FWS Transportation Program Safety Analysis Toolkit

Draft Report

Prepared for:

U.S. Fish and Wildlife Service and the Federal Highway Administration

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ACRONYMS

FWS TRANSPORTATION PROGRAM SAFETY ANALYSIS TOOLKIT

DOT	Department of Transportation
FARS	Fatality Analysis Reporting System
FHWA	Federal Highway Administration
FLH	Federal Lands Highway
FWS	Fish and Wildlife Service
FWS-IMARS	FWS Incident Management and Analysis Reporting System
MAP-21	Moving Ahead for Progress in the 21st Century Act
NHTSA	National Highway Traffic Safety Administration
RATE	Regional Alternative Transportation Evaluation
RIP	Roadway Inventory Program
RSA	Road Safety Audit
SMIS	Safety Management Information System
SMS	Safety Management System

1. INTRODUCTION

The Fish and Wildlife Service (FWS) and Federal Highway Administration (FHWA) work closely together to continually improve safety on the transportation system that serves the National Wildlife Refuges and Fish Hatcheries. The FWS and FHWA have developed a Safety Management System (SMS) that can be used to identify, prioritize, mitigate, and track the performance of transportation safety investments for the FWS transportation system. To complement the SMS and provide tools for analyzing safety issues within the FWS transportation system, the Safety Analysis Toolkit was developed. The Toolkit includes discussions on the roles and responsibilities of partner agencies, the safety analysis tools that can be used to study safety issues, and the steps for implementing countermeasures that have been identified.

Ash Meadows National Wildlife Refuge Source: USFWS

1.1 Purpose

The Safety Analysis Toolkit will support the FWS efforts to identify, analyze, and mitigate safety issues on the FWS transportation system. The Toolkit presents a safety analysis process that emphasizes the strong coordination that should occur between FWS Field Station Managers and Staff, FWS Regional Transportation Coordinators, and the FHWA Safety Discipline Team. Each of these partners plays an important role in identifying, analyzing, and developing countermeasures to address safety issues in National Wildlife Refuges and Fish Hatcheries.

The information in the Safety Analysis Toolkit is also intended to assist the FWS with developing a consistent procedure for determining the appropriate safety analysis type and to encourage a consistent level of safety analysis across the FWS. The Toolkit provides a description of a number of types of safety analysis tools that should be carefully considered when analyzing a safety issue. It provides guidance on what type of analysis to use and discusses the basic steps involved with each. Every field station and every safety issue will be different and at times none of the specific study types discussed will be a perfect fit for the analysis of a safety issue. The Toolkit encourages using a combination of studies as needed to address safety issues when appropriate.

The safety analysis process presented in this Toolkit is a key step in meeting the FWS goal of eliminating crashes on the FWS transportation system. The safety analysis process emphasizes identification of safety issues before crashes occur and promotes coordination between FWS and FHWA to work closely together to analyze safety issues and identify countermeasures if required.

1.2 Relationship to Safety Management System

The SMS establishes an annual process to collect and store safety data in order to identify transportation safety issues at FWS field stations. While some of the data collected in the SMS will include crash reports or other objective information from traffic and safety studies, much of the data collected in the SMS is subjective data compiled from surveys and other input from field stations. Regardless of the source of a safety issue identified in the SMS, the safety analysis process discussed in the Safety Analysis Toolkit can be used to move the safety issues identified in the SMS forward by providing a process to determine if a safety study is needed an if so, what type of safety study is appropriate.

When a safety issue originates from a field station, the SMS database should be reviewed to determine if additional information is available in the database that is related to the safety issue. For example, the SMS database may have a record of a crash from the FWS Incident Management and Analysis Reporting System (FWS-IMARS) at the same location, or concerns about the location may have been noted on past Regional Alternative Transportation Evaluation (RATE) surveys. This type of information would be valuable when determining if a study is needed to address the safety issue.

The SMS database will also be available to the FWS Regional Transportation Coordinators and the FWS Field Station Manager. As additional safety data is added the SMS database each year, it should be periodically reviewed to determine if there are safety issues noted in the databases that should be considered for a safety study.

1.3 How to Use this Toolkit

As stated earlier, the Safety Analysis Toolkit is intended to assist the FWS with developing a consistent procedure for determining the appropriate safety analysis type and to encourage a consistent level of safety analysis across the FWS. The Safety Analysis Toolkit should primarily be used as a guideline in selecting the type of safety analysis tool to be used for safety issues that appear to need further analysis. Use of the process and guidance provided in the Safety Analysis Toolkit should allow for more consistency in how safety issues are identified for analysis as well as more consistency in which type of analysis is used.

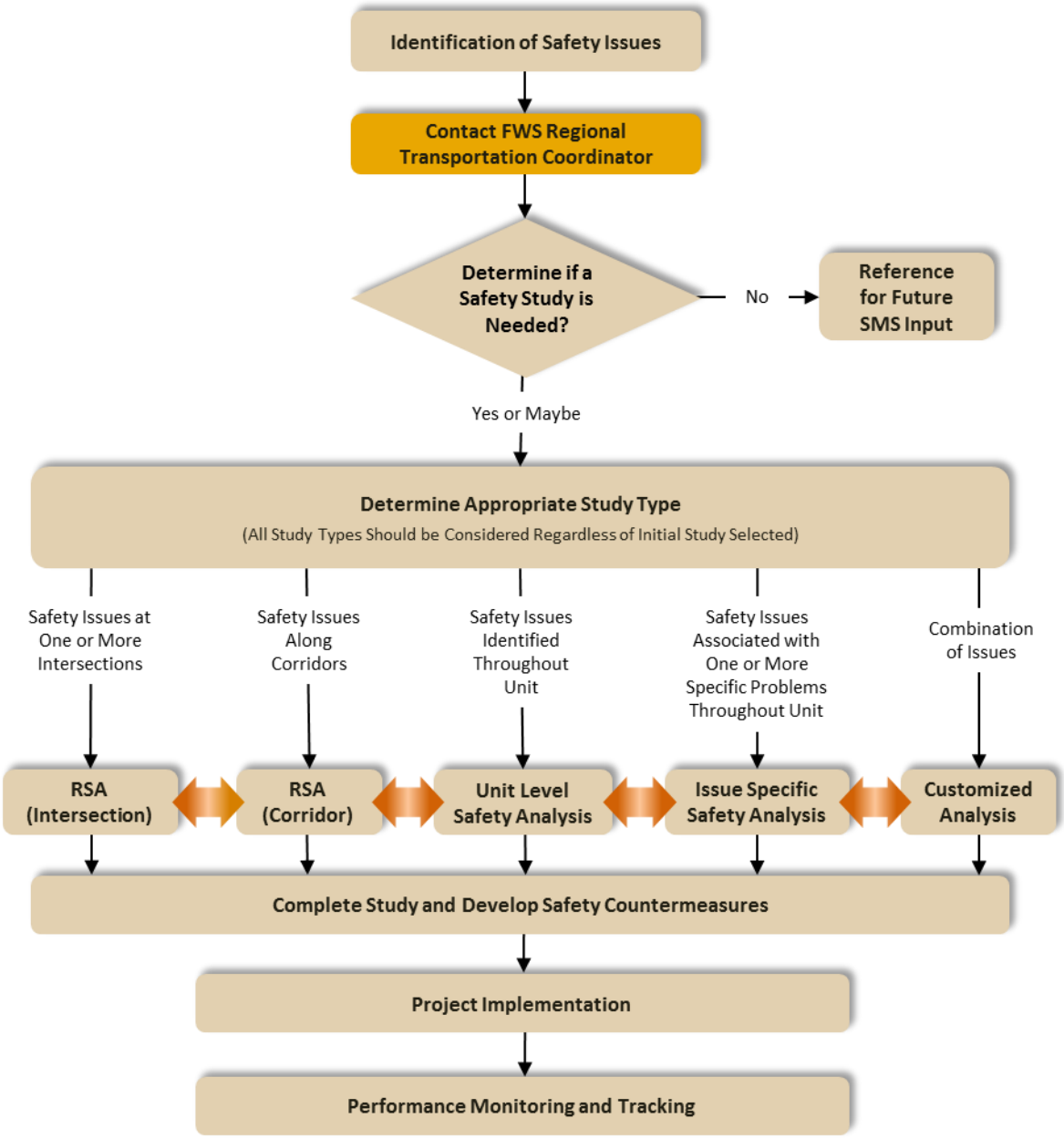
It is important to note that the Safety Analysis Toolkit provides guidance but does not provide requirements on which safety issues to study or which type of study to select. The final decisions should be based on the expertise, experience, and local knowledge of FWS, FHWA, and other partner agency staff members. When safety issues are identified at the field station level, it is strongly encouraged that as a first step the FWS Field Station Managers and Staff contact the FWS Regional Transportation Coordinators, and that the FHWA Safety Discipline Team also be brought in to partner with FWS.

The Safety Analysis Toolkit should be considered in conjunction with the Four E's of Safety: engineering, education, enforcement, and emergency medical services. While many of the safety analysis studies may be inclined to consider engineering solutions for safety issues, it is important to also consider how education, enforcement, and emergency medical services may be used to address safety issues as well. These can often provide very cost effective solutions and may address a safety issue as well or better than an engineering solution. Very often the best solution may lie in some combination of two or more of the Four E's of Safety and all four should be considered as part of every safety analysis.

2. SAFETY ANALYSIS PROCESS

The FWS and FHWA Federal Lands Highway (FLH) have defined a general process that should be considered when safety issues are identified on FWS transportation facilities. The process relies on a strong partnership between FWS Field Station Manager, FWS Regional Transportation Coordinators, and the FHWA FLH Safety Discipline Team. An overview of the process is presented in the figure below, and the process as well as the roles and responsibilities of the partner agencies are discussed in more detail in Section 2 of this report.

Safety Analysis Process



Note: The safety analysis process presented above emphasizes the need to involve FWS Regional Transportation Coordinators as soon as a safety issue is identified. Decisions on the need for a safety study as well as the type of study performed should be made by FHWA FLH Safety Discipline Team Lead in close coordination with the FWS. Although the process above provides general guidance for selecting the appropriate study type, each safety issue is unique and will need to be carefully reviewed to determine the most appropriate course of action to address the issue.

2.1 Safety Analysis Process

The FWS and FHWA FLH have defined a general process that should be considered for safety issues that arise on the FWS transportation system. The process relies heavily on a high level of cooperation between the FWS Field Stations, FWS Regional Transportation Coordinators, and the FHWA FLH Safety Team. Each of these will both lead and support the various steps that should occur from the initial identification of safety issues through project implementation if applicable. The key steps in the process are discussed in more detail below.

Identification of Safety Issues – Safety issues may be identified at the field station, regional, or national level within the FWS. While some issues, such as a missing stop sign, will be most appropriately addressed by field station staff, other may require more in-depth analysis to determine the cause of the issue and develop countermeasures that adequately address the issue. As a first step, whenever safety issues arise that cannot be readily addressed by field station staff, it is recommended that the FWS Regional Transportation Coordinator be contacted.

Contact the FWS Regional Transportation Coordinator – The FWS Regional Transportation Coordinators will act as the primary contact point for addressing safety issues that cannot be readily addressed at the field station level. The FWS Regional Transportation Coordinators will be able to share experiences of other FWS field stations that may have had similar safety issues, they will be aware of existing policies and programs available to address safety issues, and they will act as the primary point of contact between FWS and the FWHW FLH Safety Discipline Team.

Determine if a Safety Study is Needed – The determination of the need for a safety study should be made with close coordination between the FWS Field Station Staff, FWS Regional Transportation Coordinators, and the FHWA FLH Safety Discipline Team Lead, with the FHWA FLH Safety Discipline Team Lead taking the lead role in making this determination. Depending on the issue, a field review may be needed to make this determination and to gather additional information in order to determine the appropriate study type.

Determine Appropriate Study Type – Based on information available, the FHWA FLH Safety Discipline Team Lead, in coordination with the FWS, will determine the type of safety analysis study that should be completed in order to address the safety issue. There should be flexibility in this process as each safety issue is unique. In many cases a customized analysis approach may be selected to adequately address an issue. For example, a unit level safety analysis may be selected for a Refuge to address multiple safety issues, but it may also be determined that a road safety audit (RSA) should be performed at several intersections within a Refuge to address specific concerns at intersections that have had a history of crashes.

Complete Study and Develop Recommended Countermeasures – The study and development of recommended countermeasures will be led by the FHWA FLH Safety Discipline Team Lead. Key steps include:

- Formation of the Safety Team
- Data Collection and Assembly
- Develop Recommended Countermeasures

The safety team could include members of the FWS Field Station Staff, FWS law enforcement, local law enforcement, state departments of transportation (DOTs), and local DOTs or public works in addition to the FHWA FLH Safety Discipline Team Lead and the FWS Regional Transportation Coordinators.

Data collection and assembly will generally be the responsibility of FWS Field Station Staff who will have the most history on the safety issues at a field station. The FWS National SMS Specialist should also be consulted to identify any safety issues, crash reports, or other safety data that may be available in the FWS SMS.

Recommendations will be made by the safety team with the FHWA FLH Safety Discipline Team Leader taking the lead role in making recommendations to FWS.

Project Implementation – Implementation of recommendations from safety studies will ultimately depend on priority of the need, availability of funding, and jurisdictions involved. The implementation will be led by the FWS Field Station Manager but tracked by the FWS Regional Transportation Coordinators. Project implementation information should also be provided to the FWS National SMS Specialists so that the improvements can be monitored and tracked for performance measurement.

Performance Monitoring – As part of the FWS SMS, the FWS National SMS Specialist will monitor any locations with safety improvements to determine if a measurable difference in safety can be identified.

2.2 Partner Agency Roles and Responsibilities

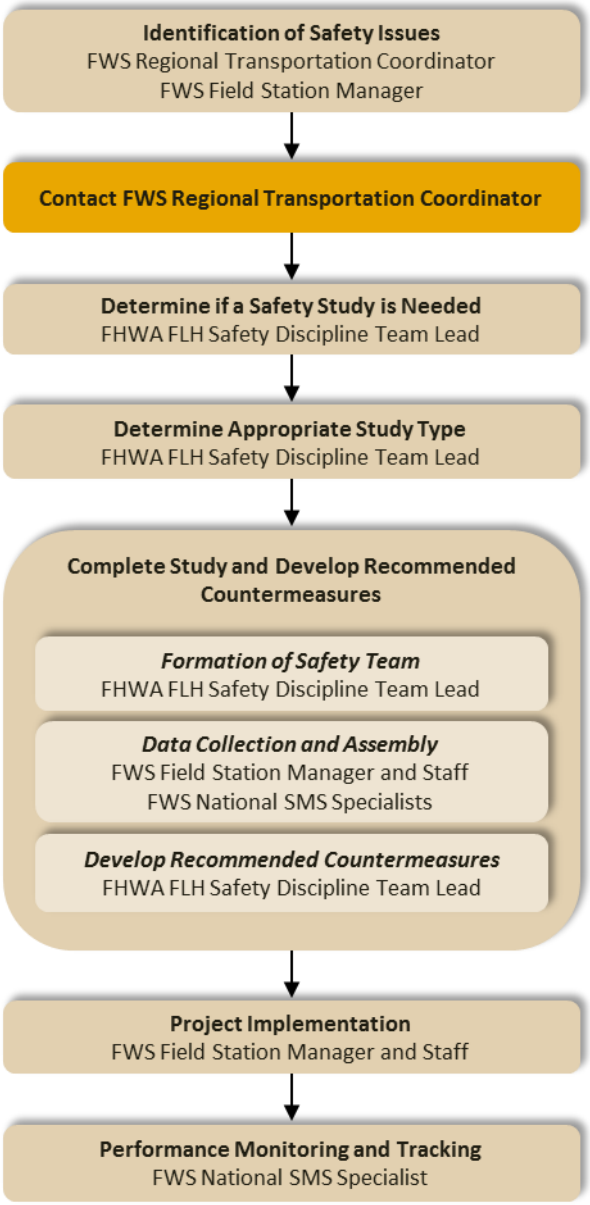
The FWS and its partner agencies each play a critical role in providing a safe transportation system within the FWS field stations. Close cooperation and partnerships between these agencies will allow FWS to continue to provide the safest transportation system possible. The key partners involved in the safety analysis process include:

- FWS Regional Transportation Coordinator
- FWS Field Station Manager
- FWS National SMS Specialist
- FWS Law Enforcement
- FHWA FLH Safety Discipline Team Lead
- State Departments of Transportation
- Local Law Enforcement
- Local DOTs or Public Works Departments

In the diagram to the right, the basic steps of the safety analysis process are identified along with the lead agency or agencies that are responsible for each step. The FHWA FLH Safety Discipline Team Lead has been identified with many of the lead roles, but it is expected that they will coordinate very closely with the FWS Regional Transportation Coordinators and the FWS Field Station Manager throughout the safety analysis process.

On the table on the following page, the specific roles of the most common partner agencies have been documented. While the FWS and FHWA are generally involved in safety work at FWS field stations, it will also be important to engage state and

Safety Analysis Process Lead Roles



local partners. For example, RSAs are defined as formal safety performance evaluation of an existing or future road or intersection by an independent, multi-disciplinary team. RSAs include state DOTs and local law enforcement officers in the process to provide an independent evaluation of safety issues from other agencies and disciplines. These partners can offer new perspectives and ideas on addressing safety issues.

Partner Agency Roles and Responsibilities

Partner Agencies	Roles and Responsibilities
FWS Regional Transportation Coordinator	**Co-Lead – Identification of Safety Issues** Determine Appropriate Study Type Develop Recommended Countermeasures Project Implementation
FWS Field Station Manager	**Co-Lead – Identification of Safety Issue** Lead – Determine Appropriate Study Type **Co-Lead – Data Collection and Assembly** Develop Recommended Countermeasures **Lead – Project Implementation**
FWS National SMS Specialist	**Co-Lead – Data Collection and Assembly** **Lead – Performance Monitoring and Tracking** (Included as part of overall role to maintain SMS)
FWS **Local Law Enforcement**	Data Collection and Assembly Develop Recommended Countermeasures
FHWA FLH Safety Discipline Team Lead	**Lead - Determine if Safety Study is Needed** **Lead – Determine Appropriate Study Type** **Lead – Formation of Safety Team** **Lead – Develop Recommended Countermeasures** Project Implementation
State DOTs **Local DOTs** **Public Works Departments**	Data Collection and Assembly Develop Recommended Countermeasures Permitting and Approval Project Implementation

3. IDENTIFICATION OF SAFETY ISSUES

The identification of safety issues can occur on a national, regional, or local level. On a national level road safety issues will be identified and compiled in the SMS. Regionally the FWS Regional Transportation Coordinators will review the SMS database as well as share experience gathered from other safety studies to identify potential safety issues at field stations. Locally, safety issues are more likely to be identified through less formal means, relying on experience within the field station as well as reports and information from staff, law enforcement, and visitors to the field station. Safety issues should include not only safety issues on the FWS transportation system, but also safety issues on roads that provide access to National Wildlife Refuges and Fish Hatcheries. In this section some of the sources of information that can be reviewed to identify safety issues are discussed and a broad overview of common safety issues is provided.

3.1 Identification of Safety Issues

A crash is not required in order to report a transportation safety issue. The goal should be to identify and address safety issues before any type of crash occurs on the transportation system.

One of the goals of FWS is to eliminate crashes on the FWS transportation system. In order to achieve this goal the FWS must be proactive in identifying potential safety issues and taking the appropriate steps to mitigate those issues as needed. Ideally safety issues are identified and mitigated before a crash ever occurs.

At the national level, the FWS is developing a SMS. The goal of the SMS is to ensure that safety is considered on the FWS transportation system and to improve safety on that system through the project selection and development process. The SMS will consider safety on the entire transportation system, not just roadways. It will include transit, bicycle facilities, water-based transportation facilities, aviation facilities, and trails in addition to roadways.

The SMS will utilize existing sources of crash and safety data to build a SMS database. These sources include the FWS-IMARS, surveys completed through the Long Range Transportation Plan process and other planning efforts, surveys completed at part of the FWS Roadway Inventory Program (RIP), and information from the National Highway Transportation Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS). In some cases statewide crash databases may also be reviewed to determine the crash history at particular locations.

Safety issues identified in the SMS can occur on both a project level and a program level. Project level safety issues will be resolved on a case by case basis following a study and development of finalized countermeasures. Program level safety issues may be addressed across the FWS when a repeated issue is noted. By taking notes and documenting complaints locally, and then passing those notes along to Regional Transportation Coordinators, program level safety concerns may be discovered earlier and

SMS Data Collection Sources

- FWS-IMARS: FWS Incident Management and Analysis Reporting System
- SMIS: FWS Safety Management Information System
- FARS: NHTSA Fatality Analysis Reporting System
- Statewide Crash Databases
- FWS Long Range Transportation Plan (LRTP) Surveys
- FWS Regional Alternation Transportation Evaluation (RATE) Surveys
- FWS Roadway Inventory Program (RIP) Surveys
- Traffic Counts
- Other Sources

resolved in a more timely matter.

The SMS will be reviewed on an annual basis to identify safety issues. The SMS will be available to the FWS Regional Transportation Coordinators to determine if there are safety issues that should be considered for additional study.

At the local level, identifying road safety issues will be an ongoing task that will require gathering of information from many sources. In the diagram below, the sources of data that may assist the FWS Field Station Staff with identifying safety concern are identified. These include local sources of data, such as field observations or coordination with local law enforcement, as well as sources of data available to local staff through the SMS, such as crash data from the FWS Law Enforcement FWS-IMARS. While there are many safety issues that can be addressed at the local level, such as a missing stop sign or damaged guard rail, whenever a safety issue exists without a clear solution the FWS Field Station Staff are encouraged to contact the FWS Regional Transportation Coordinators to determine if the issue should be considered for a safety study.

Data Inputs for Identifying Safety Issues

Finally, at all levels it is important to note that safety issues should not just be considered on FWS transportation facilities. Safety issues on transportation facilities that provide access to National Wildlife Refuges and Fish Hatcheries should also be identified and reviewed with the FWS Regional Transportation Coordinators to determine if safety studies should be conducted. The Moving Ahead for Progress in the 21st Century Act (MAP-21) transportation legislation included dedicated funding for the Federal Lands Access Program. This program provides funds for projects on Federal Lands access transportation facilities that are located on or adjacent to, or that provide access to Federal Lands but are not owned by the FLMA.

3.2 Common Safety Issues and Concerns

Safety issues can vary and each situation should be uniquely evaluated. However, within the FWS there are some commonly reported safety issues. Below is a summary of some of those issues. Although this is not an exhaustive list, it does provide some insight into the types of issues that may be expected to arise on the FWS transportation system.

Aviation

Safety issues for aviation at FWS field stations will largely consist of safety on runway and airfields. Issues may involve interaction with wildlife or appropriate levels of clearing for adjacent vegetation.

Bicycles

Bicycle safety includes well marked trails and paths as well as signed crossing points. Primary points of concern are locations where bicycles interact with motorized vehicles; this includes intersections, insufficient sight distance around curves for vehicles to see bicycles, and narrow roads with insufficient width for vehicles to pass.

Bridges

While integrity of bridge structures is often the most serious safety concern, other safety issues with bridges may include insufficient width for two-way traffic, lack or guardrail, low clearance, waterways overflowing onto the bridge deck, and unsafe conditions due to winter weather.

Parking Lots

Parking lots can present unique safety concerns. Lack of striping, poor signage, ingress and egress issues, poor internal circulation patterns, and vehicle-pedestrian conflicts can all be potential causes for accidents and/or crashes even at low vehicular travel speeds.

Kenai National Wildlife Refuge Source: Steve Hillebrand, FWS

Pedestrians

Similar to bicycles, safety issues can arise in any location where pedestrians frequently interact with motorized vehicles. Lack of adequate signing and pavement markings at crossings can be a safety issue, as well as roads without adjacent sidewalks or trails that require pedestrians to walk in the roadway.

Roadway Design

There are a significant number of roadway elements that may present safety issues. These include poor drainage, lack of guardrail or safety barriers, poor pavement quality, or inadequate pavement markings.

Roadway Intersections: Field Station Egress and Ingress

Ingress and egress to field stations can pose safety issues, particularly when vehicles that accelerate or decelerate slowly (such as large RVs and vehicle towing boats) are presented with potential conflicts with fast moving vehicles on state or county roads that provide access to the field station. Common safety issues include lack of acceleration or deceleration lanes, inadequate signage or pavement markings, nearby at-grade railroad crossings, or the need for a traffic signal.

Roadway Intersections: Internal Field Station Intersections

Internal field station intersections may have many of the same safety issues as intersections at the field station entrances. Other common safety issues may include inadequate horizontal or vertical sight distance, lack of clear right-of-way, narrow roadways, or poor pavement conditions.

Roadway Pull-out

Informal parking along roadways can create safety issues. These may occur along auto tour routes or locations where there are scenic view pull-outs that are not adequately signed. High speeds can cause safety issues at these locations as well as limited sight distance.

Wichita Mountains Wildlife Refuge Source: Kimley-Horn

Security Issues

Security related safety issues may involve unauthorized users or vehicle types on roadways, and the enforcement of roadway regulations.

Water Based Transportation

Water based transportation safety issues may include such issues as boat ramp safety or boat to boat crashes on waterways.

Weather

Weather related safety issues that may need to be addressed include roadway flooding, ponding of water on roadways, icy conditions, temporary closures due to snow, or fog.

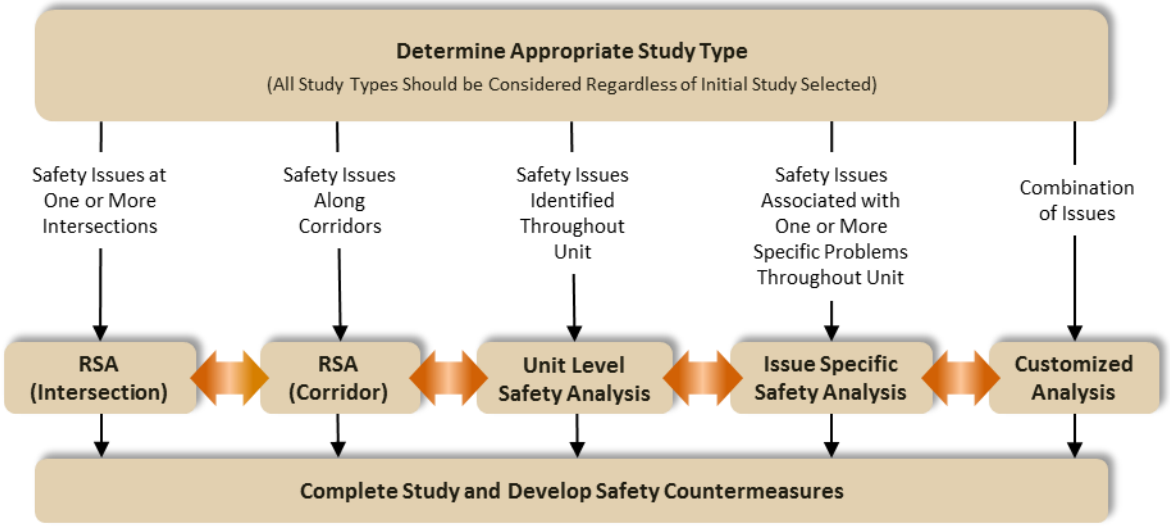
Wildlife-Vehicle Collisions

Reducing wildlife-vehicle collisions not only improves safety but also serves an important part of the FWS mission of conservation of wildlife. Roadway fencing, grade separated wildlife crossings, and improved signage are all considerations if wildlife-vehicle collisions present a safety issue at a field station.

4. SAFETY ANALYSIS TOOLS

In Section 2 of this document a safety analysis process was presented that provides recommended steps for moving from the identification of a safety issue to analysis of the issue to project implementation. In Section 4, the determination of the appropriate safety analysis study is discussed. Discussion is included on four unique types of safety analysis tools: Intersection RSAs, Corridor RSAs, Unit Level Safety Analysis, and Issue Specific Safety Analysis. The need for a customized analysis to address unique safety issues is also discussed.

Safety Analysis Process
(Safety Analysis Study Type Determination)



The determination of the appropriate study type will generally be led by the FHWA FLH Safety Discipline Lead in close coordination with the FWS Regional Transportation Coordinators and FWS Field Station Manager. The FHWA FLH Safety Discipline Lead will also take the lead on completing the safety analysis, however assistance may be sought from local and regional transportation experts as well as consultants to assist with performing the safety analysis.

In the remainder of Section 4, each of the safety analysis study types are described in more detail. The general timeframe to complete each study, the team used for each study, the commitment required from the FWS field stations, and reasons for selecting each type of study are discussed.

4.1 Road Safety Audit (RSA) – General

RSAs are a common and valuable tool used to analyze safety on roadway intersections and corridors. The FHWA defines an RSA as a "formal safety performance evaluation of an existing or future road or intersection by an independent, multi-disciplinary team." The FHWA has developed a *Road Safety Audit Toolkit for Federal Land Management Agencies and Tribal Governments*. The Safety Analysis Toolkit provides information regarding what an RSA is, when an RSA should be considered and how an RSA should be conducted. A brief summary of information found in that document is provided here.

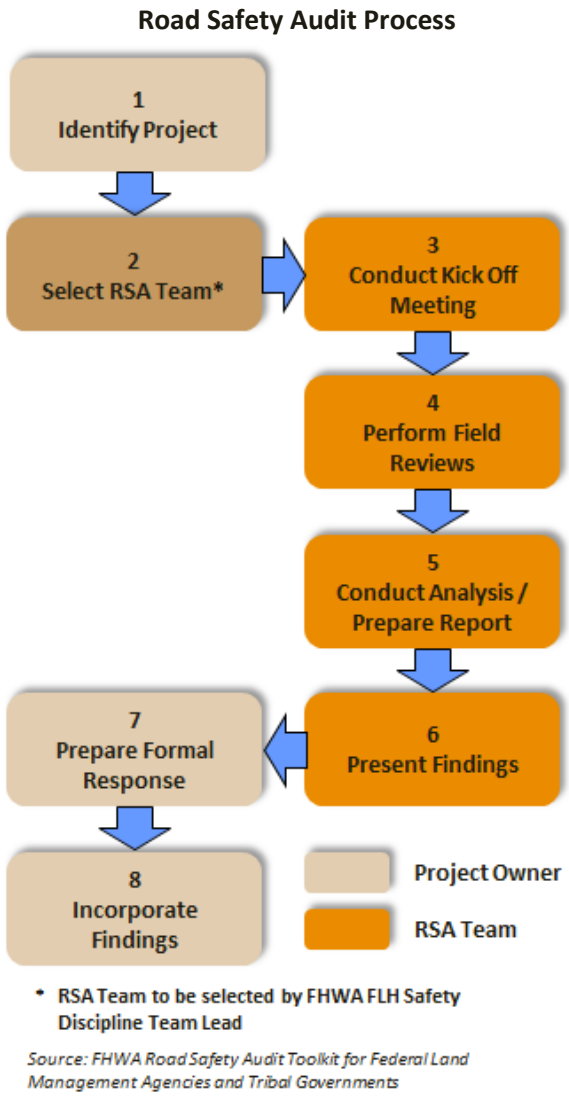
RSAs may be used on any type of facility and during all stages of the project development process; additionally, RSAs consider potential safety issues for all road users under all conditions. Attention should be given to travel conditions such as darkness, severe weather, peak travel times, special events, or other factors that may not normally exist at the site.

RSAs Are:	RSAs Are Not:
Focused on road safety	A means to evaluate the design of a facility
A formal examination	A check of compliance with standards
Proactive in nature	A redesign of a project
Conducted by a multidisciplinary team	A means of rating one design option over another
Conducted by a team that is independent of the operations, design, or management of the facility	A means of ranking or justifying one project over another
Conducted by a qualified team	A safety review
Broad enough to consider the safety of road users of the facility	A crash investigation (although the crash history of an existing facility is reviewed)
Qualitative in nature	

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

Many factors may lead to the decision to request the preparation of an RSA. Common factors may include a high crash frequency, high profile crash types, or significant changes in traffic characteristics or patterns (current or expected). Other factors may include unique design proposals for the area or a major change in adjacent or surrounding land uses.

RSA project scopes should generally remain small, including no more than one to two miles of corridor or no more than four to five intersections, if possible. Limiting the scope allows RSAs to be completed expeditiously. Typical RSA field work can be completed in one or two days, with one week being a standard maximum. If an RSA includes a corridor longer than two miles or a large number of intersections to be assessed the timeframe for completion of the project, particularly the amount of time required for field work, may increase dramatically.



Completing an RSA is an 8 step process which is outlined in the *FHWA Road Safety Audit Guidelines*. Responsibility of each step is assigned to either the project owner or the RSA Team lead as illustrated in the figure at left. The project owner would most likely be the FWS, represented by the FWS Field Station Manager as well as the FWS Regional Transportation Coordination. If a safety issue was identified on a road that provided access to a field station but was not owned by the FWS, the project owner would be the owning and operating agency such as a State DOT or a County Public Works Department. The RSA Team will most likely be led by the FHWA FLH Safety Discipline Team.

A summary of the 8 steps are provided below.

Step 1 – Identify Project or Existing Road for RSA: As noted in Section 2.1, the need for a RSA will be determined through close coordination between the FWS Field Station Staff, FWS Regional Transportation Coordinators, and the FHWA FLH Safety Discipline Team Lead. The FHWA FLH Safety Discipline Team Lead will take the lead role in making this determination.

Step 2 – Select Independent and Multidisciplinary RSA Team: The FHWA FLH Safety Discipline Team Lead will select the RSA Team. RSA Team members should be independent of the road operations and the design of facility to eliminate potential bias. RSA members can include individuals with expertise in road safety, traffic operations, road design, road maintenance, transportation planning, law enforcement, public outreach, community organizations, and user groups such as cyclists, hikers, boaters, or all-terrain vehicle users. A recommended best practice is to use the smallest team possible that still brings the necessary knowledge and experience for the location and safety issues being reviewed. In general, teams should consist of a maximum of five people, although more people may be involved in the Kick-Off meeting discussed in Step 3 when information is initially being gathered for the RSA.

Step 3 – Conduct Kick-Off Meeting to Exchange Information: The Kick-Off meeting will provide an opportunity for the Project Owner and RSA Team to understand the purpose, schedule, and roles and responsibilities of all participants. The meeting also allows the RSA Team members to ask specific questions of the Project Owner regarding the safety issues.

Step 4 – Perform Field Reviews under Various Conditions: The field review should be performed during various conditions, such as day and night as well as peak and non-peak visitor times. Certain conditions such as special events and severe weather may not exist or may not allow the RSA Safety Team to safely perform the safety review but those types of conditions should be considered to the best of the RSA Team's ability.

Step 5 – Conduct RSA Analysis and Prepare Report Findings: The RSA report should include a summary of the safety issues and suggestions for countermeasures. Prior to preparing the report the RSA Team may meet with the Project Owner to discuss the preliminary findings.

Step 6 – Present RSA Findings to Project Owner: This step provides an opportunity for the RSA Team and Project Owner to discuss the RSA findings. The Project Owner may make recommendations for additional or alternative countermeasures.

Step 7 – Prepare Formal Response: The Project Owner should review the RSA findings and prepare a formal response that outlines what action they plan to take with respect to each safety issue identified in the RSA findings.

Step 8 – Incorporate Findings into the Project when Appropriate: The Project Owner will be responsible for taking the necessary steps to implement the agreed-upon safety improvements. An after action review may also be scheduled to allow the RSA Team to evaluate the effectiveness of the safety improvements and evaluate if other measures are needed.

The field review described in Step 4 above will typically only take a few days to complete, but the entire process may take several months to several years to complete depending on the size and scope of the recommended safety improvements. In general, an estimate of approximately one to three months to complete Steps 1 through 7 would be reasonable, with Step 8 varying widely depending on the recommended safety improvements.

Additional details about the steps can be found in the *Roadway Safety Audit Toolkit for Federal Land Management Agencies and Tribal Governments.*

4.2 Road Safety Audit – Intersection Study

An intersection RSA is one in which one or more intersections are audited, but the corridor between them is not audited. An intersection RSA will use the eight-step process described in Section 4.1 regardless of size, scale, or number of intersections audited.

Road Safety Audit – Intersection Studies

A formal safety performance evaluation of an intersection by an independent multidisciplinary team.	
Timeframe	One to three months
Team	Independent multidisciplinary RSA team including safety, traffic, maintenance, and law enforcement expertise
Field Station Commitment	Facilities and law enforcement staff to assist with field review of all intersections
Reason for Use	Crashes or safety issues identified at one or more intersections

The timeframe for the field review will most likely be limited to a single day for a single intersection and up to a week for multiple intersections. The total time of the RSA, from the initial formation of the safety team until the findings are presented to the project owner, is expected to take approximately one to three months.

The RSA team will be made up of independent multidisciplinary experts representing road safety, traffic operations, road design, road maintenance, transportation planning, law enforcement, public outreach, community organizations, and user groups. The number of representatives on the RSA team will vary depending on the size and complexity of the RSA. For a single intersection RSA with low volumes, it is likely that a smaller RSA team would be used compared to an RSA that included a series of high volume intersections.

Savannah and Pinckney Island National Wildlife Refuges Road Safety Audit

The Savannah and Pinckney Island NWR RSA examined safety issues at the entrances to both refuges as well as at two other locations at the Savannah NWR.

The RSA included a review of existing geometric conditions, traffic data, and crash data. Based on this review six safety issues were identified, including roadway geometry, signing and pavement markings, traffic congestion, roadside design, night time and poor visibility, and bicyclists.

Source: FWS

Roadway geometry was determined to be the most critical issue and recommendations for countermeasures included installation of new turn lanes, lengthening of existing turn and acceleration lanes, addition of a shoulder bypass lane, and the installation of signage to improve locations where horizontal and vertical curvature limits sight distance. Recommendations also included non-engineering solutions, including increased education and enforcement.

FWS field stations where RSA's are performed may be asked to have facilities and law enforcement staff participates on the RSA team. In some cases, representatives of visitor services or special use groups such as cyclists may also be asked to participate. The local knowledge the field station staff can bring to the RSA team is extremely valuable in helping the RSA team understand the safety issues and developing feasible countermeasures.

Intersection RSAs should be considered at any location where

crashes or safety concerns are limited to one or more intersection specific issues. Following the implementation of any of the recommended countermeasures, an after action review should be considered to evaluate the effectiveness of the recommendations.

4.3 Road Safety Audit – Corridor Study

A corridor RSA focuses on a segment of a corridor, a full corridor, or multiple corridors. It may include one or more intersection as part of the study. A corridor RSA will also use the eight-step process described in Section 4.1 regardless of length or number of corridors being audited.

Road Safety Audit – Corridor Studies

A formal safety performance evaluation of a corridor by an independent multidisciplinary team.	
Timeframe	Two to four months
Team	Independent multidisciplinary RSA team including safety, traffic, maintenance, law enforcement expertise
Field Station Commitment	Facilities and law enforcement staff to assist with field review of all intersections
Reason for Use	Crashes or safety concerns identified along a corridor. Corridor studies may also be appropriate even if a safety issue is only identified at a single location, because that issue may exist elsewhere on a corridor even though it is not identified.

The timeframe for the field review will vary quite a bit depending on the length and number of corridors. The field review may take as little as one day for shorter corridors and up to a week or more for longer corridors. The total time of the RSA, from the initial formation of the safety team until the findings are presented to the project owner, is expected to take approximately two to four months.

The RSA team will be made up of independent multidisciplinary experts representing road safety, traffic operations, road design, road maintenance, transportation planning, law enforcement, public outreach, community organizations, and user groups. The number of representatives on the RSA team will vary depending on the size and complexity of the RSA. For a single low volume two-lane corridor it is likely that a smaller RSA team would be used compared to an RSA that included a series of longer high volume corridors with turn lanes, pull-outs, or other unique features.

FWS field stations where RSA's are performed may

Patuxent Research Refuge Road Safety Audit

The Patuxent Research Refuge RSA included two corridors that intersect at the Patuxent Research Refuge in Prince Georges County, Maryland. Both corridors are over two miles in length. These corridors had 126 reported crashes between 2002 and 2006, including four fatal crashes.

Source: FWS

A crash analysis was completed and field visits were conducted during both daytime and nighttime. Several safety issues and corresponding suggestions were identified as part of the study. The safety issues were categorized into seven categories: signing and pavement marking, nighttime visibility, roadside design, drainage, access to and from side streets, effects of roadway curvature on motorists, and genera intersection safety concerns.

These categories and their associated safety issues were prioritized based on how critical they were to the safety of the corridors. Signing and pavement markings were determined to be the most critical within the study area. The suggested improvements for signing and pavement markings included the addition of stop bars, the duplication of stop signs, the replacement or relocation of damaged or poorly located signs, and the trimming of vegetation around signage.

be asked to have facilities and law enforcement staff participates on the RSA team. In some cases, representatives of visitor services or special use groups such as cyclists may also be asked to participate. The local knowledge the field station staff can bring to the RSA team is extremely valuable in helping the RSA team understand the safety issues and developing feasible countermeasures.

It can be expected that a corridor RSA will likely lead to a larger number of recommendations than might result from an intersection RSA. In some cases the recommendations for countermeasures will need to be prioritized as shorter-term recommendations that may be able to be implemented in the short-term to address any immediate safety issues, and long-term recommendations that may require additional project planning, design, or programming of funding.

Corridor RSAs should be considered at any location where crashes or safety concerns have been identified along a corridor. A corridor study may also be appropriate even if a safety issues is only identified at a single location. If similar conditions exist at other locations along a corridor they should be reviewed as part of the RSA to determine if the safety issue is broader than a single location. For example, if several crashes have occurred at one curve on a road, that curve may be the only safety issue identified. But if similar curves exist on the corridor, even if there have not been any crashes, those curves should be included as part of the RSA so that countermeasures, such as improved curve warning signs, can be consistently implemented along the entire corridor.

Following the implementation of any of the recommended countermeasures, an after action review should be considered to evaluate the effectiveness of the recommendations.

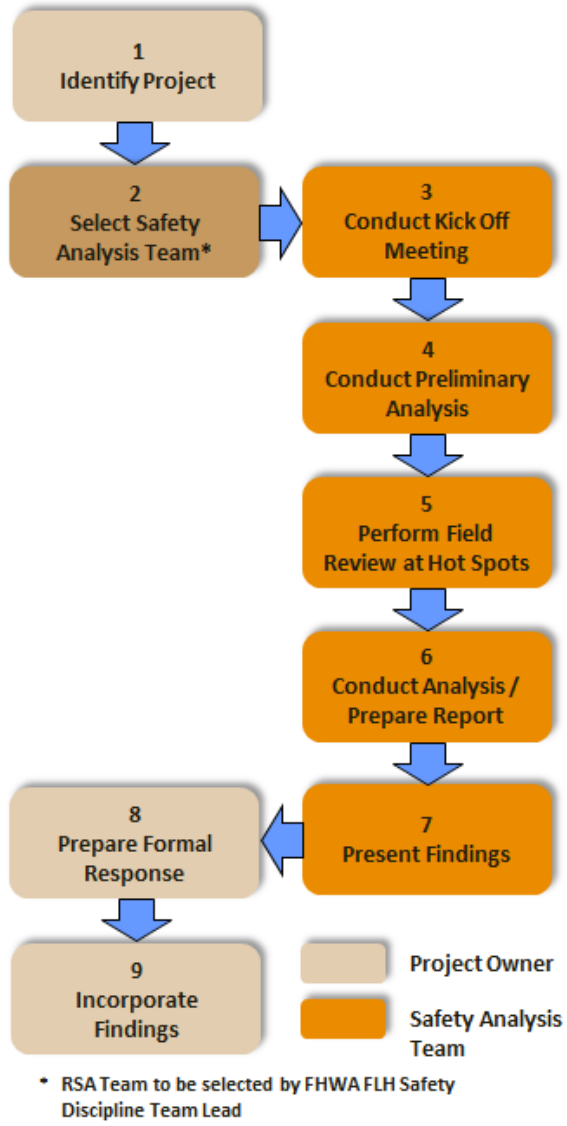
4.4 Unit Level Safety Analysis

A unit level safety analysis is intended to study safety issues throughout a field station. A unit level safety analysis should be considered when a field station has had a significant number or broad spectrum of safety issues identified throughout (rather than a limited number of safety issues identified at intersections or on corridors.) This type of safety analysis may also be recommended even if no major safety issues have been identified; regularly assessing safety on a unit wide level may help to prevent future incidents by identifying and mitigating potential safety issues.

Unit Level Safety Analysis

A comprehensive analysis of safety issues throughout a unit or field station.	
Timeframe	Three months to one year
Team	Multidisciplinary team including traffic, safety, and law enforcement expertise
Field Station Commitment	Facilities and law enforcement staff to assist with identification and field review of hot spots throughout a field station.
Reason for Use	Crashes or safety concerns identified throughout a field station.

Unit Level Safety Analysis Process



Unlike RSAs, there is not a formal process established for developing unit level safety analysis. However, many of the steps that are recommended for a unit level safety analysis are very similar to an RSA. Below are some of the steps that should be considered when developing a unit level safety analysis. Similar to the process for RSAs, the Project Owner represents the FWS field station.

Step 1 – Identify Project: As noted in Section 2.1, the need for any type of safety analysis should be determined in close coordination between the FWS Field Station Staff, FWS Regional Transportation Coordinators, and the FHWA FLH Safety Discipline Team Lead. The FHWA FLH Safety Discipline Team Lead will take the lead role in making this determination.

Step 2 – Select a Multidisciplinary Safety Analysis Team: Unit level safety analysis can cover a wide range of safety issues. It is important to select a team that represents not only traffic, safety, and law enforcement but also other safety issues that may have been identified on a Region. Examples include expertise in wildlife management if there are a large number of wildlife-vehicle collisions, expertise in boating safety if there are safety issues at boat ramps or on waterways that serve as a means of transportation, or expertise in aviation for refuges whose primary means of access are through planes.

Step 3 – Conduct Kick-Off Meeting: The Kick-Off meeting will provide an opportunity for the Project Owner and Safety Analysis Team to understand the purpose, schedule, and roles and responsibilities of all participants. The meeting also allows the Safety Analysis Team to better understand safety issues that may exist throughout the Refuge through discussions with field station staff and law enforcement.

Step 4 – Conduct Preliminary Analysis: Preliminary analysis should be conducted to identify hot spots where crashes have occurred or where there appears to be a high potential for crashes. Analysis could include a review of all available data in the SMS database, a review of crashes available through FWS law enforcement, a review of the statewide crash database, discussions of existing hot spots with field station staff and law enforcement, and a field review existing routes. The Kick-Off meeting will provide an opportunity for the Project Owner and RSA Team to understand the purpose, schedule, and roles and responsibilities of all participants. The meeting also allows the RSA Team members to ask specific questions of the Project Owner regarding the safety issues. Step 4 may occur in conjunction with Step 3.

Step 5 – Perform Field Review at Hot Spots: The Safety Analysis Team should perform a field review of the identified hot spots within a field station to determine causes of safety issues and potential countermeasures. The field review may include a combination of site specific reviews as well as corridor reviews.

Step 6 – Conduct Safety Analysis and Prepare Report: The Safety Analysis Team will prepare a safety analysis report which will include recommendations for safety improvements. A unit level safety analysis may include a large number of recommendations, some of which may require planning and programming of funds. The report should specify recommendations for short-term improvements to address immediate safety issues as well as recommendations for long-term improvements that may require additional project planning, design, or programming of funding. Prior to preparing the report the Safety Analysis Team may meet with the Project Owner to discuss the preliminary findings.

William L. Finley National Wildlife Refuge Road Safety Audit

Safety concerns, including poor sight distance, high traffic speed, high volumes of traffic stopping abruptly, and drainage issues led to a unit level RSA on William L. Finley National Wildlife Refuge. The RSA focused primarily on the two highest volume roads within the refuge as well as adjacent county roads that provide access to the refuge.

Seven locations were identified as hot spots and were assessed in more detail. These hot spots included two intersections, a roadway with wildlife viewing activities, a roadway that floods, two parking lots, and a pedestrian crossing. Each of these locations was reviewed in greater detail and specific recommendations were made.

Recommended improvements at each location were identified as priorities using two strategies: safety and cost benefits. This double prioritization of the recommendations highlighted the improvements that could have the largest impact on safety for the smallest cost.

Recommended improvements included strategies such as the relocation of the access point of a refuge road to improve sight-distance, installation of speed limit signs and increased enforcement by the county to reduce speeding, drainage improvements to reduce flooding, and the addition of a pull-out for wildlife viewing.

Source: Atkins

Step 7 – Present Safety Analysis Finings to Project Owner: The Safety Analysis Team will present the findings to the Project Owner and the recommendations should be discussed. The Project Owner may make recommendations for additional or alternative countermeasures.

Step 8 – Prepare Formal Response: The Project Owner should review the unit level safety analysis findings and prepare a formal response that outlines what action they plan to take with respect to each safety issue identified in the unit level safety analysis.

Step 9 – Incorporate Findings into the Project when Appropriate: The Project Owner will be responsible for taking the necessary steps to implement the agreed-upon safety measures. An after action review may also be scheduled to allow the Safety Analysis Team an opportunity to evaluate the effectiveness of the suggestion countermeasures and evaluate if other measures are needed.

The timeframe for the field review will vary quite a bit depending on the size of the field station and the number of safety issues and hot spots that are identified. The preliminary analysis discussed in Step 4 can also require a large investment of time depending on the availability of crash data and the amount of time dedicated to identifying hot spots within the unit. The total time of the unit level safety analysis, from the initial formation of the safety team until the findings are presented to the project owner, is expected to take approximately three months to one year.

The Safety Analysis Team assembled for the unit level safety analysis should be a multidisciplinary team that represents not only traffic, safety, and law enforcement, but also other expertise that can address unique safety issues that may have been identified at a field station. Examples include expertise in wildlife management if there are a large number of wildlife-vehicle collisions, expertise in boating safety if there are safety issues at boat ramps or on waterways that serve as a means of transportation, or expertise in aviation for refuges whose primary means of access are through aviation. The number of representatives on the Safety Analysis team will vary depending on the size of the field station and complexity of the safety issues.

Hagerman National Fish Hatchery Road Safety Audit

This unit level RSA was conducted on roads that provide access to the Hagerman National Fish Hatchery as well as three permitted facilities whose access is provided through the fish hatchery property. An increase in traffic had been observed in recent years on the FWS roads which prompted the RSA. The RSA focused on general issues associated with road safety to, from, and within the hatchery. FWS roads were analyzed as well as access and parking for fishing at an adjacent lake.

Source: FWS

Three main safety issues were identified as a result of this RSA: road improvements, signing improvements, and administration improvements. Road improvements included widening, conversion of some streets to one-way operation, and culvert improvements. Improved signing was recommended to reduce confusion for the vehicles accessing the permitted facilities located on the hatchery property, such as the University of Idaho Hagerman Fish Culture Experiment Station. A speed study and a traffic study were also recommended in order to identify and document traffic patterns, speed, and roadway usage. Finally, administration improvements were recommended to improve partnering and mediation between the permitted facilities on the hatchery property.

Safety improvement recommendations from the unit level safety analysis will vary from quick and simple improvements, such as adding a sign, to more involved recommendations that require advanced programming of funds and a design process, such as paving a section of roadway. The safety analysis report should specify recommendations for short-term improvements to address immediate safety issues as well as recommendations for long-term improvements that may require additional project planning, design, or programming of funding. An opinion of probable cost for each improvement should be developed. Improvements should be identified for each hot spot, but also categorized to develop a total recommended cost for improvement in key categories such as signing, striping, paving, and guardrail improvements. Those categories can also be classified into short, medium and long term improvements.

A unit level safety analysis can be very helpful even if specific issues have not been identified at a field station. A thorough safety analysis of a field station may identify high potential locations where crashes are most likely to occur in the future. The field station and FWS Regional Office can work together to begin developing a program to access funds and address locations considered to have the highest probability of a crash.

After the implementation of any of the recommended countermeasures, an after action review should be considered to evaluate the effectiveness of the recommendations.

4.5 Issue Specific Safety Analysis

An issue specific safety analysis is the study of a safety issue that has been identified at the field station, regional, or national level. Examples of issues which might require a safety analysis include speeding, bicycle or pedestrian safety, wildlife-vehicle collisions, and severe weather issues. An issue specific safety analysis can be challenging to define as the study could vary widely depending on the issue and if it is being studied at the field station, regional, or national level.

Issue Specific Safety Analysis

A comprehensive analysis of a single safety issue in on field station, across an entire region, or service-wide.	
Timeframe	Three months to one year
Team	Multidisciplinary team including expertise in the issues being studied
Field Station Commitment	Minimal commitment, particularly if study is regional or national. Law enforcement staff or facilities staff may be asked for assistance.
Reason for Use	One or more safety issue appearing at multiple locations across a field station, Region, or on the National Level.

Regardless of the safety issue, performance of an issue specific safety analysis should include the four E's of safety: engineering, education, enforcement, and emergency medical services. Many of the issues that may be investigated may best be solved through a combination of two or more of the four E's.

The timeframe to complete an issue specific safety investigation will vary based on the issue being studied as well as the size and scale of the study. Issues limited to a single refuge will likely take much less time to analyze than an issue that has been identified on a regional or national level. Often the countermeasures to address an issue specific safety analysis may be complex and require the participation of partners to develop non-engineering solutions.

A multidisciplinary team should be assembled to perform the issue specific safety analysis. The team will vary quite a bit depending on the issue or issues being studied. The safety analysis team should

Wildlife Mitigation and Human Safety for the Sterling Highway MP 58-79 Project

The Sterling Highway is a rural two-lane highway that bisects the Kenai National Wildlife Refuge in Alaska. The segment from MP 58-79 had historically experienced a high rate of wildlife-vehicle collisions. In anticipation of a planned reconstruction project on this segment, a study was performed in order to identify ways to reduce wildlife mortality, restore wildlife connectivity, and improve human safety through the reconstruction.

Several years prior to reconstruction over 60 moose and caribou were outfitted with GPS collars and their migration patterns were tracked. A hotline was also set up for the motoring public to report wildlife sightings along the Sterling Highway. A six mile segment was identified that contained almost half of the wildlife-vehicle collisions and a majority of the GPS crossings and hotline sightings.

Recommendations along this six mile section included fencing along with a wildlife overpass near MP 73, a wildlife underpass near MP 71, and a wildlife "crosswalk" near the ends of the fenced section. Additional crossings for large mammals were also recommended at other strategic locations along the corridor.

Source: FHWA

not be limited to a particular number of people and if needed, additional expertise should be brought in as needed to be sure all potential solutions are considered.

Issue specific studies will generally require more time from field station staff if the study is limited to a single refuge or fish hatchery. If an issue is being studied at the regional or national level there would be less impact expected on field station staff, however some field station staff may be asked to serve as part of the issue specific safety analysis team.

Expected results for this type of study will reflect the specific issue being studied. Recommendations may include broad changes implemented at the regional or national level, or smaller changes focused on local needs if the study is limited to one field station. An issue specific safety analysis is also likely to have recommendations which may go beyond traditional engineering solutions. These recommendations will rely on other partners to implement, such as a stricter enforcement of speed limits on a refuge or a public outreach and education campaign. Regardless of the recommendation, if possible FWS and FHWA should attempt to monitor the impact of changes that are made on safety at each affected field station.

4.6 Customized Analysis

Each field station is unique and not all safety issues will be able to be adequately studied using one of the safety analysis tools presented in Sections 4.1 through 4.5. The combination of safety issues that may exist at a field station or within a region may necessitate the use of a customized analysis to appropriately address the safety issues that have been identified.

Determining an appropriate customized analysis will be dependent on the expertise and experience within the FWS and FHWA. An early partnership between the FWS Field Station Manager, FWS Regional Transportation Coordinator, and FHWA FLH Safety Discipline Team Lead will allow the FWS and FHWA to closely review the safety issue and determine the best course of action to study the issue or issues that have been identified.

Customized analysis may include a mix of traditional traffic engineering tools, such as a traffic signal warrant analysis or sight distance analysis, as well as unique approaches that may be warranted. The same general approach should be followed for customized analysis as for the other safety analysis tools discussed in Section 4.1 through 4.5. This approach includes:

- Develop a partnership between the FWS Field Station Manager, FWS Regional Transportation Coordinator, and FHWA FLH Safety Discipline Team Lead to assess the safety issue and determine if a safety study is needed.
- Assemble a team of experts to assist with the study.
- Work closely with the field station to analyze the safety issues and develop recommended countermeasures.
- Present findings and provide an opportunity for the safety analysis team and the project owner to discuss the findings.
- Monitor the impacts of the implemented recommendations on safety.

5. IMPLEMENTATION

Identification and implementation of safety improvements should involve a team approach with expertise from the FWS and FHWA FLH. The FWS Regional Transportation Coordinators and FHWA FLH Safety Discipline Team Leads will serve as key partners to identify the appropriate type of safety analysis tool to use to address safety issues, conduct the safety analysis, and implement recommendations to mitigate safety issues.

Initiation

As shown in the Safety Analysis Process diagram presented in Section 2, the first step for any field station to initiate a safety analysis effort after identifying a safety issue should be to contact the FWS Regional Transportation Coordinator responsible for the Region where the field station is located. FWS maintains a current list of Regional Transportation Coordinators, located at the following address:

http://www.fws.gov/refuges/roads/contacts.html

The FWS Regional Transportation Coordinator will bring in expertise from the FHWA FLH and work with the field station manager to identify other expertise, such as law enforcement or State DOT officials, if needed for an RSA or other type of safety analysis.

Timeframe

Each safety issue is different which makes it challenging to identify a timeframe for completing a safety analysis, but in general the types of safety analysis tools identified in the Safety Analysis Toolkit should be complemented anywhere from as short as one month for a single intersection RSA, to as long as one year for unit level and issue specific safety analysis. The timeframe for the actual implementation of the safety countermeasures that are recommended through the various safety analysis efforts will also vary widely. Recommendations may include short-term improvements that can be quickly implemented to address immediate safety

Success Story: US Highway 93 Wildlife Mitigation in Montana

The US Highway 93 Wildlife Mitigation project in Montana is one of the most extensive wildlife-sensitive highway safety design efforts in the United States. Wildlife mitigation issues have been documented and studied along Montana Highway US 93 since the early 1980's. Since that time, numerous studies have been completed by a variety of agencies, and a comprehensive set of countermeasures has been implemented. These countermeasures are aimed at improving safety for the traveling public as well as wildlife by reducing wildlife-vehicle collisions and allowing wildlife to move safely across the highway and the surrounding landscape.

Specific countermeasures include the reconstruction of over 76 miles of road and the installation of 81 fish and wildlife crossing structures, including one overpass. Over 16 miles of linear wildlife exclusion fencing has also been installed and there are numerous installations of wing fencing throughout the corridor. Jump-outs have been installed to allow wildlife to safely exit the roadway if they do become trapped between the fences and wildlife "crosswalks" have been implemented to notify motorists when wildlife has crossed onto the roadway.

This project was completed using numerous safety studies, which were used to identify to the appropriate locations for each specific type of crossing and for the installation of fencing. The project is currently being studied for its effectiveness and results will not be available until 2015, however, the project is regarded as a success for its grand scale, collaborative efforts, and its use of creative solutions.

Source: FHWA

needs at minimal cost, such as relocating signs or adding striping to roadways, as well as longer-term recommendations such as the addition of turn lanes that may require programming of funds before they can be implemented.

Outputs

The results of an RSA or other safety analysis will most commonly be a series of recommendations for implementation at the field station to address the identified safety issues. These recommendations may range from simple projects that can be implemented using maintenance staff, to larger capital projects that may require more extensive design and construction efforts, to additional studies that might be needed before a safety concern can be fully addressed. FWS field stations will be asked to review the recommendations that result from a safety analysis study and prepare a formal response regarding how they plan to address the recommendations.

Implementation

The safety analysis tools identified in this toolkit will provide the FWS with a series of recommendations to address safety issues. The involvement of the FWS Regional Transportation Coordinators and the FHWA FLH early in the process will assist the field stations with prioritizing and programming the recommended safety projects that result from the safety analysis effort. While funds for larger capital improvements may not be immediately available, incorporating these projects into the project programming process as early as possible is important so that they may be implemented as soon as possible. Following implementation, the FWS should monitor the performance of the improvements to determine if the countermeasures have had the desired impact on safety.