NOTEWORTHY
PRACTICES GUIDE

Highway-Railway Grade Crossing Action Plan and Project Prioritization

U.S. Department of Transportation
Federal Highway Administration

U.S. Department of Transportation
Federal Railroad Administration

Safe Roads for a Safer Future
Investment in roadway safety saves lives

www.safety.fhwa.dot.gov

Notice

This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The U.S. Government assumes no liability for the use of the information contained in this document.

The U.S. Government does not endorse products or manufacturers. Trademarks or manufacturers' names appear in this report only because they are considered essential to the objective of the document.

Quality Assurance Statement

The Federal Highway Administration (FHWA) provides high-quality information to serve Government, industry, and the public in a manner that promotes public understanding. Standards and policies are used to ensure and maximize the quality, objectivity, utility, and integrity of its information. FHWA periodically reviews quality issues and adjusts its programs and processes to ensure continuous quality improvement.

Cover photo source: Texas Transportation Institute

Technical Report Documentation Page

Form DOT F 1700.7 (8-72)

1. Report No. FHWA-SA-16-075	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Highway-Railway Grade Crossing Action Plan and Project Prioritization Noteworthy Practices Guide		5. Report Date November 2016 6. Performing Organizations Code	
7. Authors Allan Rutter, Curtis Morgan, Jeff Warner, and Brett Graves		8. Performing Organization Report No.	
9. Performing Organization Name and Address Leidos Transportation Solutions Division 111251 Roger Bacon Drive Reston, VA 20190 Texas A&M Transportation Institute The Texas A&M University System College Station, Texas 77843-3135		10. Work Unit No. (TRAIS) 11. Contract or Grant No. DTFH61-10-D-00024 Task Order No. T-12-003	
12. Sponsoring Agency Name and Address Federal Highway Administration Office of Safety Research and Development 6300 Georgetown Pike McLean, VA 22101		13. Type of Report and Period Final Report 14. Sponsoring Agency Code	
15. Supplementary Notes The Federal Railroad Administration worked in coordination with the Federal Highway Administration to develop this document consistent with the requirements in Section 11401 of the Fixing America's Surface Transportation Act.			
16. Abstract Development of State Highway-railway Grade Crossing Action Plans (State Action Plans (SAPs)) were initially required by Section 202 of the Rail Safety Improvement Act of 2008 (RSIA08), Public Law 110-432, Division A, for the 10 States identified with the highest number of highway-railway grade crossing collisions over a specific 3-year period. The National Transportation Safety Board recommended to the Federal Highway Administration and the Federal Railroad Administration (Recommendations H-12-60 and H-12-61) the development of a model grade crossing action plan that can be used as a resource document by all States interested in producing a SAP similar to those required for the 10 States in RSIA08. Section 11401 of the Fixing America's Surface Transportation Act requires the Federal Railroad Administration to issue rules for developing a model state highway-railway grade crossing action plan and requires States to submit a SAP. It outlines a process for preparing a SAP and suggests an outline for SAP content. This document also details five overall noteworthy practices employed by State agencies in administering Federal and State highway-railway grade crossing protection programs.			
17. Key Words Section 130, grade crossing, State Action Plan, highway-railway grade crossing, railroad crossing, prioritization		18. Distribution Statement No restrictions.	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No of Pages 72	22. Price N/A

SI* (MODERN METRIC) CONVERSION

FACTORS APPROXIMATE CONVERSIONS TO SI UNITS				
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
LENGTH				
In.	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
AREA				
$in.^2$	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: volumes greater than 1,000 L shall be shown in m^3				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
ILLUMINATION				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
FORCE and PRESSURE or STRESS				
lbf	poundforce	4.45	newtons	N
$lbf/in.^2$	poundforce per square inch	6.89	kilopascals	kPa

SI* (MODERN METRIC) CONVERSION (Continued)

APPROXIMATE CONVERSIONS TO SI UNITS				
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
LENGTH				
mm	millimeters	0.039	inches	in.
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
AREA				
mm^2	square millimeters	0.0016	square inches	$in.^2$
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
TEMPERATURE (exact degrees)				
°C	Celsius	1.8C+32	Fahrenheit	°F
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-lamberts	fl
FORCE and PRESSURE or STRESS				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003).

Table of Contents

List of Figures

List of Tables

List of Acronyms

3E	education, engineering, and enforcement
ADA	Americans with Disabilities Act
BCA	benefit-cost analysis
CPUC	California Public Utilities Commission
EMS	emergency medical services
FAST Act	Fixing America's Surface Transportation Act
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
GIS	geographic information systems
HSIP	Highway Safety Improvement Program
HSR	high-speed rail
LA DOTD	Louisiana Department of Transportation and Development
LED	light-emitting diode
MAP-21	Moving Ahead for Progress in the 21st Century Act
NCDOT	North Carolina Department of Transportation
NTSB	National Transportation Safety Board
OIG	Office of the Inspector General
PennDOT	Pennsylvania Department of Transportation
RSIA08	Rail Safety Improvement Act of 2008
SAP	State Highway-Rail Grade Crossing Action Plans (State Action Plans)
SHSP	Strategic Highway Safety Plan
SMART	specific, measurable, agreed upon, realistic, and time bound
TRIMS	Texas Railroad Information Management System
TxDOT	Texas Department of Transportation
USC	United States Code
USDOT	U.S. Department of Transportation

PART I
MODEL GRADE CROSSING ACTION PLAN

Chapter 1. Introduction and Background

STATE ACTION PLAN PREVIOUS ACTIVITIES

Background

Development of State highway-railway grade crossing action plans (State action plans (SAP)) was initially required by Section 202 of the Rail Safety Improvement Act of 2008 (RSIA08), Public Law 110-432, Division A, for the 10 States identified with the highest number of highway-railway grade crossing collisions over a specific 3-year period (calendar years 2006, 2007, and 2008) as outlined in the statute. This requirement was later codified in 49 Code of Federal Regulations 234.11, and procedures for completing SAPs were determined through an official rulemaking process, which concluded on June 28, 2010.

The 10 States identified for compliance with the development of SAPs based on calendar years 2006 through 2008 crash data were Alabama, California, Florida, Georgia, Illinois, Indiana, Iowa, Louisiana, Ohio, and Texas. Each of these States was required to complete a SAP that:

- Identifies specific solutions for improving safety at crossings, including highway-railway grade crossing closures or grade separations.
- Focuses on crossings that have experienced multiple accidents or that were at high risk for such accidents.
- Covers a 5-year time period.

In completing this process to comply with RSIA08, the Federal Highway Administration (FHWA) and the Federal Railroad Administration (FRA) identified the potential value of other States developing SAPs to address highway-railway grade crossing safety issues. The primary objective of this study is to develop a model SAP outlining best practices from the existing plans and other noteworthy practices that could be included in the model SAP for use by State departments of transportation (DOTs), local agencies (e.g., cities, counties, towns, and tribal governments), and railroad companies.

Developmental History

The requirement in RSIA08 for States to develop SAPs followed a June 2004 U.S. Department of Transportation (USDOT) Office of the Inspector General (OIG) report, which found that several States had high numbers of grade crossing collisions at the same locations. In 2006, the Louisiana Department of Transportation and Development (LA DOTD) completed a pilot Highway-Railway Grade Crossing Action Plan with the assistance of FHWA and FRA, which modeled the potential format and contents for other States to follow in developing such plans. As a result of the efforts with LA DOTD, the Texas Department of Transportation (TxDOT) soon began to develop its action plan in early 2007. After passage of RSIA08 and completion of the rulemaking process in 2010, the 10 designated States began to work on specific action plans based upon the observed collision conditions in their State. Because each State and specific site had varying conditions and crash causes, each State varied in its approach to developing the SAP.

National Transportation Safety Board Recommendation

In its January 28, 2013, report regarding a June 24, 2011, railroad grade-crossing collision in Miriam, Nevada, shown in Figure 1, the National Transportation Safety Board (NTSB) recommended that FHWA and FRA (Recommendations H-12-60 and H-12-61) develop a model grade crossing action plan that can be used as a resource document by all States interested in producing an action plan similar to those required for the 10 States in RSIA08. In this particular crash, a truck traveling north on US 95 struck an Amtrak passenger train, killing the truck driver, train conductor, and four train passengers. The NTSB recommendation suggested that a model plan would incorporate available information from USDOT and the American Association of State Highway and Transportation Officials (AASHTO), as well as best practices and lessons learned after 5 years of the SAPs following RSIA08 passage.

Source: National Transportation Safety Board, Accident Involving Amtrak Train and Truck-Trailer, Accident Investigation Summary website

Figure 1. Photo. Crash scene in Miriam, Nevada, in June 2011.

The Highway Safety Improvement Program (HSIP) administered by FHWA requires a data-driven strategic approach to improving highway safety on all public roads that focuses on performance.[1] The Railway-Highway Crossings Program (Section 130) funds are set aside from the HSIP apportionment for the elimination of hazards and installation of protective devise at public highway-railway crossings. In accordance with 23 United States Code (USC) 130(d), each State is required to conduct and systematically maintain a survey of all highways to identify those highway-railway grade crossings that may require separation, relocation, or protective devices and to establish and implement a schedule of projects for this purpose. At a minimum, this schedule is to provide signs for all public highway-railway crossings.[2]

States adhere to this requirement by developing systematic prioritization methods to identify crossings that cause the greatest hazard to the traveling public. These prioritization methods vary among the States to accommodate their unique situations. Development of a SAP would go beyond this statutory requirement to focus attention and additional funding on safety improvements at highway-railway grade crossings.

FRA/FHWA Guidance in July 2015

On July 29, 2015, FRA published an interim resource document titled *Model State Action Plan Resource Guide for Highway-Rail Grade Crossing Safety*. This document outlines many of the steps recommended by FRA in producing a model SAP. The interim resource document is replaced by this document.

LEGISLATION REQUIRING ALL STATES TO DEVELOP A STATE ACTION PLAN

Section 11401 of the Fixing America's Surface Transportation (FAST) Act requires each State to develop a SAP. The 10 States that developed a SAP under RSIA08 are required to update their SAP and must submit a report to FRA describing how they implemented their previous SAP. After this document is published, FRA will develop additional regulations outlining plan requirements and due dates.

FRA will review and approve the new and updated SAPs. If FRA finds that a SAP is deficient, it will notify the State, which will have 60 days to update it. After the SAP is approved, FRA will publish the SAP on its website in accordance with the FAST Act.

For assistance with the SAPs required under the FAST Act, a State should contact Debra Chappell at debra.chappell@dot.gov.

PURPOSE

"Part I: Model Grade Crossing Action Plan" examines all 10 SAPs from the initial RSIA08 requirements for potential best practices that a State should consider adding to its SAP, which is required under the FAST Act.

"Part II: Noteworthy Methods in Project Prioritization" also provides a summary of noteworthy grade crossing project prioritization practices. It describes the results of interviews with several additional States not included in the initial RSIA08 requirement. These States have been identified as having noteworthy practices related to highway-railway grade crossing safety and closure activities based upon their annual Section 130 reports to FHWA. Their practices also have the potential to be included in future SAPs.

MODEL STATE ACTION PLAN SOURCES

This model SAP was prepared by reviewing a number of different sources, including guidance from FHWA and FRA, reports from both Federal modal administrations incorporating State submissions, State submissions of reports of highway-railway grade crossing activities as part of the State HSIP reports, SAPs submitted under RSIA08 requirements, and other related documents. In addition to these documents, nine different States were selected for interviews. These States comprised both those that had prepared SAPs and those that were not required to do so. The States represent a geographical balance as well as a variety of highway-railway grade crossing prioritization processes.

MODEL STATE ACTION PLAN OVERVIEW

What Is a SAP?

A SAP is an important part of the grade crossing program management process. It is the mechanism to implement an organizational strategy. While the strategic plan is vital to creating the framework for a State to meet its goals and support its mission statement, it is the action plan that provides the means by which a State may accomplish this.

Like a strategic plan, a SAP can be adjusted based on, but not limited to, context-sensitive data, incident trends, and regulatory and legislative requirements on highway-railway grade crossings.

Summary of SAPs Submitted under RSIA08

Because RSIA08 allowed flexibility for the States to develop their SAPs, the SAPs submitted had common elements (including a focus on multiple-accident crossings) but different approaches. Appendix B contains a detailed summary of each SAP, but the following themes or trends can be noted.

Common Elements of Data Analysis

The 10 SAPs presented different levels of grade crossing data analysis, although each plan went beyond information regularly submitted as part of their HSIP reporting. Since many States have upgraded grade crossing inventory systems, more data are available for reporting. Many States are also upgrading their motor vehicle crash databases as part of their Strategic Highway Safety Plans, so some States are also correlating crash data fields into grade crossing inventories to enhance crash information.

Stakeholder Engagement

A number of States involved rail safety stakeholders in the preparation of their SAPs. One State involved its traffic safety colleagues and contacted railroads in the State; other States convened meetings of stakeholders (railroads, Operation Lifesaver, FHWA, FRA, and local engineers) to identify action items and recommendations. Some States posted their plans for public comment, and others involved stakeholders at the outset to help generate strategies and goals.

Broader Focus

The congressional mandate to focus on grade crossings with multiple crashes resulted from a recommendation from the 2004 USDOT OIG report. Most States included information on crossings with multiple crashes and tied strategies to those locations, but many States faced grade crossing safety issues that went beyond these particular crashes and addressed those issues in their plans.

Put the Action in Action Plans

A number of States established strategies and specified responsible parties, timelines, and evaluation measures for each strategy. Table 1 summarizes information from the 10 submitted SAPs.

Table 1. State action plan summary table.

State/Agency	Structure/ Time Frame	Multiple-Crash/ High-Risk Crossings?	Major Themes/Special Conditions	Analyses	Noteworthy Practices
Alabama Alabama Department of Transportation Bureau of Multimodal Transportation, Railroad Safety Program	8 program areas for improving safety 2006–2010	Sections on multiple incidents and high-risk crossings	Emphasizes road user safety at grade crossings Includes high-speed rail (HSR) grade crossings, although State not currently pursuing HSR	Data on crashes, fatalities, and injuries included, as well as activity measures	State participated in testing of crossing protection devices that stretched across roadway lanes
California California Public Utilities Commission	10 specific strategies, a mix of new and traditional approaches 5-year action plan	Appendix E includes crossing details and evaluation	Reducing grade crossing accidents through improvements, closures, and grade separations Includes passenger rail and rail transit	Extensive analysis of 10-year crash trends, including benchmarking to other States	A number of State and local funding programs for grade separations; improving inventory with additional data such as near-miss reports
Florida Florida Department of Transportation	Eight strategy areas Not explicit but appears to be 5 years	Evaluation of 74 incidents at multiple accident locations, with overall mitigation assessment	In a high-population State, most incidents occur at public crossings with active crossing devices involving risky driver behavior Grade separations in flat coastal conditions are more expensive	Extensive analysis of incidents, causes, and results, multi-incident locations	Combines FRA safety data and driver contributing factors from crash data; corridor approach on high-train-volume corridors
Georgia Georgia Department of Transportation, Office of Utilities, Railroad Crossing Program	Four categories: education, engineering, enforcement, and data analysis 2012–2017	Addressed through data analysis, inclusion in strategies (more diagnostics at locations')	Corridor approach in overall State rail planning, follows with grade crossing evaluations No special conditions specified	Crash analysis by subdivision, not just by railroad; specific discussion of short lines and passenger rail	Ties multiple crash locations to outreach strategies; school districts report route data at crossings with active devices for inventory updates; plan developed with opportunity for stakeholder comments
Illinois Illinois Commerce Commission, Illinois Department of Transportation	Seven strategies with accompanying goals 5-year action plan	Addressed throughout the plan	Active plan with multiple approaches Includes pedestrian rail crossings	Crossing data analysis by type, railroad, county, and conditions; crash data at 5- and 10-year periods	Addresses private crossings; collision investigations use diagnostic exercises; 5 year grade crossing program updated annually

Table 1. State action plan summary table (continued).

State/Agency	Structure/ Time Frame	Multiple-Crash/ High-Risk Crossings?	Major Themes/Special Conditions	Analyses	Noteworthy Practices
Indiana Indiana Department of Transportation, Rail Office	Seven strategies, three performance measures 5-year plan with goals	Each crossing with multiple collisions is presented and analyzed	Two thirds of collisions at grade crossings with active protection devices in place, data trends identified with countermeasures Private crossings are an issue in HSR corridors in the State, even if State has no authority to regulate those crossings	Crossing data analysis and State benchmarking	Strategies include discussion of implementation challenges; motor vehicle crash data used in collision analyses
Iowa Iowa Department of Transportation, Office of Rail Transportation	Solutions developed with railroads and Office of Traffic Safety, 12 actions identified 2012–2016	Included throughout data analysis	Longer-term data trend highlighted with a range of projected values for the plan period No special conditions specified	Extensive data analyses with information on demographics, time, modes, and locations of collisions	Goals are discussed with responsibilities of stakeholders; goals have timelines; each crossing receives a benefit-cost calculation number
Louisiana Louisiana Department of Transportation and Development	12 action items, with agency leads and outcomes 5-year action plan	Included in data analysis	Updating 2006 plan (adopted as pilot for other States) No special conditions specified	Updated extensive data analysis from 2006 plan, including multiple crash locations	Strategies identified after stakeholder meeting; each action item is assigned to an agency with timeline
Ohio Ohio Rail Development Commission, Public Utilities Commission of Ohio	Six safety program objectives, with strategies, activity plans, and measurements At least 5 years, objectives have 2- to 10-year horizons	No explicit mention	Railroads play important role in State economy given Ohio's geography in the nation's rail system Two agencies involved in grade crossing protection with independent funding	No specific data analysis	Performance measurement a regular part of grade crossing activities; State funding programs provide for crossing surface improvements
Texas TxDOT Rail Division	14 strategies under evaluation and engineering, 4 strategies under education and enforcement 5-year action plan	Addressed in two appendices of extensive data analysis	Large number of railroad miles and railroad crossings Passenger and commuter rail collisions included	Very extensive data analysis, including detailed examination of multiple crash locations	Plan includes stakeholder meeting; close interaction with FRA; 18 strategies have an implementation timeline

GENERAL DISCUSSION OF STATUTORY AUTHORIZATION, FINANCIAL RESOURCES, AND USDOT GUIDELINES

Benchmarking against Other Plans

Action plans for highway-railway grade crossing safety fit within the context of many other plans that State DOTs and other related agencies prepare and implement. State rail plans are also multiyear, data-driven plans for State investments in passenger and freight railroad services. FRA has issued guidance for the content and format of State rail plans, which include rail safety matters as part of the overall State rail system inventory in the plan. Highway-railway grade crossing statistics and funding programs are usually described in State rail plans but not to the depth of typical action plans. State rail plans are required by 49 U.S.C. Sections 22701 to 22706, and Section 11401 of the FAST Act requires SAPs for all States.

As part of the HSIP, States are required to develop a Strategic Highway Safety Plan (SHSP),[1] which is a statewide coordinated safety plan that provides a comprehensive framework for reducing highway fatalities and serious injuries on all public roads. An SHSP identifies a State's key safety needs and guides investment decisions toward strategies and countermeasures with the most potential to save lives and prevent injuries. The State department of transportation develops a SHSP in a cooperative process with local, State, Federal, tribal, and private-sector safety stakeholders. It is a data-driven, multiyear comprehensive plan that establishes statewide goals, objectives, and key emphasis areas and integrates the four E's (4E's) of highway safety: engineering, education, enforcement, and emergency medical services (EMS). States are not required to include strategies for highway-railway grade crossings in their SHSPs. However, if a State does include strategies as an emphasis area, then the SAP and SHSP goals related to highway-railway grade crossings should be consistent.

SAPs and Current Section 130 Reporting

FHWA has issued guidance for the annual reports that are required as part of the Section 130 Program.[3] The reporting guidance provides a suggested format for consistent reporting among all the States. The annual reports include general information about the State's program for administering the funds and for reporting project data from the current fiscal year. It also includes reporting on the effectiveness of previously completed projects (which includes before and after crash data to be used for project evaluation). States are given the flexibility to report based on calendar years, State fiscal years, or Federal fiscal years, but they are encouraged to be consistent from year to year.

SAPs would not supplant or duplicate this reporting of Section 130 funding. The Section 130 annual reports generally describe how a State obligated its funding in previous years and how it administers its program. However, SAPs would be more comprehensive in scope (looking forward multiple years), examine detailed highway-railway grade crossing trends, and identify strategies to address those trends. The SAPs described in this document identify overall highway-railway grade crossing safety challenges and overall strategies and actions to address those challenges. Application of Section 130 funding is part of those actions, but the SAPs involve more than grade crossing improvement projects and strategies that are funded through the Section 130 Program.

1 More information on Strategic Highway Safety Plans can be found at **http://safety.fhwa.dot.gov/hsip/shsp/**.

Chapter 2. Recommended Process for Preparing a State Action Plan

PLANNING AND PREPARING TO DEVELOP A STATE ACTION PLAN

To gain the most benefit from developing a State action plan (SAP), States should map out the process for completing the plan that reflects the unique railroad and safety environment in the State. This process should be approached as an opportunity to maximize results from public and private highway-railway grade crossing safety efforts, and include consideration of matching the planning work to available resources (data, people, and time) in the SAP.

Develop the Internal and External Team to Prepare a State Action Plan

State highway-railway grade crossing program administrators should talk to others internal and external to their agencies to gain insights and additional perspectives to apply to the development of the SAP, as illustrated in Figure 2.

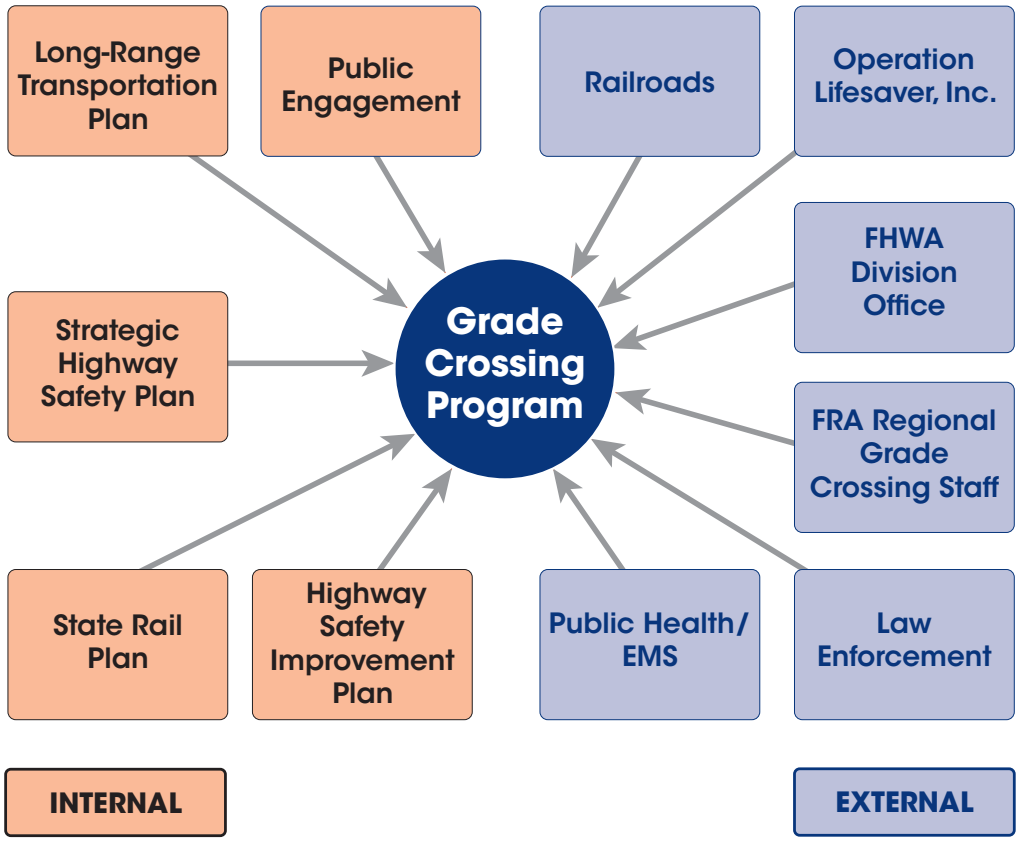

Figure 2. Diagram. State action plan resources and related plans.

State crossing managers should consider involving other safety planners familiar with the Highway Safety Improvement Program (HSIP) and Strategic Highway Safety Program (SHSP) as well as those responsible for the State rail plan and long-range transportation plan. These partners can offer expertise in data analysis, public engagement, performance measurement, and plan implementation. Agency public engagement staff can also apply agency-wide practices and resources for stakeholder outreach for the SAP. When a State develops or updates a SAP, the objectives of the SAP should be compelling enough to influence other agency officials and experts to deliver the SAP.

Transportation planning generally includes stakeholder engagement, through both formal steering or advisory committees and broader public outreach. Crossing managers have relationships with railroads (crossing program and overall risk mitigation staff) in their States as well as Operation Lifesaver, Inc.—participants that can be leveraged for SAP preparation. States should also talk to the Federal Highway Administration (FHWA) safety staff at the division level, the Federal Railroad Administration (FRA) regional grade crossing specialists, and freight and safety planners at metropolitan planning organizations. States should engage law enforcement associations and agencies, freight railroad police, emergency responders, and State health planners. In addition, community partners such as school districts, cycling associations, and others may be included if there are impacts that affect them.

A structured external committee can be a valuable resource in obtaining feedback and proof-testing recommendations. It can also be a conduit for information dissemination to the broader organizations represented by the committee members. These groups can meet remotely and in person to be respectful of private citizens' time and travel costs. The groups can offer valuable insights in setting goals and objectives for the SAP and in reviewing SAP content (should States choose to engage them in interim product reviews). The committee members can help disseminate SAP information to outside groups. Even though the SAP may identify strategies and objectives that involve stakeholders outside the State agency, this committee structure can help gain comments and commitments to action items.

Review Previous Plans and Develop the Scope for the SAP

When developing or updating a SAP, States should consult other planning documents and program manuals related to its highway-railway crossing programs. The State's SHSP should be reviewed so that action plans can be consistent with and build upon State commitments already in place.

The 10 SAPs submitted in response to RSIA08 offer examples, templates, formats, and structure for developing or updating a SAP. They can also help identify the responsible parties for implementing a SAP. However, each State faces unique rail safety challenges including, but not limited to, the State's:

- Geography.
- Rail traffic (e.g., freight versus commuter rail).
- Vehicle traffic.
- Population demographics.
- Economic activity.

Each State agency responsible for highway-railway crossing programming and project execution is also unique, with different institutional relationships, planning capacity, and available resources. Each State should tailor its SAP to available data and resources (people, time, and money). Clear expectations, time commitments, and resource allocations should guide the preparation of the SAP. States should carefully consider how a SAP can make a positive difference in reducing crashes and associated losses (i.e., injuries, fatalities, property damage, and economic losses) through goals and actions that the State and associated stakeholders can expect to achieve.

Prepare the Highway-Railway Grade Crossing Data Needed for SAP Development

States should collect and manage available data to use in preparing a SAP. Many States maintain crossing inventory data that can be aggregated to produce inventory snapshots based on crossing types, protection devices, and crash data. The inventory data can also be used to identify the risk exposure based on highway and rail traffic volumes at crossings. Some States link crossing inventory databases with crash record data that have additional information on crash causes and conditions at crossing locations. FRA can also provide access to national inventory data and reports of highway-railway crossing collisions created through railroad data submissions.

States completing State rail plans or State freight plans may also have commercial data or waybill sample data from the National Transportation Safety Board (NSTB) that include rail traffic density, commodities by rail corridors, and origin/destination data—at least at the county level. These data can augment the economic assessment that can inform a SAP.

Data collection and organization should be part of the planning process prior to actual SAP development. Taking time to identify the available data will help right-size the scope of the SAP, which is part of the process. Since the SAP is intended to add value to rail safety efforts, the work of developing the SAP should fit within existing resources instead of requiring third-party help (unless that choice is made by the State). Many States have been upgrading grade crossing inventory data as part of their 2 percent allowance under Section 130 funding, and these new data sets can enhance the analysis tools and visualization methods that can benefit the SAP.

DEVELOPING A STATE ACTION PLAN

This section describes the processes associated with putting the SAP together, after the proper planning and preparation have been completed.

Establish Goals and Objectives

As part of the SAP preparation process, States can assess trends in highway-railway crossing safety issues and identify the kinds of improvements the State wishes to see in crashes (e.g., frequency, severity, and outcomes), risk factors (e.g., accident prediction results), and protection devices (deployed by location, corridor, or crossing type). These desired improvements can be expressed in terms of goals and objectives.

According to FHWA's *Performance Based Planning and Programming Guidebook*, a goal is defined as "a broad statement that describes a desired end state." [4] An objective is "a specific, measurable statement that supports achievement of a goal." Objectives are means of measuring progress toward achievement of a goal. The FHWA guidebook further recommends the adoption of objectives that are "SMART" (**s**pecific, **m**easurable, **a**greed upon, **r**ealistic, and **t**ime bound). Figure 3 illustrates these relationships and descriptions.

Some examples of goals and objectives are as follows:

- **Goal:** Passive devices at public highway-railway crossings will be reflectorized.
  - **Objective:** For the three years beginning 2015, 20 percent of available, annual Federal and State crossing funding will be allocated to upgrading installation of retroreflective material for passive protection devices at public crossings.
  - **Objective:** By October 1, 2018, 75 percent of all passive crossing protection devices will be reflectorized according to current *Manual on Uniform Traffic Control Devices* standards.

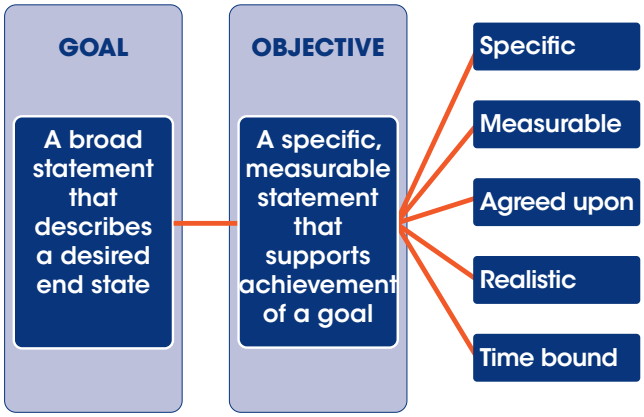

Figure 3. Diagram. Goals and "SMART" objectives.

- **Goal:** State and Federal highway-railway crossing protection funding will be fully allocated and expended.
  - **Objective:** 100 percent of annual Federal Section 130 allocations will be obligated to projects or programs within 18 months of notification of contract authority.
  - **Objective:** 100 percent of annual Federal Section 130 funding will be expended within 30 months of notification of contract authority.

Develop Data for State Action Plan Execution and Evaluation

The SAP preparation process identifies sources of data to be used in developing the plan. This includes data that can be used to measure progress toward meeting objectives along the way to achieving goals. Careful attention should be paid to data used in performance-based planning because the data will guide strategies and investments to achieve the goals of the SAP. These data should be available, reliable, and sustainable over the course of the SAP. Data availability will play a role in setting SMART objectives.

Identify Strategies, Programs, and Institutional Arrangements, and Tie Strategies to Time Periods

Strategies are a plan or method to achieve a goal (progress toward which is measured by objectives), and actions are tactics to execute the strategy. The SAP includes specific strategies for reaching objectives and outlines actions to be taken in carrying out the strategies. The SAP can also describe how current or proposed programs can advance the strategies. The SAP takes advantage of current or proposed institutional arrangements among rail safety entities as a means of advancing strategies.

The objectives and strategies should be time constrained as opposed to open ended. Some actions will necessarily precede others, and the SAP should map out the relationships among strategies and actions.

The stakeholder outreach process in developing the SAP allows States to gain commitments from external stakeholders for actions and strategies that advance the SAP's objectives.

Chapter 3. Implementation and Evaluation

MONITORING AND COMMUNICATION

After developing and finalizing the State action plan (SAP), the State should determine a process to monitor progress of the SAP. The State should regularly check in with parties assigned actions listed in the SAP to obtain information on the status of the action items. This monitoring process should produce information that can be shared with the responsible State agencies and rail safety stakeholders. As the SAP reaches its objectives, success should be shared with all stakeholders to maintain momentum and affirm commitments to the goals, objectives, and actions in the SAP. Conversely, if goals, strategies, or objectives are not met (or are not on track to be met by a specified time goal), then discussion should take place to determine the reasons, with adjustments being made as necessary.

MEASUREMENT AND REPORTING

Responsible parties within the State should be designated to consult grade crossing data to measure progress toward the objectives and goals of the SAP. The data collection cycles may create natural demarcations and milestones to use in measuring actual experience compared to the goals and objectives of the SAP. These same timing milestones can generate reporting elements that can be communicated within the annual Highway Safety Improvement Program (HSIP) Section 130 reporting process.

Crossing program managers should transmit annual reports on SAP accomplishments to the entity within the State that approves the SAP. This ensures that the program managers are communicating with the agency executives, the governing board, or the commission that adopted the SAP. The State may want to consider communicating these annual reports to members of the stakeholder advisory committee (if any) the State created to assist in developing the SAP.

ADAPTING TO RESULTS OR CHANGING CIRCUMSTANCES

The SAP is developed to respond to a certain set of safety challenges, data trends, and economic and political environments. The elements that informed the SAP could change over its time horizon. The State could achieve results much faster and with much more impact than anticipated, or challenges (either anticipated in the plan or not) could deter accomplishment of goals and objectives. As the circumstances change, the State should be ready to use the measurement and reporting cycles in the SAP's implementation process to consider amending it. States should be prepared to reset goals and objectives in light of new data and action item results.

EVALUATION DIRECTED TO FUTURE STATE ACTION PLANS

Each State determines the time horizon for its SAP, and as that time period nears completion, the State should begin to assess feedback for future iterations, considering the data collected and results. As the SAP achieves its objectives, a new planning cycle needs to build upon that success and the new baseline of grade crossing safety. The State and the stakeholders involved in the development of the SAP should take stock of the planning process itself and decide whether changes and improvements are necessary. The passage of time should give participants perspective on what processes worked and what could be improved. States are encouraged to consider how this model SAP and guidelines could also be changed and communicate those improvement ideas to the Federal Highway Administration and Federal Railroad Administration.

Chapter 4. Content and Recommended Outline for a State Action Plan

Table 2 is the outline of the model State action plan (SAP). States should modify this outline to meet their goals based on their individual needs and circumstances as discussed previously.

Table 2. Model State action plan outline.

Section	Elements
Introduction	Mission statement Scope Goals and objectives
Statewide Highway-railway Grade Crossing Safety Efforts	Highway-railway grade crossing planning Highway-railway grade crossing program administration
Public Engagement	Process for stakeholder involvement in SAP development Stakeholder involvement in SAP implementation
Data Analysis	Data discussion Broad overview of highway-railway grade crossing environment Crash data
Risk Assessment	Individual crossings and corridors Higher-level safety considerations
Highest-Priority Highway-railway Grade Crossing Safety Challenges in the State	How the challenges were determined Results
Action Plan	Goals and objectives for addressing safety challenges Action plan for accomplishing goals and objectives Process and metrics for measuring progress Challenges to meeting goals and objectives
Determine Next Steps	Short-term actions Long-term actions

INTRODUCTION

Mission Statement

The SAP contains a statement about its purpose, explaining why it exists.

Scope

The SAP specifies some of the elements identified in the planning process, including the external stakeholders being consulted and the time period covered.

Goals and Objectives

The SAP details and explains the goals and objectives that are to be achieved, as explained in the planning process.

STATEWIDE HIGHWAY-RAILWAY CROSSING SAFETY EFFORTS

Highway-Railway Crossing Planning

This section describes the relationship of highway-railway crossing safety planning for other State plans, including the State Highway Safety Plan (SHSP), State rail plan, and State transportation improvement program. Figure 4 shows a highway-railway grade crossing and signal.

Source: Operation Lifesaver, Inc.

Figure 4. Photo. Highway-railway grade crossing and flashing lights.

Highway-Railway Crossing Program Administration

This section summarizes information already being submitted as part of the programmatic description in State Highway Safety Improvement Program (HSIP) Section 130 annual reports. This information includes details of how:

- Highway-railway crossing projects are identified and selected.
- Federal and State funds are applied to crossing projects.
- Stakeholders are involved in project identification.
- Diagnostic reviews are conducted at crossings selected for funding.
- Highway-railway crossing programs are governed and administered, including descriptions of interagency agreements and sharing of responsibility (if it occurs).

Connected to the description of how crossing programs are governed, the State action plan (SAP) also describes current statewide programs for crossing safety because some States have programs to address specific crossing safety issues and circumstances with State and local funding. This inventory of current programs also describes how State safety programs addressing trespasser injuries and fatalities are connected to highway-railway crossings.

This section of the SAP also explains how highway-railway crossing projects, once selected and funded, are executed. This describes the relationship of State-level grade crossing program managers and local project contracting and administration (which in some States can be the same organization), the processes for working with freight and passenger railroads, the coordination with the Federal Highway Administration (FHWA) division office, the coordination with the Federal Railroad Administration (FRA) regional office, and the provisions for contract completion and closure.

PUBLIC ENGAGEMENT

Process for Stakeholder Involvement in State Action Plan Development

The SAP describes the process of engaging highway-railway crossing safety stakeholders and the general public. States should consider the best means of gaining outside input into the SAP without too much expense. Public outreach in some States with large areas and dispersed populations can be very expensive to conduct using traditional open-house meetings. Careful consideration of public outreach methods should also include State agency public engagement specialists because traditional methods are becoming increasingly ineffective at reaching members of the general public. Virtual open houses and web-based briefings, with interactive content and hosted chat to respond to public questions, can be very inclusive without as much expense. This model SAP is not prescriptive about the type of outreach to be employed, only that the State describe the process of seeking and responding to external views.

Stakeholder Involvement in State Action Plan Implementation

The implementation program, with cycles for data collection, reporting on strategies and objectives, and mid-term revisions, needs to include provisions for sharing information on the SAP's accomplishments with external stakeholders. The program managers should take advantage of in-house public engagement expertise to identify techniques and methods that work effectively for a given State's population, stakeholders, and transportation networks.

DATA ANALYSIS

Data Discussion

The SAP lists the data used in its development and implementation. This includes a description of the highway-railway crossing inventory system managed by the State and how the data are organized, collected (including data from outside sources), updated, and reported. If the SAP uses data beyond the inventory, then the additional data sets can be explained in a similar fashion (organization, collection, and maintenance), including explanations of how the data are used.

For example, some States integrate crash record systems with highway-railway grade crossing identifiers to add details to crossing incident analyses. Not every State has the same data in the same formats or the same details—States should describe how the available data inform the SAP's strategies, objectives, and action items.

Broad Overview of the Highway-Railway Crossing Environment

The SAP explains the highway-railway crossing safety environment, in terms of inventory and risk factors. Tables and geographic information systems (GIS) mapping can explain inventory data regarding the number of public and private crossings and the protection devices at crossings. Additional details on safety risk factors can include:

- Maps of train counts and tonnage density on rail lines in the State.
- Major rail corridors (in terms of train volumes or economic importance, or through traffic volumes and commodities).
- Trends in vehicle miles traveled, registered drivers and vehicles, and other factors.
- This section is similar to the inventory assessments in State rail plans.

Crash Data

This section includes safety data:

- Crashes.
- Fatalities and injuries.
- Crashes by geography (county or region) and by railroad.
- Available causal information for crashes.
- 10-year trends.
- Crashes and protection devices at crossings.
- Multiple crash locations.

RISK ASSESSMENT

Individual Crossings and Corridors

Whether a State uses a crash prediction model that processes inventory data or not, highway-railway crossing safety professionals understand the confluence of factors that create higher risks at some crossings than at others. The SAP includes a discussion of safety risks at certain crossings or along certain corridors—risks identified through an analysis of crossing data presented in the section on data analysis. This risk analysis helps identify crossings, types of crossings, and corridors with crossings where focused attention might make a positive impact and reduce crashes and their consequences.

Higher-Level Safety Considerations

The data analysis section of the SAP can present information on trends that can have effects on grade crossing safety beyond a certain crossing or corridor. (Figure 5 shows examples of safety devices at a grade crossing.) The SAP discusses general safety risks, particularly those factors that lend themselves to policy or programmatic strategies and mitigation.

Source: Indiana Department of Transportation, Section 130 Website

Figure 5. Photo. Highway-railway crossing and safety devices.

Higher level safety considerations can include, but are not imited to, the following situations:

- **States or metropolitan regions that have a high level of commuter rail traffic.** This increases the exposure due to the large number of passengers on the trains. In addition, the commuter rail lines also generally operate at the same time that the roads have peak travel times, which further increases the exposure.
- **States that have a high number of energy products and HAZMAT shipments by rail or trucks.** This increases the likelihood of a larger impact if there is a collision. In addition, special consideration should be given to highway-railway crossings by those States that have rapidly developing areas where energy products are extracted. The roadways in these areas are generally low volume, with lower levels of protective devices at crossings, but can quickly become higher volume roadways due to truck traffic.
- **States and regions that have crossings frequently blocked by idling trains**. The hazards from blocked crossings include but are not limited to:
  - Delays to emergency response personnel to fire, medical emergencies, or criminal activity.
  - The risk of road users driving into the side of a stopped train during nighttime or low-visibility conditions.
  - The risk of motor vehicle collisions from turning around to seek an alternative route.
  - Pedestrians cutting through or under a train to access homes, schools, or businesses on the other side of the idling train.

  See Appendix C for more information on blocked crossings.

HIGHEST PRIORITY HIGHWAY-RAILWAY CROSSING SAFETY CHALLENGES IN THE STATE

Based on the data analysis and risk assessment, the SAP presents a summary of the highest-priority highway-railway crossing safety challenges facing the State. The goals of the SAP are aimed at resolving or mitigating these challenges, and progress toward these goals is measured by the SAP's objectives.

States are encouraged to consider their unique or specific safety challenges. For instance, one State may decide to pay particular attention to crossings along corridors with frequent crude-by-rail unit trains, but another State may not need to address that particular hazardous materials issue if it has no major crude oil rail movements.

States are also encouraged to base these challenges (and the related goals and objectives) on data presented and explained in the SAP. Stakeholder involvement in the SAP's development may generate suggestions for the challenges in this section, but such ideas need to be anchored to data in the SAP to be consistent with the other kinds of performance-based planning that exists at the local, State, and Federal level.

States are also encouraged to consider the additional safety benefits that may be achieved at relatively little additional cost when selecting the types of improvements to be installed. For example, when upgrading a passive crossing to automatic warning devices, installing a flashing lights with gates system instead of a flashing lights only system would provide an 88-percent increase to safety instead of a 64-percent increase at the cost of an additional $30,000 to $50,000. Appendix D provides a table of typical cost ranges and estimated risk reductions for the improvements.

ACTION PLAN

This section of the SAP links goals and objectives to the safety challenges listed in the previous section, including tactical actions to be taken to meet the objectives and accomplish the goals.

Goals and Objectives for Addressing Safety Challenges

As stated in the planning preparation sections, FHWA planning documents define a goal as "a broad statement that describes a desired end state." An objective is "a specific, measurable statement that supports achievement of a goal." These goals should be tied to and address the safety challenges just listed. Just as the safety challenges are prioritized into a manageable list, so too should the goals and objectives be reachable and reasonable. The objectives offer the State and rail safety stakeholders measurable benchmarks for assessing progress toward meeting the goals. The objectives should be defined so they can be measured by available data maintained by or accessible to the State.

Action Plan for Accomplishing Goals and Objectives

This section contains the action elements to reach the goals to address the safety challenges. The actions in this list are specific, measurable, time bound, and assigned to responsible parties. The overall time horizon of the actions is up to each State to determine. The State and stakeholders are encouraged to delegate actions to parties outside the State agency preparing the SAP, so long as the stakeholders accept the responsibilities through the public engagement process. The listed actions may extend over the SAP's time frame, and some may be sequential and build on each other.

Example SAPs are as follows.

Iowa Department of Transportation

The SAP prepared by the Office of Rail Transportation of the Iowa Department of Transportation (DOT), incorporates enumerated strategies, lists expected time frames for accomplishment, discusses institutions and organizations involved in implementation, and identifies performance metrics for measuring strategy success. An example of this approach is summarized for Education Action Item B: Family Partnerships:[5]

- **Strategy:** Inventory public safety and health advocacy groups that already provide traffic safety training (Iowa Center for Ag Safety and Health and the Blank Children's Hospital Advocacy Group), and work with groups to include highway-railway grade crossing safety content.
- **Timeline:** 5 years.
- **Involved parties:** Office of Rail Transportation and Iowa Operation Lifesaver.
- **Success measurement:** The number of persons receiving highway-railway grade crossing safety training or safety training materials through cooperative efforts.

Louisiana Department of Transportation and Development

The SAP from Louisiana Department of Transportation and Development (LA DOTD) updates an earlier SAP prepared as a pilot effort with the cooperation of FHWA and FRA. The SAP includes detailed action items, strategies and outcomes, timelines for implementation, responsible parties (including names), and evaluation measurements. An example of this approach is summarized for Item 4, Crossing Closure/Consolidation Project List:[6]

- **Action item:** Develop a list of candidate closures and consolidations, and implement LA DOTD policy and State law.
- **Outcome/purpose:** To include a list of strong closure candidates, close redundant and unnecessary highway-railway grade crossings, and improve public safety statewide. (Figure 6 shows warning signs, signals, and deployed gate arms being avoided by a driver.)
- **Responsible party/parties:** LA DOTD.
- **Timeline/progress/comments:** Prepare the recommended closure candidate list each year, present the closure list to the Railroad Safety Program Committee, and initiate at least two closure/consolidation proceedings each year.

Source: Operation Lifesaver, Inc.

Figure 6. Photo. Highway-railway crossing and truck avoiding gate arms.

The Texas Department of Transportation

The SAP for the Texas Department of Transportation (TxDOT) lists strategies in two categories, evaluation and engineering and education and enforcement. These strategies are listed in action plans for each of the five years covered in the plan. An example of this information is summarized for an evaluation and engineering action item on signal preemption:[7]

- **Action:** Identify and mitigate signal preemption issues at signalized crossings experiencing multiple collisions located adjacent to highway intersections.
- **Plan Year 1 Actions:** Obligate FHWA Section 130 funds to perform diagnostic team inspections at the multiple-collision crossings located adjacent to highway intersections.
- **Plan Year 2 Actions:** Continue to perform diagnostic team inspections at identified crossings under the 2011 program; identify projects' scope of work; authorize plans, specifications, and engineering preparation and approval; obligate FHWA funding and approval for construction (i.e., crossing signals, preemption upgrades, and crossing closures); monitor performance workload; and measure the percentage reduction of crossings experiencing multiple collisions.
- **Plan Year 3 Actions:** Same actions as Plan Year 2.
- **Plan Year 4 Actions:** Same actions as Plan Years 2 and 3, plus assessing the effectiveness of mitigation efforts and project safety improvements at completed crossing project locations.
- **Plan Year 5 Actions:** Same actions as Plan Year 4.

Process and Metrics for Measuring Progress

This section includes a discussion of the means by which inventory and crash data are employed to measure progress in accomplishing the plan objectives. The SAP identifies the parties responsible for collecting information on activities assigned in action plan items, and specifies the timing and content of periodic reporting on progress.

Challenges to Meeting Goals and Objectives

This section includes a discussion of the possible challenges or impediments that may affect the accomplishment of the actions, objectives, and goals of the SAP. This is a normal part of any project management plan, and each challenge listed is paired with a possible means of overcoming the challenge, mitigating the problems, or establishing benchmarks for determining whether alternative actions may be necessary to reach the objectives of the SAP.

DETERMINE NEXT STEPS

The planning elements listed above—safety challenges, goals, objectives, and actions—and the planning process and engagement of stakeholders may identify some actions that are less tactical and more programmatic. For example, a State may administer a legislatively directed program with a dedicated funding source to address a particular grade crossing issue, and the State and stakeholders may conclude that the challenges and goals that led to the creation of that program no longer apply or have been superseded by other, higher-impact challenges and needs. The SAP may conclude with a series of programmatic initiatives or recommendations for policy makers within the State agency or at the legislative level.

This section outlines next steps at a higher level (if necessary) and discusses the extent to which accomplishment of these programmatic changes may require reassessment of the SAP in part or as a whole.

PART 2
NOTEWORTHY METHODS IN PROJECT PRIORITIZATION

Chapter 5. Background on Prioritization

The Highway Safety Improvement Program (HSIP) requires a data-driven strategic approach to improving highway safety on all public roads that focuses on performance. Railway-Highway Crossings Program (Section 130) funds are set aside from the HSIP apportionment for the elimination of hazards and installation of protective devices at highway-crossings. In accordance with 23 USC 130(d), each State is required to conduct and systematically maintain a survey of all highways to identify those railroad crossings that may require separation, relocation, or protective devices. Each State is also required to establish and implement a schedule of projects for this purpose. At a minimum, this schedule is to provide warning signs for all highway-crossings.

States adhere to this requirement by developing systematic prioritization methods to identify crossings that have the greatest hazard to the traveling public. These prioritization methods are tailored by the States to accommodate their unique situations, in part due to the number of crossings and crashes and the size and scale of the grade crossing protection program.

Based on the review of the 10 State action plans and discussions with several States, the approaches to prioritize projects generally follow a few general types:

- **Process driven:** States ask railroads and local governments for suggested crossing improvements on a regular basis.
- **Data and formula driven:** States apply database information (often matched with accident/risk prediction models) to rank crossings for protection consideration.
- **Hybrid approaches:** States apply data and formulas in combination with project identification from stakeholders.

Chapter 6. Noteworthy Prioritization Practices

This section summarizes the investigation findings into major practice areas associated with prioritization practices. The practices outlined in this section highlight programs in certain States to implement five general practice areas. The programs listed represent a sample of all activities undertaken by States and may not fully describe the detailed processes undertaken by the example States in implementing these practices. The purpose is to give a brief summary of how individual States have innovated within each area.

This information was compiled from a number of sources:

- Interviews with selected State highway-railway crossing administrators.
- Review of State action plans (SAP) submitted under the Rail Safety Improvement Act of 2008 (RSIA08).
- Review of annual highway-railway grade crossing reports submitted under the Highway Safety Improvement Program (HSIP).
- Supplemental information provided in interviews.
- Previous Federal Highway Administration (FHWA) highway-railway grade crossing reports to Congress.

Appendix A summarizes information for this section, including contact information for more information about State highway-railway grade crossing programs.

PRACTICE 1 – STATES ARE TAILORING RISK FORMULAS TO STATE NEEDS

Overview

There is no one-size-fits-all risk formula that is used by all States, although several common elements are used by many States. Some States have adjusted weighting factors and constants to reflect State experience. Others have internal programs for different purposes, each with a specific project selection process/formula. One State uses the Federal Railroad Administration's (FRA) GradeDec.net as a what-if simulator to evaluate corridors under changing rail traffic profiles or economic development prospects.

Additionally, some States use railroad-supplied information on near misses at crossings as part of the evaluation/risk assessment process. Other States connect State crash records with inventories to obtain more potential causal information on crossing-related crashes. Some States evaluate categories of crossings separately—passive against passive, active against active, and gates/lights against similar crossings. Even so, some States are responding to special external issues through highway-railway grade crossing programs, focusing on passenger routes with passive crossings or rail lines carrying crude oil trains.

Example Practices

New Jersey

New Jersey focuses its efforts on those crossings located along corridors with crude oil trains. New Jersey also focuses on improving crossings with 8-inch incandescent lights to upgrade these warning signals to 12-inch light-emitting diodes (LEDs).[2] Since most of the State's identified issues at the local level relate to crossing surface conditions, New Jersey is creating a listing of those crossings with surface condition issues noted within its inspection process for renewal.

Ohio

Ohio has four major grade crossing programs that use a combination of both Federal and State funds. The use of four separate programs allows for flexibility to maximize needed improvements at the State's at-grade crossings. The four programs are as follows:

- The formula-based upgrade program is based on a calculation of the most hazardous crossings.
- The corridor-based upgrade program provides a framework for systematically considering, identifying, and prioritizing projects that have public safety benefits at multiple grade crossings along a railroad corridor. Ohio identifies these corridors in collaboration with the railroads. The Heartland Corridor is an example of a corridor-based project that runs through the State.
- The constituent-identified upgrade program considers project referrals from a number of sources and makes selections based on hazard rankings, extenuating conditions, and funding availability.
- The preemption program upgrades warning devices and traffic signals to establish appropriate traffic signal preemption when a train approaches a crossing that has a highway traffic signal in close proximity.

Pennsylvania

Pennsylvania's project prioritization process uses the FRA's GradeDec.net tool to compare safety differences if physical infrastructure or traffic (rail and highway) conditions change, which could include new customers along rail lines, track speed changes, and train traffic level adjustments. This tool allows for adjustments to items such as train traffic distribution throughout the day, when trucks or other vehicles arrive, and when heavy transit or bus traffic happens.

PRACTICE 2—STATES ARE INCORPORATING BENEFIT-COST EVALUATIONS INTO PROJECT SELECTION

Overview

A number of States build benefit-cost analysis (BCA) into their project evaluation processes to varying degrees. Some states are using BCAs more comprehensively, integrating the practice department wide in order to build in consideration and monetization of indirect costs for highways (e.g., delay, rerouting, logistics, and road closure time) and railroads (e.g., passenger and freight delays, lack of alternative routes, logistics needs delayed, track closure time, and dispatch chaos). Other States include BCAs in order to rank specific safety improvement projects.

2 Section 4D.07 of the Manual on Uniform Traffic Control Devices requires 12-inch signals on all new signal faces.

Example Practices

California

California includes a cost-benefit factor as part of the final ranking process. This measure is specifically applied during the second phase of its defined project selection methodology.

North Carolina

North Carolina Department of Transportation (NCDOT) is currently transitioning to using benefit-cost evaluations within its existing prioritization methodology as part of an agency-wide effort, as explained in Figure 7.

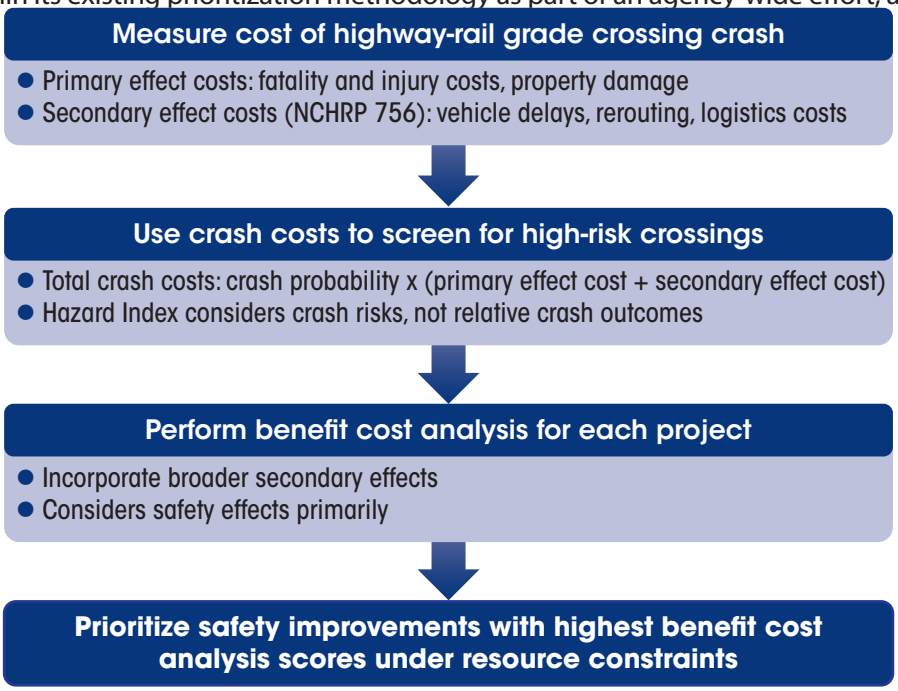

Figure 7. Diagram. North Carolina benefit-cost analysis methodology for highway-railway crossing safety programs.

NCDOT's Rail Division has contracted with a consultant to develop a benefit-cost calculation that takes into account both direct and indirect costs and benefits. This approach is scalable and adaptable, allowing NCDOT to incorporate items not currently considered in grade crossing project selection. Also, this process allows for a BCA similar to roadway improvements in the State, which will permit future grade crossing safety projects to be evaluated alongside and compete with all traffic safety projects including in additional State funding categories.

Wisconsin

Wisconsin directly uses a BCA calculation within its project selection process. Wisconsin analyzes statewide crossing improvement needs using BCA methods to evaluate a data set extracted from the Wisconsin DOT Rail Crossing Data Base. The procedure follows the USDOT Accident Protection and Severity formulas and is used to develop upgrade priority groups, which are then further reviewed using

additional procedures such as BCA.

PRACTICE 3—STATES ARE SUPPLEMENTING FEDERAL SECTION 130 HIGHWAY-RAILWAY CROSSING PROGRAM FUNDING WITH STATE DOLLARS

Overview

Some States have special funding set-asides for highway-railway crossing protection and roadway improvements that have been established by their respective State legislatures. Other States are using flexible State and Federal HSIP funding for crossings. Many of the State-based funds of this type are used for projects not eligible for Section 130 (e.g., pavement treatments at grade crossings) or bundling of State and Federal funds to complete grade separations.

Example Practices

Illinois

Illinois supplements the State's Section 130 program funding with State funds from gas tax revenues to support its Grade Crossing Protection Fund. These monies assist with funding grade crossing improvement projects along local Illinois roadways, whereas State roadways are addressed using Federal funds. Created in 1955, the Grade Crossing Protection Fund is administered by the Illinois Commerce Commission and funds improvements such as:

- Signal system upgrade or replacement.
- Crossing closures.
- Bridges (i.e., replacement/new structure).
- Pedestrian grade separations.
- Interconnect projects.
- Funding to local agencies for highway approach grading.
- Construction of connecting roads for closing projects.
- Remote monitoring systems for railroad companies.
- Renewing crossing surfaces.

Nebraska

Nebraska State statutes provide for a financial incentive to local road authorities that agree to the elimination of a highway-railway crossing by closing the crossing or rerouting the roadway. It does this by providing $5,000 from the State Grade Crossing Protection Fund and $5,000 from the railroad involved. The local road authority also receives actual costs associated with the closure, up to a cap of $12,000. These costs cover such things as barricades and the removal of the approach roadway. In addition, a State fund collected from fuel taxes can be used for crossing surfacing, with local matching funds required.

Nebraska also has a special State fund specifically for highway-railway grade separations, funded through a train mile tax. In addition, some HSIP dollars are moved into grade separation projects, given the scale of such projects. All grade separations in the State require two crossing closures, the one being replaced

and another one nearby.

Texas

Texas supplements the Federal Section 130 program by administering additional programs. The State Replanking Program replaces crossing surfaces on the State highway system. TxDOT also provides funding to railroads for crossing signal maintenance through the Railroad Signal Maintenance Payment Program and allocates State funding for grade separations.

PRACTICE 4—STATES ARE INVESTING PLANNING DOLLARS (2 PERCENT ALLOWANCE) IN INVENTORY IMPROVEMENTS

Overview

States are using inventory systems and specialized modules from consultants and vendors to expand management capabilities and tailor systems to State needs. They are expanding the reach of GIS capabilities to inventory systems and also including photos. Some States use inventory systems to create asset-management-like systems for crossing improvements and diagnostics. The States use a variety of consultants, in-house staff, or student interns to keep inventory data up to date.

Example Practices

California

California is utilizing the 2 percent allowance on a major grade crossing inventory update for the entire State. The multiyear project is split into multiple completion phases, with the first phase consisting of passive crossings and subsequent project years updating active crossings.

Oklahoma, Nebraska, and North Carolina

Oklahoma, Nebraska, and North Carolina are examples of other States using the 2 percent allowance for inventory improvements, with Nebraska maintaining a consultant under contract to provide continuing maintenance of its web-based railroad inventory management system.

Texas

The new database program in Texas, the Texas Railroad Information Management System (TRIMS), was placed into service in March 2013. Since that time, several enhancements have been made to the program to expand its functionality. Scheduled periodic updates of train and highway traffic levels by staff and consultants are an example of the types of inventory data that TRIMS maintains.

PRACTICE 5—STATES ARE APPLYING INNOVATIVE IMPROVEMENTS TO PROJECT EXECUTION

Overview

States are working directly with railroads to identify projects and improve project execution. In the case of most complicated pre-emption projects, States could benefit from better railroad appreciation and understanding of the highway traffic engineering processes required for implementation. Similarly, highway agencies would benefit from understanding the needs and requirements of railroad companies in the construction of combined projects. (A proposed process for highway agency–railroad company cooperation was outlined in the recent Strategic Highway Research Program 2 report R16-RR-1, *Strategies for Improving the Project Agreement Process between Highway Agencies and Railroads*.)

Many States depend on FHWA division office safety staff to understand the unique issues about the projects associated with Section 130 program funding. FHWA division staff often make the difference in getting Federal funds authorized on a timely basis. The following examples highlight several innovative ways in which States have improved project execution.

Example Practices

California

California recognized that the contracted local agency and railroad do not always coordinate their efforts to implement the construction aspects of the project. This led to confusion between the agencies and frequent project delays. To better facilitate the project's implementation, the California DOT and the California Public Utilities Commission are now coordinating a joint project kick-off teleconference once the contracts have been executed to ensure that expectations are understood and lines of communication are established.

New Jersey

New Jersey maintains a master agreement with every railroad operating in the State. This expedites the project execution process by developing each project as a task/change order within the standing agreement. The State's annual report also highlights the positive relationship with the local FHWA staff member, who thoroughly understands rail safety, resulting in improvements to the FHWA review process.

Pennsylvania

Pennsylvania administers a State-level short-line railroad development program through Pennsylvania DOT district personnel. The same personnel are directly involved in grade crossing safety prioritization decisions. Their activities with short-line economic development processes and stakeholders give them detailed knowledge of unique rail operational needs, specific circumstances, or needs that may be in play at candidate funding locations. The assignment of knowledgeable staff across these varied functions improves the overall selection process.

OTHER ISSUES OF NOTE

North Carolina is working to connect grade crossing inventory information into the North Carolina Department of Motor Vehicles oversize/overweight permitting systems for trucks as well as to include railroad contact information if crossings become blocked. In March 2015, an Amtrak train crashed into an oversized load that was blocking a grade crossing while attempting a turn onto an adjacent highway. The load was being escorted, but the trucking company did not anticipate the narrow turning radius complicated by the grade crossing, and the company and its escort vehicles did not communicate its position to the railroad responsible for the grade crossing.

While the Moving Ahead for Progress in the 21st Century Act (MAP-21) and the FAST Act are causing more departments of transportation to use performance measurements, applicable performance measurement tools for the highway-railway grade crossing program remain hard to come by:

- HSIP reporting on before-and-after behavior can be misleading, given the infrequency of crashes and crashes that are not the result of crossing conditions (e.g., suicides).
- Some States measure program activity—inspections, diagnostic reviews, and crossing projects completed—instead of results.

Chapter 7. References

1. Federal Highway Administration. *Highway Safety Improvement Program (HSIP)*. http://safety.fhwa.dot.gov/hsip/. Accessed on September 21, 2015.
2. Federal Highway Administration. *Railway-Highways Crossing (Section 130) Program*. http://safety.fhwa.dot.gov/xings/. Accessed on September 30, 2015.
3. Federal Highway Administration. *Railway-Highway Crossings Program Reporting Guidance*. http://www.fhwa.dot.gov/map21/guidance/guiderhcp.cfm. Accessed on September 20, 2015.
4. Federal Highway Administration. *Performance Based Planning and Programming Guidebook*. September 2013.
5. Iowa Department of Transportation, Office of Rail Transportation. *State of Iowa Highway-Rail Grade Crossing Safety Action Plan*. August 2012.
6. Louisiana Department of Transportation and Development. *Crossing Safety Action Plan Repor*t. August 2011.
7. Texas Department of Transportation. T*exas Highway-Rail Grade Crossing Safety Action Plan*. August 2011.

APPENDIX A

State Highway-Railway Grade Crossing Information Sources for Noteworthy Practices

State/Contact	Interview	RSIA08 State Action Plan	HSIP Annual Report	Extra Documents	Reports to Congress
California	Yes	Yes	Yes		2012, 2014
Bree Arnett, California Public Utility Commission, bree.arnett@cpuc.ca.gov; Lauren Clauson, Chief Railroad Crossing Safety Branch, Division of Rail, California Department of Transportation, lauren.clauson@dot.ca.gov					
Illinois	Yes	Yes	Yes		2012, 2014
Michael Stead, Rail Safety Program Administrator, Illinois Commerce Commission, mstead@icc.illnois.gov; Jason Johnson, P.E., Rail Safety Engineer, Illinois Department of Transportation, Jason.Johnson@illinois.gov					
Nebraska	Yes		Yes	Model development report	2014
Bev Vonasek, Nebraska Department of Roads Railroad Liaison Manager, Beverly.Vonasek@nebraska.gov					
New Jersey	Yes		Yes		2014
Todd Hirt, Supervising Engineer, Bureau of Railroad Engineering, New Jersey Department of Transportation, Todd.Hirt@dot.state.nj.us					
North Carolina	Yes		Yes		2014
Andrew R. (Drew) Thomas, MSE, P.E., Data Analysis and Inventory Manager, Engineering Coordination and Safety Branch, Rail Division, North Carolina Department of Transportation, dthomas@ncdot.gov					
Ohio	Yes	Yes	Yes	Ohio Rail Development Commission Programs PDF	2010, 2012, 2014
Cathy Stout, Manager, Safety Programs, Ohio Rail Development Commission, Catherine.Stout@dot.ohio.gov					
Oklahoma			Yes		
Craig Moody, Rail Programs Division Manager, Oklahoma Department of Transportation, cmoody@odot.org					
Pennsylvania	Yes		Yes		2012, 2014
Greg Vaughn, Central Grade Crossing Unit, Pennsylvania Department of Transportation, grvaughn@state.pa.us; Daniel D. Leonard, P.E., Grade Crossing Engineer, Bureau of Project Delivery, danleonard@state.pa.us					
Texas		Yes	Yes		2010, 2012, 2014
Robert Travis, P.E., Branch Manager—Rail Highway Safety, Rail Safety Section, Traffic Operations Division, Texas Department of Transportation, Robert.travis@txdot.gov					
Wisconsin	Yes		Yes	Presentation; Prioritization PDF	2012, 2014
Mark Morrison, Railroad Engineering and Safety Unit, Wisconsin Department of Transportation, mark.morrison@dot.wi.gov					

APPENDIX B

Summary of State Action Plans Submitted Under Rail Safety Improvement Act of 2008

ALABAMA

Attributes of Plan

The Alabama State action plan (SAP) is 18 pages in length, uses headings and graphics throughout the document, and has a table of contents that contains the section headings. The SAP states that the Alabama Department of Transportation (DOT) Bureau of Multimodal Transportation's Railroad Safety Program developed the plan.

Adherence to SAP Mandate

Specific Solutions

The Alabama SAP addresses efforts to improve safety for the following areas:

- Crossing closures.
- Grade crossing separations.
- Multiple crashes at a crossing.
- High-risk crossings.
- High-speed rail corridors.
- Pedestrians.
- Implementation/experimentation of innovative technologies at grade crossings.
- Engineering, enforcement, and education (3Es).

Multiple-Crash/High-Risk Crossings

Sections exist for both crossings with multiple incidents and high-risk crossings. The section about multiple-incident crossings discusses five strategies already undertaken to reduce the number of collisions. A table showing the specific crossings that experienced multiple accidents between 2006 and 2010 shows the status of these crossings, including whether they are scheduled for improvements. The high-risk crossings are identified using the USDOT Accident Prediction Formula Index on an annual basis. Improvements are undertaken using the Federal Section 130 funding program.

5-Year Period

Crossing accident and other data are presented for the 5-year period from 2006 to 2010. The SAP indicates that it was developed in accordance with the mandate. The scope reveals the plan is effective for the 5-year period following approval.

Findings

Major Themes

The SAP states that it emphasizes road user safety at public highway-railway grade crossings.

Special Conditions

The SAP includes a section discussing high-speed rail crossing safety; however, it also says that Alabama is not currently pursuing high-speed corridors.

Analyses

No extensive data analyses were performed in the Alabama SAP: total accidents, broken down by the number of accidents, fatalities, and injuries, are presented for the 5-year period from 2006 to 2010. The number of crossing closures, the number of multiple-accident crossings, and corridor projects are also presented for that time period.

Noteworthy Practices

Alabama was willing to participate in a project to install and monitor a technology that would stretch across roadway lanes to prohibit vehicles from entering a crossing upon deployment.

CALIFORNIA

Attributes of Plan

The California SAP is 67 pages long and includes a main body report (39 pages) and seven appendices (28 pages). The document is well put together with a table of contents and a breakdown of ideas with headings throughout the text. Graphics and tables are used throughout to visualize data elements. It appears to have been developed internally by the California Public Utilities Commission (CPUC).

The general flow of the SAP includes an introduction that summarizes the mandate to perform the plan and background information related to the oversight of grade crossing safety in California and improvement efforts and initiatives already used. Another chapter provides a short list followed by detailed discussion of the action plan strategies identified for the SAP. A chapter containing a summary and conclusion completes the main body report. The appendices include an acronyms and abbreviations list, a summary of the final rule, and a letter from the Federal Railroad Administration (FRA) dictating the need to develop the SAP. Additionally, appendices list each multiple-accident crossing, summarize the grade separation bond fund, and report the 10-year accident data for 2000 to 2009.

Adherence to SAP Mandate

Specific Solutions

The SAP identifies and discusses 10 specific strategies. The plan states that among these 10 items are "a number of new initiatives and projects coupled with more traditional approaches to hazardous crossing identification, evaluation, and improvement project development."

Multiple-Crash/High-Risk Crossings

The multiple-crash crossings for the years 2006 and 2011 are listed in Appendix E of the SAP. The number of incidents over the 5-year period is disclosed along with a notes field that comments on recent and/or planned improvements. Based on crossing comments, it appears that the incidents per crossing include pedestrians, with suicides noted. Therefore, some crossings may be on the list due to intentional actions and not necessarily due to safety hazards. The table signifies that each crossing was evaluated individually.

5-Year Period

The plan clearly states the mandate requirements and seems to present action items focused on a 5-year period. The SAP provides a 10-year accident history in the appendix.

Findings

Major Themes

From an overall program perspective, CPUC has made it policy to reduce the number of at-grade crossings, both through improvements (closure/separation) and the development of policies that make it very difficult to add new crossings on mainline tracks. California has a robust crossing and rail safety program that continually addresses rail safety (freight, commuter, and transit rail) within the state.

Special Conditions

The SAP discusses pedestrian safety and commuter trains, along with transit rail crossings.

Analyses

Appendix G of the SAP contains crash data for the 10-year period of 2000 through 2009. Graphs include total incidents, fatalities, and injuries over that period; gated and non-gated incidents, fatalities, and injuries; and auto, pedestrian, and truck incidents, fatalities, and injuries. Incidents and casualties (fatalities plus injuries) are provided by type of railroad equipment, including freight, passenger, commuter, switching, and other. Incidents by railroad and county are also presented. Several graphics are included that compare California to other States.

Noteworthy Practices

The following are California's noteworthy practices:

- Policies are in place to make it difficult for new at-grade crossings to be added to mainline track throughout the State.
- A dedicated, funded grade separation program helps local agencies with funding of grade separation projects.
- A voter-approved infrastructure bond package included funding specifically for grade separations and other crossing improvements.
- Several other funds can be used for grade separations.
- Strategies include updating the inventory of crossings throughout the State and incorporating additional data elements into the decision-making process that were not previously or have not traditionally been included, such as near-miss data.
- CPUC actively attempts to address the impacts to rail crossings and corridors of new developments or planned future developments. CPUC believes it is more effective to address impacts during development rather than later during inspections or accident investigations.
- One of the strategies is to "broaden communication and interaction between other involved State and Federal agencies to identify funding opportunities, safety initiatives to pursue, and laws and regulations that should be modified or updated to improve rail crossing safety."

- A strategy to review and update CPUC general orders and laws relating to railroad crossings will "identify outdated requirements, clarify language and intent, and identify regulatory gaps and deficiencies in current laws and regulations."
- PCUC provides and sponsors training opportunities for California roadway authority and railroad personnel to improve knowledge and skills in the crossing design and traffic signal preemption fields.

FLORIDA

Attributes of Plan

The 36-page Florida SAP is organized effectively with a table of contents, list of tables, list of figures, and breakdown of ideas with headings throughout the text. Graphics, tables, and maps are used throughout to visualize data elements. There is no mention of outside consulting for the production of the Florida SAP.

The general flow of the Florida SAP includes an introduction providing an overview of Florida, Florida's rail system, and Florida's railroad crossings. The following three sections include United States and Florida general rail crossing statistics, Florida crossing safety challenges, and Florida's Highway-Railroad Improvement Program. The final section in the SAP discusses action plan strategies for eight areas.

Adherence to SAP Mandate

Specific Solutions

The eight areas that guide Florida's action strategies include:

- Grade crossing closures/consolidations.
- Signal safety program.
- Grade separations—new and reconstruction.
- Corridors.
- Pedestrian issues and American with Disabilities Act (ADA).
- Research and analysis through data improvements.
- Public education and awareness programs: Operation Lifesaver.
- Law enforcement.

Each area discussion largely provides an overview of existing efforts to address safety related to that area.

Multiple-Crash/High-Risk Crossings

Within the action plan strategy discussion for the signal safety program is a section dedicated to multiple-incident locations. The plan includes an evaluation of the number of crossings with multiple incidents, with a table breaking down the 74 incidents evaluated for remedial measures by type of incident. The section also presents two improvement matrices that highlight possible strategies. Strategies are selected based on driver behavior or the physical characteristics of the crossing area.

5-Year Period

The SAP does not specifically address the 5-year mandate or specifically indicate that the strategies are for a 5-year horizon. However, the reviewer feels that the development of the SAP was designed in accordance with the mandates.

Findings

Major Themes

According to the Florida SAP, it is the goal of the State of Florida to carry out a highway-railway safety program that promotes a safe, economical, and efficient transportation system in the public interest. Florida is a large State with high population levels and several unique challenges. Since the early 1970s, the department has been very proactive in systematically addressing crossing safety hazards. During the statistical analysis, it was determined that the majority of incidents occur at public crossings, are a result of risky driver behavior, involve motor vehicles, and occur at locations with active warning devices. The same conclusions can also be associated with multiple-incident locations.

Special Conditions

The plan indicates that it is more difficult to construct grade-separated highway-railway crossings in Florida due to the flat terrain.

Analyses

The plan includes a brief analysis of crossings in the State, including presenting the location of at-grade crossings on a map. A more thorough analysis is presented pertaining to incidents within a section titled "Incident Statistics." For all incidents, the data analysis includes a multi-year notation of the number of incidents, fatalities, and injuries for the whole State. It presents the total number of incidents by public or private crossings. After reviewing and analyzing detailed incident reports from FRA, the analysis determined the number of incidents involving vehicles by incident type (e.g., stopped on rails, went around gate, did not stop/yield, or stalled). Non-vehicle incidents included pedestrian, pedestrian suicide, and bicycle. A final table for total incidents breaks down the incidents by type of crossing, active crossings without gates, active crossings with gates, and other crossings. These same analyses were performed specifically on the multiple-incident locations. In addition, multiple-incident locations are divided into urban and rural. A final bar chart demonstrates the percentage of incidents at crossings with active warning devices each year from 2000 to 2010.

Noteworthy Practices

The following are Florida's noteworthy practices:

- The plan analyzes data from FRA and identifies driver contributing factors.
- The plan presents matrices of remedial measures for given driver contributing causes and physical contributing causes. For each measure, a colored circle indicates whether the anticipated benefit from the countermeasure will offset or exceed the risk of the per-driver or physical contributing cause.
- The department has begun installing LED fixtures on east/west crossings to improve warning visibility for the motoring public.
- The Florida Rail System Plan needs assessment includes grade separations for several time periods.

- The Florida DOT works with the railroads to identify corridors where train volumes have increased, train speeds have increased, low-cost improvements can be implemented, and/or crossing consolidations are possible.
- Recent efforts have focused on ADA accessibility at crossings, and the department continues to include ADA accessibility reviews as part of diagnostic field reviews. The department also implemented a calling tree that can be activated in the event of a reported issue in order to contact the correct people for action, follow-up, and information.

GEORGIA

Attributes of Plan

The Georgia SAP is 61 total pages in length, with a 30-page main report and appendices comprising the remainder. The document is effectively organized with a table of contents and breakdown of ideas with headings throughout the text. Graphics and tables are used throughout to visualize data elements. The SAP provides two introductory chapters ("Introduction" and "Problem Identification"), followed by five chapters focused on the action strategies. Appendices provide additional background information and data analysis. It was prepared with assistance from a consultant.

Adherence to SAP Mandate

Specific Solutions

The SAP specifically indicates "the objective of the plan is to identify specific solutions that will reduce collisions between trains or on-track equipment, and pedestrians or vehicles at crossings." The action items are categorized within four categories: education, engineering, enforcement, and data analysis. The first three adhere to the 3E approach of addressing grade crossing safety, while data analysis is critical for measuring and monitoring progress.

Multiple-Accident/High-Risk Crossings

Under the action item "Increase Publicity and Awareness," multiple-accident and high-risk locations are mentioned as locations for targeted publicity and awareness. The Georgia Department of Transportation has also initiated diagnostics for each of the multiple crash locations identified in the investigation. The data analysis section includes analysis and discussions related to multiple crash crossings.

5-Year Period

The Georgia SAP provides an overview of the mandate and specifically indicates the plan applies through 2017, which represents the 5-year period after plan approval.

Findings

Major Themes

The department has taken a programmatic corridor approach in prioritizing crossings for diagnostic evaluation. It then applies programming improvements based on the evaluation. Amtrak and school bus operations are identified by the department as high-risk situations.

Special Conditions

No noteworthy special conditions exist for Georgia.

Analyses

The Georgia SAP presents crossing and crash data in a variety of ways. Data analysis as a specific strategy points to the department's desire to measure and monitor crossing safety in the State. As stated, "measurement and analysis are necessary to improve hazard elimination strategies, as well as develop and evaluate new strategies and measures to reduce crashes." One analysis presents crashes by Class I railroad segments in the State, which presents the information at a finer level than just the entire crashes per railroad. The analysis specifically addresses Amtrak and short line railroad crashes. Crossings with Amtrak operations are considered high-risk crossings.

Noteworthy Practices

The following are Georgia's noteworthy practices:

- The plan highlights using the locations of multiple crashes and high-risk crossings as areas for increased publicity and awareness.
- The department has begun using a new strategy—packaging grade crossing improvements with closures/consolidations as incentives to local areas to close crossings and receive additional improvements.
- The analysis specifically addresses Amtrak and short line railroad crashes.
- School districts in Georgia are requested to report school bus use of crossings equipped with active warning devices every 5 years; that information is then used to update inventory databases.

ILLINOIS

Attributes of Plan

The 46-page Illinois SAP is well organized with a table of contents, list of tables, list of figures, and breakdown of ideas with headings throughout the text. Graphs and tables are used throughout to visualize data elements. There is no mention of outside consulting in the production of the plan.

The general flow of the Illinois SAP includes several introductory/background sections, a section containing the seven action plan strategies, sections containing analysis of crossings and collisions, and a final conclusion section.

Adherence to SAP Mandate

Specific Solutions

The Illinois SAP identifies seven strategies, with each strategy assigning specific goals. Some of the goals listed are very specific in nature, such as closing 50 highway-railway grade crossings within 5 years, while others are goals to maintain existing activities.

Multiple-Accident/High-Risk Crossings

Multiple-accident/high-risk crossings are addressed throughout the plan among the document sections. No single section addresses only multiple accidents, but the presentation of information and data is extensive.

5-Year Period

The SAP adheres to the 5-year planning horizon according to the mandate.

Findings

Major Themes

The grade crossing safety efforts in Illinois are extensive, with the Illinois Commerce Commission and its partners actively pursuing improved safety levels throughout the State. The robust program addresses safety through the 3Es of railroad crossing safety in order to approach the problem from every angle.

Special Conditions

The plan includes analysis of pedestrian-pathway-rail crossings.

Analyses

The Illinois SAP incorporates extensive analyses for both crossings and collisions. The crossing analysis includes a breakdown of the type of crossing and type of warning device by county and railroad operating in the State. The plan also includes tables presenting exposure (the number of trains multiplied by the number of vehicles) by type of railroad, type of roadway, type of warning device, region of Illinois, location of interconnected warning devices, and nearby intersections.

The collision data analysis begins with analyses that include both public and private crossings. Collisions are documented for 5- and 10-year periods in terms of frequency, fatalities, and injuries. The 80 counties that experienced one or more collisions and 117 cities that experienced two or more collisions over a 5-year period are listed. A listing of the private crossings that experienced two or more collisions is also included, along with pedestrian pathway crossings with two or more collisions.

Focusing on public crossing collisions, the analysis provides a number of tables and graphics displaying the information for five general categories: general description of collisions, highway user characteristics, time and seasonal characteristics, highway characteristics, and railroad characteristics.

Noteworthy Practices

To the extent possible, the Illinois SAP includes private crossings within the data analysis. The most detailed analysis only uses public crossings due to data limitations. Noteworthy practices include the following:

- Illinois considers collision investigation as fact-finding evaluations of train-vehicle and train-pedestrian incidents to identify causal trends. The State uses the results of the collision investigation when making determinations where crossing safety improvements are necessary.
- Illinois publishes an annual 5-year Crossing Safety Improvement Program that itemizes projects programmed for the next 5-year period using program funds.
- The plan includes a section that develops the average collision at a public highway-railway crossing.

INDIANA

Attributes of Plan

The Indiana SAP is 34 pages in length and is clearly presented with a table of contents and breakdown of ideas with headings throughout the text. Graphics and tables are used throughout to visualize data elements. It appears to have been done internally by the Indiana Department of Transportation Rail Office. The SAP includes an executive summary followed by three additional chapters: introduction, problem identification, and action plan strategies.

Adherence to SAP Mandate

Specific Solutions

For purposes of evaluating the action plan, three performance measures are used: three-year average grade crossing collisions, the number of fatal and injury collisions at public grade crossings, and the number of multiple-crash crossings with more than two crashes. Each performance measure provides a safety improvement goal to strive for by 2017 (the 5-year period). Seven action plan strategies are included in the strategy chapter. Challenges to implementing each strategy are also included.

Multiple-Crash/High-Risk Crossings

Each crossing with multiple collisions is presented in the plan, along with a breakdown of the characteristics of those crossings (warning devices, railroad class, and counties). One of the strategies addresses multiple-crash crossings.

5-Year Period

The Indiana plan adheres to the mandate requirement and identifies three performance measures for the plan that have 5-year goals.

Findings

Major Themes

Having the fifth highest density of public grade crossings of any State, Indiana recognizes the need to further eliminate grade crossings through closures and separations. The Indiana DOT also notes that to achieve further reductions in grade crossing collision levels, a change in the approach to grade crossing safety is needed. The department supports this statement by adding that two-thirds of collisions occur at grade crossings with train-activated warning devices already in place.

The SAP highlights how grade crossing collisions are a tiny fraction of the number of the State's overall motor vehicle collisions, but that the consequences are more significant in nature.

Special Conditions

One section discusses how the State has no authority to regulate private grade crossings, but that private crossings are problematic along high-speed rail corridors.

Analyses

The Indiana SAP provides data for the number of grade crossings in the State by protection device and tables on how the Indiana grade crossings compare to other States. The plan contains a section summarizing collisions and casualties that includes a table on collisions by warning device and a table on primary factors in grade crossing collisions, among others.

An entire analysis section is focused on multiple-collision grade crossings, including a listing of each of those crossings. Other tables include multiple crossings by nearby signalized intersections, by warning device, and by railroad class. A final table in that section shows the number of multiple collision crossings by county.

The SAP includes a findings section that provides four conclusions related to the data analysis, with each of these conclusions offering two possible countermeasures to the trend.

Noteworthy Practices

The following are Indiana's noteworthy practices:

- The strategy discussions include challenges to implementation.
- Collisions at grade crossings are immediately directed to the Indiana DOT Rail Office Section 130 program manager for quick review. This rapid evaluation includes review of police reports, the corresponding inventory record, and the collision history to assist in determining possible improvements.
- Indiana uses State motor vehicle collision reports to gather additional information regarding contributing factors for collisions not captured by the FRA incident reports and to combine with FRA incident reports to provide a more complete picture of the contributing factors in those collisions.

IOWA

Attributes of Plan

The Iowa SAP is 33 pages in length with a title page, table of contents, table of figures, and executive summary; sections are divided by major headings. Graphs and tables are used throughout to visualize data elements. There is no mention of outside consulting in the production of the plan.

The SAP begins with a clearly written executive summary that conveys the requirements to perform the report, what is included in the plan, the major findings of the data analysis, and the specific action items.

Adherence to SAP Mandate

Specific Solutions

Specific actions to include within the plan were selected from a broad list of possible solutions developed with input from the Office of Rail Transportation, Office of Traffic and Safety, and railroads. The selected actions are emphasized in terms of their affiliation with education, engineering, and enforcement. A fourth category of funding programs is also used. Each of the 12 actions identifies an expected timeline for implementation, most of which fall within the 5-year plan timeline. A later section discusses evaluation measurements for the action items.

Multiple-Crash/High-Risk Crossings

The extensive data analysis incorporates all crossings, including those with multiple collisions in recent years.

5-Year Period

The Iowa SAP clearly indicates on the title page that the plan is for the 5-year period from 2012 to 2016.

Findings

Major Themes

The Iowa SAP includes a graphic that plots the trend of grade crossing collisions since 1980. As part of the graphic, the plan also incorporates upper and lower control limits and forecasts out to 2016. The conclusions indicate that the State's goal is to maintain or improve the historic trend of accident reductions.

Special Conditions

No noteworthy special conditions exist for Iowa.

Analyses

The Iowa SAP includes an extensive crash data analysis organized into demographics, temporal, modal, and location groups. The significant findings section specifies that more analyses were conducted than is presented in the plan. Using the analyses, this section also presents typical collision conditions, such as the fact that the most typical driver of a vehicle that collides with a train is a male 25 years of age or younger.

Noteworthy Practices

The following are Iowa's noteworthy practices:

- Iowa developed a list of possible solutions from input from the Office of Rail Transportation, Office of Traffic and Safety, and the railroads. These solutions were narrowed based on a wide array of considerations to determine the actions to pursue as part of the SAP.
- A section within the plan discusses the responsibilities of the entities involved in grade crossing safety and the expectations of those entities in achieving the goals of the SAP.
- Each action item has an associated expected timeline for implementation, and a discussion notes how the action items will be measured for progress.
- Iowa calculates a benefit-cost calculation ratio number for each public grade crossing in the State annually.

LOUISIANA

Attributes of Plan

The Louisiana SAP is 89 total pages in length. Louisiana developed a safety action plan in 2006, which was amended to meet the mandate. The plan provides a table of contents, graphics, and tables, and breaks the information down into sections with major headings. The flow of the report includes a main body that summarizes background information, lists the action items, and discusses programs. The appendix contains the 2006 SAP, amended action items, and a new data analysis for the time period preceding the new time frame.

Adherence to SAP Mandate

Specific Solutions

The Louisiana SAP contains a list of 12 clearly defined safety action items. Provided in a table, each item contains the action items, desired outcome, lead agency, and timeline/progress (what, why, who, and when).

Multiple-Crash/High-Risk Crossings

Both the original 2006 Louisiana SAP and the amended version performed extensive data analysis, which included evaluations of the multiple-collision grade crossings. The evaluations include a table of each of the multiple-collision crossings with the current protection level and the status of upgrades for those crossings.

5-Year Period

The Louisiana SAP clearly focuses on the action items within a 5-year period.

Findings

Major Themes

Louisiana had proactively developed a safety action plan in 2006 that developed a wide-ranging list of action items. The latest plan is an amended version of the previously developed plan.

Special Conditions

No noteworthy special conditions exist for Louisiana.

Analyses

Louisiana performed extensive data analysis for the 2006 SAP and updated that analysis for this SAP. Generally, all aspects of grade crossing collision data analysis are included within the SAP's analyses, including an analysis of the crossings with multiple collisions in recent years. As an update to the 2006 version, the new SAP offers some comparison between the 2006 and 2011 SAP data analyses.

Noteworthy Practices

The following are Louisiana's noteworthy practices:

- Louisiana had developed a safety action plan prior to the mandate requiring one be performed. The new action plan was an amended version of the original.
- Each action item has a desired outcome, lead agency responsible for the item, and timeline for implementation (i.e., what, why, who, and when).
- A stakeholder meeting was held to assist with identifying the most appropriate safety action plan items for Louisiana.

OHIO

Attributes of Plan

The Ohio SAP is 31 pages in length with a title page, table of contents, and sections divided by major headings. It uses subheadings, bullets, and graphics to more clearly delineate and present the information. It begins with the State's mission or goal statement, followed by an executive summary and program description. Each of the six objectives is written in more of a template format than the remaining body text. This formulated structure clearly presents the objective, planned completion date, plans, and defined measures. The SAP concludes with the State inspection and grant programs, State program challenges, and State program contacts. There is no mention of using outside consultants to develop the SAP.

Adherence to SAP Mandate

Specific Solutions

The Ohio SAP includes six State safety program objectives. Each objective write-up includes a year initiated and year of planned completion. A problem statement defines the problem and is accompanied by a performance objective. For each objective, there are program strategies, activity plans, activity measures, and monitoring and evaluation. One objective has two strategies, while the others have one.

Multiple-Crash/High-Risk Crossings

No mention or analysis of multiple-crash/high-risk crossings is included in the plan.

5-Year Period

The objectives included in the Ohio SAP present a clearly defined year of initiation and year of planned completion. Some of the objectives were initiated prior to the mandate to develop the SAP. The time horizons for the six objectives generally range between 2 and 10 years.

Findings

Major Themes

The State of Ohio recognizes the tremendous role railroads have played and continue to play in the State and views grade crossing and rail safety as an important activity. The Public Utility of Ohio maintains several programs that provide State money for grade crossing improvements.

Special Conditions

Ohio has two State agencies participating in grade crossing safety activities. Each agency has a number of programs.

Analyses

No data analysis is presented in the Ohio SAP.

Noteworthy Practices

The following are Ohio's noteworthy practices:

- Performance measurement for objectives and inspection programs seems to be a regular part of the program as a means of monitoring progress.
- The Public Utility Commission of Ohio maintains several programs that provide State money for grade crossing improvements.
- The Ohio Rail Development Commission maintains several different programs that allow for addressing grade crossing improvements from several perspectives.
- Each year the Public Utility Commission of Ohio contacts over 700 Ohio school districts, encouraging their transportation personnel to report any concerns with public grade crossings through which they travel.
- Through passage of a one-time legislation, the State administered a program that helped pay for profile improvements at crossings by decreasing the elevation between the roadway and railroad.

TEXAS

Attributes of Plan

The robust Texas SAP is 218 pages in length with a title page, table of contents, and sections divided by major headings. It uses subheadings, bullets, graphics, and maps throughout to display the information contained within the text. The 66-page main report contains four sections and an executive summary. Nine appendices contain additional information and extensive data analyses. The SAP was developed in-house by Texas DOT's Rail Division (crossing managers now belong to the Traffic Operations Division).

Adherence to SAP Mandate

Specific Solutions

Texas DOT held a stakeholder meeting where a diverse group of local traffic engineers, railroad partners, representatives from Texas Operation Lifesaver, and staff from the Federal Highway Administration (FHWA), FRA, and TxDOT developed a list of action plan recommendations. The recommendations were developed under four program areas for grade crossing safety improvements: evaluation, engineering, education, and enforcement. The extensive list of action items is divided into two strategy categories: evaluation/engineering and education/enforcement. The Texas SAP includes a section that offers an implementation timeline, where the action items are assigned to each fiscal year of the 5-year time frame.

Multiple-Crash/High-Risk Crossings

The Texas SAP contains a major data analysis section and two appendices that identify and analyze crossing locations with multiple crashes. The SAP also identifies significant findings for multiple-crash locations as part of the strategy development section and includes maps showing the location of each of the crossings that experience multiple crashes.

5-Year Period

The Texas SAP clearly focuses on the implementation of the identified action items over a 5-year period. It includes a section that offers an implementation timeline where the action items are assigned to each fiscal year of the 5-year time frame.

Findings

Major Themes

Texas has a large rail network and large number of highway-railway grade crossings. TxDOT used the knowledge and input of its many rail crossing safety partners to help facilitate the plan.

Special Conditions

Passenger and commuter rail collisions were identified and included in the SAP.

Analyses

The Texas SAP performed a tremendous amount of data analysis, virtually examining grade crossings and grade crossing collisions in the State from every angle. Additional specific analyses were performed on the multiple-collision crossings.

Texas used the data analysis to determine major findings associated with grade crossing collision locations, casualty information, and highway users . A major section also presents significant findings associated with multiple-crash locations.

Noteworthy Practices

The following are Texas's noteworthy practices:

- TxDOT held a stakeholder meeting where a diverse group of local traffic engineers, railroad partners, Texas Operation Lifesaver representatives, and staff from FHWA, FRA, and TxDOT developed a list of action plan recommendations.
- In addition to the overall stakeholder meeting, the SAP indicates that TxDOT worked closely with FRA to develop the action items.
- The Texas SAP includes a section that offers an implementation timeline, where the action items are assigned to each fiscal year of the 5-year time frame.

APPENDIX C

Blocked Highway-Railway Grade Crossings

Highway-railway grade crossings blocked by standing trains can pose multiple risks to public safety. Emergency response times can be dangerously impacted if responders find the fastest route to an incident is blocked by a train in a crossing. For example, Emergency Medical Technicians responding to a victim with heart attack symptoms could be delayed as they try to find an alternate route when the crossing is blocked by a standing train. Fire trucks and response teams, if forced to take another route because of a stopped train, may arrive at a fire scene too late to prevent major structure damage or to safely evacuate trapped victims. Delayed police response can lessen the chance to apprehend a criminal or prevent a more serious crime.

There may be other negative consequences when a train is stopped on a crossing as well. For example, a blocked crossing on a signed truck route can result in the detouring of large trucks over local streets not designed for their use and that cannot safely accommodate their large turning circles or heavy axle loadings. This can expose local neighborhoods to increased risk of collisions or blocked access when these trucks encounter difficulty maneuvering through small, local streets not intended for their use.

Blocked crossings can greatly impact pedestrians in areas with a significant amount of non-motorized users because any increase in detour routes significantly increases the time to travel between destinations at walking or cycling speeds. Blocked crossings near schools are especially critical safety hazards due to the potential for children to cut through the idling trains.

Blocked crossings can also create a time-consuming inconvenience on the motoring public as well. Travel to accomplish daily tasks such as commuting to work, school, shopping, and similar activities can create secondary ramifications that could affect quality of life, extend travel times, and increase vehicle emissions. Depending on the length of time that a crossing is blocked, the type of vehicles at a blocked crossing, and the configuration of the highway, drivers could experience dangerous or illegal responses if the driver attempts to seek an alternate route. Drivers also may try to "outrun the train" by speeding to cross the tracks before the oncoming train reaches the crossing at locations that are frequently blocked.

Identification and Evaluation of Safety Risks

While the Federal Railroad Administration (FRA) does not collect data on blocked crossings, anecdotal evidence which includes a significant amount of correspondence seems to indicate the frequency at which highway-rail grade crossings are blocked by standing trains is increasing. Therefore, FRA strongly encourages States to address blocked crossings in their SAPs.

States should consider making a concerted effort to collect and track reports of blocked crossings. These reports can come from many sources such as local citizens, law enforcement, emergency responders, and parcel delivery drivers. Therefore, States are encouraged to publicize their efforts to collect and track reports of blocked crossings at stakeholder meetings. As data on crossing blockages is accumulated, trends in causation and negative effects can start to be extracted. However, effective data collection will depend upon creating a standardized data collection form with all relevant information the States want to receive from the blocked crossing report. Instructions for the form should indicate standard formats and syntax for recording blocked crossing information such as the street name, railroad involved, the locomotive numbers (if possible), the USDOT National Highway-Rail Crossing Inventory number, and the time, date and duration of the blockage.

Best Practices

Improved Communication

In cases where crossings are found to be regularly blocked at the same time of day, routine railroad operations may be contributing to the problem. Making contact with local railroad personnel should be the first step for localities seeking to reduce the number and duration of crossing blockages. FRA's Regional Highway-Rail Crossing Managers can often provide contact information for local railroad personnel and help facilitate communication between the local community and the railroad.

It may well be that railroads can hold trains waiting to enter a yard or industry facility at a location that would not require blocking grade crossings. Railroads also can sometimes change places where trains wait to enter single track territory to avoid blocking a nearby crossing.

Localities and railroads can both benefit from improved working relationships with each other. Frequent interaction between local governments and railroad personnel on safety issues important to both parties can provide the opportunity to address the problems resulting from trains blocking grade crossings. Good working relationships can facilitate major mitigation projects, such as crossing consolidation and grade separations. Providing information to the motoring public, particularly in areas where block crossings occur frequently, can also mitigate travel challenges. Communication to highway travel management centers, which serve as highway travel communication hubs, will also assist with transportation operations.

Coordination between Emergency Services and Local Railroad Personnel

An improved relationship between the locality and the railroad can also provide greater understanding and collaboration to address the complex operational needs of modern emergency response agencies as well as the issues surrounding safe and efficient operation of the railroad. Once emergency services have established their preferred response routes for various neighborhoods or businesses, they should share those routes with the railroad so railroads can anticipate and avoid blocked crossing conflicts through good planning and cooperation. Similarly, when a highway-rail grade separation project is completed, the highway authority should contact local emergency services so those emergency services can adjust their preferred response routes to take full advantage of the newly enhanced accessibility provided by the grade separation structure.

Relocation of Railroad Infrastructure

Sometimes, where there are large railroad corridors carrying high volumes of rail traffic that cross busy arterials or run through city centers, it can become financially viable to consider relocating the railroad infrastructure (by means of a rail bypass or a rail grade separation project). An example is the Alameda Corridor in the Los Angeles area. This type of project requires large expenditures by railroads and can involve reconfiguration of local roadway networks to accommodate the new railroad facilities. Close collaboration between railroads and localities is central to the completion of such a large-scale planning and engineering undertaking.

Likewise, it is important to consider the potential of crossing blockages during the design phase of a new crossing or when evaluating the possible relocation of an existing crossing. For example, the likelihood of a crossing being blocked by a standing train is much less if the roadway crosses the tracks at a location other than one where trains meet or pass each other. Therefore, communication between the locality and the railroad to determine where a new highway-rail grade crossing should be located is critical.

Land-use Planning and Zoning Considerations

Localities with jurisdiction over land-use planning and zoning should always consider the location and number of grade crossings that could be impacted by long-term land development and the establishment of new residential developments that would be dependent on grade crossings for access into and out of new communities. For example, the California Public Utilities Commission (CPUC) noted in its State Highway-Rail Grade Crossing Action Plan that it actively attempts to address the impacts new developments or planned future developments have on grade crossings and railroad corridors. The CPUC notes that it is more effective to address impacts during development rather than later during inspections or accident investigations.

When selecting a site for a new emergency services facility, localities should consider the location of nearby grade crossings and assess the potential negative impacts on response times that could result should a crossing become blocked during an emergency event.

Enforcement

Some State and local governments have laws or ordinances intended to limit the time a highway-railway grade crossing may be blocked by trains or other rail equipment. Therefore, the State or local government could seek to enforce any relevant requirement it has.

However, many State laws in this area have the effect of regulating aspects of railroad operations currently regulated by FRA (such as train speed, train length, air brake testing, other air brake safety requirements, and the operation of trains at crossings). Therefore, courts have found some State laws on this issue to be preempted, either by Federal railroad safety statutes and regulations, or by the Interstate Commerce Commission Termination Act, which establishes the general authority of the Surface Transportation Board over certain aspects of railroad operations.

Additional Signage

Where alternative routes exist which enable a motorist to avoid a blocked crossing, providing signs to reroute traffic is a way to mitigate the effects of the blocked crossing. One example of an excellent solution that mitigates the impacts of a blocked crossing is from downtown Kirkwood, MO. Amtrak trains servicing the passenger station in Kirkwood frequently block Kirkwood Road, a major arterial also known as US-61 and US-67. The street network is a grid. A parallel street one block from Kirkwood Road has an overpass over the tracks. When the Kirkwood Road's crossing's automatic warning devices are activated, a sign lights up on Kirkwood Road at the adjacent intersections on each side of the tracks that directs motorists to the overpass on the parallel street. The illuminated sign has an arrow that reads "Use Overpass 1 Block." A driver unfamiliar with the area would probably not know there is an overpass one block away without the sign due to buildings blocking the view of the overpass.

APPENDIX D

Costs and Benefits of Various Crossing Improvements

There are a wide variety of crossing treatments that will improve crossing safety and may help mitigate blocked crossings. However, the costs of these treatments may vary greatly depending on the specific physical and operating characteristics of a crossing. The chart below provides a list of some of the common infrastructure improvements that reduce the risk of a crossing collision occurring. It also provides typical cost ranges and estimated risk reductions for the improvements.

Improvement	Estimated Cost Range*	Effectiveness**
No signs to passive (crossbuck assembly)	$500 to $1500	25%
Passive to flashing lights	$120,000 to $250,000	64%
Passive to flashing lights with gates	$150,000 to $300,000	88%
Flashing lights to flashing lights with gates	$150,000 to $250,000	44%
Flashing lights with gates to 4 quadrant gate system	$250,000 to $500,000	82%
Flashing lights with gates to flashing lights with gates and medians	$30,000 and up depending on construction and right-of-way acquisition	80%
Flashing lights with gates to flashing lights with gates and channelization	$15,000	75%
Grade separation	$5M - $40M	100%
Closure	$25,000 to $100,000	100%

** Based on 2015 dollars.*

*** The effectiveness of a treatment refers to the expected reduction in the number of highway-railway collisions at a location. It does not reflect a reduction in the severity of collisions or a reduction in the number of fatalities.*

For More Information:

http://safety.fhwa.dot.gov/

U.S. Department of Transportation
Federal Highway Administration

U.S. Department of Transportation
Federal Railroad Administration

NOVEMBER 2016

FHWA-SA-16-075

Safe Roads for a Safer Future
Investment in roadway safety saves lives