



# ROAD SAFETY AUDIT MANUAL



## TABLE OF CONTENTS:

Table of Contents .....	i-iii
Executive Summary .....	iv
<b>1. INTRODUCTION</b> .....	<b>1</b>
1.1 Purpose.....	1
1.2 Scope.....	1
<b>2. OBJECTIVES</b> .....	<b>1</b>
<b>3. DEFINITIONS</b> .....	<b>1</b>
<b>4. HISTORY</b> .....	<b>2</b>
<b>5. SAFETY AUDIT IMPLEMENTATION PROCESS</b> .....	<b>3</b>
5.1 Brief RSA Process .....	3
5.2 Who Initiates the Audit? .....	3
5.3 RSA Management.....	5
5.3.1 DTE .....	4
5.3.2 RSA Team Leader .....	4
5.3.3 RSA Team Size .....	5
5.3.4 Selection of the RSA Team Members .....	5
5.3.5 RSA Team Responsibilities.....	5
5.4 Relevant Data and Documents.....	5
5.5 Conduct a Briefing Meeting .....	6
5.6 Perform Field Review .....	6
5.6.1 Suggested Field Review Equipment.....	6
5.6.2 Field Review Procedures.....	6
5.7 Conduct a De-Briefing Meeting .....	6
5.8 Presentation of RSA Results.....	7
5.9 RSA Report.....	7
5.9.1 Content of Report .....	7
5.9.1.1 Report Title Page.....	7
5.9.1.2 Introduction .....	7
5.9.1.3 Scope of the RSA .....	7
5.9.1.4 Objectives.....	8
5.9.1.5 RSA Process.....	8
5.9.1.6 Summary of Recommendations .....	8
5.9.1.7 Cost Estimate.....	8
5.9.1.8 Approval/Disapproval/Comment .....	8
5.10 District Response to Safety Improvement Recommendations .....	9
5.11 Filing and Archiving.....	9
<b>6. PERFORMANCE MEASURES</b> .....	<b>9</b>
<b>7. CONCLUSION</b> .....	<b>9</b>
<b>8. KEY REFERENCES</b> .....	<b>9</b>
<b>9. ACRONYMS</b> .....	<b>10</b>
<b>LIST OF APPENDICES</b> .....	<b>10</b>

- Appendix A: Safety Audit Exemption Justification
- Appendix B: Sample Crash Data
- Appendix C: Prompt List for Existing Roads
- Appendix D: Sample GIS Map Showing Crash Severity
- Appendix E: Sample RSA Report
- Appendix F: History

## **Executive Summary**

**Road Safety Audits (RSAs) have become a proven countermeasure for improving safety on roadways. The Idaho Transportation Department (ITD) plans to utilize this countermeasure to reduce the number of crashes and the severity of crashes on Idaho's roads.**

**The RSA process is a formal, independent safety evaluation on planned or existing roadways by an experienced and multidisciplinary team of specialists. The team looks for existing and/or potential safety hazards that may affect any type of road users and identifies possible countermeasures to address those safety issues. The RSA team is composed of transportation professionals and individuals with special safety knowledge from federal, state and local agencies and may include engineers, law enforcement, first responders, maintenance and other disciplines that may provide valuable input for a section of road.**

**The following guidelines formalize ITD's procedures on RSA's. It contains the steps for conducting an RSA on an existing road or project. The principal purpose of the RSA is to identify potential safety issues that may be caused by the design, or some operational aspect of the facility and is meant to be proactive. It should consider all road users such as drivers, pedestrian, motorcyclists and bicyclists. The RSA is not meant to rank projects or to determine compliance with standards.**

**The key to a successful RSA is capturing essential safety and operational issues. The prioritized recommendations are *low cost suggestions* that generally pertain to traffic signs, striping, rumble strips, bike and pedestrian safety enhancements, sight distance and other safety issues.**

**The guidelines presented in this manual utilize information from the *NCHRP SYNTHESIS 336 & 321, FHWA Road Safety Audit Guidelines 2006* and from Nevada's Department of Transportation's *RSA Procedures and Guidelines 2009*.**

## 1. INTRODUCTION

### 1.1 Purpose

The benefits resulting from RSAs have been documented in many countries in Europe as well as in New Zealand, Australia and Canada. In the United States the concept is beginning to be recognized as a cost-effective tool in reducing risks on roadways and more than 20 states are using this process to help improve road safety in their states.

This document provides guidance for the use of RSAs on new transportation project plans and on existing roads.

These guidelines will give users a detailed process for conducting effective RSAs that focus on safety perspectives that may reduce the number and severity of crashes on Idaho roadways.

### 1.2 Scope

- An independent, qualified and multidisciplinary team shall perform the RSA.
- The primary purpose of the RSA is to identify existing or potential road safety hazards that could adversely affect road users and look at ways to reduce conflicts under all road-operating conditions.
- The RSA should consider only road safety related issues and is not a technical review for compliance with design standards. Its main focus should be identifying low cost safety countermeasures.
- Considers all road users' safety – younger and older drivers, motorists, pedestrians, and bicyclists – rather than traditional automobile drivers only.
- The purpose of the RSA is not focused on increasing the road's capacity and structure adequacy unless it directly affects safety.
- The RSA team should follow the procedures specified in these guidelines.

## 2. OBJECTIVES

- Reduce the risk and severity of crashes by identifying and addressing existing and potential road safety issues.
- Identify conflicting road messages from the road user's viewpoint.
- Improve awareness of safe maintenance practices.
- May reduce the need for safety modifications after construction.

## 3. DEFINITIONS

- 3.1 **Road Safety Audit (RSA)** – a formal and independent safety assessment of a road segment or project by an experienced team of specialists, addressing the safety of all road users.
- 3.2 **RSA Team** – a group of trained transportation professionals with pertinent road knowledge and may include individuals from federal, state and local agencies and other entities selected to conduct the RSA. Selected team members should be independent from the project design team in order to conduct the RSA without bias.

- 3.3 **RSA Team Leader** – refers to a member within the RSA team designated as the leader. The selected leader should have management skills and should have participated in previous RSAs. The leader’s tasks include but are not limited to coordinating and holding the briefing and debriefing meetings, writing the audit report, and ensuring that the audit process is conducted in accordance with the procedures specified herein.
- 3.4 **RSA Report** – refers to the report prepared by the RSA team. The report describes potential safety issues identified during the RSA and the recommendations for possible solutions.
- 3.5 **RSA Exemption Justification (RSAEJ)** – a written report justifying why a project does not warrant an RSA.
- 3.6 **District Traffic Engineer (DTE)** – Engineer responsible for commissioning an RSA and ensuring that the procedures specified herein are properly followed through to completion.
- 3.7 **District Engineer (DE)** – The safety administrator who has the responsibility of reviewing and approving the audit recommended safety improvements. This administrator is responsible for approving, disapproving or deferring the RSA recommended schedule for implementation.
- 3.8 **State Highway Operations and Safety Engineer (HOSE)** – Engineer responsible to manage the RSA program and approve or disapprove RSAEJ’s.
- 3.9 **Crash Data** – The collection of historical crash information from a recent study period to identify high crash locations, common trends, or patterns and factors that may have contributed to crashes. Typically includes three years for urban roads and five years for rural roads.
- 3.10 **Independent** -Members of the team should not be involved directly with the project or be responsible for the section of road being audited.

#### 4. RSA IMPLEMENTATION PROCESS

##### 4.1 Overview of RSA Process

Generally, it takes about a month to complete an RSA from the time the team is organized to the time the final audit report is completed.

- RSA initiated
- Determine if RSA is to be done
- Team leader appointed
- Team members finalized
- RSA scheduled
- Conduct a briefing meeting and provide relevant data and documents to the RSA team
- Perform field reviews
- Conduct a debriefing meeting
- Draft the RSA report
- Compile appropriate recommendations from RSA for future projects
- Present the recommendations to the safety administrator (DE)
- Completion and distribution of final RSA report

##### 4.2 Who Initiates the RSA?

Anyone can request an RSA for a new project or operational roadway by contacting the DTE. Typical stages to consider conducting a RSA are:

- Projects utilizing HSIP funding
- Public request
- DTE identified operational or safety locations
- Existing roadways where maintenance or law enforcement have identified concerns
- Locations where crash data indicate possible problems exist
- Planning stage/scoping process or feasibility study
- Preliminary design stage
- Intermediate design stage
- Work zone temporary traffic control planning
- Work zone temporary traffic control implementation
- Pre-opening to the public or before temporary traffic control device removal
- Other safety program projects

#### 4.3 RSA Management

##### 4.3.1 DTE

The DTE investigates whether or not a requested RSA would be useful based on statistical crash data and/or extent of project scope or other factors, such as if a similar RSA has been done in the past. Should the DTE elect not to perform an RSA, the DTE should fill out and file a RSA Exemption Justification (RSAEJ) as shown in [Appendix A](#). If the DTE determines that a RSA should be performed, the DTE will be responsible for identifying an RSA team leader and core members. If the district elects to consult out all or part of the RSA, funding is the responsibility of the district.

When the RSA is complete, the DTE distributes the final report to the DE, district decision makers, HOSE, and to all RSA team members.

After the final report has been issued and the district action has been determined, the DTE should distribute a memo summarizing the district decisions for all safety improvement recommendations put forth by the RSA team.

DTE should ensure that safety vests are available for all team members.

##### 4.3.2 RSA Team Leader

The RSA team leader schedules and coordinates the RSA as well as suggests the remaining RSA team members to be approved by the DTE.

The RSA team leader contacts individuals selected to be a part of the RSA team. A formal meeting should be scheduled using Outlook or another recognized scheduling program for all members and facilities involved in the RSA. A meeting reminder should be sent to the entire RSA team one week prior to the beginning of the audit process.

The RSA team leader ensures the RSA report gets drafted and finalized. The RSA team leader may elect to write the report themselves or select an alternate to write the report.

The RSA team leader is responsible for the presentation of the draft report to the DTE and other district decision makers.

RSA team leader finalizes the report and submits the report to the DTE for distribution.

#### 4.3.3 RSA Team Size

Depending upon the project scope and intricacy of safety issues, the recommended RSA team size is from three to six members, and can be as large as ten.

#### 4.3.4 Selection of the RSA Team Members

The RSA team members should be trained and experienced transportation professionals and individuals with pertinent road safety knowledge.

The core team typically includes an independent district traffic engineer, maintenance foreman, roadway designer and highway safety research analyst. In addition to the core team, individuals from specific disciplines may be added to provide their expertise on the project or existing roadway being audited. Such individuals include emergency medical services responders; law enforcement personnel; highway geometrics engineer; bridge engineer; materials engineer; those with skills in road maintenance, pedestrian and bicycle pathways, intelligent transportation systems, street lighting, traffic calming; and those individuals with knowledge and experience in ITD's *Work Zone Safety and Mobility Program*.

#### 4.3.5 RSA Team Member Responsibilities

- Participate in all RSA activities
- Minimize all competing distractions during RSA activities
- Identify potential safety issues
- Consolidate findings for safety improvement(s) recommendations
- Participate in a debriefing meeting to present the findings to the sponsors of the RSA
- Select safety improvement recommendations to incorporate into the draft report
- Review and comment on the draft report

#### 4.4 Relevant Data and Documents

The RSA team leader obtains all relevant data and documents and distributes the materials to the team. The RSA team leader should ensure that pertinent data and documents needed for the RSA are available at least one week before the audit is undertaken. The team members should review the information before the start of the RSA. Typical data and documents include:

- Statement of project scope, stage of the design, and potential/expected road users
- Plans showing the right of way, alignment, drainages, utilities, and other roadway appurtenances that may be helpful for the RSA
- Plans showing pavement striping, traffic signs, temporary traffic control devices, barriers, and other roadway features that may be useful for the RSA
- Potential/expected traffic volume – this includes turning movement count
- Crash data (from the latest three-year study period for urban roads and five-year for rural roads) of existing roads that are or that may be affected. Sample crash data is shown in [Appendix B](#)

- Aerial photographs (i.e. Google Earth)
- Public input (if available)
- Land use (if available)
- Traffic impact study (if available)
- RSA prompt lists ([Appendix C](#))
- Previous RSA report(s), if available
- As-Built Plans, showing the right of way, alignment, drainage, utilities, and other existing roadway appurtenances that may be helpful for the RSA
- GIS map showing crash frequency and severity (sample map - [Appendix D](#))
- Maintenance records, if applicable
- Safe Routes to School Plans, if applicable

#### 4.5 Conduct a briefing meeting

The objective of the briefing meeting is to bring together the project owner, the design team, the audit team and any other relevant individuals to discuss the scope of the audit and to review the available information. The purpose of the briefing meeting is to:

- Review the scope and objectives of the RSA
- Discuss the roles and responsibilities of the team members
- Agree upon a schedule for the RSA

#### 4.6 Perform Field Review

Once the briefing meeting has finished, a field review of the site should be conducted. A site visit is essential to the RSA process. The team should have previously looked at the relevant data and documents and clarified any questions. The field review should focus on safety issues and is not meant to tackle non-safety related concerns such as aesthetics and amenities. More than one site visit may be necessary to adequately perform the RSA.

##### 4.6.1 Suggested Field Review Equipment

The team should conduct the field review in a manner that is safe and maximizes time and effort. Some useful field instruments during the field review are:

Digital Camera	Smart level
Laptop Computer	Safety Vests and Hats
Recording Device	Flashlights
Measuring Tape/Wheel	Speed Gun
Vehicle to accommodate the entire RSA team	

##### 4.6.2 Field Review Procedures

- At the end of the briefing meeting, the team will identify a person to take notes, a driver, and a photographer. The team should bring relevant data and documents for use in any discussions during the field review. It is recommended that the team travel as a unit in one vehicle to allow full discussion of all the safety issues.
- The review team should be outfitted with all necessary safety equipment including safety vests, appropriate shoes, and hard hats when required.
- The team should inspect the site both in the daytime and at night, stopping as needed to discuss observations and recommendations giving emphasis on road *geometry*,

*operations, road users, and environment (G.O.R.E.).* Consideration of time of day issues, such as sunlight glare, should be a factor in determining the time for visits.

#### 4.7 Conduct a De-Briefing Meeting:

After the field review, the team should meet to discuss and consolidate the team observations and suggest safety improvement recommendations. The team should then prioritize the safety recommendations. To get the most from the meeting, the team should consider the following:

- The RSA team leader should encourage discussion and keep a positive tone.
- Team members should discuss their observations and suggest safety improvement recommendations.
- The RSA team selects which safety improvement recommendations to include in the RSA report. Significant comments, observations and recommendations not included by the RSA team should be recorded in a separate attachment to the RSA report, along with the reasoning for the RSA team's lack of endorsement.

#### 4.8 Presentation of RSA Results

After the RSA debriefing meeting and the RSA report is drafted, the RSA team leader should preview the significant components of the report with the DTE. When the DTE is satisfied with the concepts of the draft report, the DTE coordinates an informal meeting for the presentation of the draft report by the RSA team to the DTE and other district decision makers. Typically all members of the RSA team participate in the presentation. Any significant comments from this presentation should be addressed in the final report.

#### 4.9 RSA Report

The RSA team leader is responsible for getting the RSA report written. The report should be concise and to the point. Pictures, charts, diagrams, and maps to further illustrate points made in the report may be included.

##### 4.9.1 Content of the Report:

The report should contain a report title page, introduction, scope of the RSA and background information, objectives, RSA process, summary of recommendations, cost estimates and a section for approvals/disapprovals/comments. Below is a sample outline.

##### 4.9.1.1 Report Title Page

The report title page should include a title that identifies the road name(s), location limits or milepost limits, project title and design stage, and RSA date; *e.g.*:

- US-95 from MP 0.0-5.27 Road Widening, July 22, 2010, *or*
- US-95 from MP 0.0-5.27 Road Widening, Work Zone Temporary Traffic Control, July 22, 2010, *or*
- US-95 from MP 0.0-5.27 RSA Safety Corridor, July 22, 2010

##### 4.9.1.2 Introduction

The introduction should list the purpose of the RSA and the procedure used to conduct the RSA. Include a list of the participants.

##### 4.9.1.3 Scope of the RSA/Background Information

The scope of the RSA should be similar to the one stated below.

“The RSA Team conducted a formal safety review on “specified roadway and date” (example: SH-55, Karcher Blvd. from the I-84 business loop to Farmway road on July 22, 2010). The goal of this RSA was to identify potential road safety issues and identify opportunities for improvements in safety for all road users. The RSA is not intended to evaluate design work, check for compliance with standards or investigate crashes. Instead, the RSA Team strived to look at safety issues from a different perspective and develop recommendations for potential safety enhancements.”

#### 4.9.1.4 Objectives

State the specific objectives and what you want to accomplish with the RSA.

#### 4.9.1.5 RSA Process

The section on the RSA process should address the following topics:

- Describe the briefing meeting including the attendees, date, place and discussion notes.
- Describe the field review process for both day and night reviews, including the date, time and lighting conditions and the participants.
- Summarize the discussions from the de-briefing meeting.
- List the observations and recommendations and indicate the agreed upon comments and recommendations from the de-briefing meeting.
- Include any significant comments, directions or suggestions from the report presentation to the district decision makers.

#### 4.9.1.6 Summary of Recommendations

The report should include a prioritized list of the RSA team’s reasonable safety recommendations. Low cost/high impact improvements should be prioritized higher than higher cost improvements. The summary of recommendations should include the following information:

- Safety issues that warrant immediate attention
- Short term safety recommendations to be done by the DTE and/or maintenance forces within a reasonably short time frame.
- Safety recommendations that warrant inclusion in near-term capital improvement projects.
- Future safety improvement recommendations that can be done when they become warranted due to future traffic volume increases, neighborhood growth and development, or some other cause for change.
- Appendix E shows a sample Summary of Recommendations

#### 4.9.1.7 Cost Estimate

A cost estimate may be provided for each safety recommendation from the Summary of Recommendations. The cost estimate should be based on the best estimate of current bid pricing.

#### 4.9.1.8 Approval/Disapproval/Comment

This section should include a statement similar to the following: “After the final RSA report has been received and in order to increase the effectiveness of the RSA process, a memo should be distributed to the RSA team members by the DTE stating the districts actions for the safety improvement recommendations listed in the report”.

#### 4.10 District Response to Safety Improvement Recommendations

The district decision makers should review the final RSA report and determine which recommendations to implement and the time frame for implementation, and which recommendations will not be implemented. These decisions should be documented and be distributed to the RSA team members.

#### 4.11 Filing and Archiving

All filing and archiving is the responsibility of the DTE.

### 5. Performance Measure

A performance measure is a way of assessing the effectiveness of the RSA recommendations after they have been implemented. Three years after the RSA recommendations were implemented, OHOS will reexamine the RSA roadway using the following steps:

- An OHS principal research analyst will evaluate crash data for the RSA roadway, covering a period three years before and three years after the RSA recommended changes were implemented.
- An OHS principal research analyst will evaluate the crash types that decrease or increase in crash severity for reduction or amplification factors.
- An OHS principal research analyst calculates the actual benefit to cost ratio.
- An OHS principal research analyst will document the report findings and distribute them to the DTE.

### 6. CONCLUSION

The preceding guidelines were developed for Idaho in an effort to reduce the number of crashes and the severity of crashes on Idaho’s roadways. These guidelines are the beginning of an RSA program being initiated by ITD, therefore, changes to the procedures may be expected in the future as we continue developing the program. Documentation of the RSA recommendations that were implemented in a project is an essential factor in assessing the benefit of the RSA. These guidelines formalize ITD’s RSA procedures.

### 7. REFERENCES

Louisa Ward, *FHWA Road Safety Audit Guidelines*, Federal Highway Administration  
Publication NO. FHWA-SA-06-06, 2006

*Road Safety Audits*, a Synthesis of Highway Practice, NCHRP 336, Transportation Research Board, Washington D.C., 2004

*Road Safety Tools for Local Agencies*, a Synthesis of Highway Practice, NCHRP 321, Transportation Research Board, Washington D.C., 2003

*AUSTROADS, Road Safety Audit*, Austroads, Sydney, Australia, 1994

*Road Safety Audit Guidelines*, National Roads Authority, St. Martins House, Waterloo Road, Dublin, July 2004

*Road Safety Audit Procedures for Projects, Guidelines*, Transfund New Zealand, P.O. Box 2331, Wellington, November 2004

*Road Safety Guidelines*, University of Brunswick, Transportation Group, Department of Engineering, Fredericton, New Brunswick, 1999

Asian Development Bank, 2003, *Road Safety Audit for Road Projects – An Operational Tool Kit*, Manila, Philippines

Girish N. Modi, P.E., *Benefits of RSAs*, Bureau of Highway Safety and Transportation Engineering, Pennsylvania DOT

Global Road Safety Partnership

*FHWA Study Tour for Road Safety Audits, Part 1 – Final Report and Part 2 – Case Studies & Check Lists*, FHWA Scanning program, U.S. Depart. of Transportation, FHWA, Dec 1997

*Road Safety Audits, an Emerging and Effective Tool for Improved Safety*, U.S. Department of Transportation, Federal Highway Administration, April 2004

*Conducting In-Service Road Safety Operational Review of Temporary Traffic Control in Work Zones*, Monte Johnston, E.I.T., Transportation Safety Engineer, Hamilton-Finn, Road Safety Consultants; Dr. John Morrall, P. Eng., president Canadian Highway District Institute, Ltd.; Bruce Swanson, P. Eng., Detour Engineer, Road Traffic Assessment Division, The City of Calgary.

## 8. ACRONYMS

FHWA.....	Federal Highway Administration
ITD.....	Idaho Transportation Department
OHOS.....	Office of Highway Operations and Safety
OHS .....	Office of Highway Safety
MP.....	Milepost
NCHRP .....	National Cooperative Highway Research Program
RSA.....	Road Safety Audit

## 9. LIST OF APPENDICES

- Appendix A: Safety Audit Exemption Justification
- Appendix B: Sample Crash Data
- Appendix C: Prompt List for Existing Roads
- Appendix D: Sample GIS Map showing Crash Severity

Appendix E: Sample RSA Report

Appendix F: History

# APPENDIX A

## SAFETY AUDIT EXEMPTION JUSTIFICATION

**Project Title:** .....

**Project Stage:** .....

**Brief Description of Potential RSA:**

**Reasons for not undertaking the RSA:**

**Signed:** ..... (District Traffic Engineer)

**Name (print):** .....

**Date:** .....

## Appendix B Sample Crash Data

**Total Accidents: 129**    **Total Fatalities: 0**  
**Total Units: 267**    **Total Injuries: 75**  
**Total People: 411**

**Report Criteria:**

Accident #	Street1	IntersectionDistance	IntersectionDistanceUnits	DirectionFromIntersection	Street2	LaneOfImpact	SegmentCode	AccidentDate	AccidentTime	SerialNumber
1	Eagle Rd	100.0000	F	N		52	002005	12/22/2009	13:20	09C256334
	Eagle Rd	100.0000	F	N		52	002005	12/22/2009	13:20	09C256334
2	Eagle Rd				Fairview Ave	49	002005	12/15/2009	15:14	09C251763
	Eagle Rd				Fairview Ave	49	002005	12/15/2009	15:14	09C251763
3	Eagle Rd	60.0000	F	N		49	002005	11/25/2009	12:09	09C251386

This is just a sample list of crashes to show the format. The actual crash report would include all 129 crashes for this location.

## Appendix B Sample Crash Data

### Intersection Analysis Report

AgencyCaseId	LightCondition	WeatherCondition	RoadSurfaceCondition	RoadConditionOther	Units	Fatalities	Injuries	AgencyName	Severity	UnitId	TravelDirection
09-007287	Day	Cloudy	Dry	None	2	0	2	Meridian Police Dept	C Injury Accident	11379025	S
09-007287	Day	Cloudy	Dry	None	2	0	2	Meridian Police Dept	C Injury Accident	11379026	S
09-007144	Day	Cloudy	Wet	None	2	0	1	Meridian Police Dept	C Injury Accident	11305003	N
09-007144	Day	Cloudy	Wet	None	2	0	1	Meridian Police Dept	C Injury Accident	11305004	N
09-6727	Day	Clear	Dry	None	2	0	2	Meridian Police Dept	C Injury Accident	11295025	N

## Appendix B Sample Crash Data

UnitType	OperatorAction	Age	Injury	LicenseState	ProtectiveDevice	Ejection	Citation	fldAccidentYYYY	CountyName	Cityname	Image
Pickup/Van/Panel/SUV	Going Straight	32	None Evident	Idaho	Non-Activated Air Bag- Belts In Use	Not Ejected	49-638	2009	Ada	Meridian	COMPLETE
Pickup/Van/Panel/SUV	Stopped In Traffic	40	None Evident	Idaho	Non-Activated Air Bag- Belts In Use	Not Ejected		2009	Ada	Meridian	COMPLETE
Pickup/Van/Panel/SUV	Merging	55	None Evident	Idaho	Shoulder And Lap	Not Ejected	49-638	2009	Ada	Meridian	COMPLETE
Pickup/Van/Panel/SUV	Merging	46	Possible	Idaho	Shoulder And Lap	Not Ejected		2009	Ada	Meridian	COMPLETE
Car	Merging	19	Possible	Idaho	Non-Activated Air Bag- Belts In Use	Not Ejected	49-603	2009	Ada	Meridian	COMPLETE

## Appendix B Sample Crash Data

UnitNumber	Person	Seating	IntersectionRelated	Milepost	Event	Location	Circumstance	Sex	fldRefPrimaryName	View Accident Image
1	8	Y	Y	13.1130	Rear End	Intersection Related	Following Too Close	F	Fairview Ave	Select
2	8	Y	Y	13.1130	Rear End	Intersection Related		M	Fairview Ave	Select
1	2	Y	Y	13.0950	Rear End	In Intersection	Following Too Close	M		Select
2	2	Y	Y	13.0950	Rear End	In Intersection		M		Select
1	4	Y	Y	13.1060	Rear-End Turning	Intersection Related	Inattention	F	Fairview Ave	Select



**APPENDIX C**

**Prompt List: Existing Roads**

Date:

Signs and Lighting	<i>Observation and Recommendation</i>	Marking and Delineation	<i>Observation and Recommendation</i>	Barriers and Clear Zones	<i>Observation and Recommendation</i>	Traffic Signals	<i>Observation and Recommendation</i>
1. Lighting		1. General issues		1. Clear zones		1. Operations	
2. General signs issues		2. Centerlines, edge lines, lane lines		2. Barriers		2. Visibility	
3. Sign legibility for ADA standard		3. Guideposts and reflectors		3. End treatments/crash cushions		3. Placement of signal heads	
4. Signs supports		4. Curve warning and delineation		4. Pedestrian railing signs			
		5. Reflectors' intensity		5. Visibility of barriers and fences			

**APPENDIX C**

**Prompt List: Existing Roads**

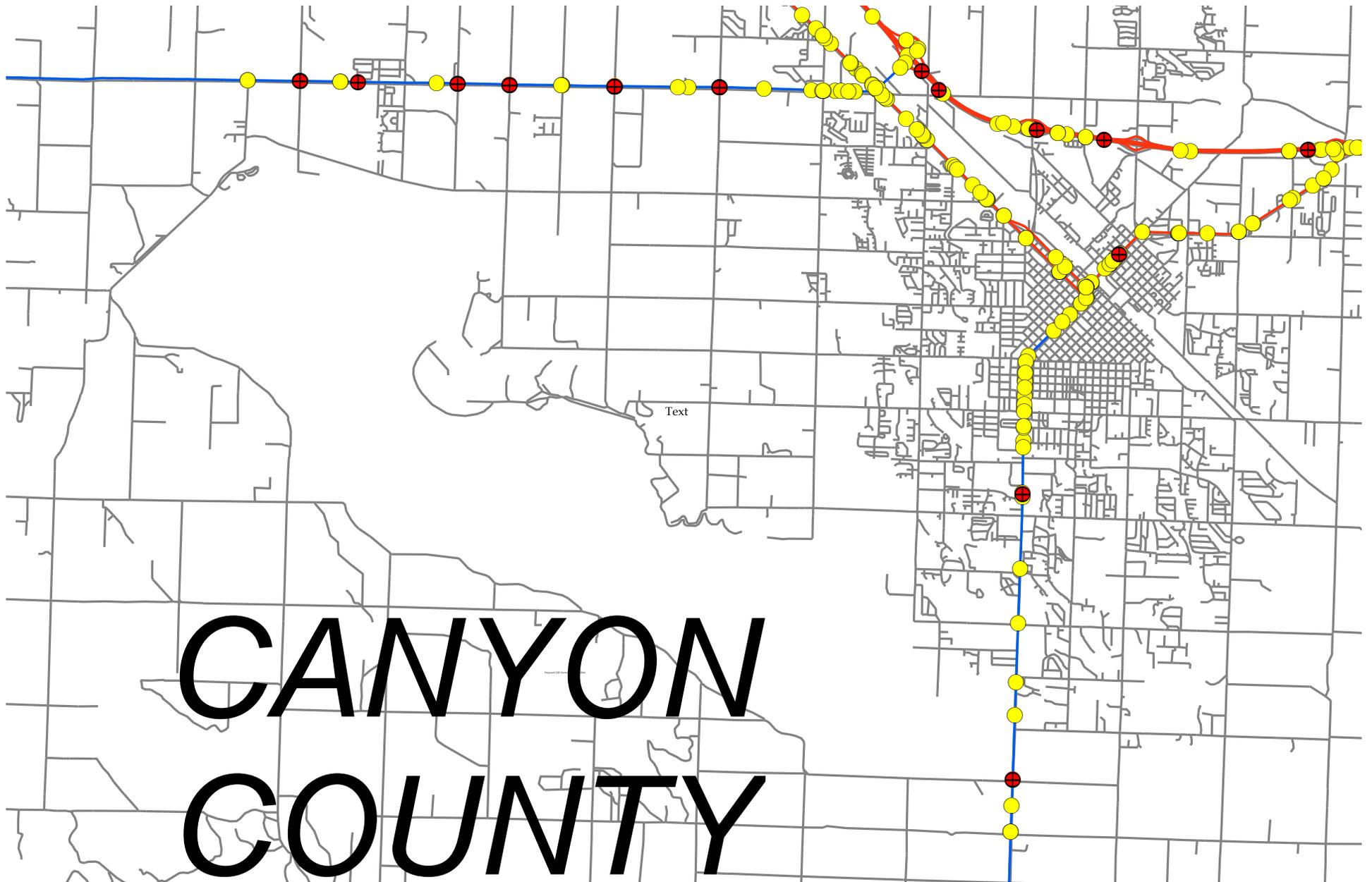
Date:

Pedestrians and Bicyclists	<i>Observation and Recommendation</i>	Older Drivers	<i>Observation and Recommendation</i>	Bridges & Culverts	<i>Observation and Recommendation</i>	Pavement	<i>Observation and Recommendation</i>
1. General issues		1. Turning radius		1. Design features		1. Pavement defects	
2. Pedestrians		2. Channilization, opposing left turn lanes		2. Barriers		2. Skid resistance	
3. Bicyclists		3. Sight triangles		3. Pedestrians and recreational facilities, delineation		3. Pond, icing/snow accumulation	
4. Public transport		4. Signing, marking and delineation				4. Loose stones/materials	
		5. Traffic signals				5. Manholes	



# Appendix D

## Fatal and Serious Injury Crashes 2005-2009

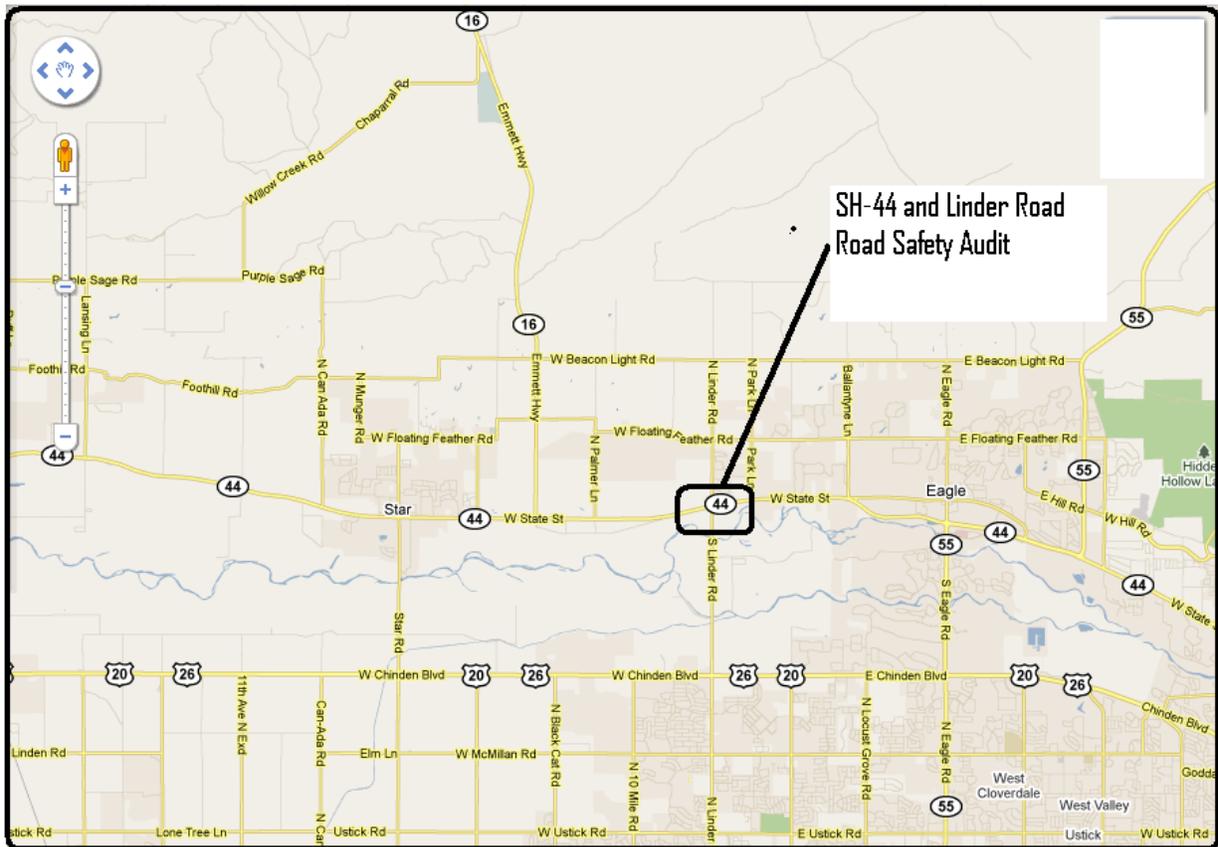


# Appendix E

## Road Safety Audit on SH-44 and Linder Road

Boise, Idaho

February 1 – 3, 2011





## Project Data

### RSA Team:

- Michael Garz – Idaho Transportation Department, D-3
- Bruce Christensen – Idaho Transportation Department, D-4
- Michael Williams – City of Eagle
- Joshua Saak – Ada County Highway District
- Mike Boydston – Ada County Highway District
- Eric Copeland – Idaho Transportation Department, D-3
- Kelly Campbell – Idaho Transportation Department, OHS
- Lance Johnson – FHWA-ID
- Craig Allred – FHWA-RC
- Special thanks to Deputy Jim Long and Sergeant Mike Rowe, ADA Co. Sheriff's Office for meeting the Team on site

## **RSA Introduction/Close-out Participants:**

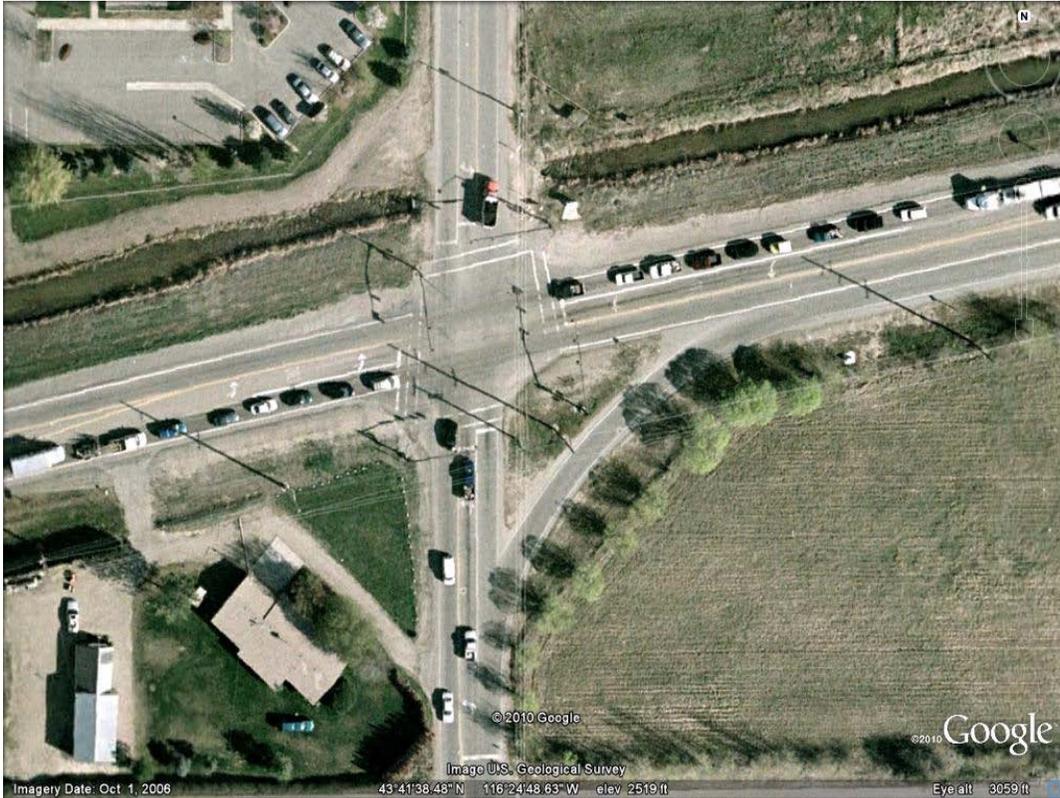
- RSA Team
- Dave Jones - Idaho Transportation Department, D-3
- Gary Moles - Idaho Transportation Department, D-3
- Scott Gurnsey - Idaho Transportation Department, D-3
- Kevin Sablan - Idaho Transportation Department, D-3
- Aaron Bauges - Idaho Transportation Department, D-3
- Herbert McDowell – Idaho Transportation Department, D-3
- Bryon Breen – Idaho Transportation Department, D-3
- Dyan Bevins - Ada County Highway District
- Terry Little - Ada County Highway District
- John Perry – FHWA-ID

## **Background:**

The Road Safety Audit (RSA) was conducted at the intersection of SH-44 and Linder Road, February 1 - 3, 2011. The intersection is under the jurisdiction of the Idaho Transportation Department (SH-44) and the Ada County Highway District (Linder Road). The intersection is near the western edge of the City of Eagle.

The location was selected by ITD, District 3 (District) due to the high number of crashes and a planned maintenance project at this location in spring of 2011. According to the High Accident List maintained by ITD, this intersection is ranked 20th on the Statewide list and 15th on the District list.

Where available, crash modification factors (CMF) are included in this report for each of the Team's recommendations. The source for this information is the Crash Modification Factors Clearinghouse (CMFCH) or the AASHTO Highway Safety Manual (HSM). See <http://www.cmfclearinghouse.org> or the AASHTO Highway Safety Manual for application details, definition of terms and additional information.



### **Traffic Volumes and Growth Projections:**

As witnessed by the RSA Team (Team), this area is experiencing some congestion. SH-44 experiences congestion during the commute hours, with very little on Linder Road. The traffic signal performed well and typically cleared queues within one cycle throughout the day and evening.

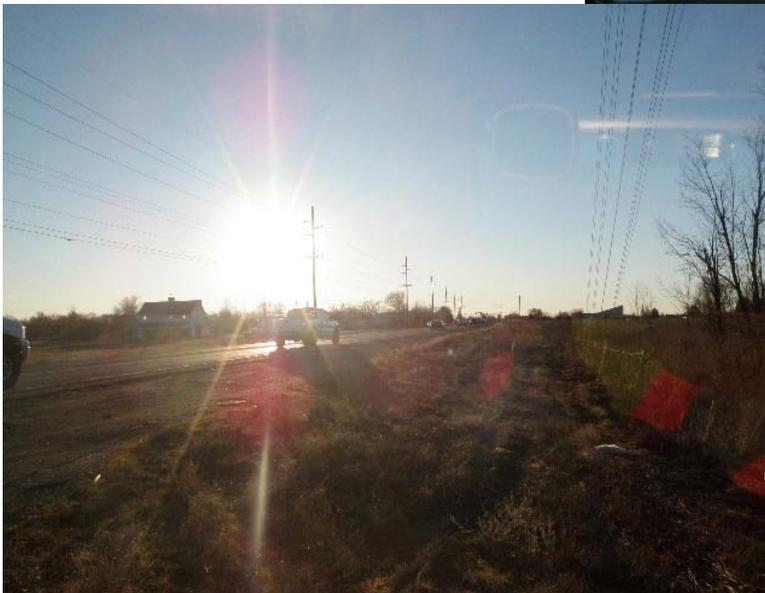
This area is projected to experience tremendous residential, retail and commercial growth. The Average Annual Daily Traffic (AADT) volumes are expected to double by 2035 (see appendix, A-1). During the start-up and closeout-meetings, the future widening of SH-44 was discussed. As the Team learned, SH-44 is proposed as a divided four-lane facility with 10' shoulders, which will help address the future capacity issues.

Here is a summary of the approved developments in the area (see appendix, A-2 and A-3 for additional information):

- ▶ Residential units: 9,351
- ▶ M3 commercial acreage: 245
- ▶ Retail space: 678,000 SF

It should be noted, that while the RSA Team reviewed the projected traffic volumes and growth projections, the focus of this was on evaluating the existing conditions.

## Sun Glare



---

### **Crash Data Summary (2006-2009, intersection related crashes only):**

The crash data for this audit was collected by ITD's Office of Highway Safety. As described on the following page, the primary safety issues at this intersection are multi-vehicle, rear-end crashes on SH-44 in the EB direction, especially during the morning commute (for additional information see appendix, A – 4). The crash data for the surrounding intersections were also reviewed to determine if they had similar crash characteristics. As shown below and in A-4, the intersection of SH-44 and Linder Road has a higher crash frequency than the surrounding intersections, with rear-end crashes being the most common type of crash.

As shown above, sun glare during the morning commute is a safety concern. It was mentioned as a contribution factor in a number of crashes.

For intersection of SH-44 and Linder Road

1. Cost of crashes at the intersection: \$376,000/year
2. 73% of the crashes involved two vehicles.
3. 64 crashes over the four year time period
4. 86% of crashes were on dry roads
5. 81% occurred during daylight hours
6. 40% of the crashes were during the morning commute (6-8 am)
7. 28% of the crashes were during the evening commute (4-6 pm)
8. 81% of crashes were on the EB leg of SH-44
9. 16% of the crashes were on the WB leg of SH-44
10. 2% of the crashes were on the NB leg of Linder Road
11. 1% of the crashes were on the SB leg of Linder Road
12. 92% of the crashes were rear-end
13. 3% of the crashes were angle
14. 3% of the crashes were head-on or same directions turning

At the intersection of SH-44 and Old Valley Road(Park Lane)

33 crashes recorded (32 rear-end, one angle crash)

At the intersection of SH-44 and Fisher Park Way

6 crashes recorded (6 rear-end, all WB)

At the intersection of SH-44 and SH-16

1. 21 crashes
2. 66% rear-end
3. 15% rear-end turning
4. 10% sideswipe
5. 7% overturn
6. 2% ditch

# Safety Improvements Already Implemented by ITD and ACHD



## **What is Working**

The Team witnessed many things that were performing well at this intersection. These included:

- Clear zones on SH-44
- Pavement markings and staggered stop bars on Linder Road
- Low crash numbers on west-bound (WB) SH-44
- Signs are in good condition
- Available right-of-way for future improvements
- Access management
- Traffic signal
  - Off peak signal performance- timing plans are working well
  - Visibility of heads (12" heads)
  - Countdown pedestrian signal heads on all corners
  - Intersection illumination on north side of the intersection
  - Good back plates

## Short Term Recommendations (within six months)

The following safety strategies are recommended for implementation within the next six months:

### 1. Intersection Ahead Warning Sign



---

It is recommended that a new Signal Ahead warning sign, with a supplemental plaque indicating the distance, be added on EB SH-44 in advance of the signal. The Signal Ahead sign pictured above is on north-bound (NB) Linder Road.

From the CMFCH: CMF=0.65

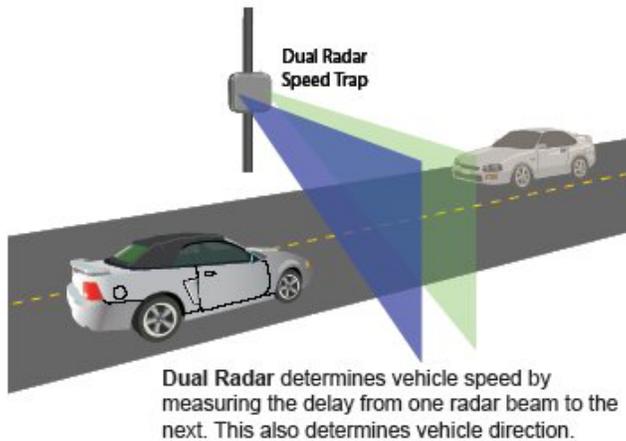
## Intersection Ahead Warning Sign (cont.)



The Team recommends that the Signal Ahead warning signs have the following features:

1. Be placed on both sides of SH – 44 facing east-bound (EB) drivers (see example above on left).
2. Utilize a retroreflective strip on the face of the sign supports (see example above on right).
3. Use florescent yellow sheeting on warning signs and supports (this is an optional color in the 2009 MUTCD). From CMFCH:  $CMF=0.65-0.82$

## 2. Advanced Congestion Detection



Dual Radar determines vehicle speed by measuring the delay from one radar beam to the next. This also determines vehicle direction.



Remote Traffic Microwave Sensor (RTMS)

---

To warn drivers of the congestion and queues on EB SH-44, an advanced congestion detection system is recommended. In the short term, a stand-alone data collection device, such as a radar could be installed to track congestion and detect queues. This equipment could be added as a component of the pending ACHD ITS project which will be making improvements in this area (2012 build). The placement of the device will depend on studies to determine the average queue lengths.

### 3. Refresh Pavement Markings: SH-44



---

It is recommended that the pavement markings on SH-44 be retraced in the vicinity of the intersection. This includes the stop bars and crosswalks, which are showing signs of wear as shown in the photo above.

CMF values are available but they are based on the retroreflectivity of the existing and new markings. Without this information no estimate can be made.

## 4. Refresh Pavement Markings on SH-44 (cont.)



---

As shown above, the pavement markings on Linder Road were in good condition and the continental style of cross walk markings were performing well. It is recommended that similar markings and materials be used on SH-44, i.e. continental style markings that are spaced outside the wheel paths and using thermo plastic or similar durable materials.

#### 4. Cross Hatching on Inside of Curve on Free-Running Right



---

The team witnessed vehicles cutting the inside corner of the free-running right and immediately entering the EB travel lanes on SH-44, instead of using the acceleration lane. This is raveling the shoulder on the inside of the curve and creating safety issues with merging traffic. To encourage vehicles to stay left of the edge line, it is recommended that white cross hatch markings (as shown above) be added to the inside of the curve of the free-running right lane (NB Linder to EB SH-44). This will also help drivers get in the proper lane position in the acceleration lane.

## 5. Free Running Right-Tubular Markers



To address the issue of vehicles not utilizing the acceleration lane, the Team recommends placing white tubular markers along a portion of the lane line (approximately 50-75') that separates the free running right from the WB lane on SH-44. The intent is to help guide drivers around the curve at the free running right and provide a visual queue where drivers should begin merging.

## 6. Free Running Right-Trim or Remove Trees on Inside of Curve



---

The trees and vegetation on the inside of the curve of the free-running right causes a sight obstruction for drivers. The Team recommends removing or trimming these trees.

## 7. Trim Vegetation on Northwest Corner of Linder



---

The trees and vegetation on the northwest corner of SH-44 and Linder Road causes a sight obstruction. The Team recommends trimming or removing these plants.

## 8. Yellow Sheeting on Traffic Signal Back Plates



To improve the visibility of the traffic signals, one strategy recommend by the Team is to place 3" yellow retroreflective sheeting on traffic signal back plates. The purpose is to increase the conspicuity of the signals heads and decrease the crashes at this intersection. This would be the first deployment of yellow back plates in Idaho.

CMFCH: CMF-0.85

## 9. Re-Evaluate Speed Limit on SH-44

[WWW2.uslimits.org](http://WWW2.uslimits.org)



The speed limit on SH-44 at this intersection is currently 55 mph. It should be re-evaluated to ensure it is appropriate, especially as development brings additional traffic volumes, commercial vehicles and pedestrians/cyclists to the intersection. A tool is available at [WWW2.uslimits.org](http://WWW2.uslimits.org) that could be helpful in making this evaluation.

To better adjust the speed limit based on real time traffic and weather conditions, the Team recommends using variable speed limits in advance of this intersection (example shown above). The speed limits could be adjusted based on the weather conditions, incidents and congestion detected by the Advanced Congestion Detector (see described in the Short Term Recommendations, item #2). These devices could be regulatory, as shown above, or advisory.

## Medium Term Recommendations (Six Months to Three Years)

# 1. Add Right Turn Lanes to SH-44 on WB and EB Lanes



The Team witnessed vehicles using the paved and unpaved shoulders as right turn lanes at this intersection. To improve safety and traffic operations, right turn lanes should be built on SH-44. Truck turning movements and the associated off-tracking should be considered in the design. While little truck traffic was observed by the Team, this may change in the future as the area develops.

HSM, Table 14-15: CMF=0.89-0.93 (note: these values are based on guidance from FHWA-RD-99-207, which recommends using  $\frac{1}{2}$  of the values reported for stop controlled intersections for signal controlled intersections.)

## 2. Dynamic Message Sign/Advanced Warning Sign/ITS Device



Due to the high percentage of rear-end crashes on SH-44 in the EB direction, the Team recommends installing a dynamic message sign, advanced warning sign or some other type of ITS device that would alert drivers to the slowing or stopping traffic at the intersection. Two potential devices are shown above. The “Be Prepared to Stop” warning sign and flasher could be used to warn drivers of the need to stop at the traffic signal. Another option is to install a congestion warning sign to alert drivers of the slowing or stopped traffic near the signal. The device could include flashers that activate when congestion is detected. The trigger to activate the flashers could be based on the information gathered by the Advanced Congestion Detector (see described in the Short Term Recommendations, item #2). If flashers are included, the sign assemble could include a “When Flashing” plaque or legend on the sign. The location of the devices should be based on the maximum queue length.

### 3. Option A: Extend Existing Acceleration Lane



---

To improve safety at the existing free-running right on NB Linder Road, one option is to extend the acceleration lane in accordance with AASHTO guidelines (AASHTO recommends 670', the existing acceleration lane is approximately 350'). A longer acceleration lane will provide merging drivers with an opportunity to better match the speed of EB vehicles and provides them an opportunity to accept proper gaps.



## 6. Add Luminaires: South Side of Intersection and West of Linder



---

To increase the conspicuity of the intersection, especially for EB drivers, the Team recommends additional illumination on SH-44. HSM, Table 13-56:  $CMF=0.71-0.83$

Currently, there are luminaires on the north side of intersection. It is recommended that luminaires be added on the south side of the intersection and along SH-44 west of the Linger Road. These improvements will give EB drivers the sense they are entering an urbanized area. HSM, Table 14-18:  $CMF=0.62$  (note: this is based on no existing illumination, so this value should be adjusted accordingly)

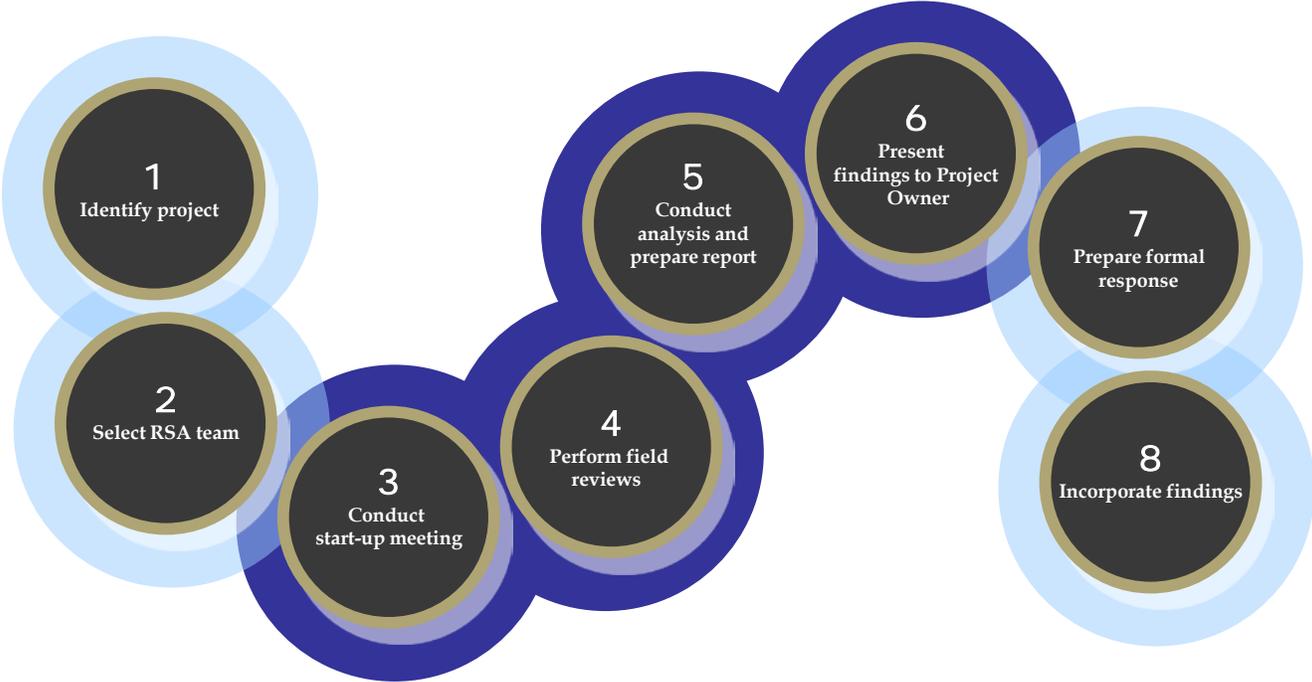
## Long Term Recommendations (Three years or More)

In the long term, development in the area will require adding capacity to SH-44 and Linder Road. As the Team understands it, a divided four-lane facility is in the long range plan for SH-44. A higher capacity or alternative intersection should also be considered, such as continuous flow intersections or four-quadrant intersection or jug handle. All alternative designs should be considered in regards to the projected traffic growth planned for this intersection and the surrounding area. The alternative designs are likely to require additional ROW.

# Next Steps

## Responsibilities

-  **RSA Team**
-  **Design Team / Project Owner**



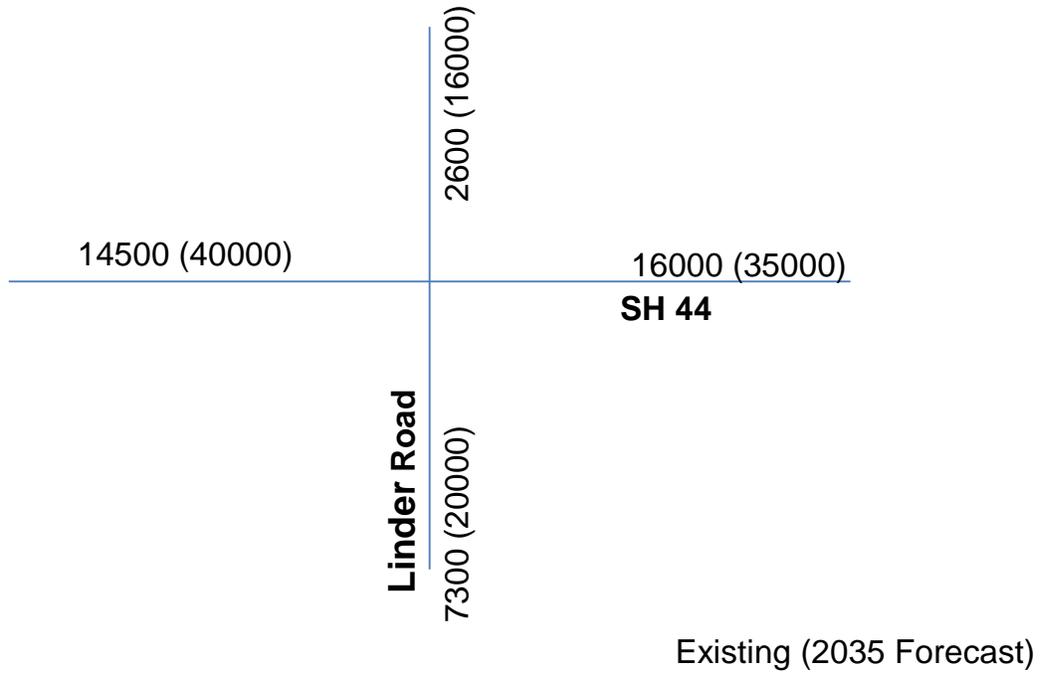
---

As outlined above, this report documents and concludes the work of the RSA Team. The next step in the RSA process is a formal response from the District to the Team. It should summarize the District’s response to the recommendations described in this report. The response can be sent to Lance Johnson, FHWA-ID, preferable via email (lance.johnson@dot.gov). Lance will distribute it to the other Team members.

The Team hopes that the District finds the recommendations helpful in addressing the safety issues at SH-44 and Linder Road.

# Appendix, A-1

## Traffic Volumes (AADT)



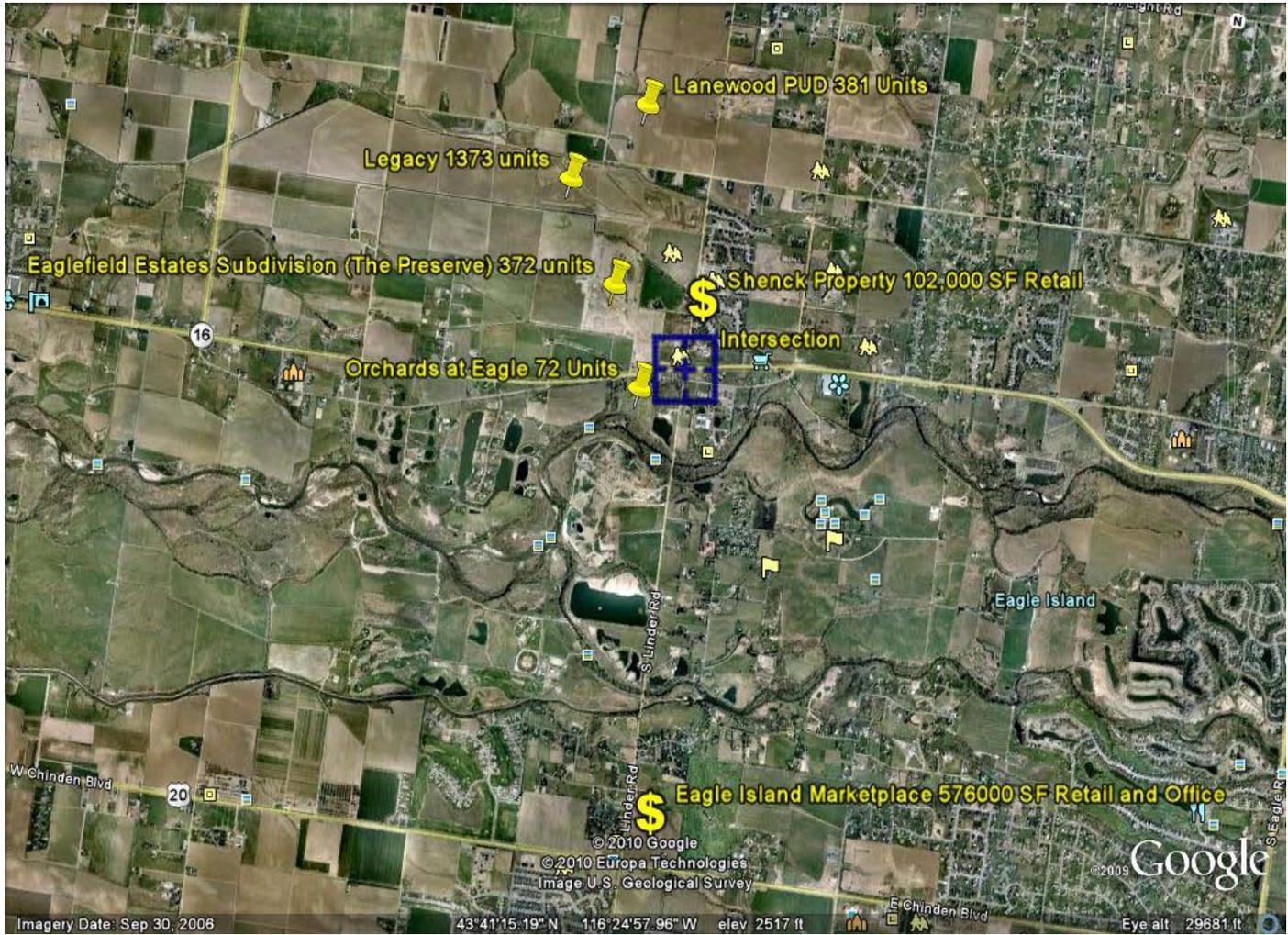
## Appendix, A-2

The following approved developments (either through proposed subdivisions or development agreements associated with a rezone) will have impacts to the intersection of SH-44 and Linder Road:

<b>Development (Location)</b>	<b>Residential Units or Commercial Lots</b>
Eaglefield Estates Subdivision (SH-44/Linder)	372 residential dwellings
Schenk Property (NE corner SH-44/Linder)	10 commercial pad sites consisting of up to total of 102,000 sq. ft. of retail space.
Legacy (S of Floating Feather/Linder to SH-16)	1,373 residential units/school site and commercial
Lanewood Planned Unit Development ( N of Floating Feather/Linder to Lanewood)	381 residential units
M3 – (Foothills N of Beacon Light) <i>a portion of which will utilize Linder for access</i>	7,153 residential units with 245 acres of retail and office uses
The Orchards at Eagle (SW corner SH-44/Linder – S of ITD parcel)	72 residential units
Eagle Island Marketplace and Foxtail G.C. (NE corner US 20-26/ Linder) <i>indirect affect to intersection</i>	576,000 sq. ft. retail and office uses

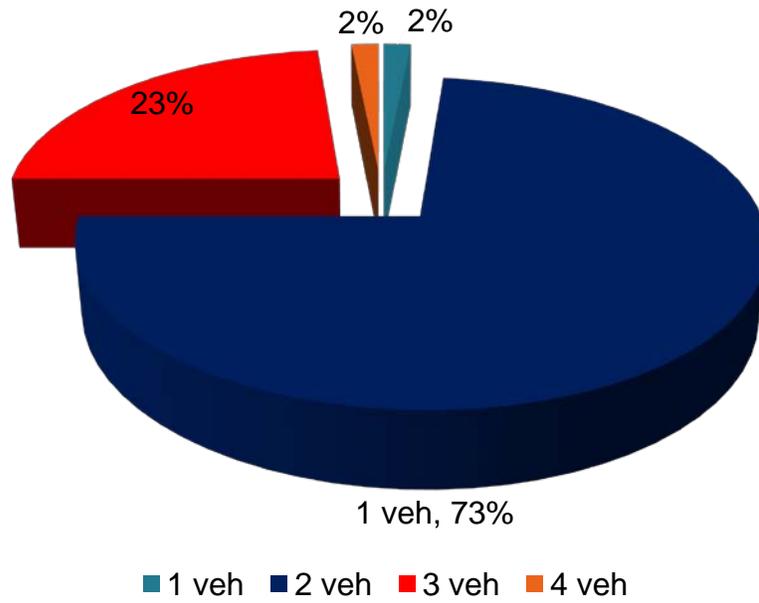
# Appendix, A-3

## Location of Approved Developments

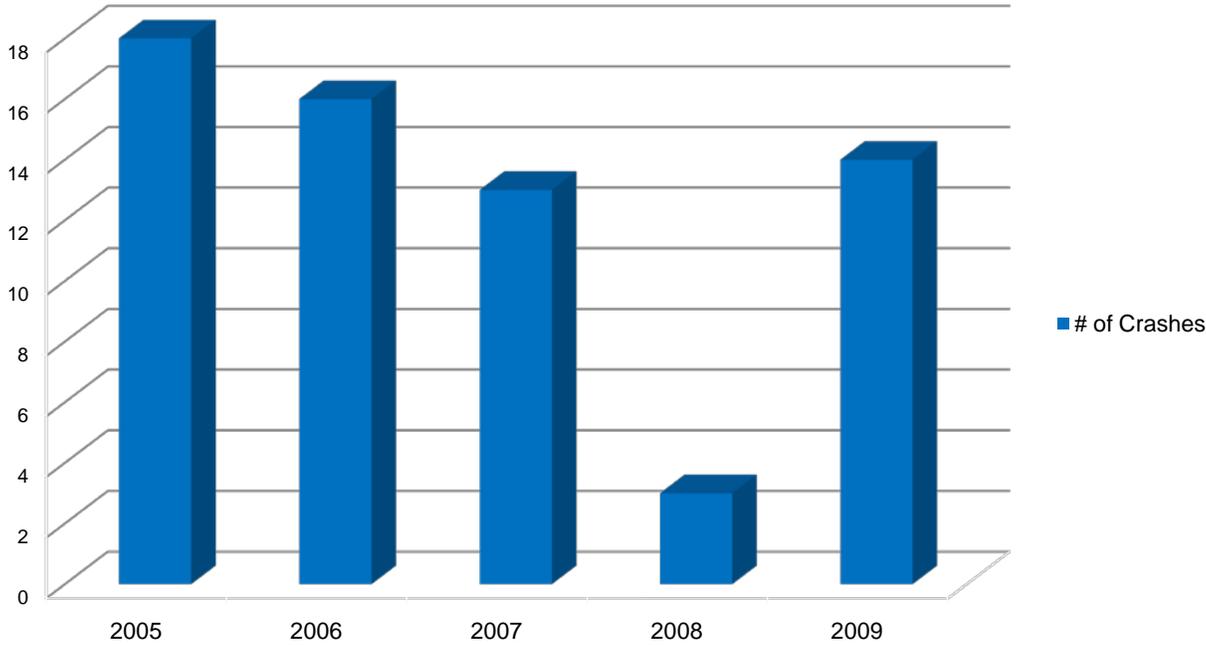


## Appendix A-4 (Crash Data from 2005-2009)

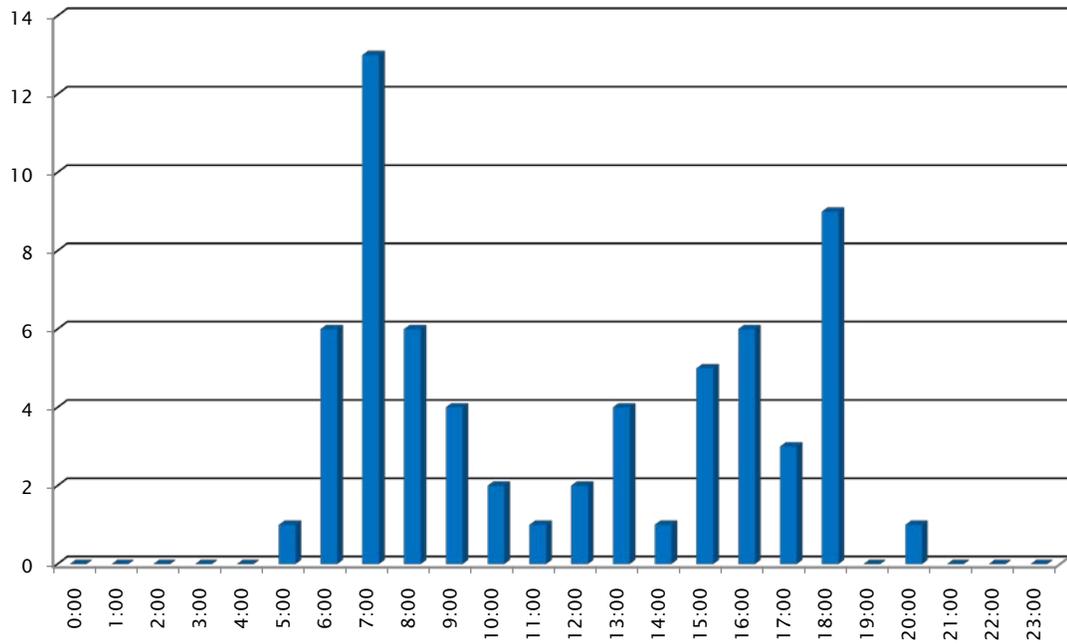
### Crashes: Number of Vehicles Involved



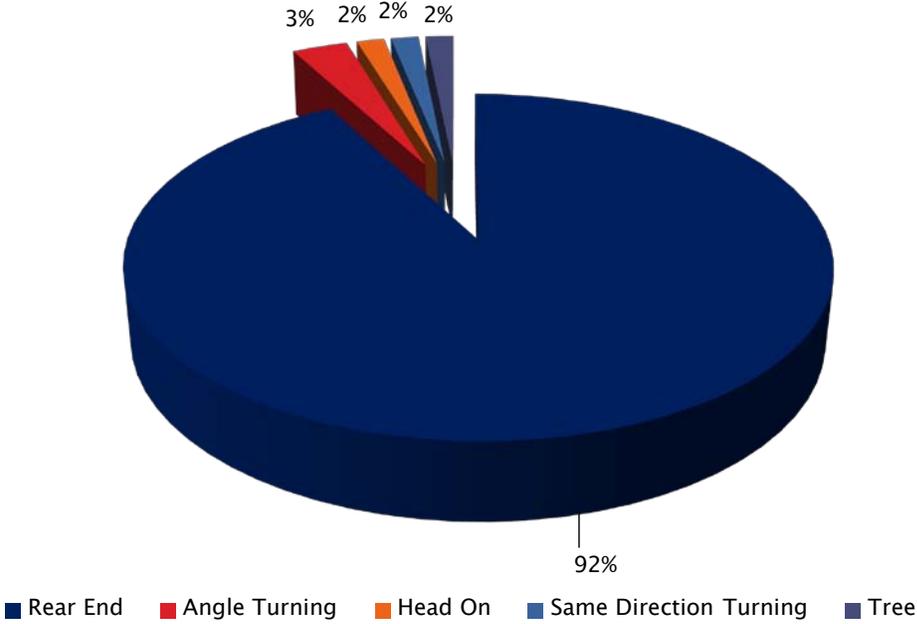
# Annual Crashes 2005-2009



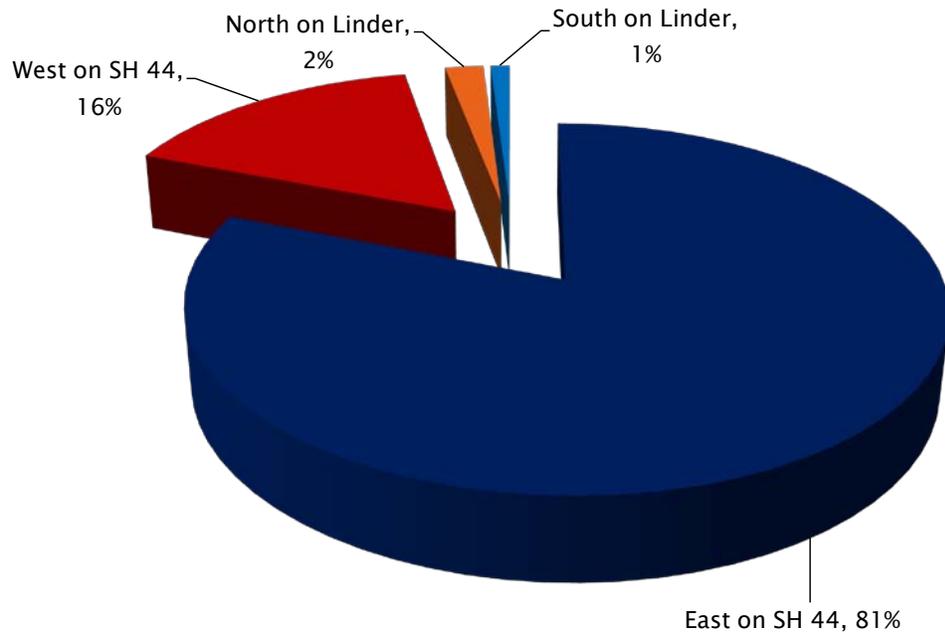
# Hourly Crashes



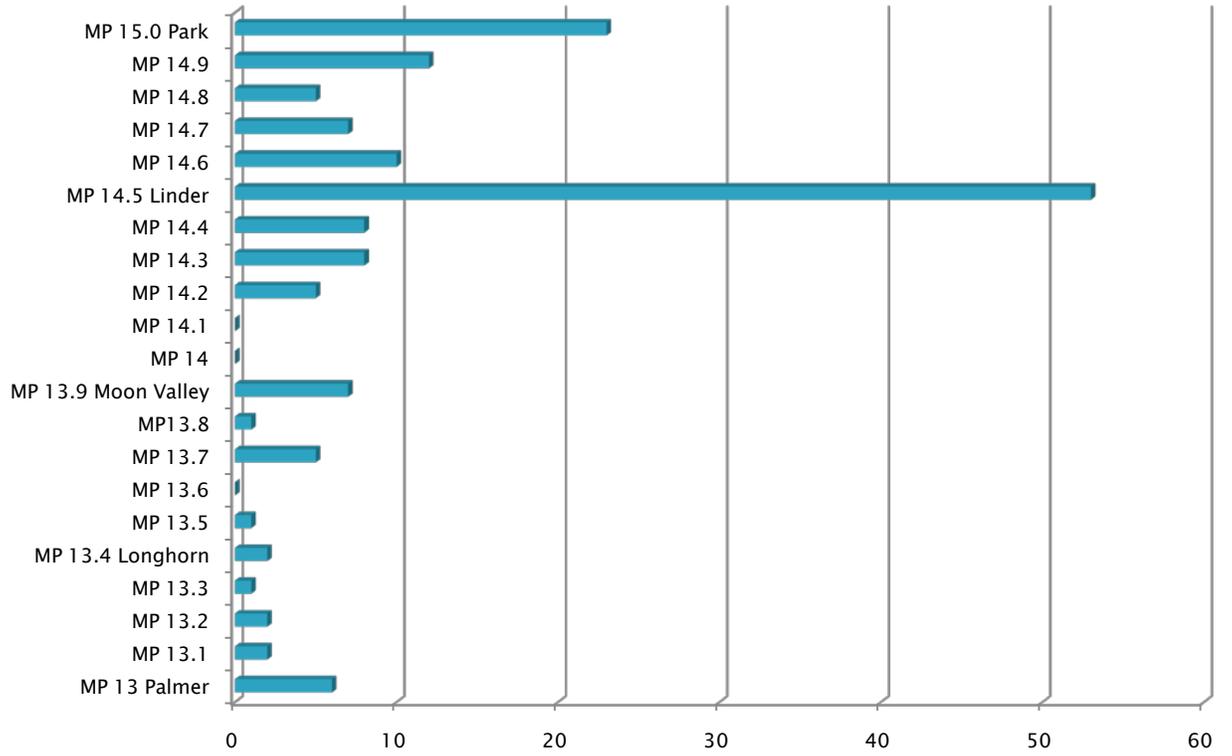
# Crash Types



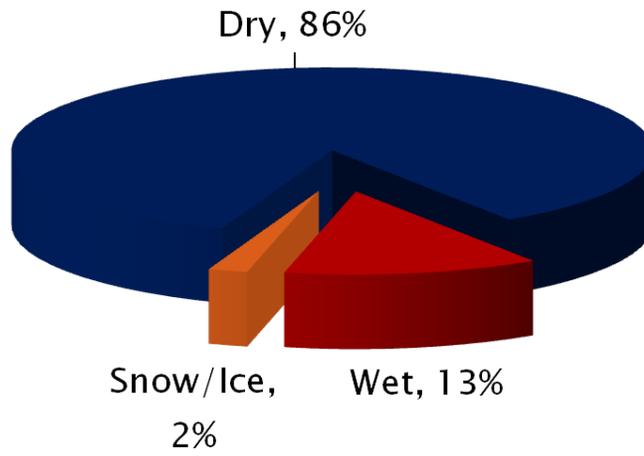
# Direction of Travel



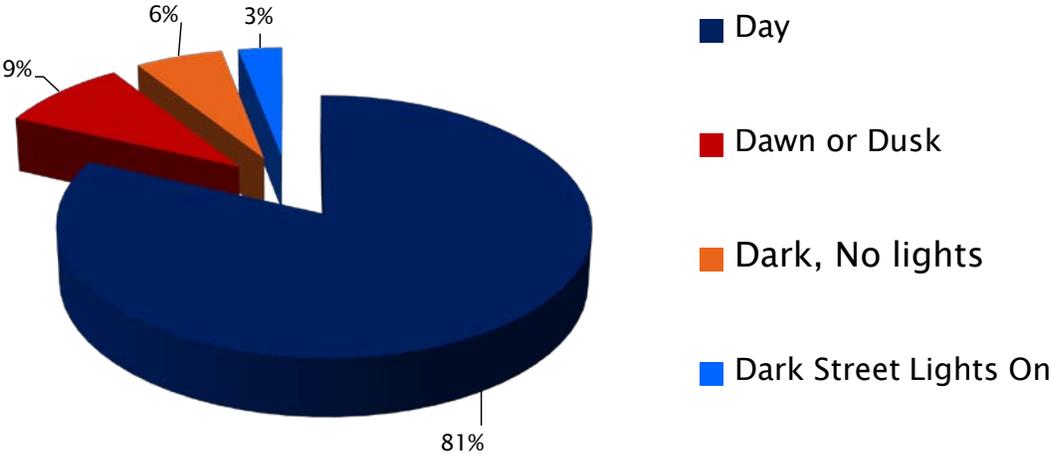
# Crashes on SH-44



# Crashes: Road Surface



# Crashes: Light Conditions



## Appendix F

### History

The development of roadway audits is generally attributed to Malcolm Bulpitt of the United Kingdom.

In the 1980's, Bulpitt applied safety audit concepts that were originally introduced on railroad networks during the Victorian Period. At that time the government appointed officers to inspect all aspects of a new railway line before it could be opened for use. Bulpitt applied the concept of independent checking to improve operational safety on road projects carried out by the Highways and Transportation Department of the Kent County Council.

In 1990, the Scottish Development Department made the RSA procedures operational one year earlier than the equivalent English agency.

In 1990, RSAs were introduced in the State of New South Wales, Australia when the audit of the Pacific Highway used specially prepared checklists.

In 1994, the *Austrroads Guide Road Safety Audit* was published.

In April 1991, the U.K. Department of Transportation made safety audits mandatory for all national trunk roads and motorways (freeways) over a specified cost.

In 1989 Transit New Zealand was created. By 1993 a set of safety audit policies and procedures was developed and implemented.

In 1994, the FHWA sponsored an international technology scanning review that focused on Japan, Australia and New Zealand. Its purpose was to review the application of safety management systems. One of the primary findings was that safety audits were effective in improving highway safety in the countries where they are implemented, specifically Australia and New Zealand. In addition, the ITE has included several presentations on RSAs in recent meetings, and the World Bank uses RSAs in its projects.

In 1996, based on the recommendations of the FHWA study, a follow up scanning review on highway RSAs was undertaken. The mission of the RSA scanning team was to review and document international efforts to enhance highway safety and safety management systems through the implementation of RSA initiatives. Road RSAs were first introduced and continue to be used in the United Kingdom, but the scanning team visited Australia and New Zealand only. The RSA concepts from these countries have been expanded and integrated into the overall safety programs at federal and state levels in the U.S.

*\* (Information excerpted from RSA Part 1-Final Report by FHWA's Scanning Program, December 1997)*

In 2003, AASHTO sponsored a research project in cooperation with the FHWA, *NCHRP Synthesis 321, and Roadway Safety Tools for Local Agencies*. It discusses the benefits of using RSAs on new roads and existing roads to identify potential road safety hazards.

Subsequently, in 2004, *NCHRP Synthesis 336, Road RSAs* was published to give greater emphasis on the process of effectively conducting RSAs.

In 2006, *FHWA Road RSA Guidelines* was published.

Now there are more than twenty states using RSAs in their safety program.