Cost Effective Local Road Safety Planning and Implementation
Introduction

According to the Bureau of Transportation Statistics, local roads (i.e., county and small rural community roads) comprise approximately 0.4,009,428 miles of the United States highway network as of 2009. Figures from the National Highway Traffic Safety Administration for 2008 indicate that there were 15,762 fatal crashes on rural roads, comprising 55 percent of such crashes on United States roadways for that year. The corresponding fatality rate per 100 million vehicle miles traveled on rural roads was 2.11, compared to 0.81 for urban roads. While these figures have been dropping in recent years, they indicate that much work remains to be done in improving the safety of U.S. roads, and local roads in particular.

Working to improve the safety on local roads can be a challenge for officials, particularly those faces with limited staff and financial resources. The extensive depth and breadth of information pertaining to safety analysis and treatments can be daunting to these officials, particularly when they are tasked with a variety of other daily duties. These officials may know a safety problem exists at a given highway location (e.g., a high number of crashes occurring at a particular site), but the time to identify and assess the available solutions to address that problem is not necessarily available. Furthermore, conveying both the problem and potential solutions to non-engineers (elected officials, the general public), can also be a challenge. Finally, identifying and obtaining funding for potential safety improvements can be difficult. Consequently, there is a need for a general guide which local officials can utilize to identify and quantify existing safety issues, identify potential solutions to those issues, and identifying potential state and local partnerships to fund them.

The American Traffic Safety Services Association (ATSSA) and the National Association of County Engineers (NACE) have partnered to develop such a guide for local officials that will serve as an easy-to-read resource and reference on roadway infrastructure safety. This publication, Cost Effective Local Road Safety Planning and Implementation, is the result of that partnership. The focus of this work has been on local roads (i.e., county and smaller rural community roads), but the approaches and solutions presented are often just as transferable to urban areas. Of course, engineering judgment should be used in all cases when employing the material presented in this document.

The information provided in this document is not for reference, it is also intended to aid in implementation. By identifying where issues exist and implementing low cost safety solutions, a jurisdiction can contribute to the overall improvement of safety of the roadway network from the local level. It is hoped that the approaches and countermeasures presented in this document are sufficiently low cost so that they can be considered by local jurisdictions regardless of the level of funding that may be available.

Acknowledgements

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**Part 1: Analyzing and Planning**

Locally owned roads comprise over 3 million miles, or 76 percent of the highway network in the United States. The fatality rate along these roads is disproportionately higher than it is on their urban counterparts. Consequently, there is a need to dramatically improve safety along these roadways by all available means. Toward Zero Deaths (TZD), an effort to develop a national approach to eliminating highway fatalities, is seeking to address fatal crashes from a variety of perspectives, including engineering. This document provides an overview of approaches and countermeasures that can be employed to identify and make low cost safety improvements to local roads toward achieving this national goal.

Before safety can be improved along a roadway, the problem(s) itself must first be identified and understood. For a local entity faced with limited budgets and staffing, knowing where to begin when addressing safety can be daunting. In light of this, Part 1 of this document has been developed to provide information and approaches on how to examine and address highway safety from a number of different perspectives. The sections provide an overview of how a crash study can be conducted, as well as what crash data is and how it can be used in making safety investments. An alternative discussion of making a safety investment without the use of crash data using a risk-based approach is also provided. In line with the analysis of crash data, the Highway Safety Manual (HSM) is discussed, providing the reader with an alternative tool for evaluating various aspects of safety.

In addition to the reactive approach to safety, proactive approaches are also discussed, namely Road Safety Audits (RSA). RSAs are formal safety performance examination of an existing or planned roadway segment or intersection by an independent audit team that qualitatively estimates and reports on potential road safety issues and identifies opportunities for safety improvements. They seek to identify potential or existing issues before they result in crashes and have shown useful in defending tort liability.

Finally, county wide safety plans and rural road safety programs are outlined. County wide safety plans identify high-priority safety projects, both proactively and reactively. This allows a county to identify and document safety concerns they wish to emphasize and address, select appropriate countermeasures to address them, and prioritize specific projects, locations or elements that will be addressed. In completing a county wide safety plan, a county will not only better understand what its safety issues are and how to address them, but also begin to position itself for pursuing funding opportunities to improve safety. Rural road safety programs establish that county will not only better understand what its safety issues are and how to address them, but also begin to position itself for pursuing funding opportunities to improve safety.

**Conducting a Crash Study**

Identifying Where Safety Issues Exist and Their Causes

Local roads comprise a majority of the total highway mileage in the United States. Most of these roads carry lower traffic volumes and possess decades-old design features. As a result, these roads present a number of safety issues. A previous ATSSA publication, entitled Low Cost Local Road Safety Solutions, classifies these problems into five main safety issues, including 1) inadequate roadway geometry (e.g. width, grades, alignment, sight distances), 2) lack of passing opportunities due to either limited sight distance of heavy oncoming traffic, and 3) traffic conflicts due to turns at access points (e.g. intersections and driveways). Widening, realigning or completing other extensive reconstruction activities on a roadway to address a safety issue is typically not financially feasible; as a result, it is necessary to identify low cost safety improvements to address issues.

In order to identify proper solutions to a safety issue, that issue must initially be identified and understood. To do so, crash studies are necessary. As noted by different reports crash studies are generally comprised of six steps: 1) identify sites with potential safety issues, 2) characterize crash experience, 3) characterize field conditions, 4) identify contributing factors and potential countermeasures, 5) assess countermeasures and select the most appropriate, and 6) implement the countermeasures and evaluate their effectiveness. In addition, application of the Highway Safety Manual (HSM) is discussed, providing the reader with an alternative tool for identifying safety issues and estimate the potential crash reductions of different countermeasures should also be considered.

Identify Sites with Potential Safety Issues

The initial step in a crash study is to identify where a safety issue(s) may exist. A number of different approaches can be used in completing this step, both formal and informal. These include examining crash data (e.g. identifying accident clusters or high crash sites), traffic studies (spot speed studies, etc.), on-site observation, citizen and law enforcement input and surrogate measures (traffic conflicts at intersections, brake light observations, etc.). Each of these approaches has its benefits and drawbacks which must be carefully considered by a practitioner when selecting them. In most cases, crash data is readily available from transportation departments by request and therefore, the most commonly used approach to identifying a safety issue. Additionally, crash data is accessible from sources such as the Fatality Analysis Reporting System (FARS) easily accessed via the Center for Excellence in Rural Safety’s (CERS) Safe Road Maps tool.

Crashes are random events and consequently, can occur at any location along the roadway. However, geometric, traffic and other features may lend themselves toward more crashes happening in specific locations. As a result, identifying such “clusters” of crashes is the most simplistic approach to identifying a site-specific crash issue. Another applicable method is to identify the top nth number of locations with crash problems. Spot mapping, the mapping of crashes along a roadway (either by GIS or simpler methods like pin mapping) and identifying locations where clusters of crashes have occurred is another approach, although this approach may produce misleading conclusions. As traffic volumes can vary considerably from site to site, two locations with the same number of crashes may not reflect the true safety issue that is present when one site has twice the traffic volume as the other. Consequently, more sophisticated approaches to identifying and prioritizing safety issues should be considered.

In addition to the crash rate method, there are several methods available in identifying sites with safety issues. These include the crash rate method, which is most commonly used, the crash frequency method, the crash density method, the frequency-rate method, quality control methods, crash severity methods, index methods, and the use of complimentary methods. A document from the Iowa Department of Transportation provides a thorough overview of each of these methods, including the approaches to calculation, and the reader is encouraged to reference this work.

Characterize Crash Experience

The next step is to characterize the safety issues of the sites identified. This includes a review of the types of crashes that have occurred, a review of crash report forms, preparation and review of collision diagrams (primarily at intersections) and site visits. The review of this information will begin to provide an indication of the predominant crash types that may be occurring at a location, the contributing factors, and an initial indication of potential treatments that could be employed.

Characterize Field Conditions

If a field visit has not occurred during the previous step, one should now be carried out in order to better understand and record the geometrics, traffic levels and behaviors and other general features present at a site. Data should be recorded as notes, photographs/videos, diagrams/drawings, measurements, as well as other means as appropriate. The site visit should be made at a time that coincides with the safety issues identified previously. Additional data should be obtained as needed, such as traffic counts and signal timings. This data may be available from databases (e.g. signal timing plans) and may not need to be collected in the field. In other cases, specific information, such as turning movement volumes per hour at an intersection, are not typically recorded in existing agency databases; this information should be measured in the field at a time that corresponds to observed crash trends.

**References**


**Cost Effective Local Road Safety Planning and Implementation**

For more information on Low Cost Local Road Safety Solutions visit ATSSA.com.
Identify Contributing Factors and Potential Countermeasures

At this point, the factors contributing to crashes should have been identified from crash records, but they should also be identified through observations made while in the field (e.g., field notes, aerial photography, other engineering studies, best practices employed by other agencies, past research/studies for similar sites or crashes, and additional technical information obtained from other agencies/organizations). This will help in determining countermeasures that may be implemented to address safety issues. Appropriate countermeasures are available from different references, including ATES/AACE’s Low Cost Local Road Safety Solutions, 1 the American Association of State Highway Transportation Officials (AASHTO) Highway Safety Manual, 2 the National Cooperative Highway Research Program’s (NCHRP) Report 500: Guidance for Implementation of the AASHTO Strategic Highway Safety Plan Transportation Research, 3 and NCHRP Report 440: Accident Mitigation Guide for Congested Rural Two-Lane Highways, 4 among others.

Assess Countermeasures and Select the Most Appropriate

This step determines which potential countermeasure(s) holds the greatest promise for addressing a safety issue. This includes identifying all applicable countermeasures, including the do-nothing option, determining which countermeasures may be applicable in combination with others, identifying constraints and limitations to the countermeasures, and identifying what the potential effect of each countermeasure might be. The data and process employed in evaluating and selecting applicable countermeasures should be documented for later reference if needed. The evaluation of different countermeasures should be made in such a way as to determine which will provide the greatest return for the amount invested. The countermeasure which minimizes the number of future crashes at the lowest investment cost should be selected. This is not to say that higher cost countermeasures should be excluded. Rather, careful consideration of the amount of savings (to an agency, society, etc.) accrued over time should be considered versus the cost of implementing a countermeasure. Countermeasure evaluations may range from simplistic (comparing advantages versus disadvantages) to complex (cost/benefit analysis based on modeling expected crashes). This more complex approach would entail estimating the expected number of crashes (using an approach such as the Highway Safety Manual discussed elsewhere), assigning a dollar value to the reduction in crashes, determining the payback period of a countermeasure, and estimating the cost of the countermeasure, examining effectiveness by each location and ranking site priorities. The result of this step is the selection of one or more countermeasures for implementation.

Implement the Countermeasures and Evaluate Their Effectiveness

Steps two and three are implemented and evaluated the selected countermeasure(s). Implementation consists of applying the countermeasure(s) in the field, and may range from simple (new pavement markings) to complex (roadway reconstruction), depending on the nature of the safety issue(s) being addressed. Evaluation entails the monitoring of the performance of the selected countermeasure(s) and determining if they are meeting the primary objective of reducing or eliminating crashes.

The Federal Highway Administration laid out a six step procedure for evaluating the effectiveness of safety improvements, including 1) develop an evaluation plan, 2) prepare the evaluation data, 3) perform the effectiveness analysis based on modeling expected crashes), 4) perform statistical tests, 5) perform economic analysis and 6) prepare documentation. 5 In performing the statistical test of step six, practitioners will likely employ a before-after study. Before–after studies can be grouped into three types: the simple (naive) before–after study, the before–after study with control groups and the before–after study that employs the Bayesian (EB) technique. 6 The selection of the study type is usually governed by the availability of the data, such as crashes and traffic flow, and the amount of available data (or sample size), among other factors.

Of the three approaches to before-after studies, the EB technique has become the most commonly employed. This is the result of the ability of the EB method to provide better performance in addressing the issues typically posed by crash data (e.g., regression-to-mean (RTM), short time before or after the time period of data), RTM is the potential for a high or low number of crashes to occur during any given year, but over time, for such crashes to hover around a mean annual figure. While the EB method may appear to be statistically daunting to many practitioners, the recent publication of the Highway Safety Manual has provided a step-by-step process to follow in completing an analysis. The reader is encouraged to refer to this document, as well as others which outline different statistical approaches to evaluation. 7, 8

In conclusion, in order to address a safety issue along a local road, a practitioner must first identify and understand the issue(s). This is accomplished through a crash study. This section has provided a general outline of the approach to completing such a study. Of course, the needs of each agency are unique, and a different approach may be applied to a crash study on a case by case basis. This information should serve as a starting point to guide the overall process employed by an agency in identifying crash issues and potential countermeasures to address them. 9

References


for low cost solutions stemmed from the fact that the county experienced a very low density of severe crashes annually across the entire system. Consequently, improving safety at the local level is essential to supporting the overall U.S. Department of Transportation’s Safety Strategic Goal to “Enhance public health and safety by working toward the elimination of transportation-related deaths and injuries.” Using the Highway Safety Manual will also allow limited funding to be used at sites that can benefit most from a reduction in the frequency of crashes.

It is imperative for practitioners to understand how the HSM can and cannot be utilized. “The HSM focuses on the reduction of crashes and crash severity where it is believed that the roadway/environment is a contributing factor, either explaining or through interactions with the vehicle or the driver, or both.” The HSM does not address educational, policy and legislative or enforcement activities that may enhance safety. Similarly, the HSM only introduces the reader to human factors (Chapter 2). It directs those willing to learn more to NCHRP Report 650: Human Factors Guidelines for Road Systems.

The Highway Safety Manual can be used when one is interested in the safety of a new design or to compare design alternatives. It allows for an estimate of roadway safety. The HSM only introduces the reader to human factors (Chapter 2). It directs those willing to learn more to NCHRP Report 650: Human Factors Guidelines for Road Systems.

The reader should also note that other approaches, such as USRA’s Safer Roads Investment Plan, are investigating the development of safety improvement plans in the U.S. based on road attributes, without the need for site-specific crash data. These should be monitored and considered as they become available. In addition, other strategies may also be employed to identify potential locations for safety improvement, including Road Safety Audits (discussed in another section of this document); traffic studies (spot speed studies, etc.); on-site observations and citizen and law enforcement input. 19

References
4 Federal Highway Administration. Geometric Design of Rural Highways and Streets (the “Green Book”) only provides a user with an understanding of
5 Fatality Analysis Reporting System
6 Highway Safety Manual
to/con/stud/7 educación/8212986998212847963.html
13 References
15 For more information on Low Cost Local Road Safety Solutions visit ATSSA.com.
16 Cost Effective Local Road Safety Planning and Implementation
17 Applying the Highway Safety Manual to Local Road Safety
18 The Highway Safety Manual (HSM) is a new tool for transportation professionals. It is safety what the Highway Capacity Manual is to capacity and operations. It allows users to quantitatively assess roadway safety. The HSM allows for an estimat...
to quantify the safety of the three alternatives allows the designer to consider factors that influence the design decisions for each alternative. Environmental and right-of-way trade-offs are considered in the Federal Highway Administration's (FHWA) Highway Safety Manual. The FHWA may also be used to quantify the safety benefits from implementing an individual or a combination of treatments. In general, there are three types of roundabouts:
1. Upstream roundabout
2. Conventional roundabout
3. Channelized roundabout

These types of roundabouts are currently not addressed in the HSM. Part D presents the basic process for establishing safety improvement treatments. Here, the reader will find the 18-step process describes how to calculate expected crash frequencies (SPFs) and crash modification factors (CMFs). Part B provides details of the roadway safety management process. Part C presents the predictive method of assessing the HSM. Figure 3 presents the comprehensive listing of crash modification factors found within the HSM.

Figure 3: Highway Safety Manual Components

There are several software tools which were designed to support the Highway Safety Manual. The SafetyWizard was designed to complement Part B of the HSM. The Interactive Highway Safety Design Model was designed to support Part C of the HSM. The Crash Modification Factor (CMF) is calculated for each treatment. Furthermore, they can help by smoothing out the variability of the crash data, which in turn address issues like regression-to-the-mean. A calibration factor (C) is used to adjust an SPF to local conditions. The HSM also discusses crash modification factors (CMFs). Part D, as highlighted previously, discusses them in-depth. However, a nice overview of CMFs is presented in Chapter 3. CMFs represent the relative change in crash frequency due to a change in one specific condition. CMF ≤ 1.00: No change CMF > 1.00: Expected Average Crash Frequency is Reduced CMF < 1.00: Expected Average Crash Frequency is Increased

The HSM does not set requirements or mandates. The HSM is not a best practice document for design or operations. The HSM contains guidelines and standards and does not supersede other publications that do. The HSM does not establish a legal standard of care. GMO does it create a legal standard of care. GMO does it crate a legal standard of care. GMO does not warrant or standards and does not supersede a specific design project. GMO does not warrant or standards and does not supersede a specific design project. GMO does not warrant or standards and does not supersede a specific design project. GMO does not warrant or standards and does not supersede a specific design project. GMO does not warrant or standards and does not supersede a specific design project. GMO does not warrant or standards and does not supersede a specific design project. GMO does not warrant or standards and does not supersede a specific design project.

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3. Campbell, J.L., C.M. Richard, and J. Graham. Liability and the HSM,” start at 36:25 in the “Introductory Webinar hosted by the Federal Highway Administration providing an overview of a similar application of the HSM from a case study in Missoula, Mont.6 The Highway Safety Manual provides an overview of a similar application of the HSM from a case study in Missoula, Mont.6 The Highway Safety Manual provides an overview of a similar application of the HSM from a case study in Missoula, Mont.6 The Highway Safety Manual provides an overview of a similar application of the HSM from a case study in Missoula, Mont.6 The Highway Safety Manual provides an overview of a similar application of the HSM from a case study in Missoula, Mont.6 The Highway Safety Manual provides an overview of a similar application of the HSM from a case study in Missoula, Mont.6 The Highway Safety Manual provides an overview of a similar application of the HSM from a case study in Missoula, Mont.6 The Highway Safety Manual provides an overview of a similar application of the HSM from a case study in Missoula, Mont.6 The Highway Safety Manual provides an overview of a similar application of the HSM from a case study in Missoula, Mont.6 The Highway Safety Manual provides an overview of a similar application of the HSM from a case study in Missoula, Mont.6 The Highway Safety Manual provides an overview of a similar application of the HSM from a case study in Missoula, Mont.
In Clark County, an RSA was conducted during the design phase (80 percent complete) of a project that involved roadway realignment and intersection improvements on a two-lane rural road. The project was initially identified because of safety concerns stemming from high-severity run off the road crashes. An audit team comprised of county and private consultant staff with different backgrounds (County and consulting engineers, law enforcement, and a transportation planner) and no association with the project was assembled to complete the RSA.

Planned improvements at the time of the RSA included a roadway realignment, introduction of a new signalized intersection, improvements to stop-controlled intersections, including introduction of a free right turn lane at an approach at one intersection, and intersection realignment. The RSA team reviewed the most recent design plans for the project, crash and traffic data, as well as data collected as part of their audit. During the design plan review and in-field audit, they identified a number of safety concerns that could not be flattened. New conflict points would need to be established following reconstruction, increasing the potential for near end, turning and merging crashes. The free right turn lanes that were incorporated into the design added to driver workload and presented a safety concern to the team. Limited clear zones had been designed into the project, and proposed signage and pavement markings were deemed inadequate.

Following their audit, the team analyzed their data and observations and prepared their report of findings. As part of the report, a number of recommended changes and improvements to the design project were made, incorporating both low cost solutions and more extensive changes. These interim improvements included the removal of vegetation to improve intersection sight triangles, the addition of new pavement markings and the introduction of a left turn lane at one intersection where adequate pavement width was already present. In the project design, the team recommended the inclusion of a centerline in right of way areas and reviewing the safety of allowing right turns on red to address conflicts. Turning radius radii and yield control were also recommended, along with examinations of proposed guardrail locations to confirm that they would not restrict sight distance. It was also recommended that clear zone areas be expanded to remain in the zone and the provision of barriers at locations with steeper slopes if a clear zone could not be achieved.

Several site-specific issues were also identified during the RSA. This included one severe angle intersection in which the low cost solution of installing advanced warning signs was recommended. A culvert extension was also identified, and slope flattening was recommended for a site with a relatively high culvert pipe beneath a narrow shoulder and steep side slopes, along with the low cost treatment of delineators.

Following the site visit, the auditors conducted analysis and review of the observed and collected field data, identified the needed improvements discussed earlier, and developed a report of findings. Along with the low cost solutions identified, the team recommended upgrading the roadway to current design standards in the future to address existing sight distance issues. The report was presented to Day County officials, in accordance with the RSA process. As a result, the recommendations was developed, resulting in the Day County Commission requesting funding assistance from the FHWA High Risk Rural Road Safety Fund, through the South Dakota Department of Transportation, to make the recommended construction improvements on the route. 1

In summary, the conduct of RSAs is a straightforward process that can proactively identify safety issues during the project design phase, during construction/reconstruction, after a project has been completed or along an existing roadway. Often, low cost solutions exist to address these issues. The improvements identified often represent elements that would not have been overlooked had an RSA not been made, such as signage and pavement markings, removal of obstructions from the clear zone, etc. Field visits made to a project site can yield further opportunities to improve safety, as an RSA team in the field may make observations which may not have necessarily been identified, such as the absence of adequate delineation or barrier protection.

Corridor RSA Example

To illustrate the application of an RSA to a corridor a case study from Day County RSA Example resulted of the audit and the presentation of results and recommendations, crashes. During the RSA, it became evident that the new design actually achieved, incorporating both low cost solutions and more extensive changes. The feedback if these could not be flattened. Finally, pavement marking and signage were recommended, along with examinations of proposed guardrail locations to confirm that they could not be flattened. In summary, the conduct of RSAs is a straightforward process that can proactively identify safety issues during the project design phase, during construction/reconstruction, after a project has been completed or along an existing roadway. Often, low cost solutions exist to address these issues. The improvements identified often represent elements that would not have been overlooked had an RSA not been made, such as signage and pavement markings, removal of obstructions from the clear zone, etc. Field visits made to a project site can yield further opportunities to improve safety, as an RSA team in the field may make observations which may not have necessarily been identified, such as the absence of adequate delineation or barrier protection.

Identifying High-Priority Safety Projects Countywide Both Proactively and Reactively

A part of SAFETEA-LU, the state department of Transportation (DOTs) have been tasked with generating Strategic Highway Safety Plans (SHSPs). 2 These plans (sometimes referred to as Comprehensive Highway Safety Plans) provide a framework for each state in reducing fatal and serious injury crashes on all public roads. They have been developed in consultation with a number of stakeholders, including local entities such as county officials. Given that a significant portion of the nation’s public roadway system falls under the jurisdiction of local governments, their role in improving safety through SHSPs is considerable. However, translating the goals and objectives of these plans into actionable strategies at the county and local level is a significant challenge. In addressing this challenge, county wide safety plans are a useful tool for practitioners to employ in identifying high-priority safety projects of low, medium and high cost, both proactively and reactively. 3

The RSA team reviewed the most recent design plans for the project, crash and traffic data, as well as data collected as part of their audit. During the design plan review and in-field audit, they identified a number of safety concerns that could not be flattened. New conflict points would need to be established following reconstruction, increasing the potential for near end, turning and merging crashes. The free right turn lanes that were incorporated into the design added to driver workload and presented a safety concern to the team. Limited clear zones had been designed into the project, and proposed signage and pavement markings were deemed inadequate.

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In summary, the conduct of RSAs is a straightforward process that can proactively identify safety issues during the project design phase, during construction/reconstruction, after a project has been completed or along an existing roadway. Often, low cost solutions exist to address these issues. The improvements identified often represent elements that would not have been overlooked had an RSA not been made, such as signage and pavement markings, removal of obstructions from the clear zone, etc. Field visits made to a project site can yield further opportunities to improve safety, as an RSA team in the field may make observations which may not have necessarily been identified, such as the absence of adequate delineation or barrier protection.

Identifying High-Priority Safety Projects Countywide Both Proactively and Reactively

A part of SAFETEA-LU, the state department of Transportation (DOTs) have been tasked with generating Strategic Highway Safety Plans (SHSPs). 2 These plans (sometimes referred to as Comprehensive Highway Safety Plans) provide a framework for each state in reducing fatal and serious injury crashes on all public roads. They have been developed in consultation with a number of stakeholders, including local entities such as county officials. Given that a significant portion of the nation’s public roadway system falls under the jurisdiction of local governments, their role in improving safety through SHSPs is considerable. However, translating the goals and objectives of these plans into actionable strategies at the county and local level is a significant challenge. In addressing this challenge, county wide safety plans are a useful tool for practitioners to employ in identifying high-priority safety projects of low, medium and high cost, both proactively and reactively. 3

While each county will have its own high priority focuses and corresponding safety strategies, in some cases, the SHSP produced by a state may identify specific crash issues on a county or regional basis, providing local officials with initial guidance on where a county wide safety plan should focus its efforts. Regardless, a systematic approach should be taken in developing a county wide safety plan. While the approach outlined here may vary in details from case to case, in general it represents the core steps necessary to produce a county wide safety plan.

The development of a county wide safety plan is a multi-step process and relies on input during various stages from local stakeholders with experience in the four E’s of safety: Engineering, Enforcement, Education and Emergency Response. This input develops focus areas, identifies strategies and solutions and aids in selecting projects for implementation.

Generally, the process in establishing a county wide safety plan consists of the steps outlined in Figure 1 and was employed by Olmsted County, Minn. 4 Depending on the specific needs of a county additional steps may be required, such as the conduct of a public hearing or review period.

The county safety plan process begins with a crash analysis. This analysis may consist of information provided from the state DOT and include identification of state trends and areas of concern, such as run off the road crashes, or more localized trends for a specific county or region. A county official might also be interested in addressing localized concerns in addition to the state issues they are concerned by the state. In such cases, it could perform its own crash analysis using data from the state DOT, local police or other sources (such as the Center for Excellence in Rural Safety’s Safe Roads Map tool which maps FARS data.) 5 The analysis of this data should examine total crashes, crash types and their locations to narrow the focus of the county’s plan.

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Rural Road Safety Programs

How to Identify The Most Effective Low Cost Safety Countermeasure for Your Rural Road

With more than 50% of all fatal crashes occurring in rural roads, it's crucial to identify effective low-cost solutions. This presentation outlines a systematic process for developing a rural road safety program.

1. Identify high-crash locations using available crash data.
2. Determine potential benefits of solutions to establish expected reductions, countermeasures or projects can be compared from the use of a particular countermeasure. Based on the Crash Reduction Factors (CRFs) that aid in establishing
3. Implement solutions to address safety problems with low expected cost and achievable within the resources, including National Cooperative Highway Research Program (NCHRP) Report 500, the American Traffic Safety Services Association/National Association of County Engineers’ (ATSSA/NACE) Low Cost Local Road Safety Solutions 1 and other documents.
4. Determine potential benefits of solutions to establish implementation priorities. This is accomplished through the use of Crash Reduction Factors (CRFs) that aid in establishing expected reductions in crash costs that could potentially result from the use of a particular countermeasure. Based on the expected reductions, countermeasures or projects can be ranked accordingly.
5. Address safety problems with low cost solutions, based on ranking/priority and available funding.

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As this approach illustrates, a rural safety program can be as simple as identifying existing safety problems on the network and countermeasures to address them, evaluating the potential benefits these countermeasures may provide, and pursuing implementation as funding and needs warrant.

An example of a more complex rural road safety program is provided by Wyoming, whose approach was developed to help counties identify high-risk roads and develop a strategy to obtain funding to reduce crashes on these segments. 1 2 3 The approach consisted of five steps, including:

1. Crash data analysis, which examined various aspects of crashes over a ten-year period in most cases, three years for total as well as fatal and injury crash rates, to establish high-risk locations for one mile segments.

2. Conduct a Level I field evaluation, which examined the geometric design of the roadway at each identified site. A score of 0 (most dangerous) to 10 (least dangerous) based on the answers to a series of questions was assigned to five categories, which included:
   a) General (design features, visibility, pavement conditions, etc.)
   b) Intersection and Road Crossings
   c) Signage and Pavement Markings
   d) Fixed Objects and Clear Zones
   e) Shoulder and Right of Way (ROW)

3. Ranking of high-risk locations, which combined the rankings of crash data (largest to smallest number of crashes) and the Level I field evaluation rankings. This process employed a weighting approach this discussion is in detail in the project report.

4. Conduct a Level II field evaluation, which identifies the causative factors for crashes on each road section and identifies potential counter measures, including low cost items, to address the problems.

5. Conduct cost-benefit analysis, which evaluates which countermeasures most effectively reduce crashes while requiring the lowest cost to implement. This step allows for selection of appropriate safety countermeasures that can achieve best economic effectiveness. The Wyoming approach incorporated a cost-benefit analysis, with Crash Reduction Factors provided by the Federal Highway Administration’s Desktop Reference for Crash Reduction Factors employed to estimate the potential crash reductions (benefits) of each available countermeasure.

The Wyoming approach incorporated more rigorous analysis in order to develop rankings and perform economic evaluation of projects and countermeasures prior to their implementation. However, aside from the greater emphasis on analysis, the overall approach matches the basic outline employed in the Georgia and Washington examples.

Rural road safety programs offer agencies an opportunity to identify where safety problems may exist on their system and what countermeasures are available to address them. Such a program is an effective way to identify safety problems that can be addressed through low cost solutions. As a result, improvements in highway safety can be achieved for a lower investment, while often maximizing the benefits being achieved. A rural road safety program can range from basic to complex, depending on the needs and capabilities of a particular agency. In establishing a rural roads safety program, a number of resources are available for practitioners to consult. 4 5 9 10 Regardless of the approach, a rural road program will typically incorporate information regarding crashes, countermeasures to address them and implementation.  1

The countermeasures discussed in the following sections include horizontal curve chevrons, selection of sign sheeting, uses of signage to improve safety, improved pavement markings, rumble strips and stripes, lane separators with flexible channelizer posts, high friction treatments, unsignalized intersection lighting, w-beam guardrail, and the Safety Edge. 11 Finally, technologies on the horizon are highlighted. These items are still relatively new, but hold promise in addressing safety issues along local roads, including dynamic curve warning systems, intersection warning systems and cable guardrail. Each section provides a description of what the countermeasure is, what it does, its costs, its effectiveness in past applications, and other general information. 12

References

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**Cost Effective Local Road Safety Planning and Implementation**

**Improved Chevrons for Horizontal Curves: Enhanced Curve Delineation for Drivers**

Horizontal curves present a significant challenge to safety, especially in rural areas. This is underscored by recent statistics from the Federal Highway Administration (FHWA), which indicate that 27 percent of fatal crashes occur at horizontal curves, with over 90 percent of these crashes involving roadway departure. As these figures illustrate, horizontal curves represent locations where significant improvements in safety can be made, often at low cost.

One of the National Cooperative Highway Research Program's Report 500 focus areas is on the reduction of crashes at horizontal curves. One of the lowest cost strategies to improve safety is the use of improved curve delineation. An FHWA report entitled Low Cost Treatments for Horizontal Curve Safety also presented a number of different treatments that can be applied singularly or in combination to address crashes, including the use of improved signage, chevrons, and/or retroreflective sheeting. This section focuses on the use of improved chevrons as a low cost strategy.

Chevrons are simple geometric shapes that can be used at any curve radius, and can be used individually or in combination. The choice of where to use chevrons and their configuration is dependent on the curve radius, design speed, and other factors such as the visibility of the driver at the time of the crash. The installation of chevrons can be simple, with a single chevron or a dual chevron bracket, and requires less installation time and cost compared to other treatments.

**Reference**


**Cost Effective Local Road Safety Planning and Implementation**

**Choosing the Most Effective Sign Sighting to Ensure Visibility at All Times**

One quarter of travel occurs at night yet there are three times as many nighttime crashes as during the day. The loss of half of the fatalities occurring on the nation’s roads each year, therefore, the visibility of a traffic signing at high light levels is critical to saving lives. One of the most straightforward and low cost treatments that can be used to address the different crashes that contribute to these statistics is the installation of retroreflective traffic control devices. This consideration and selection of reflective sheeting to increase the visibility at night should be based on the MUTCD requirements and life cost. Effective traffic control devices such as chevrons have shown that incorporating retroreflective traffic control devices into horizontal curves can enhance visibility through all hours of daylight and can greatly improve safety from a performance and cost perspective. There is not one universal type of retroreflective traffic control device or retroreflective sheeting solution for all agencies. Therefore, guidance on the selection of effective, retroreflective traffic control devices is necessary.

When choosing sign sighting for an application, different factors must be taken into account. Most importantly, sign location should incorporate retroreflectivity (reflecting light back to the source). Sign location matters, as it will face over time and require replacement. Cost is another consideration, as certain materials will have a higher cost but may be likely to last longer before failing compared to other alternatives.

In general, the Manual on Uniform Traffic Control Devices (MUTCD) has required signs to be illuminated or use retroreflective sheeting materials as horizontal curve signs in order to enhance visibility at night. The MUTCD has adopted a language requiring agencies to maintain retroreflectivity at or above specific levels. In selecting sheeting, many practitioners have referred to the American Society for Testing and Materials (ASTM) Standard Specification for Low Reflectance Reflective Sheeting for Traffic Control, which describes the different types of retroreflective materials that can be used on traffic signs. A summary of common sheathing types listed in this reference is presented in the accompanying table. The life cycle of sign materials will be considered when deciding the type of material to purchase. Type I sheeting has a life span of 7 years, while the other types listed have life spans ranging from 10 years to 20 years. A practitioner must consider the longevity of a material that they plan to use, as the cost of signs will vary based on the number of signs being installed.

In choosing which curves to address, different approaches may be taken. This could include examining crash history, average daily traffic, or performing a traffic analysis.

**References**


COST EFFECTIVE LOCAL ROAD SAFETY PLANNING AND IMPLEMENTATION

Using Signage to Make Local Roads Safer

Traffic signs visually communicate regulations, warnings, directions and locations to drivers. In conveying this information in a uniform manner, a safer environment is created for drivers. Signage falls into three categories: regulatory (ex. stop, yield), warning (ex. intersections, curves) and information (ex. street names, directions). When inadequate or deficient signage exists, drivers may make inappropriate responses, negatively impacting safety and increasing agency liability.

The source of standards and warrants for the design and use of signs in the United States is the Manual on Uniform Traffic Control Devices (MUTCD). The MUTCD establishes the shapes and colors of various signs to ensure uniformity and establish driver expectations. An effective traffic control device, such as a sign, should fulfill a need, command attention, convey a clear and correct message, avoid misleading or confusing drivers with the guidance and information necessary to drive safely. The low cost of signs (both materials and installation) make them an ideal approach to improving safety along local roads, particularly if past crash history indicates correctable problems exist. Figures have shown that the use of signs results in crash reductions and produces positive cost-benefit ratios.

A simple approach can be employed to improve safety on local roads using signs. This can consist of a review of site conditions and crash data to identify locations or crash patterns where deficiencies exist or signs can address a safety issue. In using signs on local roads, a practitioner should take care to avoid overuse, which could potentially lead to drivers ignoring them and degrading safety.

The use of signs has been found to have a positive impact on safety. Figures from the Institute of Transportation Engineers (ITE) indicate that a number of different signs have produced crash reductions. These include curve warning arrows (20 percent), advance curve warning signs and speed placards (20 percent), advisory speed signs (35 percent) and a special curve warning arrow with stated speed (75 percent). Further information from ITE indicated that traffic signs in general could be expected to reduce fatal crash rates (25 percent), injury crash rates (14 percent) and combined fatal and injury crash rates (14 percent), while producing a cost-benefit ratio of 7.3. Information from the Federal Highway Administration (FHWA) indicates that the installation of double stop signs reduced total crashes by 11 percent and right angle crashes by 55 percent, while advance warning signs reduced total crashes by 40 percent at rural locations.

The use of signs to make local roads safer does not need to be a complicated process. Mendocino County, Calif., established a simple program that demonstrated that additional signs on local roads can improve safety. From 1992 through 1998, the county reduced crashes along its roads by 42.1 percent by simply adding and improving signage. The approach taken was basic, with a review of each road in the county made on a three year cycle to identify signing deficiencies. This included a combination of field reviews and a review of recent crashes that had occurred on each road. Over six years, a total of $79,290 was spent on this effort; when crash reductions were accounted for, the program produced a cost-benefit ratio of 29.9.

When examining the use of signs to improve safety, a local agency should consider both roadway segments and intersections. Along segments, geometric features such as curves should be examined to determine whether adequate signage is present to provide drivers with advanced warning. The appropriateness of existing signs, such as the posted speed limit should also be reviewed with changes or removals made as needed. Intersections should also be reviewed for sign needs and existing adequacy. The FHWA indicates that signage should be used to provide drivers with advanced notice of the presence of an intersection and applied where highlighted patterns of right angle, rear end or turning crashes exist. It should also be recognized that more or better signs are not an automatic panacea. In some cases, more extensive improvements (such as those highlighted in other parts of this document) may be needed to either prevent crashes or mitigate the impact if a driver does leave the roadway.

Signs are an important component of roadway safety, providing drivers with the guidance and information necessary to drive safely. The approach taken was basic, with a review of each road in the county made on a three year cycle to identify signing deficiencies. This included a combination of field reviews and a review of recent crashes that had occurred on each road. Over six years, a total of $79,290 was spent on this effort; when crash reductions were accounted for, the program produced a cost-benefit ratio of 29.9.
COST EFFECTIVE LOCAL ROAD SAFETY PLANNING AND IMPLEMENTATION

More Visible Pavement Markings: Improved Vehicle Guidance

Roadway departure crashes represent a significant safety concern, particularly in rural locations. Statistics from 2009 indicate that 20 percent of fatal crashes occurred during the night, while 10 percent of fatal crashes occurred during rain, snow or sleet conditions. Although many of these are single vehicle runs off the road crashes, they also include vehicles that leave their lane and crossover into oncoming traffic, one of the causes of head-on crashes. During reduced visibility, under such conditions as nighttime and wet weather, drivers require more assistance in identifying and maintaining their travel lane and require additional preview time to drive confidently and safely at night. To provide this preview time, effective roadway delineation is important. Sufficient roadway delineation can be achieved through a variety of means, including more visible pavement markings, which can make a significant contribution to safety.

More visible pavement markings can help address traffic crashes by providing a roadway that is more clearly marked so that drivers can identify and maintain their lane. AASHTO’s Strategic Highway Safety Plan cites the use of pavement marking improvements as a strategy to reduce run-off-the-road crashes. Among the means, including more visible pavement markings, which can make a significant contribution to safety.

Wider pavement markings have shown to be effective in improving safety. Data from New York indicated that a 10 percent decrease in total crashes and a 33 percent decrease in fixed object crashes were observed when 8-inch wide pavement markings were used as opposed to 4-inch wide markings. Similarly, the Texas Transportation Institute found that in Michigan, wider markings produced different percentages of reductions for different crash types, including a 24.6 percent reduction in fatal and injury crashes, a 30.5 percent reduction for crashes at night and a 33.2 percent reduction in wet crashes at night. The dimensions of wider markings can vary, ranging from 5 inches to 8 inches, with 6 inches being the most commonly used according to the TTI study. The cost of a wider pavement marking is generally 20 to 50 percent higher than standard markings, which can cost between 10 cents to $2.35 per foot depending on location and material (paint, thermoplastic, tape).

Raised pavement markers are reflective markers used on longitudinal lines which provide additional delineation and can also provide auditory and tactile warning if driven over. They may be retroreflective (reflecting light back to the source) or non- retroreflective and can be installed in a raised position on the pavement or in a recessed groove to allow for snow plowing. The effectiveness of this countermeasure on local roads varies. The Benefits of Pavement Markings: A Renewed Perspective Based on Recent and Ongoing Research report found that raised pavement markers were only effective on high-volume two-lane roads (Annual Average Daily Traffic (AADT) greater than 15,000 vehicles per day) with degrees of curvature less than 3.5 degrees, reducing crashes by 24.3 percent. A Kentucky study found that raised pavement markers on two-lane roads with AADTs greater than 2,500 produced slightly lower crash rates than on roads without markers (2.65 versus 2.70). The cost, including installation, per raised pavement marker ranges from $2 to $38, depending on whether the marker is non-snowplowable, snowplowable, recessed, etc. Note that no discussions of the maintenance costs at locations where regular plowing is necessary are available.

Even where standard pavement markings may be used, they have been shown to have a positive effect on safety. Using data from a number of different states, it was found that an average crash reduction of 21 percent could be attributed to pavement markings, producing a benefit-cost ratio of 17.5. As an example, the addition of an edgeline where one is not already present has been shown to have the potential to improve safety for a low cost and should be considered. However, the addition of a centerline on low-volume rural roads (500 vehicles per day) was only beneficial to safety when roadway widths were 20 feet or greater.

All pavement markings can be beneficial, but by their nature, they will wear out, fade and lose their effectiveness over time. Therefore, it is important to have a plan for maintaining pavement markings and upgrading them when necessary. The plan should consider traffic, environmental conditions and potential safety needs. Using this systematic approach will allow for the planning and justification of resources needed to keep pavement markings maintained and effective. Retrofitreflectivity is a good practice to employ when pavement markings are present on a roadway. Whenever pavement markings are installed or rehabilitated, they should incorporate retroreflective performance to the greatest extent possible. For some types of markings, such as liquid pavement markings (i.e. paint, thermoplastic), this is achieved by dropping glass beads onto the liquid binder. For other types of markings, such as preformed tape, the pavement marking material already contains retroreflective beads manufactured into the product.

Warrants for and details of pavement markings can be found in the MUTCD, and supplemental guidelines on implementation can be found in the Roadway Delineation Practices Handbook. The reader is encouraged to review each of these references for details as they pertain to their specific application. Additionally, the reader should reference local guidance (e.g., state Department of Transportation manuals) regarding pavement marking standards and applications for their locale.

References

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A large proportion of these crashes occur along rural, two-lane roadways. The majority of these crashes are driver behavior related, including speeding, alcohol, distraction or inattention. A common, low cost solution to provide warning that a vehicle has left the travel lane is the use of shoulder and center line rumble strips and stripes. These strategies are one of the first and most promising strategies recommended by the National Cooperative Highway Research Program’s (NCHRP) Report 500 Volume 6, which focuses on the reduction of run off the road crashes.

Rumble strips and stripes in all forms are crosswise grooves milled into a pavement that produce an auditory rumbling sound and vibratory sensation to the vehicle when driven on, alerting the driver that the vehicle has left the travel lane and is encroaching on the shoulder or crossing the center line. These sensory warnings provide an opportunity to take corrective action. Rumble strips were originally used on expressways and freeways along shoulders, but have been increased use in two lane rural road applications on both the shoulder and the center line. When applied to the center edge line, a rumble strip more often takes on the form of a stripe, as the line is painted over the milled grooves.

Rumble Strips

In general, it has been noted that there is a great deal of variability regarding rumble strip dimensions between states. 1 The FHWA’s Office of Safety has developed technical advisories for shoulder and center line rumble strips, including dimensions which are based on those provided in NCHRP Report 641. 2 Shoulder rumble strip dimensions are 5 to 7 inches wide by up to 16 inches long, with varying depths and spacings. The center line rumble strip dimensions can vary by agencies, ranging from 6.5 to 7 inches wide, 8 to 16 inches long, a half inch deep, and spaced between 12 and 24 inches apart. Note that shoulder and centerline rumble strips can be used together on a segment. The reader is encouraged to reference the standards which pertain to their locale for further information on dimensions.

The cost of a shoulder rumble strip ranges from 18 cents to $1 per foot, installed, while center line rumble strips cost between 20 cents to 60 cents per foot, installed. Costs will vary by location and the type of rumble strip being installed. Their layout may vary, depending on conditions and needs, and include continuous strips which only break for intersections, or incorporate recurring gaps in the pattern. Installation of all types of rumble strips can be performed at the time of paving/repairing (both asphalt and concrete) by rolling or forming the groove, or at a later time through milling. Note that milling is the preferred approach to installation, as rolling can produce construction problems and does not produce the same warning effect.

Rumble strips do raise noise concerns, particularly for adjacent residents. These concerns may be addressed by the removal of rumble strips in spot locations, increasing the distance between grooves, or modifying their dimensions. There have also been concerns from bicyclists regarding safety on roads with rumble stripes. 3 When center line rumble strips are used, a width of 14 feet of pavement beyond the strip should be provided, while shoulder rumble strip treatments can incorporate recurring gaps, adjusted design dimensions or the use of edge rumble stripes. 4

The effectiveness of rumble strips has been evaluated by several studies. In Connecticut rumble strips produced a 32 percent reduction in single vehicle fixed object off roadway crashes. 5 Rumble strips on two-lane rural roads with limited shoulders in Kentucky produced statistically significant lower crash rates than roads without rumble strips. 6 Data from California, Colorado, Delaware, Maryland, Minnesota, Oregon and Washington indicated that center line rumble strips reduced total crash frequencies by 14 percent and injury crash frequencies by 15 percent. 7 Rumble strips also produce high benefit-cost ratios ranging from 2.0 to 2.1, depending on roadway volume and shoulder width. 8

Edgeline Rumble Strips (Rumble Stripes)

Edgeline rumble strips (sometimes referred to as rumble strips) involve the placement of rumbles on the edgeline of a roadway, with the edge line pavement marking painted over the rumbles. The dimensions of rumble strips vary by location, but in general, they are 6 to 12 inches wide, 7 inches long, and one half to five-eighths inches deep, with 5 inch gaps between each miling. They are installed by milling existing pavements, with a cost of between 25 cents and 50 cents per linear foot (depending on location). A shoulder should not be present to produce rumble strips for use.

An evaluation by the Michigan Department of Transportation found that dry and wet rumble strips provide six to 20 times more retroreflectivity compared to standard edgelines. 9 In Texas rumble strips held the potential to produce benefit-cost ratios ranging from 50.0 to 200.0. 10

Both rumble and stripes offer a low cost approach to addressing run off the road and center line crossover crashes. Evaluations performed to date for different installations have shown that they significantly reduce crashes and produce high benefit-cost ratios. In providing drivers with an auditory and vibratory warning, rumble strips and stripes provide an opportunity to correct a vehicle’s path and remain in the travel lane. Their low cost and ease of installation makes them an attractive safety solution. The reader is encouraged to reference other sections of this document that discuss the identification of safety issues for different approaches in identifying roadways where rumble strips and stripes might be employed.

References

5 Daniel, Janice. Shoulder and Centerline Rumble Strips and Background. New Jersey Department of Transportation, June 2007.
COST EFFECTIVE LOCAL ROAD SAFETY PLANNING AND IMPLEMENTATION

Lane Separators with Flexible Channelizer Posts

Lane separators, also called mounted raised curb systems, have predominately been utilized at highway-railroad crossings to discourage motorists from driving across lowered gate arms. Lane separators, as defined in the 2009 MUTCD, typically consist of a plastic or rubber curb section supported with an upright tubular marker or vertical panel.1 States such as North Carolina, Florida, Arkansas and Michigan have implemented and documented their experiences with lane separators at highway-railroad crossings.2 More recently, a study in Iowa employed curb systems for traffic calming purposes in rural communities with mixed results. Finally, while curb systems have also been used along right-turn lanes or in medians to restrict access, limited evaluation results have been published to date.

An evaluation in Florida investigated the safety effects of the installation of curb systems at three highway-railroad grade crossings.3 They used video cameras to record the violations in the before and after periods. Most installations had the curb systems extend for 107 feet on each side of the crossing unless the geometry of the crossing limited the length. A total of 25 violations across the three locations were observed in the before period. The length of the separators proved to be a factor; only one violation was observed in the after period where the flexible traffic separators extended for a shorter distance because of an adjacent intersection. The authors provided four recommendations based on the study results:

1. Consider the width of the pavement; some channelizers were damaged where the width was less than 11 feet.
2. The length of the channelizing system should extend to the maximum expected queue length to discourage violations.
3. The treatment should only be applied to locations with a violation history.
4. The treatment should only be applied to locations with traditional geometry (i.e. 90 degree intersection, no intersections in close proximity).

The installation of curb systems in the median on the approach to railroad gates has been implemented at 18 locations along the North Carolina “Sealed Corridor.”4 Curb systems were one of nine total warning or “other improvement type” of devices being used to improve safety. The objective of installing the curb systems is to discourage motorists from going around lowered railroad gates. Each installation costs approximately $10,000, and 80 percent reduction in left-turn crashes was performed to quantify the safety effect of the curb systems and other treatments. It found that by themselves, the curb systems reduced gate violations by 77 to 80 percent.5 When combined with a 4-quadrant gate, they were found to be from 92 to 98 percent effective.6,7

Lane separators were utilized as a traffic calming device in Slater, Iowa, a small rural community.8 The county highway outside of town has a posted speed of 55 mph whereas in town, the posted speed limit is 25 mph. The yellow curb systems were arranged to form two separate islands about a block apart. They were spaced such that 11 feet of roadway remained on either side. The authors planned the arrangement of the curb systems so that farm equipment and snowplows were not negatively impacted. At each end of the island, 25 mph speed limit signs were attached to a mountable sign support. The 85th percentile speeds observed before the installation were 40, 45, 36 and 40 mph. As a result of snowplow blades extending wider than expected, the curb systems were removed after nine months due to their installation, although reinstalled when the weather allowed. Therefore, there were two periods during which the curb systems were installed. During both before and after periods, approximately one and three month after periods showed a reduction in 85th percentile speed from 1 to 2 mph. The 85th percentile speeds observed three months after the first installation were 39, 42, 35 and 39 mph. The 85th percentile speeds observed three months after the second installation were 40, 43, 35, and 40. Additionally, a reduction in the percentage of motorists traveling at speeds 5 and 10 mph over the speed limit was observed; however, speed counts of 15 and 20 mph over the speed limit remained fairly consistent. Because of the removal of the devices at nine months, there is a need to consider the longer term effects of the speed reductions. Additionally, installations similar to this one in areas with snow accumulation should be carefully considered to ensure that a snowplow has sufficient space to perform its duties.

Several states, including New Mexico, Florida and California, have installed flexible traffic separators in medians to convert full-median to directional-median or completely close off turning movements as shown in Figure 3.9 The installations of curb systems are both a quick and inexpensive way to address high-crash locations. A study in Florida employed an Empirical Bayes before-and-after study to analyze 45 sites where the flexible traffic separators converted full-access medians to either left-in or directional medians.10 They found a statistically significant 60 percent and 70 percent reduction in left-turn crashes, respectively, as a result of the conversion. Zhou et al. estimated the construction costs to be about $25,000 per location.11

Lane separators are a low-cost option that can be used for railroad-highway crossing compliance, traffic calming and to close or restrict median turning movements. They have proven to be quite effective, achieving 80 percent compliance. Applications for traffic calming are limited, but initial results indicate a slight benefit. Finally, the use of curb systems with upright channelizers to restrict or eliminate turning movements in medians has shown a reduction or elimination of left-turn crashes. These applications are particularly appealing because they can be implemented in a relatively short period of time at a cost significantly lower than reconfiguring the curb and gutter of the median.12

References


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COST EFFECTIVE LOCAL ROAD SAFETY PLANNING AND IMPLEMENTATION

High Friction Treatments for Horizontal Curves Reduce Skid-Related Crashes

Federal Highway Administration (FHWA) statistics indicate that 28 percent of fatal crashes occur at horizontal curves, and over 80 percent of these crashes involve some form of roadway departure. Over 50 percent of these fatal crashes occur on roadways classified as Local Roads and Collectors. One contributor to vehicles leaving the roadway at horizontal curves is insufficient pavement friction. A Federal Highway Administration technical advisory on pavement friction management stresses that curves tend to lose friction at a faster rate than other locations and require higher friction. When a vehicle’s frictional demand exceeds the frictional force between the tire and the pavement, a skid develops. Such skids are particularly a problem at horizontal curves when the pavement is wet, but may also be a problem because of low friction due to polished aggregate. On local roads, approaches to address low curve friction should be considered, such as the addition of high friction surface treatments. These treatments can address these conditions of concern: low friction, marginal friction affected by weather and friction values not compatible with approach speeds and geometrics.

A high friction surface is different from other pavement treatments since it generally provides friction numbers in the range from 60 to the upper 90s. It is a thin application added on existing asphalt or concrete pavement and it provides no additional pavement structure. High friction surfaces consist of resin and polymer binders (urethane, silicon or epoxy) that are topped with extremely hard aggregates. One of the best performing commonly used aggregates is calcined bauxite but other less expensive aggregates have been successful for some conditions. The aggregate size is typically less than six millimeters, and its rough texture and greater surface area act together to increase friction. The binder acts to lock the aggregate in place, with the combined treatment able to withstand heavy braking and snowplowing. The result is a pavement surface that is resistant to polishing and provides improved friction and skid resistance. Since added friction is typically needed at spot locations (ex. curves), often the location only requires short sections. If the problem is high approach speed, pavement friction demand; the treatment may be needed in only one direction or approach lane.

The installation of high friction surfaces can be accomplished mechanically or manually. As the technology and application has evolved, the process has become more mechanized and easier to complete. However, for smaller treatment projects, a manual approach may be more practical. The installation of high friction surfaces is completed through a thin overlay process. Following implementation of any necessary traffic control, the pavement surface is swept clean and dried as needed. Large cracks may need to be sealed and weakened pavement repaired. The binder is mixed and spread over the treatment area using squeegees (manual) or a mechanical spreader. Aggregate is spread over the binder by hand or mechanically, with the excess swept away by brooms or sweepers. The binder takes two to four hours to set, depending on temperature, allowing for vehicles to drive on the treated area shortly after completion.

The use of high friction surface is not new and has shown to be effective over time, both internationally and in the U.S. Observations of the effectiveness of the treatment date back to 1975, when findings from 800 intersections in New York indicated crash reductions of 31 percent were achieved. In Florida, a before and after comparison found that two crashes occurred in the year following an overlay on an interchange ramp, compared to 12 crashes over a two year period prior to treatment. The New York DOT found that after high friction surfaces at 36 sites produced a reduction of more than 800 annually recurring wet pavement crashes. Finally, on a recent curve application in Kentucky which had experienced 59 crashes in the two years prior to installation (2009), two crashes have occurred since.

The cost of high friction surfaces is low, ranging from $16 to $25 per square yard, including implementation with traffic control. For a low speed curve requiring an assumed road section 300 feet long with a pavement width of 26 feet (867 square yards of surface), treatment would cost between $13,872 and $21,675. The exact cost will vary by the amount of surface being treated and locale. As indicated earlier, treatments can be applied to limited lengths of roadway manually or mechanically, providing an opportunity to achieve safety improvements quickly once a site has been identified and materials acquired. Maintenance needs are not a significant issue, as aggregate materials have been observed to retain high friction numbers (exceeding 60), in long term testing under heavy traffic conditions.

The key to effectively employing high friction surfaces is to identify the sites where they will achieve the greatest impact. One approach is to look for sites with high occurrences of skid related crashes, including during wet conditions. An agency can also perform field measurements of pavement friction, should testing equipment be available; however, note that some devices such as skid trailers do not measure friction in curves well. In light of this, other approaches such as the identification of most severe curves for treatment based on different aspects such as site friction demand and kinetic energy might be considered. In the case of friction numbers, studies have indicated that numbers less than 35 to 40 (measured at 40 mph using a ribbed tire) are associated with increased crashes. Note that this does not take into account the additional friction needed of vehicles in curves.

High friction treatments on horizontal curves offer an opportunity to enhance friction and reduce skid crashes for low cost. Such treatments employ a binder and wear resistant aggregate to enhance friction in a small but critical area. These treatments can be applied on curves which have exhibited problems with skid-related crashes in a relatively short timeframe, allowing for safety improvements to be achieved quickly. Installation can be completed manually or mechanically and generally takes less than one day to complete. The cost of high friction treatments will vary by surface area and locale, but in general the overall project can be low cost, offering an opportunity to treat curve locations on a spot basis quickly. For further information on high friction surfaces, the reader is encouraged to visit the high friction roads website.

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COST EFFECTIVE LOCAL ROAD SAFETY
PLANNING AN IMPLEMENTATION

Unsignalized Intersection Lighting Improves Site Visibility

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pproximately 39 percent of fatal crashes occur at rural intersections. These crashes are 42 percent more likely to result in fatalities and 25 percent more likely to result in injuries when compared to crashes at urban intersections. In rural areas, there are also more non-motorists involved in crashes. Overall, 39 non-motorists were involved in each fatal crash at a rural intersection, whereas in urban areas, there were 23 non-motorists involved. Non-motorists are also more likely to be killed in rural crashes than in urban crashes. A non-motorist fatality rate of 52 percent is found in rural areas, compared to 24 percent in urban areas. This is because non-motorists are more likely to be pedestrians when involved in rural crashes.

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The purpose of overhead lighting at rural intersections is to add to the illumination provided by a vehicle’s headlights. Lighting can improve overall visibility, or destination, to guide a driver to the intersection or alert them to its presence. The application of lighting should be done at sites which experience substantial patterns of nighttime crashes. The installation of lighting at these sites will provide additional illumination for drivers, including non-motorists, and may increase the visibility of other vehicles and avoid conflicts. It also enhances sight distances and improves the visibility of non-motorists. The identification of such sites can be completed through the safety review processes outlined in other sections of this document.

A number of studies have found that lighting at rural intersections has produced a positive safety benefit. The Federal Highway Administration has reported that a crash reduction factor (i.e., the percentage of crashes that can be reduced) of 38 percent for crashes at rural intersections would be expected from the application of lighting at rural intersections. In Minnesota, a before and after study of 33 rural intersections found a 37 percent lower night time crash rate following installation of lighting.9 A previous Minnesota study of 12 rural intersections found reductions in night time crashes ranging from 40 percent and cash severities of 4 to 26 percent.9 Further analysis found that a lighting installation produced an average cost-benefit ratio of 15.0.9 Finally, an application of lighting projects as a cost-effective strategy at rural intersections in Kentucky found a 45 percent reduction in nighttime crashes following the installation of lighting.9

The time required to implement lighting at a rural intersection can also add an additional cost design needs and arrangement of a connection to local power. The initial costs of lighting include design, materials, and installation, which will vary by locale. Design must consider pole height, lighting wattage and type (light emitting diodes, mercury vapor, etc) and placement. In some cases, light fixtures are designed such that they can be placed on a guardrail post (i.e. destination lighting) reducing material and installation costs. However, this may not be a viable option from a proximity standpoint, and in other cases, illumination of the intersection itself (full lighting) is more desirable. In addition to initial costs, there are ongoing maintenance and power costs for each installation.

County figures from Minnesota (2008) indicated that the average cost to install a light ranged from less than $500 to $1,500. While maintenance and power costs must be made. Still, rural lighting is a low-cost tool to address intersection safety and can be applied in a systematic manner.

One limitation to the addition of rural intersection lighting is that the costs of the lighting itself are a significant portion of the cost of installation, which is electrical power is available. Consequently, if power is not located nearby, an agency must be prepared to incur additional costs to bring power lines to the site. If running the power to the site is cost-prohibitive, consideration should be given to other low-cost treatment strategies such as supplemental signage, approach rumble strips or clearing sight triangles, among others, before choosing to add overhead lighting.

In considering the installation of intersection lighting, the reader should keep in mind that some states or agencies have warrants or legal codes when intersection lighting may be mandated. It is advisable to go through the safety review process to determine whether warrants or legal code for lighting exist in their state, they are encouraged to contact the appropriate state or local Technical Assistance Program (TAP) for their state, which can be identified through the national TAP website, http://www.tap.fhwa.dot.gov. This will assist in understanding local projects as a cost-effective strategy at rural intersections in Kentucky found a 45 percent reduction in nighttime crashes following the installation of lighting.9

The installation of intersection lighting, particularly in rural areas, may not always be practical from a proximity standpoint, and in other cases, implementation at rural intersections can be achieved through the safety review processes outlined in other sections of this document. In summary, w-beam guardrail may be installed on horizontal curves to protect motorists from hazardous terrain or objects. Therefore, with the proper steps in place, guardrail can be installed over the barrier because they help to maintain the height of the wall. Strong barriers provide added protection and help motorists to avoid conflicts, particularly at sites where they may need to be met.9

References

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18. The study was conducted in Pend Oreille County in Washington State has installed some of the guardrail is protecting (Figure 1).2,4,3
The Safety EdgeSM Reduces Pavement Edge Drop Off Crashes

According to the Federal Highway Administration (FHWA), roadway departures account for approximately 53 percent of fatal crashes each year. Among the roadway departure crashes that are most likely to be severe are those involving pavement edge drop-offs. These crashes occur as the result of a vehicle leaving the paved surface and encroaching on an unpaved surface lower than the roadway, followed by an over-correction to return to the travel lane. Pavement edge drop off is a condition where the pavement edge is at nearly a 90 degree angle to the pavement surface or around shoulders. Study results suggest drop-off becomes problematic at a depth between 2.25 inches and 2.5 inches. The presence of pavement edge drop off may cause “scrubbing” action to tires when drivers attempt to steer back onto the roadway. To overcome this scrubbing and climb back onto the roadway, drivers may over steer, losing control when the vehicle suddenly overcomes the scrubbing. The result may be a head-on, sideswipe, overrun or run off the road crash. Illustrations of pavement edge drop off are provided in the accompanying images.

Previous work has established that pavement edge drop off represents a significant problem along the nation’s rural roadways. Settling material adjacent to the pavement will create drop offs along all roads. On narrow pavements or segments such as curves, vehicle tires will create greater drop-offs where gravel or earthen shoulder material migrates away from the pavement edge. Significant drop-offs are also created by erosion of this material where vegetation is lacking or grades create high-velocity run-off of water. In addition to maintenance to pull shoulder material back to the pavement edge/surface, a low cost solution to the drop off problem is the installation of the Safety EdgeSM. The Safety EdgeSM is a technique to shape the pavement edge/surface, indicating that it should be incorporated into all Federal-aid new asphalt paving and resurfacing projects. By the end of 2012, the FHWA expects that 49 states will have used the Safety EdgeSM on projects and adopted it as a standard on paving projects, with corresponding design specifications established in each state. The reader is encouraged to reference the design guidance specific to their state when considering the inclusion of the Safety EdgeSM in their particular project. If a state does not have guidance developed, a reader should refer to the FHWA’s specifications.

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In summary, the Safety EdgeSM offers a low cost solution to address pavement edge drop off issues and run off the road crashes. The Safety EdgeSM offers a gradual transition back onto the pavement surface when the pavement or shoulder edge has been encroached by a vehicle. It is a straightforward installation that can be made during any construction or repaving project for a minimal increase in materials and cost. The Safety EdgeSM has shown to be effective in reducing crashes and produces high cost-benefit ratios through a reduction in fatalities, injuries, property damage and tort liability claims.

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Technology Solutions on the Horizon

We are fortunate in the highway community that new life-saving technologies and innovations continue to emerge from our universities, highway agencies, and private sector. Through research, development, testing and deployment, the range of innovative technology solutions continues to expand and provide new tools for highway safety professionals. As with any research, not every new idea is ultimately successful; however, it is good to keep an eye out for these new ideas, particularly as they begin to emerge into the marketplace and begin showing results.

One example are Dynamic Curve Warning Systems (DCWS), a new product that uses solar power and microchip technology to provide added warnings on horizontal curves that continue to have a history of high crash rates, even after other approaches have been installed. Dynamic curve warning systems (DCWS) have been developed to both remind and persuade motorists to reduce the speed of their vehicles to the advisory speed limit on horizontal curves. They have been installed and used in addition to static signs because they have a greater effect on high-speed vehicles.1

Several installations of dynamic curve warning systems have been implemented on interstates, whereas implementations on rural highways are limited. However, there are several appealing aspects of cable barriers including impacting less force on vehicles contained by them when compared with semi-rigid or rigid barriers, relatively low installation costs especially when compared with other barrier options and aesthetic appeal that make them a potential countermeasure on local roads in the future.

Another new technology that is emerging is Intersection Warning Systems (IWS). These systems use low power vehicle detection sensors, Changeable Message Signs (CMS), wireless communications and solar power to provide active warning on cross roads that vehicles are approaching on the mainline. In general, the systems can be as basic as the addition of light emitting diodes to existing static signage (stop signs, advanced warning signs). Conversely, more complex systems have also been developed which use CMS signs to provide drivers with a visual indication of gap warning in real time. The FHWA provides an extensive discussion of different aspects of some of these systems online, including signing options, layout and placement, and cost (a maximum cost of $35,000).2 An evaluation of IWS in Minnesota found that they reduced traffic conflicts at intersections from 3.8 per 1000 vehicles before installation to 1.8 per 1000 vehicles after installation.3 Surveys of drivers found that they were aware of the signs and understood their meaning. Intersection Warning Systems are still in the initial stages of deployment and evaluation on local roads, and the reader is encouraged to track their progress in the future through additional evaluations and reports.

With the development of high-tensioned cable barriers, there has been a renewed interested in the use of cable barriers in recent years. The majority of studies discuss cable barriers in terms of installations in medians, especially related to high-tensioned cable barriers. Furthermore, applications to date tend to be on interstates as compared with local roads. However, there are several appealing aspects of cable barriers including imparting less force on vehicles contained by them when compared with semi-rigid or rigid barriers, relatively low installation costs especially when compared with other barrier options and aesthetic appeal that make them a potential countermeasure on local roads in the future.

In contrast with low-tensioned cable barriers, high-tensioned cable barriers have shown to be able to withstand several hits.7,8,9 Even so, while the cables may maintain a servicable height and are in theory functional, manufacturers do not assert that they are.10 When hit, they also exhibit less deflection as compared with low-tensioned cable barriers. However, these characteristics also result in high-tensioned cable barriers imparting more force on the vehicles contained by them when compared with low-tensioned cable barriers. Research results indicate that the benefits of installing high-tensioned cable barriers when considering accident severity may be small if not negligible.11 However, when compared with rigid barriers, they still contain a vehicle rather than redirecting it back into traffic.12 There have been reports of high-tensioned cable barriers containing large vehicles which would otherwise “tear through the w-beam barrier.”

There are additional drawbacks and benefits to cable barriers. First, there are concerns with the impact of cable barriers on motorcycles. However, the Roadside Design Guide identifies concerns with a motorcycle’s impact with w-beams as well.12,13 Second, in areas with significant snowfall, cable barriers can be damaged by snow plow operations.13 Third, special care is needed in the installation of the cable barriers – they are sensitive to correct installation height and maintenance.14 Where installations have not been to specification, reports of vehicles underriding or overriding the cable barriers have been occurred.13,14,15,16 There are also concerns with the performance of cable barriers on horizontal curves.15,16 In particular, cable barriers placed on the inside of horizontal curves will need additional deflection distance before the tensioning in the cables develops. Along with the drawbacks, there are several benefits. First, cable barriers reduce snow drifting.13,15 Second cable barriers are aesthetically appealing because they unobtrusive to the surrounding landscape.16 High-tensioned cable barriers were reported to cost between $8 and $15 per linear foot (2004, 2005).14,15 Adjusted to 2011 dollars, this equates to a range of $9.27 to $17.05.16 A potential user of cable barriers should consider that there may be more maintenance costs associated with cable barriers over their lifetime.

These examples simply highlight the kind of innovations that are “on the horizon” to address safety problems on rural roads and intersections. The cost of such systems will likely become even more attractive as additional applications are developed, and more autonomous power sources (solar power and batteries) are brought to market. While these technologies are still in the initial stages of deployment and evaluation, they may very well offer just the kind of solution that you need. This is why it would be good for you to keep an eye out for these new products and innovations, particularly as they are evaluated and tested in the coming years.

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Illinois’ Towards Zero Deaths Partnership

Illinois had 911 traffic-related fatalities in 2005, which is the lowest number since 1931.1 It is no coincidence that the drop corresponded with the creation and subsequent initiatives of the Bureau of Safety Engineering. The bureau made it a priority to direct more funding to local roads, where 50 percent of the fatalities occurred.2

Eighty percent of roadway miles in Illinois are under local jurisdiction. However, only 20 percent of total vehicle miles are traveled on these local roads.3 Since 50 percent of the fatalities occurred on these roads, the Illinois Department of Transportation decided to “jump in both feet first” by allocating 20 percent of their State Highway Improvement Program and High Risk Rural Roads Program money toward infrastructure improvements on local roads.4 While this may not seem like a significant change, consider the expenditures before and after the creation of the Bureau of Safety Engineering. Before its creation, $750,000 of the $17 million allocated for safety improvements went to local roads. The funding level, which was about 4 percent, could only address one or two major projects. Now with the Highway Safety Improvement Program investments, the Bureau of Safety Engineering has $50 million to operate with, of which $8 to $10 million is invested at the local level. That is a significant increase in investment. The only “challenge” that Illinois has with investing the funds at the local level is identifying appropriate projects. However, the Statewide Local Safety Summits and development of county safety improvement plans will assist with identifying more appropriate projects.

Illinois holds annual Statewide Local Safety Summits. These summits serve the purpose of helping to inform people on the State Strategic Highway Safety Plan, allowing discussions on the emphasis areas for Illinois and current crash statistics. Participants are also given an overview on how to perform data analyses and county measure selections and identify potential funding sources. In addition, initiatives like Road Safety Assessments (RSAs) and system-wide improvements are presented. The summits benefit participants and the state in understanding the process of identifying types of projects, what projects are eligible for funding and how to request them. It allows the bureau to consult with local entities to meet one-on-one with state employees where they can determine if they need additional assistance on addressing a local problem.

Illinois is in the process of working with eight counties to develop a county safety improvement plan that ties in the larger Strategic Highway Safety Plan. These counties were chosen because they had a higher number of fatalities when compared with the other counties. The DOT is organizing a workshop where representatives of the 4Es (engineering, education, enforcement and advocacy) will convene to develop a plan with the counties. Illinois is facilitating the process by providing manpower and funding for a consultant to assist in the development of the plans. The Bureau of Safety Engineering, with key safety team members, is involved in coordinating the infrastructure and education programs and other projects to address areas with high concentrations of severe crashes. These RSAs typically result in local projects. The use of law enforcement has helped expand the use of RSAs on the local roadway system.

The state of Illinois was not always able to provide crash reports to the local entities. Similar challenges are found within other states throughout the United States. Legislation had to be modified to allow local entities to access the crash data. Privacy concerns were the biggest issue in allowing access to these documents because of the personal information contained in the crash reports. As a result of their efforts, the local agencies are now able to access crash reports, which assist local entities in addressing safety in their area.

As another means to analyze local crash data, Illinois partnered with the AAA to plot uRAP, a program designed to help out death and serious injury rates through systematic risk assessment, to ensure that current & future risks are addressed.5 Illinois and AAA worked with one of the urban counties in Illinois to analyze data and develop risk maps using uRAP. This program has been an effective method for identifying high priority safety locations that meet benefit-cost efficiencies. This program will be expanded to seven additional counties of focus.

The Illinois Department of Transportation also credits the Federal Highway Administration’s (FHWA) Illinois Division, a partner, with the improvements to traffic safety in the State. The partnership with the FHWA is so fluid that it has been described as an “extension of staff” as a result of working closely with the local agencies and the state.6

Illinois has demonstrated that significant investments at the local level can provide notable results. Working with local entities through workshops and Statewide Safety Summits helps further engage the local entities. The state is currently working on developing county-specific safety plans that tie into the state plans but which only help advance transportation safety in Illinois. Finally, Illinois shows that while some hurdles, like outdated legislation may exist, being proactive at the local level can help to remove such barriers.

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COST EFFECTIVE LOCAL ROAD SAFETY PLANNING AND IMPLEMENTATION

Minnesota’s Towards Zero Deaths Partnership

Minnesota had 918 traffic-related fatalities in 2005, which was the lowest number since 1935.1 It is no coincidence that the drop corresponded with the creation and subsequent initiatives of the State Aid Safety Engineer, initiated a Towards Zero Deaths program.2 The program focuses on implementing an interdisciplinary approach to traffic safety through the use of the 4Es: education, engineering, enforcement and emergency medical and trauma services. The success of the program speaks for itself. Minnesota went from 655 traffic fatalities in 2003 to 411 in 2010 (Figure 1), a 37 percent decrease. Furthermore, the state can now boast the second lowest number of fatalities per 100 million vehicle miles traveled in the nation. Since the program’s inception, MnDOT estimates that 900 lives were saved. As a result of the program’s success, MnDOT was recognized in 2009 with the Global Road Achievement Award by the International Road Achievement Award by the International Road

What was the key to Minnesota’s success?2 Local investment. Minnesota realized that the crash data was telling them that money should be spent on local highways, not just on state roads.3 Redistributing funding solely from state to a combination of state and local roads did not happen overnight. To begin, Minnesota started small. In the first year, a very small amount of the funding that Minnesota received from the federal government was allocated to local roads.4 This funding was only used for smaller projects like safety installations. As the program matured, the safety projects at local levels advanced from safety inventories to low-cost treatments like chevron installations and rumble strip implementations.5

As the program grew, additional initiatives were implemented, including the creation of a State Aid Safety Engineer position, providing funding for each county to develop county-wide safety plans, and the requirement for a county to have a 4E Coordinating Committee with Coordinating Committee with Coordinating Committee funding. All of these initiatives will be discussed in the following sections.

MnDOT utilized funding provided by the federal government to develop the State Aid Safety Engineer position.6 What does a State Aid Safety Engineer do?7 Looking at the position holistically, the engineer is there to assist the local entities. They are the glue that connects the state and local level in the partnership Towards Zero Deaths. In addition, the State Aid Safety Engineer helps ensure that the money is being spent appropriately, and they take good ideas from other locations and share them with the local entities.8 Most importantly, the individual holding this position helps the local entities implement the most effective safety project, not just a safety project.9 While it is true that funding some projects may take some funding away from other projects, the MnDOT says that the benefits far outweigh not being able to implement the projects.

Minnesota developed a State Highway Safety Plan in 2004.10 Not, as Minnesota began to address local roadway safety. It realized that it needed a “data-driven” plan for local entities.11 This realization led to the idea of developing county-wide plans that spoke to the statewide safety plan.12 The state utilized funding to hire consultants to work with each county to develop county-wide safety plans so as not to overburden the counties with this task.13 Minnesota may have a bit of an edge when compared with other states. Minnesota has a much larger road network, which has provided them with a much larger crash database available at the local level; however, the data was not very user friendly. Therefore, Minnesota borrowed a crash analysis tool called CMAST from its neighbor, Iowa, and modified the tool to fit Minnesota’s needs.14 Minnesota has named their version VM-CMAT. The State Aid Safety Engineer assisted with the conversion.15 MnDOT addresses safety through the 4Es, and these initiatives are designed so that the actions in one entity are not conflicting with the actions in another.16 A county that received safety money from the state must establish a County 4E Coalition. The coalition is composed of educators, law enforcement, city engineers, a county engineer and the Minnesota regional traffic engineer. They meet on a quarterly basis to discuss their projects and future plans. In some cases these meetings further advance the safety initiatives. For example, the group discussed a crash that was in the border of two counties because of its location, it was not clear which entity would respond. Therefore, the group developed a future protocol to identify the responding agency for future crashes that may occur along borders.

An important part of sustaining Minnesota’s Towards Zero Deaths initiative is the dramatic reduction in fatal crashes. To get to this point, Minnesota started small by investing in small projects at the local level. Due to the successes of these initial investments, larger projects requiring more financial investment, forming the State Aid Safety Engineer position and providing funding for county-wide safety plans were made.17

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Utah’s Towards Zero Deaths Partnership

In 2006, Utah launched its ‘Zero Fatalities: A Goal We Can All Live With’ program.1 Zero Fatalities is a ‘mutual effort between various state partners to address the top behaviors that lead to road fatalities in Utah.’2 The program has already seen success when in 2009 Utah had its lowest number of traffic fatalities, with 244, in 35 years.3

To help promote its safety initiatives, Utah hosts Safety Summits. The Safety Summits provide two primary benefits: bringing the focus to safety issues during the summits and generating new ideas.4 Like other states, Utah has found that roadway fatalities are overrepresented in rural parts of Utah.5 Therefore, it is no surprise that rural road safety remains one of the 10 Continuing Safety Areas for the Utah Department of Transportation. For each Continuing Safety Area, leaders from the partnership are identified. For the Rural Road Continuing Safety Area, the Utah DOT, Federal Highway Administration and Utah Local Technical Assistance Program Center are the identified leaders. Their strategies to address rural road safety include three initiatives:

1. Continue the rural roadway signing program
2. Continue Road Safety Audits
3. Implement a High Risk Rural Roads Program.

The rural roadway signing program benefits local entities by providing them with additional guidance and expertise.6 For this program, state department of transportation personnel and local entities work collaboratively to look at the roadway signing.

The Road Safety Audits (RSAs) benefit local entities by considering a problem from a wider perspective.7 Collaboratively working with law enforcement on RSAs is a very important part of the partnership. As a result of the broader perspective from participants of an RSA, a more diverse set of solutions may be proposed. Although the High Risk Rural Roads Program was initiated in 2006, the High Risk Rural Roads Program Manual was recently updated for Utah in April 2011.8,9 Utah has a unique challenge from many states due to the rural nature of many roads. The definition of rural in Utah differs from that in the east because from many states due to the rural nature of many roads. The definition of rural in Utah differs from that in the east because above average fatality statistics, state employees sat down with counties within Utah to operate with a very small staff typically consisting of an office manager, law enforcement person and maintenance person. Therefore, the ‘grant application’ style of program administration seen in other more populous states may deter counties from participating. As a result, the state worked to partner more directly with counties. After identifying counties with above average fatality statistics, state employees sat down with county staff to gain an understanding of operational observations. The results of these collaborations are projects that include installing warning signs, like curve chevrons, and delineators along the roadside. One of the partners, the Utah Local Technical Assistance Program, followed up with the counties that had installed signs as a result of the High Risk Rural Roads Program to assist the county in creating an inventory.

Finally, the Utah Department of Transportation provides additional support to local entities by providing equipment, like speed monitor trailers, in-car video cameras and other safety equipment, which local entities might not otherwise be able to afford.10 For example, the speed monitor trailers can help to address local speeding issues.

In summary, Utah is working Towards Zero Deaths by addressing safety problems in local areas. It holds Safety Summits, coordinates a rural highway signing program, RSAs, and it loans out safety-related equipment to local entities. All of these initiatives have helped to contribute to the success of the Utah Department of Transportation in reducing the number of traffic fatalities.11

References

6 Information obtained from W. Scott Jones, P.E., PTDE, Safety Program Engineer for the Utah Department of Transportation.

Washington State’s Towards Zero Deaths Partnerships

The state of Washington began working toward the objective of achieving zero deaths by 2030 in 2001.1 The pay-offs of this program have already generated successes: traffic fatalities are the lowest that they have been in 60 years, even with an increase in vehicle miles traveled.2

Sixty-one percent of traffic fatalities occur on rural roads in Washington.3 When diving deeper into these traffic fatalities, the major crash type identified is run-off-the-road.4 There were approximately 3,900 crashes between 2002 and 2006 on approximately 39,000 miles of roadway. Addressing each crash would likely only address a random occurrence, not solve the larger problem. Therefore, Washington considered the issue at the county level. It ranked the 39 counties based on the rate of fatal and serious injury run-off-the-road crashes per mile traveled. Using these rankings a funding/programming target was developed for each county. Again, because there were many miles over which the crashes occurred, systematic safety improvements are being implemented at the local level by each county. Some examples of improvements include edgeline and centerline rumblestrip installation, adding striping on the centerlines and edgelines, removing and delineating fixed objects, limited guardrail installations, addition of safety edges to pavement or upgraded the signage.5 A similar approach was developed based on intersection related crashes on county roads, which considered intersection related crashes per mile. An additional funding/programming target was provided to each county for intersection improvements.

The final count of each county level problem was required to be consistent with the Strategic Highway Safety Plan and was negotiated between the state and each county.

A unique agency in Washington is the County Road Administration Board (CRAB). CRAB has been in existence since 1965, originally to provide statutory oversight of Washington’s counties.6 Now CRAB is also in charge of overseeing the Rural Arterial Program (RAP) and County Arterial Preservation Program (CAP). It also administers Certificates of Good Practice. RAP’s money is generated through fuel tax revenues. The money is directed to road and bridge reconstruction. RAP funding is competitive, and safety is a big part of the competition. RAP projects may encompass corrections to site distances or getting pedestrians off of the roadway. The level to which a proposed RAP project incorporates safety contributes to its likelihood of funding. CAP provides counties with the preservation of existing, paved arterial road networks. CAP is not competitive. There are no points for safety considerations in the projects. However, aspects of the program, including ensuring that fog lines are on the road, bring their own safety benefits. Finally, when a county maintains a Certificate of Good Practice, it is eligible to receive a portion of the gas tax funding.7 To receive a Certificate of Good Practice, a county is required to submit accident reports to the state in a timely fashion. Counties must also promptly respond to unsafe or insufficient aspects, like a downed stop or yield sign.

Maintaining County Roads Accident Reports is included as an aspect of the Certificate of Good Practice. Counties are required to submit accident reports to the state in a timely fashion.

Washington illustrates that significant improvements in safety can be achieved when safety funding is channeled down to the local level. By identifying the counties with the most significant safety problems and providing funding to address those problems, Washington was able to make advances in addressing a number of different crash types along local roads in partnership with various counties. This was achieved through the use of low-cost countermeasures which could be applied in a short time period to address different safety problems in a comprehensive manner.

References

2 Information obtained from Washington State Department of Transportation H&LP Engineering Services Manager.
3 Information obtained from William Shepp, P.E., Washington State Department of Transportation H&LP Engineering Services Manager.
6 Information from John Waddel. Executive Director of the County Road Administration Board (CRAB) in Washington State.
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