Google Street View. Since the road owner will not be present during the WZRSA team's field review, he or she may be able to lay out the work zone and improve the team's understanding of the future or existing work zone prior to their site visit.

4.4 STEP 4: Conduct Review of Project Data and Field Review

In Step 4, the WZRSA team begins to review project-specific documentation and drawings and visits the site where the work zone is planned or active. The team will use prompt lists to identify work zone safety considerations relevant to the phase in which the WZRSA is conducted.



In addition to the prompt lists included in Chapter 5, the WZRSA team may find that developing their own prompt lists leads them to consider project-specific details they might otherwise overlook. For example, work zones planned (or active) in locations with transit stops may need additional considerations or prompts than those provided in Chapter 5. Using the prompt development process described in Chapter 5, the team member most knowledgeable on the subject would develop more detailed prompts related to the interaction of transit stops in the work zone. A process for identifying and tailoring project-specific prompts is discussed in Section 5.3. The team should develop prompts after they review the project information in Step 3 of the WZRSA and before beginning to review project data in Step 4.

Remember, a WZRSA assesses the *temporary* elements that will eventually be removed once the active work zone phase is completed.

4.4.1 Review Project Data

Approach to Data Review. The WZRSA team should review design drawings and other project information before and after the field review. The team should conduct field reviews as part of every WZRSA regardless of the phase or type of project. The review of design drawings (including the traffic control plan, construction staging, and other relevant documents) will be crucial to understanding the interaction between the proposed work zone and its environment.

The WZRSA team should examine the design drawings in detail, imagining how the road would appear from the perspective of road users (including drivers of different vehicle types and older drivers), road workers and, if applicable, cyclists and pedestrians (including pedestrians of different age groups and abilities). A useful approach is to review the design drawings systematically in one direction at a time for each road section and to review each movement individually at freeway interchanges and at-grade intersections. Simulation models can also be a helpful tool for visualizing how the work zone will appear to roadway users.

The WZRSA team may also want to review the design study report and environmental impact statement. Knowing the rationale used to determine important work zone design and implementation concepts helps the WZRSA team structure their recommendations. The WZRSA team should also review how the actual construction is progressing and consider how it affects the safety of the work zone. For example, the WZRSA team should look at the lane paving sequence (if applicable). If the road is super-elevated and the lowest lane is paved first, water may pond between lanes when it rains creating a hazard for drivers.

The team should review the project data and design drawings both as a group and individually. Individual auditing allows an in-depth consideration of different aspects of the design while “brainstorming” in the team setting can lead to the identification of new safety issues and better ways to mitigate or eliminate safety concerns.



The WZRSA team members may refer to the prompt lists in Chapter 5 as a reminder of relevant aspects of the WZRSA. During the field review, it may be possible to verify identified issues and discover additional safety issues that might not be evident from the design drawings and other project data.



The team’s review of design drawings will be crucial to understanding the interaction between the proposed work zone and its environment.

When design documentation contains missing or misleading information the audit team deems critical to carrying out the WZRSA, the WZRSA team should contact the road owner to ask for an explanation of the design before the site visit. This should be done in a cooperative manner, as a means of gaining a better understanding of the proposed project.

Commenting on Project Data. The WZRSA team should restrict its comments to issues affecting the safety of workers and road users. Their comments may be either specific to a particular location, such as conflicting TTCDs, or broad-based, such as mentioning that a particular element of the work zone design may lead to aggressive driving. The team may also comment on issues relating to aesthetics, amenities, or congestion, but only if they will lead to less-safe conditions. Should they identify immediate safety concerns outside the project limits during an RSA at an active work zone, the team should notify the road owner immediately rather than include those comments in the formal WZRSA report.

The WZRSA team should fully review any project data provided to them prior to the field review to familiarize themselves with the location. However, there may be merit in setting aside for later review the project data that identifies past safety issues (e.g., crash data) so that it may be used to confirm and complement the WZRSA findings. Such an approach would allow the WZRSA team members to remain completely objective during the field review.

Types of Project Data to Review. Determining the available and appropriate materials to review before conducting the WZRSA will depend upon the project phase in which the safety examination takes place. During this task, the WZRSA team will solicit information to review from the road owner. The following sections describe the types and availability of documentation that may be available, as well as appropriate considerations for each project phase.

Hint!

Document which WZRSA team member makes a recommendation during the RSA. Team members may come and go throughout the RSA due to schedules and other responsibilities. If suggestions are associated with a specific team member, the WZRSA team and owner can follow up on the recommendation.

Planning Phase

During this early phase in the project's life, there are several considerations that may affect future safety and mobility outcomes during the active work zone phase. While no formal plans may exist, the planning phase is ideal for reviewing:

- Project significance, according to the Final Rule on Work Zone Safety and Mobility (§ 630.1010) and State or local policy;
- Consideration of planned adjacent projects and work zones;
- The availability of alternate road networks;
- Geometric and sight distance considerations at the work zone location; and
- Impacts to businesses and communities in the vicinity.

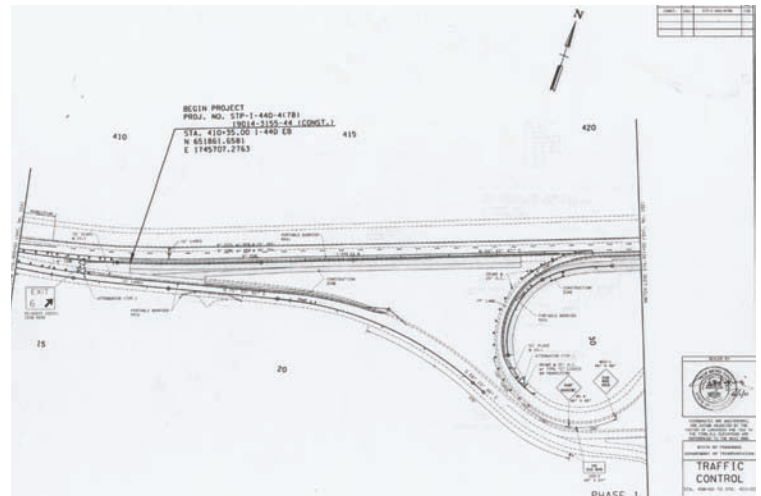
Other considerations within this step of the WZRSA process include a review of project timing with respect to seasonal travel volumes, the presence of school and bus routes, tourism events, and local impacts to schools, businesses, military posts, and local festivals and events.

Preliminary Design and Final Design Phases

The design phase can span many years and present multiple opportunities for the inclusion of formal examinations for safety and mobility.

During preliminary design, it is common to produce basic plans that indicate horizontal and vertical alignments, general limits of the work zone, and possibly a determination of how to stage the work. At this point, WZRSAs could consider:

- How work zone activities affect all roadway users, such as pedestrians, bicyclists, motorcyclists, older and teen drivers, motor carriers, and Americans with Disabilities Act (ADA) considerations;
- Impacts to work zone safety and mobility goals, including tradeoffs between the two;
- Assessments made during considerations for alternate design concepts, construction staging, and construction techniques;
- Environmental documents and design commitments;
- Impacts contributed by adjacent projects and work zones; and
- Impacts from seasonal travel.



In the final design phase, activities include the development of temporary traffic control plans (TTCP), construction staging plans, a work zone impacts assessment, a TMP, and a detailed set of project plans that address the remainder of design considerations before being bid upon by contractors. The final design phase is the time to ensure that:

- Strategies appearing in the TMP correlate with defined safety and mobility goals;
- Available ITS, interactive communications, and safety devices are incorporated into the TMP and TTCP;
- The impacts of construction staging, phasing, and methods on safety and mobility have been mitigated;
- Projects across a corridor have been coordinated;
- Roadway geometry and characteristics within the work zone limits provide for optimal safety and mobility;
- TTC does not conflict with itself or with existing traffic control;
- TTC does not adversely affect specific roadway users, or if it does, those impacts are mitigated (e.g., motorcycles and transverse rumble strips); and

- The interaction between work zone activities and other transit modes provides for optimal safety and mobility for all, including interaction with bus routes/stops, light rail, and other occurrences.

Active Work Zone Phase

In this phase, work zone activities are in full-effect. Transportation management strategies and TTCDs are deployed and monitored for effectiveness based on measurements against safety and mobility goals determined during the design phase. The active work zone phase provides a real-time opportunity to ensure that plans are executed and achieving favorable results. A WZRSA conducted during this phase may examine whether:

- Road user expectations align with proper deployment and use of transportation management strategies and TTCDs (e.g., drivers have been informed of upcoming back of queue, flagger ahead, or a change in speeds);
- The transportation management strategies, TTC, and speed limit are appropriate for field conditions;
- The work zone provides road users with the appropriate amount and type of guidance;
- Roadway and geometric conditions meet driver expectations;
- Roadway and geometric conditions support work zone safety and mobility goals;
- Interaction with other transit modes exists (e.g., rail, light rail, transit);
- Enforcement and EMS are properly accommodated; and
- All road users are accommodated within the work zone.

4.4.2 Field Review

Once the WZRSA team identifies issues by reviewing project data, they should verify these issues in the field. During the field review, the team should take photographs and video footage of anything they will review or revisit while writing the WZRSA final report or while presenting the findings to the road owner.

Safety of the WZRSA Team. WZRSA's themselves can present certain risks to the team members who are performing field reviews in active work zones. The safety of the WZRSA team, workers, and of all road users during a field review is a key consideration and should be planned for at the outset. Members should use proper safety equipment and traffic control at all times, and the potential for adverse impacts on road traffic and audit team safety must be managed during the field review. The team leader should consider conducting basic safety and awareness training prior to visiting the work zone site for team members not accustomed to working in traffic or around construction activities.

When performing a WZRSA in an active work zone, the WZRSA team leader should drive and/or walk through the site in advance of the field review to identify safe and convenient locations where the team can pull over. The team will want to review the pre-work area, work area, and post work area; locations for a safe pull-off will be needed, if feasible, in each section of the work zone. The team leader may also consider contacting the project inspector regarding the upcoming WZRSA and field visit as further means of ensuring the team's safety.

To ensure the safety and visibility of the WZRSA team, each member should wear a minimum of Class 2 safety apparel.²³ At the work site, the team should identify a safe location to inspect work zone elements. When driving through the work zone to conduct the WZRSA, the team should not to create visual distractions for other drivers or decrease the safety and mobility of any road users or workers. Should immediate changes to the work zone be required, adjustments should be performed in an unobtrusive and organized manner to reduce confusion and not detract from the functionality or safety of the work zone.

General Considerations. Schedule WZRSA's planned or located in urban areas for peak periods so that the audit team may observe the work zone under heavy

Photographs and video should be an integral part of capturing elements during the field review. They can also be used to communicate actual field conditions during the presentation of findings to the road owner.



²³ American Traffic Safety Services Association. *High Visibility Apparel in Work Zones*. 2009. Available at: http://www.workzonesafety.org/fhwa_wz_grant/atssa/atssa_high_visibility_pocket_guide.

traffic conditions. Afternoon observations may facilitate remaining onsite into the evening so the audit team may observe lower volume conditions and issues relating to inadequate lighting and visibility of roadway delineation. Whenever possible, the WZRSA team should conduct a nighttime visit to identify any issues under dark conditions and should consider reviewing the site both on foot and in-vehicle. During nighttime reviews, the WZRSA team should observe how newer vehicle headlights illuminate traffic control devices. Headlights on newer vehicles act differently and have a more definitive cut-off point that may not illuminate signs and other temporary traffic control devices if not in the beam's direct line of illumination.

The WZRSA team should also review the site during periods of inclement weather, if possible. As the WZRSA team is performing the field review, they should keep environmental conditions in mind and consider how they might affect the work zone. For example, in coastal areas, wind and sand may shift the placement of or degrade temporary signs. Additionally, lighting used for nighttime operations can affect wildlife. For example, it can attract sea turtles (which are protected).



During the WZRSA, the team should move through the site as a group, with each team member noting issues they encounter. The team will have the advantage of seeing the site firsthand and should navigate through the site in all directions on all approaches, first by driving and then by walking. During the review, the WZRSA team should consider how the work zone impacts the local road network and other adjacent roads. For example, if the work zone encompasses an interstate ramp, the team should consider movements on any affected ramps as well as the deceleration and acceleration lanes. Similarly, if the work zone contains an intersection, the team should consider right-turning, through-, and left-turning movements on each approach. Driving and walking the site allows the team to see the work zone from each worker's and road users' perspective and to see the traffic control elements as each road user sees them. As the team drives through, remember that a driver's perspective will vary depending

on the type of vehicle being driven. For example, a commercial motor vehicle driver will view the work zone differently than a motorcyclist traveling through the same work zone. Limitations and specific requirements of drivers of different vehicle types, older drivers²⁴, pedestrians of different age groups, disabled persons, etc. should be considered.

Other elements the WZRSA team should observe during the review include the pavement types, placement, and transitions between lanes. Coloration differences between asphalt and concrete pavements may lead to driver confusion when the different pavement types transition between lanes, especially at night.

The team should also investigate pedestrian and bicyclist facilities, particularly at points where they conflict with vehicular traffic. The team should review locations with pedestrian traffic on foot. If the work zone is on a route with sidewalks and/or a bike path, the team will want to consider the perspectives of these users and how the work zone impacts their ability to travel.



During the field review, the audit team should freely refer back to notes made during their review of the project data, design drawings, and prompt lists to further verify any safety concerns initially identified. The appropriate prompt list, included in Chapter 5, should serve as a reference for elements the team should be looking for while performing the review.

Pre-Work, Active, and Post-Work Areas. After driving through the work zone in its entirety, the team should walk the site, starting with the pre-work area. Team members should note both positive elements and opportunities for safety improvements. Questions that team members may want to ask are, "Is there enough advance warning to alert drivers of the work zone?" and "Are the warning signs visible, or are they obscured by vegetation?" Team members should spend time observing traffic as it approaches the work zone and document driver behavior. For example, are cars moving out of the lane that will be closed early,

Hint!

The WZRSA team should consider observing live traffic feeds from field-located cameras if they are accessible (such as through a Traffic Management Center). This allows the WZRSA team to observe driver behavior and also provides a good orientation to the project and traffic patterns prior to the field visit. This is especially helpful if traffic volumes and speeds along the project are high.



²⁴ Refer to *Guidelines and Recommendations to Accommodate Older Drivers and Pedestrians*. Federal Highway Administration Publication No. FHWA-RD-01-051.

or are they waiting until they see barriers? Is there any aggressive driving observed due to the lane closure? Is traffic backing up?

After observing the pre-work area, the team should move into the active work area to continue the review. If on foot, the team must stay behind the barriers and be cognizant of the movement of the construction vehicles and activities. The team must avoid interfering with activities in the work zone.

Within the work area, it is important to note the workers' and road users' safety. For example, is positive protection in place and are workers wearing acceptable (level and condition) high-visibility safety apparel? How are drivers behaving

in this section? Are there any hazards that might be especially harmful to motorcyclists (e.g., steel plates)?

The team should also imagine how the work zone would operate if an incident occurs. After a crash, will first responders be able to get to the scene and is there an alternate egress? Is there space to allow law enforcement or disabled vehicles to safely pull over? Will the work zone accommodate large vehicles?

The final section for the team to review is the post-work area. As in the previous work zone sections, the team will want to document observed driver behaviors as they exit the work area and note the effectiveness of the work zone's final traffic control elements.

At the end of the field review, the WZRSA team should have a clear understanding of potential safety issues inherent in the design plans and other project data reviewed or observed in the field.



4.5 STEP 5: Conduct Audit Analysis and Prepare Report of Findings

Each audit team should establish how they wish to evaluate risk and prioritize safety concerns. When considering WZRSA recommendations, the WZRSA team may want to give the road owner guidance on the level of risk associated with the various safety issues identified (e.g., low, medium or high). During the WZRSA analysis, the WZRSA team reviews the findings and establishes consensus on the improvements that should be recommended to mitigate safety concerns. The recommendations can be categorized by cost or amount of time to implement (immediate, mid-term, or long-term). Also consider prioritizing the WZRSA recommendations. The WZRSA team's proposed priorities can then be discussed with the road owner in Step 6. Ranking WZRSA recommendations can assist the road owner with prioritizing recommendations, also taking into consideration other variables that affect implementation (i.e., feasibility, funding, etc.).

Upon completion of the WZRSA analysis, the audit team leader can begin writing the WZRSA report and/or assigning sections of the report to team members. In some instances, the WZRSA report will need to be written immediately after completion of the site visit, such as in a WZRSA performed during an active work zone. Other WZRSA reports are typically completed within a relatively short timeframe (two weeks).

The objective of conducting a WZRSA analysis and preparing the WZRSA report is to succinctly report the findings of the audit team through identification and prioritization of safety issues. Suggestions should then be made for reducing the degree of risk. A template for the WZRSA report is found in Appendix D.

In the previous step, the audit team may have identified a number of safety issues. Next, the team will finalize the WZRSA findings and suggest strategies for treatment. When considering audit suggestions, the audit team may want to give the project development team and the road owner guidance on the level of risk associated with the various safety issues identified (e.g., low, medium, or high), according to guidelines established with the road owner at the pre-audit meeting.

For examples of work zone practices that may improve safety, visit these sources:

- Work Zone Best Practices Guidebook
- Work Zone Safety Clearinghouse
- ATSSA's website

Due to the temporary nature of work zones, it is imperative that WZRSA recommendations are provided to the road owner in a timely fashion.

The report should be concise. Where possible, it should include photos and diagrams to further illustrate points made. The audit team should number each safety issue identified and, as appropriate, provide a map indicating its location. References to other reports, standards, policies or published research on road safety may also be made within the WZRSA report.

Section 1.0 – Introduction. The introduction should include a brief description of the project, including the scope and objectives and any special issues raised by the road owner. The project limits should be clearly defined – preferably through use of a map or plan. The stage of the WZRSA should be identified. The report should mention design and operational elements that the team did and did not review. It should be emphasized that some design elements will not be reviewed because of the phase of the WZRSA.

For example, a WZRSA conducted in the planning phase will not contain a review of signs and pavement markings. A WZRSA conducted in the active work zone phase will not contain a review of interchange configuration.

Section 2.0 – Background. The report should include background information that identifies the audit team members’ names, their affiliations and qualifications, as well as the date of the pre-audit meeting and dates and times that the WZRSA was conducted. This section should also discuss the constraints and limitations associated with the project and the guidelines by which the WZRSA was conducted, as mentioned during the project overview meeting with the road owner.

The report should acknowledge data that was provided by the road owner and/or project development team. It should also include general observations from the site visit, such as day of the week and time of visit, traffic, lighting and weather conditions and other extenuating circumstances. The WZRSA team may want to summarize the features of the road or design helping to improve safety at that location.

Section 3.0 – Findings and Recommendations. The main body of the report will contain the identified safety issues and recommendations. The audit team may wish to group safety issues into broad topics (e.g., General, Traffic Control Devices, Roadway/Geometric Characteristics, Environmental/Site Specific Considerations, Enforcement Issues, Special Road Users, etc.) broken down into subtopics (e.g., Visibility/Conspicuity of TTCD, Retro-reflectivity, Placement, Night/Day Difference, Speed, Motor Carriers, etc.). For smaller projects the audit team may report on high risk safety issues first, leaving lower priority concerns until later in the report.

The report should identify each safety issue with a brief description of why it poses a risk. The issue identified should be specific. An appropriate example of how to word a safety issue in a WZRSA report may be:

“Due to the disagreement of temporary signing and pavement markings at the intersection of Route 126 and Spring Street, there is a higher risk that roadway users may not comply with traffic control at this intersection. Consideration could be given first to removal or modification of the temporary pavement marking. If that is not feasible, modify temporary signing to give roadway users a clear message or use a changeable message sign to reiterate the intended message of the temporary traffic control elements present at the intersection.”

Avoid broad descriptions of safety issues. An inappropriate example of a safety issue description would be:

“Temporary traffic control elements at many locations along Route 126 are not acceptable and may cause crashes to occur.”

RSA Sample Report Outline

- 1.0 Introduction
 - Scope and purpose of RSA
 - Identification of project stage, items reviewed
 - Work zone limits
- 2.0 Background
 - Audit team, affiliation, and qualifications
 - Commentary on data received
 - General site visit observations
- 3.0 Findings and Recommendations
 - Description of each issue
 - Evaluation of work zone safety risk
 - Suggestions

ID	Location Description:	Observation Overview:	Suggestions for Consideration:
6	Ashely merge with 1275	Merge with 1275 feels quick	Extend merge area
			
Observation Details: The team observed that the merge area, beyond the Kay/Ashley yield, for the ramp merging with 1275 seems somewhat short.			
Suggestion Details: Consideration should be given to reconfiguring the barrier wall to extend the merge lane.			
Assigned to:			
Response:			
			

Avoid terms such as “unsafe,” “sub-standard,” “unacceptable,” “dangerous,” and “deficient.” Provide detailed descriptions of the concerns.

Provide constructive, realistic suggestions for improvement (bearing in mind the costs and other feasibility issues involved). Recognize that the road owner may have several different options to achieve the desired result. The audit team leader should not demand specific corrective measures. It will be up to the road owner and project development team to review the safety issue and determine how best to implement the suggestion.

The WZRSA should result in suggestions appropriate to the work zone phase and the elements being examined. For example, in a WZRSA in the active work zone phase, it would not be appropriate to suggest making modifications to the season in which the work zone is active due to high traffic volumes. More appropriate suggestions may be to use a detour or employ contingency TMP strategies. Conversely, a WZRSA conducted during the planning phase should not cite specific safety or mobility strategies to be used before modeling or analysis of the work zone occurs. Instead, suggest strategy considerations for further review.

After the main body of the report, the audit team leader may suggest that another WZRSA be conducted at a later point in the project or on subsequent changes to the road design, if significant design alterations were suggested in the WZRSA report.

4.6 STEP 6: Present Audit Findings to Road Owner

The presentation of audit findings to the road owner should convey the key findings presented in the audit report. Set a positive tone at the beginning of the meeting. Start the meeting by reviewing the scope of the WZRSA followed by an overview of the positive elements that the WZRSA team identified during the review. The WZRSA team may also preface the meeting with a reminder that the intent of a WZRSA is to identify opportunities to improve safety, rather than critique the work of the design team.

Comments regarding safety concerns should be as specific as possible. The report should describe the issues identified in terms of where they are located and how they represent a safety risk. The team may elect to show pictures or video footage to the road owner to further illustrate the issue.

This presentation opportunity allows for informal feedback from the road owner, for the WZRSA team to clarify its findings and suggestions and to ensure that findings are within the scope of the WZRSA.

Starting the meeting in a positive tone lets the road owner know that the WZRSA findings are not an attack, but a proactive team effort to identify improvements that can potentially reduce project costs and increase safety for roadway users and workers.

4.7 STEP 7: Road Owner Prepares Formal Response

The objective of responding to the audit report is for the road owner to document their response to the findings of the audit report. Once the road owner has reviewed the WZRSA report, they should prepare a written response to its findings. The response should outline what actions the road owner will take related to each safety concern listed in the audit report. Depending on the project phase, the detail of the response and the timeline to respond will vary. For example, in a planning phase WZRSA, the response may take several weeks, months, or more. In the case of an active work zone, the findings from WZRSA may need to be addressed in a timelier manner.

The documentation of a formal response is especially beneficial if the road owner is not planning to address all of the safety issues outlined in the WZRSA report. A letter report format signed by the road owner is a valid method of responding to the WZRSA report. Appendix E provides a template for the road owner’s response letter.

In responding to the WZRSA report, the road owner should consider the competing objectives involved in a project, some of which may be seen as conflicting with safety. The road owner may consider the following in choosing whether or not to proceed with a suggestion:

- Is the WZRSA report finding within the scope of the project?
- Do the suggestions made in the WZRSA report address the safety issue, reducing the likelihood of crash occurrence?
- Will the suggestion made in the WZRSA report lead to mobility, environmental, or other non-safety related problems?
- What would be the cost associated with implementing the suggestion?
- Are there more cost-effective alternatives that would also be effective?

Based on the outcome, the road owner may agree/disagree with a valid safety issue identified by the audit team. In this situation, the road owner may elect to either:

- Agree with the suggestion described and commit to its implementation, outlining a schedule for the completion of the suggestion.
- Disagree with the suggestion described and commit to an alternative, outlining a schedule for the completion of the alternative. In doing so, the road owner should provide a valid reason as to why they choose not to adopt the audit team's suggestion.
- Choose not to implement any improvement at all due to project constraints. If so, the road owner should document the reasoning behind the decision.
- The road owner may disagree with a safety issue, believing that there is no increased risk associated with the concern raised. In this case, the road owner should document the reasoning behind the decision.

4.8 STEP 8: Incorporate Findings into the Project and Evaluate Results

The objective of the final step is to incorporate findings into the project when appropriate and to ensure that the WZRSA process is a learning experience for all parties. After sending the response report to the WZRSA team, the road owner should ensure that the agreements described in the response report are completed as described and in the timeframe documented.

As the road owner applies WZRSA-recommended strategies to work zones, the agency should develop a method to measure, document, and communicate the results of the changes made. Identifying the effectiveness of strategies is an important aspect to continued progress in work zone safety and mobility. To formally quantify the benefits of performing WZRSAs, an agency should consider the development of a tracking system to monitor WZRSA improvements and the results.

Road owners should use the WZRSA as a learning opportunity. Internally, the recipients of the WZRSA report should gain a better understanding of road safety and principles of road design, operations, and human factors that either contribute to or take away from the elements of risk on their road network. The lessons learned apply to future projects as critical components in the agency's future design and management of safer work zones.

The road owner should also review the WZRSA process to identify best practices and findings that may benefit future audits. Some key questions to consider include:

The Florida Department of Transportation (FDOT) has created an RSA tracking database. To access a sample FDOT RSA tracking database, go to <http://safety.fhwa.dot.gov/rsa/sampled/>.

- Was the WZRSA conducted at the appropriate project phase?
- Is it more efficient and effective to conduct the WZRSA at an earlier project phase for a more accurate assessment of the cost-benefit of the safety treatments?
- Were the parameters established at the beginning of the WZRSA appropriate for meeting the desired objectives?
- Was the composition of the WZRSA team appropriate?
- Did the audit team get all of the data required to conduct the WZRSA?
- Was sufficient staff time and scheduling allocated for the WZRSA?
- Was the audit team timely in their response to the road owner?
- Did the audit team satisfy the requirements and goals of the WZRSA, as established by the road owner?
- Did the road owner respond in an appropriate way to the safety issues identified and suggestions made by the audit team?
- Did the road owner respond to team suggestions in a timely fashion?
- Is there any evidence to validate that safety improved at the audit location?
- Was the overall WZRSA process appropriate or are modifications needed for future audits?

To refine the process for future Work Zone RSAs, the road owner may consider how the WZRSA was conducted and modifications that may make future Work Zone RSAs more successful.

5. Work Zone RSA Prompt Lists

5.1 Purpose of Prompt Lists

The purpose of the WZRSA prompt lists is to help the WZRSA team identify potential safety issues and to ensure that they do not overlook something important. The prompt lists may also be used by planners and designers to help identify potential safety issues proactively as the design progresses.

Even the most detailed WZRSA prompt lists should be viewed as a prompt only. The lists are not a substitute for knowledge and experience; rather, they serve as an aid in the application of knowledge and experience. The WZRSA high-level prompt lists found in this guideline are not all-inclusive, nor will they cover all potential issues and circumstances. The road owner and WZRSA team are encouraged to adjust the list to meet the individual audits' demands.

5.2 Organization of Prompt Lists



Sections 5.3 and 5.5 provide a process for team-developed prompt lists and examples of more detailed prompt lists, respectively. These lists provide a high-level outline of the topics typically considered to be within the scope of WZRSAs conducted during each phase and highlight areas that should be examined for safety issues.

The WZRSA prompt lists provided are organized as follows:

Prompt List 1 – Planning Phase

Prompt List 2 – Preliminary Design Phase

Prompt List 3 – Final Design Phase

Prompt List 4 – Active Work Zone

WZRSA prompt lists should be viewed as a prompt only. They are not a substitute for knowledge and experience; rather, they are an aid in the application of knowledge and experience.

5.3 Team Development of Prompt Lists

As an alternative to using the prompt lists found in these guidelines, or for use in addition to the prompt lists, the WZRSA team may find that developing project/user specific prompts suits the needs of the review.

Figure 7 illustrates how the team can identify prompts to tailor considerations to the work zone. Initially, the team works together to identify the work zone goals. For example, the team may cite “Increased Road User/Worker Safety” as the primary goal. Team members whose role contributes to that goal are noted as the “WZRSA Team Member.” The means in which that team member will contribute to the WZRSA process will be decided as it pertains to the work zone goal. Based on their role in the review process, team members will develop prompts, or questions, as they relate to their specific role and the overall goal. Figure 8 shows how a law enforcement team member may develop prompts related to work zone enforcement as a means of achieving the overall work zone goal of increased safety for workers and road users.

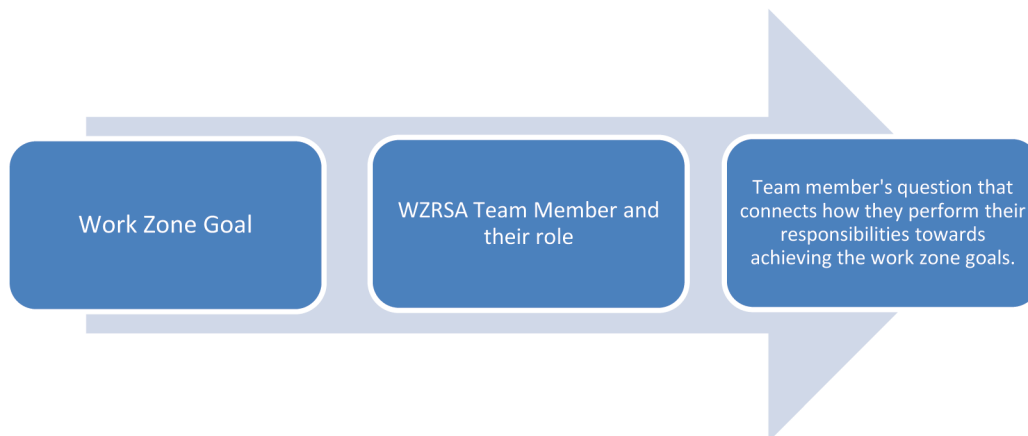


Figure 7. Prompt List Development Method

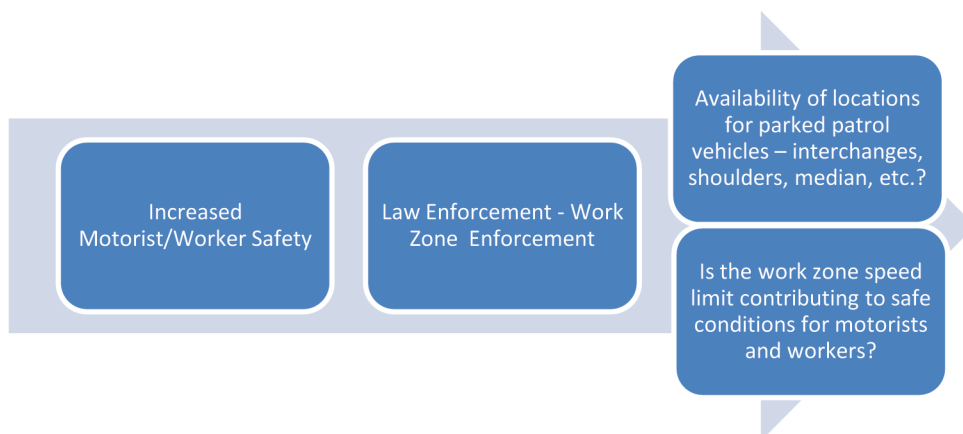


Figure 8. Example: Work Zone Enforcement Prompt List Development

5.4 When to Use the Prompt Lists

Use the prompt lists during WZRSAs when:

- Reviewing project data, particularly when project plans and drawings are being examined;
- Conducting site visits;
- Conducting the WZRSA analysis; and
- Writing the WZRSA report.

During project data and plan review, prompt lists may assist the WZRSA team in identifying missing information relevant to the scope of the WZRSA.

During WZRSA site visits (planning and design phases), a review of prompt lists may assist the WZRSA team in visualizing and assessing how the proposed work zone will function. During WZRSA site visits (active work zone phase), the prompt lists provide a means of ensuring that no safety-related elements are overlooked.

When filled out during project data and plan review, and during the field visits, the team may use the information contained in the comment fields of the prompt lists to facilitate writing the audit report more rapidly and accurately.

The team should not amend prompt lists to conform to the WZRSA report. The written WZRSA report should contain a sufficient explanation of the identified safety issues, the extent of safety concern, and the resulting suggestions, without any need to refer to notes or prompt lists.

5.5 How to Use the Prompt Lists

Apply the prompt lists to meet each WZRSA team member's needs. The prompt lists are structured to support the WZRSA team regardless of how they choose to undertake their work (independently then collectively, by progressing through the project in the same manner as a road user, and/or by examining each feature as it manifests itself in the project). Just as there is no single way to identify safety issues, there is no single way to use prompt lists.

Even the most detailed prompt lists cover only the more common elements of work zone design and practice; they are not exhaustive. WZRSA team members should use their own experience, skills, and judgment about the safety of any feature. If a listed topic is not apparently relevant to the project being audited, the team should take a broad view of the topic to see if it prompts a relevant question. For example, sight lines may be obstructed by features not listed in the prompt lists, but only at particular times of day or during a particular season of the year. An understanding of the general environment around the project will help auditors make the best use of prompt lists.

The following guidelines outline a general procedure of using prompt lists:

- Before starting, the WZRSA team should decide collectively if they want to use prompt lists, and if so, which prompt lists to use and how to use them. The prompt lists found in the guidelines are general prompts only. The WZRSA team may wish to photocopy the prompt lists provided. Printable and electronic prompt lists are downloadable from the National Work Zone Safety Information Clearinghouse website (www.workzonesafety.org).
- Some WZRSA team members may find it useful to tailor the prompt lists to a specific scheme to be audited (i.e., delete non-relevant items or adding specific questions to be used). Discussion on how to develop these prompts is found in Section 5.3.
- The prompt lists are generally designed to help the WZRSA team members think about broader issues first ("general topics") and to get into specific details after the more general issues are considered.
- In the WZRSA process conducted during any project phase, the WZRSA team may note on the prompt lists any issues that represent a safety concern or require further review and provide their comments. Additional details can be logged on the plans and drawings. It is helpful to take photographs illustrating the identified safety concerns and reference them in the prompt lists. These graphics may be used during WZRSA analyses and may subsequently be appended to the WZRSA report.

WZRSA Prompt List 1 – Planning Phase

Note: The prompt list is a trigger for WZRSA team members, not an exhaustive list of work zone safety issues.

Number	Prompt
1	<p><i>Project Significance</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Has project significance been determined? <input type="checkbox"/> Have considerations established in the Final Rule on Work Zone Safety and Mobility (§ 630.1010) and State or local policies been followed according to the project significance level?
2	<p><i>Project Vicinity</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Has consideration been given to planned adjacent projects and work zones? <input type="checkbox"/> Are alternate road networks available? <input type="checkbox"/> What are the potential impacts to businesses and communities? <input type="checkbox"/> Should this location be considered for a total road closure?
3	<p><i>Historical Data</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> What is the historical crash and volume data near the planned work zone? <input type="checkbox"/> Do volumes fluctuate based on the season or the day of week? <input type="checkbox"/> Are there known issues with this location in the past?
4	<p><i>Road Users</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Are pedestrian and bicycle facilities present? <input type="checkbox"/> Have ADA accessibility issues been discussed/addressed? <input type="checkbox"/> Are heavy vehicles a predominate vehicle group? Motorcycles?
5	<p><i>Transit</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> What effect will the work zone have on other transit modes (e.g., light rail, heavy rail, buses, airports etc.)?
6	<p><i>Horizontal and Vertical Geometry</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Are there sight distance concerns related to geometric conditions at the work zone location? <input type="checkbox"/> Will the presence of temporary traffic control devices cause sight distance issues?
7	<p><i>Incident Response</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> What is the availability of emergency response in this location? <input type="checkbox"/> Will the work zone impact response time? <input type="checkbox"/> How will emergency responders access the work zone? <input type="checkbox"/> Are detour routes available should an incident occur?

WZRSA Prompt List 2 – Preliminary Design Phase

Note: The prompt list is a trigger for WZRSA team members, not an exhaustive list of work zone safety issues.

Number	Prompt
1	<p><i>Historical Data</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> What is the historical crash and volume data near the planned work zone? <input type="checkbox"/> Do volumes fluctuate based on the season or the day of week? <input type="checkbox"/> Are there known issues with this location in the past?
2	<p><i>Work Zone Geometric Design</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Do merge points, tapers, and ingress/egress to the work zone meet the needs of workers and all road user types? <input type="checkbox"/> Does the geometric design conform to the work zone speed limit? <input type="checkbox"/> Are lane widths sufficient for the intended road user?
3	<p><i>Construction Methods/Staging</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Does the proximity of work allow road users to maintain sufficient work zone speeds? <input type="checkbox"/> Has consideration been given to night and day work? <input type="checkbox"/> Has consideration been given for the time of day that lane closures will occur? <input type="checkbox"/> Does alternate construction staging provide for safer conditions for workers and/or road users? <input type="checkbox"/> Have accelerated construction techniques been considered?
4	<p><i>Positive Protection and Worker Safety</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Was analysis performed on various types of positive protection? <input type="checkbox"/> Do positive protection devices cause any adverse impacts (i.e., barriers encroaching on traffic lanes)?
5	<p><i>Transit</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> What effect will the work zone have on other transit modes (e.g., light rail, heavy rail, buses, airports, etc.)?
6	<p><i>Road Users</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> How do work zone elements interface with all road user types (e.g. pedestrians, bicycles, motorcycles, motor carriers, older drivers, etc.)? <input type="checkbox"/> Have ADA accessibility issues been addressed?
7	<p><i>Project Vicinity</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Are upgrades or changes required on detour routes sufficient to sustain additional volumes? <input type="checkbox"/> Should this location be considered for a total road closure? <input type="checkbox"/> How is access being given to driveways and other routes that are present within the work zone?

8	<p><i>Safety and Mobility</i></p> <p><input type="checkbox"/> Are there tradeoffs between safety and mobility?</p> <p><input type="checkbox"/> If so, how can these be addressed or minimized?</p> <p><input type="checkbox"/> Can any Work Zone Best Practices be incorporated to increase safety? (Go to http://www.ops.fhwa.dot.gov/wz/practices/best/bestpractices.htm and http://www.workzonesafety.org for more information.)</p>
9	<p><i>Temporary Traffic Control Devices/ITS/Lighting</i></p> <p><input type="checkbox"/> Have various types of temporary traffic control devices, ITS, and lighting been considered to enhance safety?</p> <p><input type="checkbox"/> Has pre-emption been considered for new signals?</p>
10	<p><i>Incident Response</i></p> <p><input type="checkbox"/> Has pre-coordination with law enforcement and EMS taken place?</p> <p><input type="checkbox"/> Will detour routes be considered for temporary use or for incident response?</p> <p><input type="checkbox"/> Does the work zone design account for incident response accessibility (i.e., locations to pull off the road, turn around, intermittent access to the work zone)?</p>
11	<p><i>Public Information Plan</i></p> <p><input type="checkbox"/> What strategies have been considered to inform the public?</p>
12	<p><i>Enforcement</i></p> <p><input type="checkbox"/> Have enforcement strategies been considered within the work zone?</p>

WZRSA Prompt List 3 – Final Design Phase

Note: The prompt list is a trigger for RSA team members, not an exhaustive list of work zone safety issues.

Number	Prompt
1	<p><i>Work Zone Geometric Design</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Do merge points, tapers, and ingress/egress to the work zone meet the needs of workers and all road user types? <input type="checkbox"/> Does the geometric design conform to the work zone speed limit? <input type="checkbox"/> Are lane widths sufficient for the intended road user?
2	<p><i>Environmental Impact Assessment/Impact Study and Design Study Reports</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Have findings from these studies that impact work zone safety been incorporated into the final design?
3	<p><i>Construction Methods/Staging</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Does the proximity of work allow road users to maintain sufficient work zone speeds? <input type="checkbox"/> Has consideration been given to night and day work? <input type="checkbox"/> Has consideration been given for the time of day that lane closures will occur? <input type="checkbox"/> Does alternate construction staging provide for safer conditions for workers and/or road users? <input type="checkbox"/> Have accelerated construction techniques been considered? <input type="checkbox"/> Does the length of the work zone promote reliable communication between workers? How does the length affect the mobility for road users?
4	<p><i>Project Vicinity</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Are there opportunities for ingress/egress of the work zone for construction vehicles? <input type="checkbox"/> How is access being given to driveways and other routes that are present within the work zone? <input type="checkbox"/> Should this location be considered for a total road closure?
5	<p><i>Safety and Mobility</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Are there tradeoffs between safety and mobility? <input type="checkbox"/> If so, how can these be addressed or minimized? <input type="checkbox"/> Can any Work Zone Best Practices be incorporated to increase safety? (Go to http://www.ops.fhwa.dot.gov/wz/practices/best/bestpractices.htm and http://www.workzonesafety.org for more information)
6	<p><i>Temporary Traffic Control Devices/ITS/Lighting</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Does temporary traffic control conflict with existing traffic control (e.g., traffic signals, signing, pavement marking, etc.)? <input type="checkbox"/> Does the interaction between types of temporary traffic control provide a clear message to road users (e.g., pavement markings, signing, Dynamic Message Sign messages, etc.)? <input type="checkbox"/> Have various types of temporary traffic control devices, ITS, and lighting been considered to enhance safety? <input type="checkbox"/> Has pre-emption been considered for new signals? <input type="checkbox"/> Does the proposed location of temporary traffic control conform to the estimated back of queue?

7	<p><i>Road Users</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> How do all work zone elements and temporary traffic control devices interface with all road user types (i.e., pedestrians, bicycles, motorcycles, motor carriers, older drivers, etc.)? <input type="checkbox"/> Have ADA accessibility issues been addressed? <input type="checkbox"/> Has consideration been given to the effects of transverse rumble strips, gravel, steel plates, and gaps at bridge ends on road users?
8	<p><i>Transit</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> What effect does the work zone have on other transit modes (e.g., light rail, heavy rail, buses, airports, etc.)?
9	<p><i>Incident Response</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Has pre-coordination with law enforcement, fire, and EMS taken place? <input type="checkbox"/> Will detour routes be considered for temporary use or for incident response? <input type="checkbox"/> Does the work zone design account for incident response accessibility (i.e., locations to pull off the road, turn around, intermittent access to the work zone)?
10	<p><i>Work Zone Impacts Assessment</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Have work zone safety goals been defined for all road users and workers? <input type="checkbox"/> Does the traffic volume data indicate that the proposed design will accommodate road users with minimal queuing? <input type="checkbox"/> How does construction staging/phasing affect safety? <input type="checkbox"/> How do the construction methods affect safety? <input type="checkbox"/> Have the tradeoffs between safety and mobility been estimated?
11	<p><i>Transportation Management Plan</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Are strategies consistent with the safety goals of the work zone? <input type="checkbox"/> Have mitigation strategies been put in place to address historical crash types? <input type="checkbox"/> Have projects and active work zones been coordinated across the corridor?
12	<p><i>Public Information Plan</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> What strategies have been considered to inform the public, including those in the immediate vicinity and unfamiliar drivers/tourists?
13	<p><i>Enforcement</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Have enforcement strategies been considered within the work zone?

WZRSA Prompt List 4 – Active Work Zone

Note: The prompt list is a trigger for RSA team members, not an exhaustive list of work zone safety issues.

Number	Prompt
1	<p><i>Warning Signs</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Is there an overlap in signing due to an adjacent project? Is the intent of this signing clear to the driver? <input type="checkbox"/> Did you have enough or excessive advance warning of this work zone? <input type="checkbox"/> Were the signs easy to understand?
2	<p><i>Flagger</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Did the flagger communicate with you clearly? <input type="checkbox"/> Could you identify that a lane closure was coming up?
3	<p><i>Signing/Markings</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Were the signs easy to understand? <input type="checkbox"/> Were all guide and warning signs accurate (e.g., “Left Lane Closed” on the sign actually came true in the work zone)? <input type="checkbox"/> Were all electronic signs and arrow boards easy to read and understand? <input type="checkbox"/> Were the markings visible and in good shape? <input type="checkbox"/> Did the signing and markings conflict?
4	<p><i>Overall Setup</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Did the work zone look neat, clean, and organized? <input type="checkbox"/> Did the pavement marking, cones, and barrels guide you through the work zone?
5	<p><i>Speed Limit</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Did you feel comfortable driving at the posted work zone speed limit? <input type="checkbox"/> Did other drivers seem to be obeying the work zone speed limit?
6	<p><i>Mobility</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Were you delayed more than is reasonable in this work zone? <input type="checkbox"/> Did motorists make aggressive movements due to queues, delay (e.g., drive on shoulder, cross grass median)? <input type="checkbox"/> Did you witness issues related to weaving, merging, and/or lane changing? <input type="checkbox"/> Did queuing exist? Were there queues associated with turning movements, or other queues experienced at intersections?
7	<p><i>Night-time Work</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Was the existing lighting adequate at critical points (i.e., ramp terminals, curves, etc.)? <input type="checkbox"/> Did you have a clear sight distance as you traveled through the work zone? <input type="checkbox"/> Was on-site work zone lighting distracting? <input type="checkbox"/> Was on-site lighting sufficient to safely accomplish the work being performed? <input type="checkbox"/> Was there ample conspicuity of workers and devices?

8	<p><i>Road Users/Worker Safety</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> How do all work zone elements and temporary traffic control devices interface with all road user types (i.e., pedestrians, bicycles, motorcycles, motor carriers, older drivers, etc.)? <input type="checkbox"/> Have ADA accessibility issues been addressed? <input type="checkbox"/> Will the height of any TCDs block the view of motorists (e.g., a barrel may block the view of motorcyclists)? <input type="checkbox"/> Are workers visible? <input type="checkbox"/> Are positive protection devices being used correctly? <input type="checkbox"/> What mitigation factors have been considered to alleviate driver error (i.e., during wet/night conditions, sunny conditions where pavement joints/pavement color don't align with lane lanes, etc.)?
9	<p><i>Safety and Mobility</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Are there tradeoffs between safety and mobility? <input type="checkbox"/> If so, how can these be addressed or minimized? <input type="checkbox"/> Can any Work Zone Best Practices be incorporated to increase safety? (Go to http://www.ops.fhwa.dot.gov/wz/practices/best/bestpractices.htm and http://www.workzonesafety.org for more information.) <input type="checkbox"/> Have there been unintended consequences as a result of the work zone that impact safety?
10	<p><i>Project Vicinity</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Are there opportunities for ingress/egress of the work zone for construction vehicles? <input type="checkbox"/> How is access given to driveways and other routes that are present within the work zone?
11	<p><i>Temporary Traffic Control Devices/ITS/Lighting</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Does temporary traffic control conflict with existing traffic control (e.g., traffic signals, signing, pavement marking, etc.)? <input type="checkbox"/> Does the interaction between types of temporary traffic control provide a clear message to road users (e.g., pavement markings, signing, Dynamic Message Sign messages, etc.)? <input type="checkbox"/> Have various types of temporary traffic control devices, ITS, and lighting been considered to enhance safety? <input type="checkbox"/> Has pre-emption been considered for new signals? <input type="checkbox"/> Are signals within the work zone coordinated to prevent queuing? <input type="checkbox"/> Does the proposed location of temporary traffic control conform to the estimated back of queue?
12	<p><i>Transit</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> What effect does the work zone have on other transit modes (e.g., light rail, heavy rail, buses, airports, etc.)?
13	<p><i>Public Information Plan</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> What strategies are being used to inform the public, including those in the immediate vicinity and unfamiliar drivers/tourists?
14	<p><i>Enforcement</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Is enforcement being used within the work zone?

6. Conclusion

The practice of conducting a RSA is a proactive approach to identifying issues and recommending treatments to improve safety. It involves independent, multidisciplinary team members who bring their individual experiences and expertise to perform a safety examination. The concept of performing a WZRSA is similar in that a team can take this approach to solving work zone safety issues. The basic principles of an RSA can be applied to the WZRSA. The difference between the two can be found in the tailored approach and considerations toward work zones that takes place during a specific project phase. A WZRSA assesses the *temporary* elements of a project that will eventually be removed once the active work zone phase is completed. Due to the *temporary* nature of work zones, WZRSA recommendations need to be provided to the road owner in a timely fashion.

A unique set of safety and operational benefits are achievable when applying the RSA process to work zones, and agencies using this approach are recognizing a variety of these benefits. By conducting WZRSAs early in the project development phase, the potential exists to save overall project costs. Implementing a WZRSA can achieve the following results:

- Make a work zone safer;
- Result in a lower number of risk claims;
- Reduce societal costs;
- Lower crash severity levels; and
- Feed back into the active maintenance of traffic as well as future design processes and plans.

In addition to the projects being reviewed, lessons learned from a WZRSA team may be recycled for future work zone projects and design phases.

The WZRSA is an eight-step process that can lead to the selection of more effective traffic control strategies during the planning and design phases. WZRSAs can also modify construction or work zone staging efforts before or during an active work zone, which gives the potential for project cost savings and less intrusion for motorists.

The recommendations from the WZRSA team have the potential to affect roadway users and workers immediately when used on an active work zone, and it can lead to additional benefits such as improvements in travel times, enhanced notification in advance of road work, and in TTC visibility and conspicuity improvements. Though operational and mobility enhancements are not necessarily the primary goal of the WZRSA process, it is important to consider the relationship and balances that occur between safety and operational matters during the roadway planning, design, and active work zone phases.

This Guidebook provides the practitioner with an overview and step-by-step process for conducting a WZRSA. In the nation's quest toward zero roadway deaths, these guidelines are another tool designed to help reach that goal and eliminate fatalities that occur in work zone areas. The benefits of the WZRSA make it a viable, worthwhile approach for all practitioners to consider as part of their roadway planning projects and overall safety plans. Additional information on the RSA process may be found on the FHWA RSA Website - <http://safety.fhwa.dot.gov/rsa> and the National Work Zone Safety Information Clearinghouse website - <http://www.workzonesafety.org>.

Appendices – Work Zone RSA Additional Materials

- A. Work Zone RSA Pilot Event - Design Phase: Case Study
- B. Work Zone RSA Pilot Event - Active Work Zone: Case Study
- C. Additional RSA Products
- D. Road Owner Briefing Packet Example
- E. Work Zone RSA Report Template
- F. Work Zone RSA Response Letter from Road Owner Template

Appendix A – Work Zone RSA Pilot Event - Design Phase: Case Study

The ATSSA team performed a pilot WZRSA for a project in the design phase during the week of January 28, 2013 in Tampa, Florida. The purpose of the pilot event was to test the process outlined in the pre-final *Work Zone Road Safety Audit Guidelines & Prompt Lists* so the ATSSA research team could revise and incorporate more robust information into the Final Guidelines and Prompt Lists. The ATSSA team conducted the following steps during the WZRSA process:

Pre-Coordination. The ATSSA team held two pre-coordination meetings and exchanged emails in the month leading to the pilot event with Florida Department of Transportation (DOT) in advance of the pilot event to identify the project, choose members of the WZRSA team, collect project data, and coordinate logistics. During the pre-coordination meetings and once on site, the WZRSA team followed the process as outlined in the pre-final draft of the *Work Zone Road Safety Audit Guidelines & Prompt Lists*.

Step 1 – Identify Project. The ATSSA team and Florida DOT chose a design project on 118th Avenue at the 60 percent completion level for the design phase WZRSA. The existing 118th Avenue is a six-lane urban divided highway with major intersections at US 19 and 49th Street. The facility has a posted speed of 45 mph and is classified as a minor arterial. The proposed roadway will be an urban principal arterial which will consist of a multi-lane elevated roadway with frontage roads. The design speed is 60 mph for the new mainline express lanes, 40 mph for flyover ramps, and 45 mph for frontage roads and mainline ramps. During the active work zone phase, the design team plans to utilize several local roads as detour routes. Special work zone staging and construction techniques were considered due to the proximity of a nearby small airport. A location sketch of the project is shown in Figure 9.



Figure 9. 118th Ave. Project Location

This project was chosen due to its significant construction and traffic control staging, impact on multiple road users (including transit, pedestrians, and bicyclists), effect on local businesses and emergency service providers, and proximity to an airport. Since the project's design was approximately 60 percent complete at the time of the WZRSA, semi-significant recommendations could be made during the WZRSA and incorporated as a result.

Step 2 – Select WZRSA Team. The ATSSA team coordinated selection of the WZRSA team members during several calls with Florida DOT in the weeks leading to the pilot event. The independent, multi-disciplinary WZRSA team was selected by Florida DOT and the ATSSA team and included the members shown in Table 2.

Table 2. Work Zone RSA Team

Name	Discipline	Agency	WZRSA Team Member or Road Owner
Craig Allred	Safety – RSA	FHWA	RSA Team Member
Becky Crowe	Safety – RSA	FHWA	RSA Team Member
Felix Delgado	Safety	FHWA	RSA Team Member
Chris Webster	Work Zones	FHWA	RSA Team Member
Marvin Williams	Work Zones	FHWA	RSA Team Member
Frank Chupka	118th Ave Design Team	FL DOT	Road Owner
Tim Drawhorn	118th Ave Design Team	FL DOT	Road Owner
Peter Hsu	Traffic and Safety	FL DOT	RSA Team Member
Mike Kopotic	Construction	FL DOT	Road Owner
Stephanie Maxwell	Maintenance of Traffic/Work Zones	FL DOT	RSA Team Member
Joe Santos	Safety	FL DOT	RSA Team Member
Pete Kelliher	118th Ave Design Team	Atkins Global	Road Owner
W.T. Bowman	Safety	Tindale-Oliver & Associates	Road Owner
Anthony Chaumont	Safety	Tindale-Oliver & Associates	RSA Team Member
Rudy Umbs	Safety	Tindale-Oliver & Associates	RSA Team Member
Jennifer Atkinson	Work Zones, Traffic Operations, Design, Safety, RSAs	SAIC	RSA Team Member
Heather Rigdon	Work Zones, Safety, RSAs	SAIC	RSA Team Member

Step 3 – Conduct a Pre-audit Meeting to Review Project Information and Drawings. During pre-coordination meetings with Florida DOT, the ATSSA team identified the project information for the road owner to present to the WZRSA team. Once the WZRSA team was convened at the district office, the road owner presented information about the project, a summary of the crash history, specific safety concerns about the location, and answered questions posed by the team. Other information that was presented included the following:

- Project description and type of work being conducted;
- Geographical area information and maps;
- Roadway classification, speed limit and design speed;

- Availability of adjacent road networks;
- Impacts to and from emergency service provider locations;
- Historical crash and volume data near the work zone, including variations by days of the week and seasonally;
- Statewide work zone crash data trends;
- Number, severity, and cause of crashes that have occurred within the active work zone;
- Hours/days of work zone operation; and
- The number and types of road users present within the limits of the work zone and how they are being accommodated.

The road owner also led the team visually through the future work zone site by using an internet-based mapping tool, as shown in Figure 10.



Figure 10. 118th Avenue as viewed from Google Maps

Step 4 – Conduct Review of Project Data and Field Review. The team reviewed the project plans at 60% completion level, including the temporary traffic control plan (TTCP) and transportation management plan (TMP), and discussed construction staging. When the work zone becomes active, the design team plans to utilize several local roads as detour routes, as shown in Figure 11.

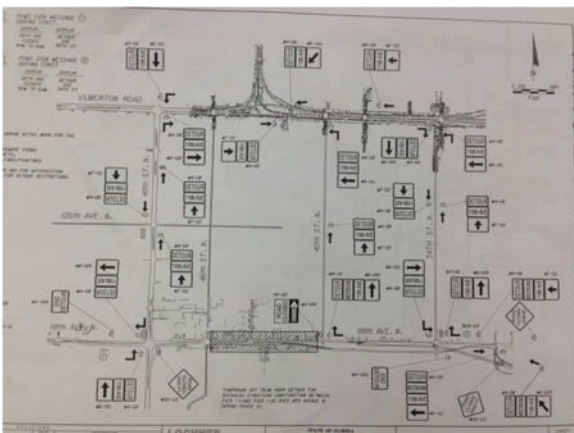


Figure 11. 118th Avenue Planned Detour Routes

The 118th Avenue corridor has existing sidewalks so the team reviewed how the TTCP impacted pedestrian traffic and accommodations. A small airport is situated just north of the future work zone. Since the project entails constructing flyover ramps with overhead cranes, the team looked at potential conflicts with air traffic.

After reviewing the project data, drawings, and available crash data, the WZRSA team performed a field review of the project. During the 118th Avenue field review, the team drove through the proposed work zone and the detour routes that were identified in the design plans. There were approximately 10 different detour routes, all of which were local roads with narrow widths and on-street parking, non-compliant with MUTCD signing/stripping/pavement marking standards. The roads had the capacity to carry very low volumes. Due to on-street parking, sight distance obstructions were present at nearly every four-way Stop controlled intersection.

While in the field, the team visited a fire station that will be impacted by the project. Team members documented input provided by firefighters

on considerations that need to be made to accommodate emergency responders during construction activities, as indicated in Figure 12.

Steps 5 and 6 – Conduct Audit Analysis and Prepare Report of Findings/ Present Audit Findings to Road Owner. After the field review, the team reconvened at the Florida DOT District 7 office to discuss the group’s observations, develop recommendations, and write the report. The team observed the following safety issues with the detour routes:

- Inadequate capacity
- Signing/stripping issues
- Limited sight distance due to on street parking
- Inadequate signal phasing to accommodate additional traffic volumes

The team presented its findings for the WZRSA to the road owner and District 7 management in a debrief meeting on the final day. The debrief meeting was led by the WZRSA team leaders and began with positive findings from the WZRSA; those included:

- The design was comprehensive. It was evident that substantial time and study of the location went into the design.
- The first responders were happy to be engaged in the project through public meetings and discussion during the WZRSA.

Table 3 shows the observations identified by the team and associated recommendations to improve safety.

Table 3. Design Phase Work Zone RSA Team Observations and Recommended Improvements

WZRSA Team Observation	Recommendation
Long construction duration.	Potentially close 118th Avenue and move all traffic to detour routes (provided that the next recommendation is implemented).
Detour routes have: <ul style="list-style-type: none"> • Inadequate capacity • Signing/stripping issues • Limited sight distance due to on-street parking • Signal phasing 	Consolidate detour routes and make upgrades to observed items.

Steps 7 and 8 – Project Owner Prepares Formal Response/Incorporate Findings into the Project and Evaluate Results. While these steps were not performed as a part of the pilot event, the WZRSA team provided comments on the steps as described in the guide. These comments have been incorporated into the *Final Work Zone Road Safety Audit Guidelines & Prompt Lists*.

I went into this not having any idea as to what to expect, except FHWA is going to review my project! No pressure – right? I know your efforts will produce big dividends for Design and Construction. Keep up the great work!

Tim Drawhorn, Florida DOT Project Manager for 118th Avenue



Figure 12. Firefighters Provide Input on 118th Ave. Project

Appendix B – Work Zone RSA Pilot Event - Active Work Zone: Case Study

The ATSSA team performed a pilot WZRSA for a project in the active work zone phase during the week of January 28, 2013 in Tampa, Florida. The purpose of the pilot event was to test the process outlined in the pre-final *Work Zone Road Safety Audit Guidelines & Prompt Lists* so the ATSSA team could revise and incorporate more robust information into the Final Guidelines and Prompt Lists. The ATSSA team conducted the following steps from the WZRSA process:

Pre-Coordination. The ATSSA team held two pre-coordination meetings and exchanged emails in the month leading to the pilot event with Florida Department of Transportation (DOT) in advance of the pilot event to identify the project, choose members of the WZRSA team, collect project data, and coordinate logistics. During the pre-coordination meetings and once on site, the WZRSA team followed the process as outlined in the pre-final draft of the *Work Zone Road Safety Audit Guidelines & Prompt Lists*.

Step 1 – Identify Project. The ATSSA team and Florida DOT chose a construction project on Interstate 275 (I-275) for the active WZRSA (see Figure 13). I-275 is an urban freeway/expressway with a speed limit of 65 mph. The design speed is 60 mph from SR 60 to Himes Avenue, 65 mph from Himes Avenue to Willow Avenue, and 50 mph from Willow Avenue to the Hillsborough River. This project is a complete reconstruction of I-275 from SR 60 (Memorial Highway) to the Hillsborough River. The project will replace 13 bridges, widen three bridges, and construct three new bridges. It also involves constructing mechanically stabilized earth walls, earthwork fills, drainage, concrete and asphalt pavements, lighting, signing, intelligent transportation systems (ITS), landscaping, and architectural treatments.



Figure 13. I-275 Project Limits

The active work zone spans several construction seasons, shifts traffic to newly constructed lanes over several segments, and replaces two former right-hand exits with temporary left-hand exits from the freeway. During the WZRSA, the team focused its review on two specific locations at the request of the project manager: the Armenia/Howard interchange and Ashley/Kay interchange.

This project was chosen due to its complexity, significant construction and traffic control staging, considerable impact on traffic, and high-profile nature. In addition, Florida DOT has a deep-rooted RSA program and has extensive foundational knowledge related to applying the RSA process. The project was easily accessed, as it was located within 15 minutes of the Florida DOT District 7 Office.

Step 2 – Select WZRSA Team. The ATSSA team coordinated selection of WZRSA team members during several calls with Florida DOT in the weeks leading to the pilot event. The independent, multi-disciplinary WZRSA team was selected by Florida DOT and SAIC and included the members shown in Table 4:

Table 4. Work Zone RSA Team

Name	Discipline	Agency	WZRSA Team Member or Road Owner
Craig Allred	Safety – RSA	FHWA	RSA Team Member
Becky Crowe	Safety – RSA	FHWA	RSA Team Member
Felix Delgado	Safety	FHWA	RSA Team Member
Chris Webster	Work Zones	FHWA	RSA Team Member
Marvin Williams	Work Zones	FHWA	RSA Team Member
Richard Frank	I-275 Design Team	FL DOT	Road Owner
Peter Hsu	Traffic and Safety	FL DOT	RSA Team Member
Mike Kopotic	Construction	FL DOT	Road Owner
Stephanie Maxwell	Maintenance of Traffic/Work Zones	FL DOT	RSA Team Member
Joe Santos	Safety	FL DOT	RSA Team Member
Tracy Keenan	Construction (I-275)	Cardno TBE	Road Owner
Joel Provenzano	Safety	Cardno TBE	Road Owner
John Temple	Construction (I-275)	Cardno TBE	Road Owner
W.T. Bowman	Safety	Tindale-Oliver & Associates	Road Owner
Anthony Chaumont	Safety	Tindale-Oliver & Associates	RSA Team Member
Rudy Umbs	Safety	Tindale-Oliver & Associates	RSA Team Member
Jennifer Atkinson	Work Zones, Traffic Operations, Design, Safety, RSAs	SAIC	RSA Team Member
Heather Rigdon	Work Zones, Safety, RSAs	SAIC	RSA Team Member

Step 3 – Conduct a Pre-audit Meeting to Review Project Information and Drawings. During pre-coordination meetings with Florida DOT, the ATSSA team identified the project information for the road owner to present to the WZRSA team. Once the WZRSA team was convened at the district office, the road owner presented information about the project, a summary of the crash history, specific safety concerns about the location, and answered questions posed by the team, as shown in Figure 14. Other information that was presented included the following:

- Project description and type of work being conducted;
- Geographical area information and maps;
- Roadway classification, speed limit and design speed;
- Availability of adjacent road networks;
- Impacts to and from emergency service provider locations;
- Historical crash and volume data near the work zone, including variations by days of the week and seasonally;
- Statewide work zone crash data trends;
- Number, severity, and cause of crashes that have occurred within the active work zone;
- Hours/days of work zone operation; and
- The number and types of road users present within the limits of the work zone and how they are being accommodated.



Figure 14. I-275 Work Zone RSA Team at the TMC

During the WZRSA, the team focused its review on two specific locations at the request of the project manager: the Armenia/Howard interchange and Ashley/Kay interchange. The Ashley/Kay interchange was technically outside of the work zone limits, but traffic merging onto I-275 from the interchange immediately entered the work zone. The Ashley Street ramp merges with the Kay Street ramp before merging with I-275 approximately 200 feet later, as shown in Figure 15.



Figure 15. Ashley/Kay Interchange on I-275

The Armenia/Howard interchanges were typical right hand exits prior to construction. During the active work zone, however, both exits were converted to left hand exits. Traffic was led to either Armenia Avenue or Howard Avenue, depending on the direction traveled. Both exits at Armenia and Howard Avenues were signalized intersections, along with successive signals along each corridor with approximately 300-400' temporary signal spacing. Figure 16 shows the interchanges. The signalized intersections are indicated by red circles.

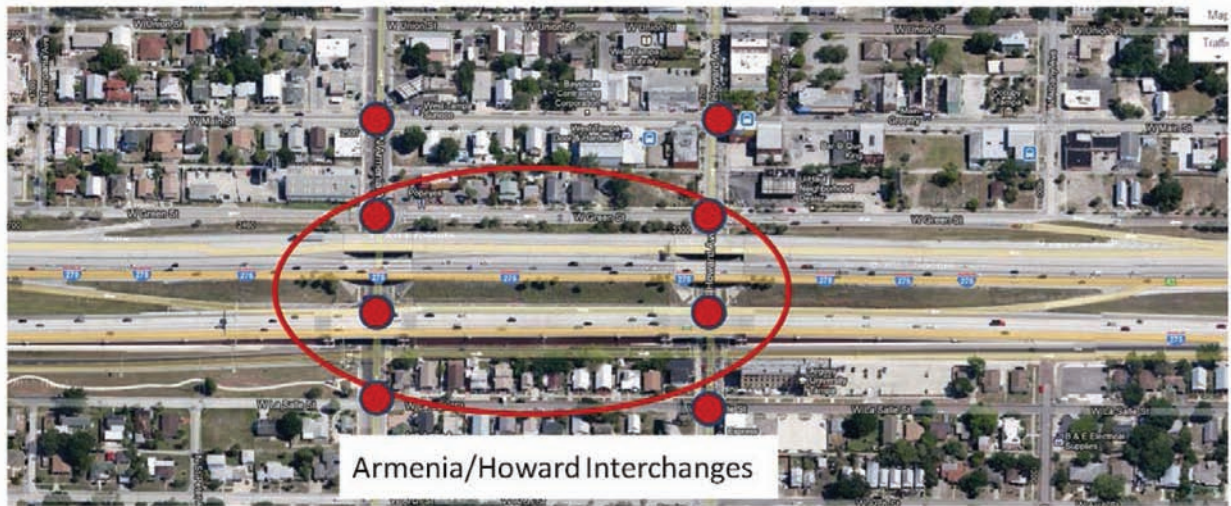


Figure 16. Howard/Armenia Interchanges on I-275

Step 4 – Conduct Review of Project Data and Field Review. For the I-275 WZRSA, the team reviewed temporary traffic control plans (TTCP), the transportation management plan (TMP), and the construction staging. The team also asked about historical crashes that occurred prior to the work zone and those that had happened during the active work zone within the four mile segment. The contractor supplied detailed crash information pertaining to type and causation.

After reviewing the project data, drawings, and available crash data, the WZRSA team performed a field review of the project. Before visiting the I-275 project site, the team visited the Transportation Management Center (TMC) to observe traffic in the work zone using live feed from cameras in the field. This was a valuable experience that allowed the team to become oriented to the project and observe traffic patterns and driver behavior. After the team visited the TMC, they divided into two Florida DOT vans to drive through the entire active work zone in both directions. The team stopped to walk the areas of the Howard/Armenia interchange and Ashley/Kay interchange, as shown in Figure 17. The team visually observed driver and pedestrian behaviors, noting how each interacted with TTC and the work zone.

Steps 5 and 6 – Conduct Audit Analysis and Prepare Report of Findings/ Present Audit Findings to Road Owner. After the field review, the team reconvened at the Florida DOT District 7 office to discuss the group's observations, develop recommendations, and write the report.



Figure 17. Field review of I-275 at Ashley/Kay

Observation 1: Speeding on the corridor increases at night as congestion decreases.

Observation 2: Vehicles were observed encroaching into the crosswalks in a few locations on Howard and Armenia Avenues, as shown in Figure 18.

Observation 3: Successive signalized intersections have inconsistent alignment and placement of signal heads (both horizontal and vertical), as shown in Figure 19.



Figure 18 (left). Drivers Encroach the Pedestrian Crosswalks on Howard and Armenia Avenues.
Figure 19 (right). Inconsistent Signal Head Alignment on Howard and Armenia Avenues.

Observation 4: The yield signs at the merge between Kay Street and Ashley Drive for the Kay Street approach seem too high. Also, the white yield pavement marking on Kay Street seem to blend with the concrete pavement, as illustrated in Figure 20.

Observation 5: The team observed several vehicular conflicts during the off peak at the merge where the thru movement at Kay Street did not yield to the ramp traffic from Ashley Drive. Drivers from Ashley were observed stopping to yield for the Kay ramp. The geometry of the merge/yield is such that drivers on the right expect to yield, as with any other loop ramp. This condition is shown in Figure 21. During the peak times, the yield condition was observed to operate as a merge with vehicles alternating.

Observation 6: The team observed that the merge area, beyond the Kay/Ashley yield, for the ramp merging with I-275 seems somewhat short.



Figure 20 (left). Sign Height on the Left-hand Merge was Too High.
Figure 21 (right). The Left-hand Merge Condition Could Violate Driver Expectation.

Table 5 shows the observations identified by the team and associated recommendations to improve safety.

Table 5. Active Work Zone RSA Team Observations and Recommended Improvements

WZRSA Team Observation	Recommendation
1. Speeding on the corridor increases at night as congestion decreases	Increase enforcement during non-peak hours.
2. Pedestrian crosswalks at Howard and Armenia are parallel bars and vehicles stop within crosswalk.	Provide special emphasis crosswalks.
3. Successive signalized intersections have inconsistent alignment of signal heads.	Realign signals heads at either lane line or travel line and provide optically limited heads.
4. Yield signs on the Kay Street approach appear high.	Lower yield signs and improve pavement markings.
5. Yielding the left-hand traffic at the Ashley/Kay merge goes against driver expectations.	Reverse the yield condition.
6. Ashley/Kay Street merge onto the mainline feels quick.	Extend the merge area at Ashley/Kay Street by shifting the barriers.

The team presented its findings for the WZRSA to the road owner and District 7 management in a debrief meeting on the final day. The debrief meeting was led by the WZRSA team leaders and began with positive findings from the WZRSA.

Steps 7 and 8 – Project Owner Prepares Formal Response/Incorporate Findings into the Project and Evaluate Results. While these steps were not performed as a part of the pilot event, the WZRSA team provided comments on the steps as described in the guide. These comments have been incorporated into the *Work Zone Road Safety Audit Guidelines & Prompt Lists*.

Appendix C - Additional RSA Products

Currently, several RSA products are available for use, including:

- *Road Safety Audit Guidelines and Prompt Lists.* This publication provides a foundation for public agencies and tribal governments to develop their own RSA policies and procedures, and to provide a structure for conducting RSAs. These guidelines are meant to present basic RSA principles and to encourage public agencies to implement RSAs and embrace them as part of their everyday practice. For more information, visit <http://safety.fhwa.dot.gov/rsa/guidelines/>.
- *Pedestrian RSA Guidelines and Prompt Lists.* This specialized set of guidelines provides transportation agencies and RSA teams with a better understanding of the safety and accessibility needs of pedestrians of all abilities. The guidelines present a broad overview of the RSA process and how pedestrians should be considered in that process. More information can be found at http://safety.fhwa.dot.gov/ped_bike/tools_solve/ped_rsa/.
- *Bicycle RSA Guidelines and Prompt Lists.* The purpose of this product is to provide transportation agencies and RSA teams with a better understanding of the safety of cyclists in the transportation system when conducting an RSA. These Guidelines present the RSA team with an overview of basic principles of the safety of cyclists and potential issues affecting cyclists. It also provides information on how to conduct an RSA and effectively assess the safety of cyclists. Prompt lists describe safety considerations when conducting a cyclist-specific RSA. These Guidelines will help RSA teams evaluate and suggest a multimodal approach to safety by improving the safety of cyclists and all roadway users. For further information, visit http://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa12018/.

Appendix D – Road Owner Briefing Packet Example

Road Owner Responsibilities

The information provided in this document will guide the road owner through their responsibilities associated with a WZRSA. The road owner should coordinate with the WZRSA team leader for when the road owner will present the information found in this document to the WZRSA team. Also, the road owner should come to the project overview meeting prepared to distribute one copy of project materials for the WZRSA team.

Project Overview Meeting

During the project overview meeting, the road owner should be prepared to present and discuss the following project-specific information with the WZRSA team (dependent on which phase the project is in):

- Specific goals and objectives for the WZRSA;
- Concerns with the roadway section where the work zone will take place;
- Safety concerns with similar projects;
- Work zone schedule and duration;
- State laws and agency policies related to work zone activities (e.g., no texting and driving, how speed limits are established);
- Constraints and limitations associated with the project, including guidelines by which the WZRSA will be conducted and the types and extent of recommendations that can be made by the team; and
- Guidance on the level of risk associated with the various safety issues identified (e.g., low, medium, or high).

At this time, the road owner should provide an overview of pertinent basic information related to the location and design criteria of the work zone. Based on the project phase, the road owner should be prepared to summarize the following items, at the very least:

Planning Phase

- Project description and type of work to be conducted;
- Geographical area information and maps;
- Roadway classification, speed limit and design speed;
- Availability of adjacent road networks;
- Potential impacts to and from emergency service provider locations;
- Historical crash and volume data near the planned work zone, including variations by days of the week and seasonally;
- Statewide work zone crash data trends;
- Findings from previous corridor studies conducted within the area of the planned work zone; and
- The number and types of road users within the planned work zone.

Preliminary Design and Final Design Phases

- Project description and type of work to be conducted;
- Geographical area information and maps;
- Roadway classification, speed limit and design speed;
- Availability of adjacent road networks;
- Potential impacts to and from emergency service provider locations;
- Historical crash and volume data near the planned work zone, including variations by days of the week and seasonally;
- Statewide work zone crash data trends;

- Findings from previous corridor studies conducted within the area of the planned work zone;
- How the limits of the work zone were decided; and
- The number and types of road users within the planned work zone.

Active Work Zone Phase

- Project description and type of work being conducted;
- Geographical area information and maps;
- Roadway classification, speed limit and design speed;
- Availability of adjacent road networks;
- Impacts to and from emergency service provider locations;
- Historical crash and volume data near the planned work zone, including variations by days of the week and seasonally;
- Statewide work zone crash data trends;
- Number, severity, and cause of crashes that have occurred within the active work zone;
- Hours/days of work zone operation; and
- The number and types of road users present within the limits of the work zone and how they are being accommodated.

Conduct Review of Project Data

The available and appropriate materials to review before conducting the WZRSA are dependent upon the project phase in which the safety examination takes place. The road owner will provide the WZRSA team with the following types of documentation that may be available according to project phase.

Planning Phase

During this early phase in the project's life, there are several considerations that may affect future safety and mobility outcomes during the active work zone phase. While no formal plans may exist, the planning phase is ideal for reviewing:

- Project significance, according to the Final Rule on Work Zone Safety and Mobility (§ 630.1010) and State or local policy;
- Consideration of planned adjacent projects and work zones;
- The availability of alternate road networks;
- Geometric and sight distance considerations at the work zone location; and
- Impacts to businesses and communities in the vicinity.

Other considerations within this step of the WZRSA process should include a review of project timing with respect to seasonal travel volumes, the presence of school and bus routes, tourism events, and local impacts to schools, businesses, military posts, and local festivals and events.

Preliminary Design and Final Design Phases

The design phase can span many years and present multiple opportunities for the inclusion of formal examinations for safety and mobility.

During preliminary design, it is common to produce basic plans that indicate horizontal and vertical alignments, general limits of the work zone, and possibly a determination of how to stage the work. At this point, the WZRSA could consider:

- How work zone activities affect all roadway users, such as pedestrians, bicyclists, motorcyclists, older and teen drivers, motor carriers, and Americans with Disabilities Act (ADA) considerations;
- Impacts to work zone safety and mobility goals, including tradeoffs between the two;
- Assessments made during considerations for alternate design concepts, construction staging, and construction techniques;

- Environmental documents and design commitments;
- Impacts contributed by adjacent projects and work zones; and
- Impacts from seasonal travel.

In the final design phase, activities include the development of temporary traffic control plans (TTCP), construction staging plans, a work zone impacts assessment, a TMP, and a detailed set of project plans that address the remainder of design considerations before being bid upon by contractors. The final design phase is the time to ensure the following:

- Strategies appearing in the TMP correlate with defined safety and mobility goals;
- Available ITS, interactive communications, and safety devices are incorporated into the TMP and TTCP;
- The impacts of construction staging, phasing, and methods on safety and mobility have been mitigated;
- Projects across a corridor have been coordinated;
- Roadway geometry and characteristics within the work zone limits provide for optimal safety and mobility;
- TTC does not conflict with itself or with existing traffic control;
- TTC does not adversely affect specific roadway users, or if it does, those impacts are mitigated (e.g., motorcycles and transverse rumble strips); and
- The interaction between work zone activities and other transit modes provides for optimal safety and mobility for all, including interaction with bus routes/stops, light rail, and other occurrences.

Active Work Zone Phase

In this phase, work zone activities are in full-effect. Transportation management strategies and TTCDs are deployed and monitored for effectiveness based on measurements against safety and mobility goals determined during the design phase. The active work zone phase provides a real-time opportunity to ensure that plans are executed and achieving favorable results. A WZRSA conducted during this phase may examine whether:

- Road user expectations are aligned with proper deployment and use of transportation management strategies and TTCDs (e.g., drivers have been informed of upcoming back of queue, flagger ahead, or a change in speeds);
- The transportation management strategies, TTC, and speed limit are appropriate for field conditions;
- The work zone provides road users with the appropriate amount and type of guidance;
- Roadway and geometric conditions meet driver expectations;
- Roadway and geometric conditions support work zone safety and mobility goals;
- Interaction with other transit modes exists (e.g., rail, light rail, transit);
- Enforcement and EMS are properly accommodated; and
- All road users are accommodated within the work zone.

Appendix E – Work Zone RSA Report Template

Work Zone RSA Project Title:

Date: [beginning and end date of the Work Zone RSA]

1.0 Introduction

Scope and Purpose of WZRSA:

WZRSA Stage: [per FHWA Work Zone RSA Guidelines: planning, preliminary design, final design, active work zone]

Items Reviewed:

2.0 Background

WZRSA Team and Participants:

[RSA team leader, members, affiliations, qualifications]

Background:

[Work Zone RSA initiation, project/road entity selection, project location, issues already known, previous RSAs etc]

Data Received:

WZRSA Process:

[How the project/road entity was audited]

General Site Visit Observations:

3.0 Major Work Zone RSA Findings and Recommendations

Concise description of most important WZRSA Findings, e.g., most severe (Road Safety Risk high or very high) or typical/recurrent issues

Issue: [brief issue title is provided here]

Location: [brief location description is provided here]

Description of Safety Issue:

[Concise description of safety issue is provided here]

*** Photos or schemes are provided to illustrate safety issues*

Suggestion:

[Concise description of suggestion to mitigate/eliminate safety issue is provided here]

Appendix F – Work Zone RSA Response Letter from Road Owner Template

Road Owner's Name and Organization:

Audit Stage: Planning, preliminary design, final design, or active work zone

Today's Date:

Description of Issue	Location of Issue	Safety Problem Acknowledged (yes/no)	Safety Recommendation Accepted (yes/no)	Alternative Recommendation	Schedule for Implementing Safety Recommendation

Signed _____

Name _____

Road Owner Organization _____

This completed and signed form should be sent to the Work Zone Road Safety Audit team.





Developed by:

The American Traffic Safety Services Association

15 Riverside Parkway Suite 100

Fredericksburg, VA 22406-1022

800-272-8772

Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the Federal Highway Administration.



U.S. Department of Transportation
Federal Highway Administration