Alabama Speed Management Action Plan

Problem Identification, Solutions, Implementation, Evaluation

FHWA Safety Program

U.S. Department of Transportation
Federal Highway Administration

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

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Glossary

The following are definitions of terms used in this document.

85th percentile speed – The speed at or below which 85 percent of vehicles travel.[1]

Basic Speed Rule – "*The Basic Speed Rule requires vehicle operators to drive at a speed that is reasonable and prudent. As a corollary to this rule, State laws usually provide that every person shall drive at a safe and appropriate speed when approaching and crossing an intersection or railroad grade crossing, when approaching and going around a curve, when approaching a hill crest, when traveling upon any narrow or winding roadway, and when special hazards exist with respect to pedestrians or other traffic or by reason of weather or highway conditions."* Alabama's Basic Speed Rule states*, "No person shall drive a vehicle at a speed greater than is reasonable and prudent under the conditions and having regard to the actual and potential hazards existing."* [2]

Comprehensive approach – A comprehensive approach uses a full range of strategies to address speeding-related safety issues related to the road user, the streets and highways, the vehicle, the environment, and the management system. Comprehensive strategies in this Plan include engineering and design, enforcement and judicial measures, education and publicity, management strategies, policies, evaluation, and coordinating the strategies to achieve the bottom-line safety targets.

Coordinated approach – The goal of a coordinated approach to any traffic safety area, including speed management "is to move away from independent activities of engineers, law enforcement, educators, judges, and other highway-safety specialists," including injury prevention and publicity experts, and to promote the formation of working groups and alliances that represent all of the elements of the safety system. A coordinated approach uses the combined expertise and resources of a project team to reach the bottom-line goal of targeted reduction of crashes, fatalities, and injuries.[3]

Countermeasure – A countermeasure is a targeted treatment to reduce the frequency and severity of crashes. Treatments may include design or engineering changes, enforcement, or education and public-information measures.

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[1] Donnell, E.T., Hines, S.C., Mahoney, K.M., Porter, R.J., McGee, H. (2009). Speed Concepts: Informational Guide. Report No. FHWA-SA-10-001, Washington, D.C.: Office of Safety, Federal Highway Administration.

[2] NHTSA (2011b). *Summary of State Speed Laws.* Eleventh Edition. Current as of February 1, 2010. DOT HS 811 457. U.S. DOT National Highway Traffic Safety Administration.

[3] National Cooperative Highway Research Program (NCHRP). (2009). Guidance for implementation of the AASHTO Strategic Highway Safety Plan. Volume 23: A guide for reducing speeding-related crashes. NCHRP report 500. Retrieved from: http://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwasa09028/resources/nchrp_rpt_500v23.pdf.

Crash modification factor (CMF) – A crash modification factor (CMF) is a multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure relative to the expected crashes if no changes are made. Standard errors of the estimate give an idea of the quality of the estimate and potential variation of effect. If available, calibrated State estimates may provide a better estimate of effects for a State.[4]

Crash reduction factor (CRF) – A crash reduction factor (CRF) is an estimate of the percentage reduction in crashes due to a particular countermeasure.[5] The crash modification factor (CMF) estimates in the *Speed Management Toolkit* document can be used to estimate expected crash reduction percentages [(1 – CMF) * 100].

Data Driven Approach to Crime and Traffic Safety (DDACTS) - DDACTS integrates location-based crime and traffic crash data analysis to determine the most effective methods for deploying law enforcement and other resources.[6]

Design Speed – The speed established as part of the geometric design process for a specific roadway.[7]

Highway Safety Improvement Program (HSIP) – The **"***Highway Safety Improvement Program (HSIP) [is] a core Federal-aid program. The goal of the program is to achieve a significant reduction in traffic fatalities and serious injuries on all public roads, including non-State-owned public roads and roads on tribal lands. The HSIP requires a data-driven, strategic approach to improving highway safety on all public roads that focuses on performance.*" This program was continued by MAP-21, the federal transportation law that went into effect on October 21, 2012.[8]

Operating speed(s) – Operating speeds are the speeds at which vehicles actually travel under free-flow (unconstrained or uncongested) conditions. The most often used measure of operating speed is the 85th percentile speed (see definition), but average or mean speed and other speed distributional measures may also be used.[9]

Proactive approach – A proactive approach, as described in this document, is a practice of planning and designing new roads or street improvements that considers intended operating speed and appropriate speed limits in the very earliest stages of the planning process. A proactive approach aims to engage safety and mobility goals and various stakeholders in the planning, design, and operations of streets and highways to target speeds appropriate to the land uses and purposes of the road to minimize future speed management and safety issues. (See "self-enforcing road design.")

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[4] Crash Modification Factors Clearinghouse. U.S. Department of Transportation, Federal Highway Administration. http://www.cmfclearinghouse.org/.

[5] *Ibid.*

[6] Data-Driven Approaches to Crime and Traffic Safety (DDACTS), NHTSA web page

[7] Donnell, et al. (2009).

[8] See FHWA's HSIP webpage for more information on eligibility and requirements: http://safety.fhwa.dot.gov/hsip/gen_info/resources_npr.cfm

[9] Donnell, et al. (2009).

Road Departure Plan – The Alabama Roadway Departure (Safety) Implementation Plan (2013) was developed with support from FHWA. The Road Departure Plan describes strategies and implementation of countermeasures to reduce road and lane departure crashes and injuries.

Road Safety Audit (RSA) – Road Safety Audits (RSAs) offer a formalized methodology for an expert, multi-disciplinary team to make a qualitative assessment of safety conditions from the perspective of different road users, and to identify potential treatment alternatives. [10]

Rural/urban crash – A rural or urban crash indicates whether the crash was reported to occur inside municipal boundaries (urban) or outside municipal boundaries (rural).

Rural/urban road section – Rural or urban road sections are defined in this Plan by whether or not a road section is within municipal boundaries (urban) or outside municipal boundaries (rural).

Self-enforcing road design – A self-enforcing roadway design is road design that reinforces established limits, which are consistent with the desired operating speed, and reduces *opportunities* to speed.[11] The goal of such a design is to increase consistency of design with limits, and to design the road itself to induce drivers to adopt operating speeds that are within established limits, thereby reducing the need for traffic law enforcement of speed limits. A self-enforcing roadway design may be an objective of a proactive approach (see "proactive approach" definition).

Self-explaining road design – Self-explaining road design keys on the development of a consistent design and appearance for each roadway purpose or function category.[11] Self-explaining road design complements self-enforcing road design by making the type of road and associated speed limit(s) more readily evident to drivers.

Severe crash – Severe crashes result in injuries that include fatalities (K-type), incapacitating-type injuries (A-type), or non-incapacitating, but evident injuries (B-type), as indicated in the crash reporting system. These crashes are used to help identify areas, times, etc., where more severe crashes are concentrated relative to total crashes. Speed at impact affects crash severity and consequently the distribution of severe crashes. An over-representation of severe crashes suggests a possible mismatch between operating speeds and road design or operating conditions (whether or not it is known if speed limits were exceeded).

Speeding-related crash – In this Plan, speeding-related crashes refer to Alabama crash data indications that the primary contributing circumstance of the crash was a driver "over the

[10] See FHWA Roadway Safety Audit Guidelines (2006) and other resources on FHWA's RSA webpages (http://safety.fhwa.dot.gov/rsa/) for more information. Include speed limit review and assessment of speeding-related safety issues as part of the audit process.

[11] Brewer, J. et al. (2001). Geometric Design Practices for European Roads. Report No. FHWA-PL-01-026, Washington, D.C.: FHWA. http://contextsensitivesolutions.org/content/reading/geometric-design-practices/resources/geometric-design-practices/.

speed limit" or "driving too fast for conditions," or that a contributing unit (driver) involved in the crash contributed to the crash by travelling "over the speed limit" or "driving too fast for conditions." Public safety officers responding to and reporting on the crash make these assessments. A conclusion of "driving too fast for conditions" derives from the Basic Speed Rule (see definition).

Strategic Highway Safety Plan (SHSP) - *"A Strategic Highway Safety Plan (SHSP) is a highly-coordinated, statewide plan that establishes optimum strategies, projects, and programs among multiple agencies to reduce highway fatalities and serious injuries on all public roads."*[12]

Systematic approach – In this Plan, a systematic approach is a process to identify and prioritize locations where speeding-related crashes are concentrated or greater than expected, and to apply systematic diagnosis and treatment of the issues contributing to the crashes. Diagnosis includes checks for consistency between speed limits, road design and operations (such as signal timing), land use and road purposes, and operating speeds. The systematic approach prescribes the application of appropriate remedies, including potential changes to speed limits to rectify inconsistencies and improve safety. Remedies may include design and engineering changes as well as the application of enforcement and educational measures.

Toward Zero Deaths - A Toward Zero Deaths framework encompasses a highway safety vision that seeks to eliminate highway fatalities as a threat to public and personal health.[13]

[12] State of Alabama, Strategic Highway Safety Plan, 2nd ed.
[13] Toward Zero Deaths: A National Strategy on Highway Safety. Available at http://safety.fhwa.dot.gov/tzd/

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1 Overview of the Plan

1.1 Plan Purpose and Description

The primary purpose of the Alabama Speed Management Action Plan (Plan) is to help the State, in partnership with local agencies, reduce speeding-related fatal and injury-causing crashes. This Plan aims to help meet Alabama's short- and long-term strategic highway safety plan (SHSP) goals.

The Plan is intended to be used by a diverse group of stakeholders, including Alabama Department of Transportation (ALDOT), the State Department of Public Safety, and the Alabama Public Health Department. In addition, other agencies with a significant role in roadway safety, injury prevention, and speed management may potentially use and help to implement elements of the Plan.

The Plan characterizes speeding-related crash problems, sets safety goals, describes Plan actions to meet the goals, and discusses evaluation measures appropriate to the goals and objectives. The Plan outlines broad actions needed to implement best speed management strategies Statewide to reduce future loss of life and injury. ALDOT, the Department of Public Safety, and their partners will be primarily responsible for further outreach, development, and implementation of these strategies.

In addition to comprehensive and strategic actions, the Plan also includes specialized information for engineers, enforcement agencies and their partners, regarding systematic identification and treatment of high-crash routes or other local area issues. Countermeasures described include engineering and design, enforcement and penalty systems, public information, and communications measures.

The remainder of this chapter outlines the safety goals of the Plan, the need for the Plan, broadly describes the speed management approaches, and provides an overview of the issues and Action Items outlined for implementing specific strategies.

1.2 Safety Goals of the Plan

Speeding is associated with about 28 percent of fatal crashes and 17 percent of fatal and incapacitating injury crashes in Alabama. With these statistics in mind, the Plan aims to help ALDOT and other stakeholders meet these three fundamental safety goals:

Goal #1: Reduce fatal and injury-causing crashes, especially those attributed to speeding, by 10 percent within five years. Speeding includes operating a vehicle above speed limits and exceeding a safe speed for existing conditions.

Goal #2: Improve compliance with speed limits by 10 percent within five years.

Goal #3: Improve and strengthen speed management knowledge and practices among State and local road safety stakeholders through preparation and dissemination of guidance such as the *Alabama Speed Management Manual*.[14]

1.2.1 Coordination with Strategic Plan and Objectives

Achieving the goals set forth in this Plan will help the State meet its Strategic Highway Safety Plan (SHSP) safety goals. The second edition safety goal was as follows:

> *Reduce fatalities and injuries by 50% in 25 years: from 39,190 fatalities and injuries (2010) to 19,595 fatalities and injuries (2035).*[14]

The process for updating the third edition of the SHSP has begun. If implemented, this Speed Management Action Plan will help ALDOT and other stakeholders to meet the safety goals identified in the updated and future versions of the SHSP. This Plan may also prove useful for suggesting overall SHSP goals and strategies.

The ALDOT Office of Safety and Operations also has a speed policy with a mission statement as follows:

> *To reduce deaths, injuries and the economic cost due to speed-related crashes through enforcement, engineering, emergency medical services, legislation, setting realistic and credible speed limits, research and adjudication."*[14]

This Action Plan will also help to achieve that mission. Strategies identified in the Speed Policy document include:

1. Targeting enforcement to locations with high numbers of speed-related fatal and injury crashes.
2. Setting realistic and credible speed limits based on engineering studies;
3. Understanding the problem: who speeds, where, when, and why.
4. Using multi-agency, multi-disciplinary processes, assessment, techniques and technologies, including conducting multi-agency, multi-disciplinary field investigations of locations with high numbers of speed-related fatal and injury crashes.

[14] "*The purpose of this manual* (the *Alabama Speed Management Manual*, in draft form at the time of this Plan development) *is to set forth guidelines and thereby provide a framework for establishing realistic and credible regulatory speed zones on roadways throughout the state highway system. The manual, which is different from the present Action Plan, is intended to be used as a guide for entities who have authority to set speed limits on any roadway. Use will be required by the Alabama Department of Transportation (ALDOT) and local governing agencies when establishing speed limits along state roadways."* Use will be encouraged when setting limits on local roads.

5. Providing public information and education on the risks and consequences of speeding especially at locations with high numbers of speed-related fatal and injury crashes.
6. Proposing legislation.
7. Fair and consistent adjudication of speeding citations.
8. Evaluating the impact and effectiveness of speed management programs and using the results to modify or reinforce speed management programs.

In addition, Alabama adopted a Toward Zero Deaths highway safety vision in the most second edition of the SHSP. [15] Implementing this Action Plan is consistent with and supports the above objectives and the goal of continually striving to reduce traffic-related deaths to as near zero as possible.

1.3 Need for the Plan

This section describes the general magnitude of the safety problems related to speeding. It also provides an overview of speed management challenges and opportunities relating to public policies and support for speed management strategies, issues with setting and enforcing speed limits and other policy or cultural issues that may affect the selection and application of effective speed, and safety countermeasures and strategies.

1.3.1 Crashes and Injuries Related to Speeding

From 2010 to 2012, fatal crashes have taken the lives of 2,637 people, nearly 900 per year. Twenty-eight percent (741) of the fatalities during that three-year period involved speeding. In addition, nearly 116,000 people were injured over the three years, with more than 13,400 of these injuries indicated to involve speeding.

The following are major characteristics of the speeding-related crash and injury problem:

- Seven percent (27,406) of all reported crashes (386,336) over the three-year analysis period involved speeding by one or more drivers.
- Twenty-eight percent (678) of fatal crashes involved speeding.
- Fifteen percent of all crashes were severe (involved fatalities, incapacitating injuries, or non-incapacitating—but evident—injuries).
- A majority of speeding-related (59 percent) and severe crashes (51 percent) occurred on roads owned by counties and cities, with the remainder on roads managed by the State.

Figure 1 illustrates the relationship between crash severity and indications of speeding and shows that speeding is most often indicated for fatal crashes (16.7 percent), followed by incapacitating-injury crashes (13.4 percent). For possible injury and property damage only crashes, the speeding-related proportions are 6.6 percent and 5.7 percent, respectively. Speeding involvement in a crash is most often subjectively determined after the fact of a crash,

[15] State of Alabama, Strategic Highway Safety Plan, 2nd ed.

rather than being based on scientific investigations. Thus, many instances of speeding may be missed (especially at lower levels above limits). Conversely, some instances of apparent "speeding" may relate to distraction or other causes. In addition to crash-based indicators of speeding, high proportions of severe crashes *may* indicate a mismatch of travel speeds with the road design and land use context. Therefore, fatal and injury crashes are used in helping to identify and prioritize potential treatment targets. This Plan makes use of crash severity indications to aid in problem screening.

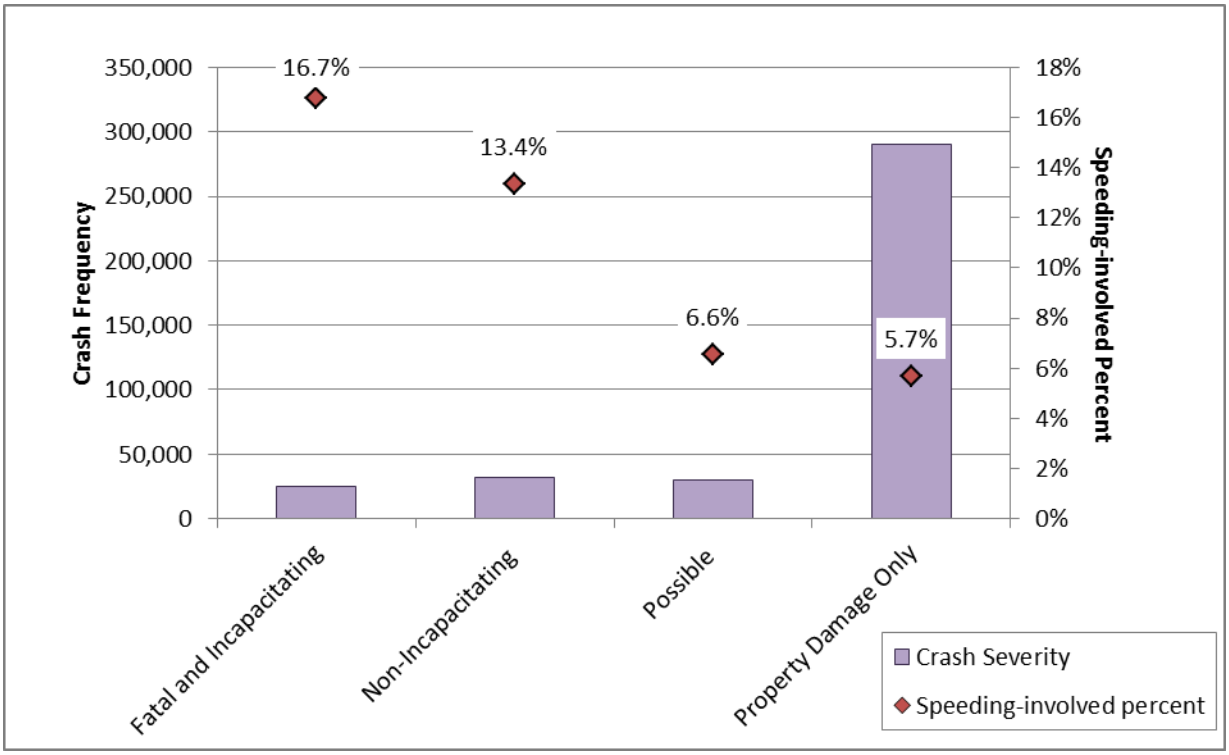

Figure 1. Bar Chart. Speeding-involvement by crash, maximum injury severity, 2010-2012.

Speeding-related and severe crashes are spread across State, County, and municipal jurisdictions, with large portions occurring on non-State owned roads. The locations and jurisdictions relating to the speeding crash problem are as follows:

- As in many States, Alabama's speeding-related crashes are over-represented in rural areas (nearly 61 percent) as compared to total crashes occurring in rural areas (25 percent; see Table 1).
- Severe crashes are also over-represented in rural areas. A majority (56 percent) of severe crashes, nevertheless, occurs in urban areas (see Table 2).
- Crashes in remote rural areas require longer emergency response times in the event of a crash, as well as being more difficult to treat through traditional enforcement approaches.

Table 1. Speeding-related Crash Distributions by Rural/Urban Crash Location.

Location Type	Speeding-related Crashes	Speeding-related Percent	Total Crashes
Rural no.	16,686	17.4%	95,707
Rural %	60.9%	--	24.8%
Urban no.	10,720	3.7%	290,629
Urban %	39.1%	--	75.2%
Total	27,406	7.1%	386,336

Table 2. Severe Crash Distribution by Rural/Urban Crash Location.

Location Type	Severe Crashes	Severe Percent	Total Crashes
Rural no.	24,842	26.0%	95,707
Rural %	43.6%	--	24.8%
Urban no.	32,085	11.0%	290,629
Urban %	56.4%	--	75.2%
Total	56,927	14.7%	386,336

Drivers do not necessarily recognize different jurisdictional ownership or management of roads and streets, and diverse practices may affect the speed limits and designs of the different systems in ways that drivers do not comprehend. Figure 2 further illustrates one of the challenges of treating speeding-related crashes or, in this case, severe crashes. As illustrated by this figure, the number of severe crashes are highest in more populous counties (urban areas), but the population-based crash rates are higher in lower-population (more rural) counties. In order to counter these situations, it is essential that procedures help to identify routes or areas most likely to benefit from treatment in order to have the greatest possible impact on a widely dispersed problem.

It is also essential, however, that speeding and safety issues be managed or targeted comprehensively on a Statewide and population-wide basis to substantially drive down the numbers. This means all partners must work on the problem, including local and rural road owners and law enforcement. A comprehensive speed management program that conveys a consistent message, that speeding is a serious problem wherever it occurs, is most likely to have a greater impact.

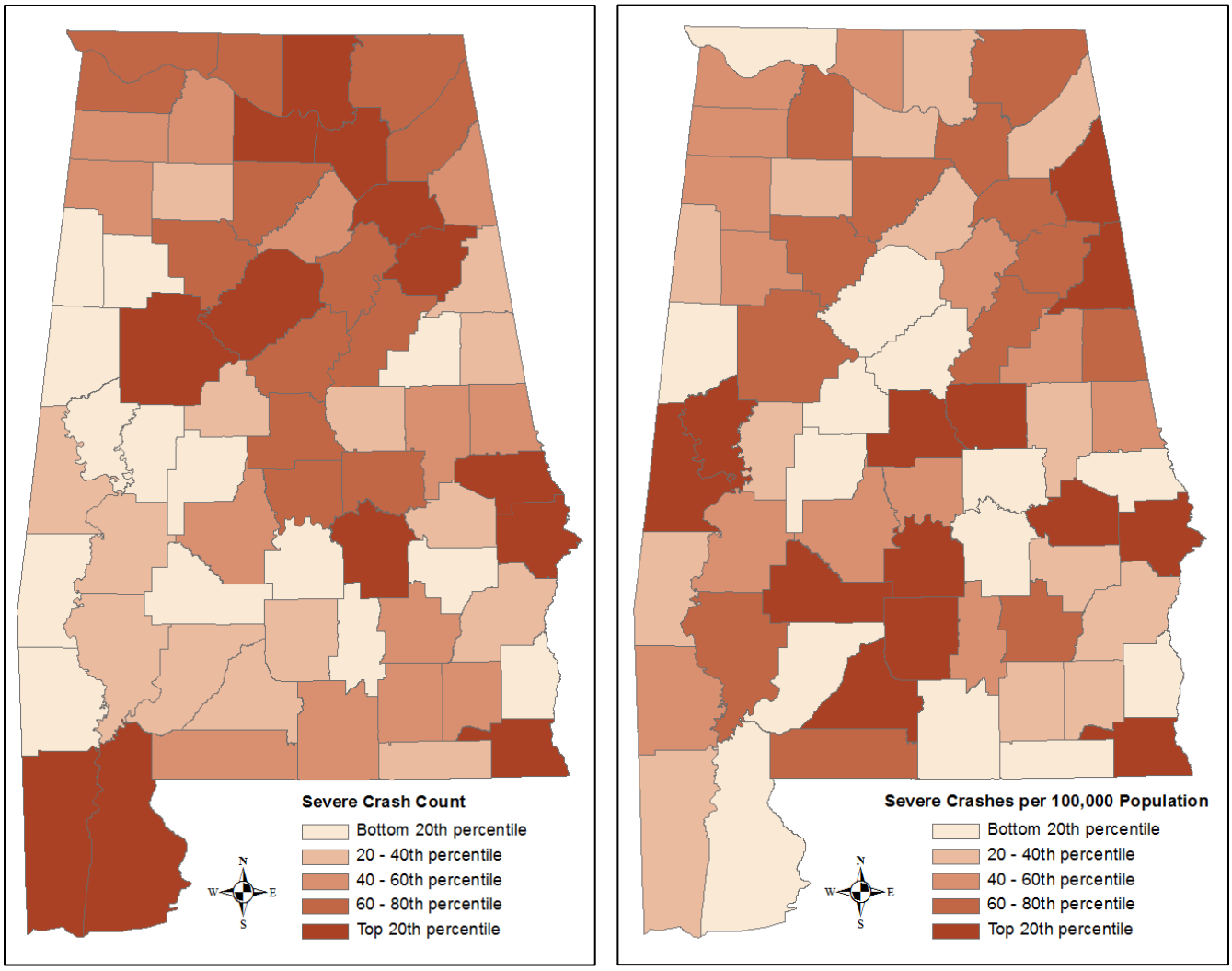

Figure 2. Maps. Severe crashes by County. Frequencies (left), and normalized by population (right). Vehicle miles traveled (AADT) could also be used as the rate denominator instead of population.

See Chapter 2 for a more detailed description of the speeding-related crash problems.

1.3.2 Economic Cost of Speeding-related Crashes

The estimated economic cost to Alabama in one year of crashes (2010) was $5.1 billion, which amounts to an average cost of $1,062, or 3.1 percent of per capita income per person living in the State.[16] These costs are based on Alabama's portion of national fatal, injury, and property-damage crashes. Actual costs for Alabama may be different from national average crash costs.

[16] Blincoe, L. J., Miller, T. R., Zaloshnja, E., and Lawrence, B. A. (2014, May). *The Economic and Societal Impact of Motor Vehicle Crashes, 2010*. (Report No. DOT HS 812 013.) Washington, D.C.: National Highway Traffic Safety Administration.

(ALDOT is currently developing crash-cost estimates for use by the State.) Speeding-related crashes also contribute disproportionately to more severe injuries and higher crash costs.

1.3.3 Prevalence of Speeding

Alabama lacks data from driver surveys or Statewide speed monitoring that would provide valuable information on how widespread speeding is, or on which road types speeding is most prevalent. One of the goals of the SHSP is to better understand who speeds, and where, when, and why.

1.3.4 Other Major Issues and Challenges

Appropriately set speed limits represent a concerted effort to balance safety and travel efficiency for all modes of travel. This section describes current policies, practices, and other issues that may limit safety effectiveness of speed limits, design and engineering, enforcement, and communications measures.

Alabama uses a variety of statutory speed limits on rural and urban streets, and uses engineering studies to post speed limits different from statutory limits, as do most States. In Alabama:

- A number of different rural and urban statutory maximums are used. Even so, statutory maximums may not always adequately address the road conditions, land use, user needs, or other safety conditions present. Many different limits, especially applied to the same types of roads, may further confuse drivers.
- Engineering studies are typically used to assess the need to post speed limits that are different from the statutory maximums. Until now, though, there has been no coordinated training or practice. Stakeholders mentioned the need for more consistency in setting “rational” speed limits across the State, but the situation is complex. For instance, some roads, including urban streets, were designed for high speeds even though they were intended for lower travel speeds. Rather than providing an increased safety margin, such road designs can send a wrong message to drivers about safe operating speed, especially if designed without consideration to a statutory maximum or the land use and user needs.
- Design consistency is also important. Some roads have design exceptions, or lower design speed elements that do not correspond with the posted limits for the corridor. This situation can result in safety issues at those locations. Advisory limits may not always induce drivers to slow sufficiently; however, speed limit credibility may be affected by posting lower regulatory limits based on one or two design exceptions for an entire corridor. Advisory speeds may also be subject to variation in application.
- Geometric features should transition from high to low speed gradually. Speed limit zoning should also account for the transition needs of drivers.
- Engineers must pay attention to the need for speed limit reviews. However, this typically happens, at present, through reactive processes rather than through a

proactive, systematic process or periodic reviews. In addition, sufficient resources are needed to conduct those reviews and to make changes to the roadways, to limits, and/or to enforcement, as needed.

- Traffic speed studies typically rely strongly on the current 85th percentile operating speed, which begins with the assumption that a majority of drivers adopt a "reasonable and safe speed." However, if overly high design speeds were used, enforcement tolerances are high, and/or enforcement presence is low, drivers may adopt operating speeds that significantly exceed limits, affecting the 85th percentile speed. Research indicates that drivers have many non-safety reasons for choosing operating speed, including many who will operate at the speed at which they think they can avoid being ticketed, or a speed that provides other "rewards" such as a perception of improved mobility. Other reasons for speeding include keeping up with traffic, the excitement of risk-taking, or being in a hurry. In addition, drivers may not always know the speed limit and, as mentioned, the roadway environment does not always send the right cues about safe speed. Consequently, the operating speed distribution may reflect all of the above factors as well as a "reasonable" driver's perception of a safe speed.
- According to Alabama stakeholders, there is a need for improvements in speed limit setting procedures for more consistent outcomes. The State DOT has requested a guidance document to be prepared (the *Alabama Speed Management Manual,* referred to on the first page of Chapter 1) to improve the consistency of outcomes with designs when speed limits are reviewed and revised, as well as the consistency of signs, markings, and other features that support the speed limits.
- In addition, work zone (highway construction) speed limits were observed to be implemented long before work started, and to remain in place long after highway projects seemed complete and the workers have left. These practices were perceived by stakeholders as undermining drivers' respect for speed limits in work zones. While an Alabama policy memo from March 2013 requires covering or removing work zone speed limit signs when work is not ongoing (unless other conditions necessitate a continued lower limit), this policy is apparently not being uniformly implemented.
- Currently, the State Department of Public Safety has about 300 officers Statewide charged with enforcement on the State's road network of nearly 94,000 miles. Supplemental overtime enforcement has been sponsored by the ALDOT Safety Office, using HSIP funds (currently funded at $1 to $1.5 million per year over a two-year period). In general, however, enforcement resources have not kept pace with increases in vehicle miles travelled over the years. The supplemental enforcement project is being evaluated. Supplemental enforcement programs can be difficult to sustain financially when using overtime pay, so evaluation of effects is important.
- Per the stakeholder speed management workgroup meeting participants, another issue is that many Sheriff's offices—the primary enforcement agencies in rural areas—could do more traffic enforcement.
- Automated speed enforcement (ASE) has not been widely implemented, despite not being prohibited by State law. Some local communities have used ASE, but programs may not always follow best practice recommendations.

- Publicity or education and awareness programs have been used very little to leverage enforcement effectiveness or improve public demand for speed management measures.
- Traffic courts are very busy. Every court will be different in terms of prosecution and managing case loads. Alternatives such as driving school and community service work may result in a dismissal on conditions, rather than a finding of guilty. Research indicates that alternatives that allow drivers to escape a guilty verdict may increase recidivism or at least do nothing to help deter future violations or crashes.[17] In addition, consistency and certainty of punishment may be more important than degree of punishment for upholding deterrence principles.[18]

1.3.5 Overcoming Barriers

This Plan identifies engineering and road design countermeasures, and enforcement and publicity strategies, to help better manage speeds and to target related safety issues. Since it is only possible for engineering countermeasures to treat a small portion of the road network each year, the State and other partners need to seek ways to improve enforcement and adjudication to support established speed limits. Even if all roads are well designed to support reasonable and safe speed limits, highly visible and committed enforcement and public communication are also needed to support those limits.

Speed management is a complex endeavor that requires commitment of all stakeholders to work together. In addition, many strategies require the support of policy-makers. Therefore, outreach to all types of stakeholders, including the public, practitioners, and policy-makers, will be keys to success. ALDOT has already demonstrated a commitment to provide guidance to State and local traffic engineers in the pending *Alabama Speed Management Manual* (Alabama Department of Transportation, 2013 draft), and other training and outreach to both State engineers and local jurisdictions for setting appropriate speed limits, among other practices.

While this Plan includes much technical information useful to decision-makers, engineers and other transportation professionals, a number of strategies and high-level actions are also included for law enforcement, injury prevention specialists, policy-makers, and other public stakeholders to help make roadways safer for all users. Cooperation and communication is imperative among all stakeholders to be successful. Some of the challenges to effective implementation can be met through Plan activities that:

1. Specifically address the barriers to a more systematic approach to implementing effective solutions.
2. Prioritize strategies based on factual information and best practice knowledge.

[17] Masten, S. V. and Peck,R. C. (2004). Problem remediation: A meta-analysis of the driver improvement literature. Journal of Safety Research 35:403---425.

[18] Shinar, D. (2007). Traffic Safety and Human Behavior. Bingley, UK: Emerald Publishing Group, Ltd., 813 pp.

3. Strengthen existing partnerships, communication, and working toward mutually agreeable solutions to help meet the strategic highway safety goals of the State and local communities.

Collaboration and cooperation also helps reinforce the concept of speed limits as a safety countermeasure.

A collaborative approach that includes planning and public outreach can help to implement proven speed-managing safety countermeasures (e.g., roundabout intersection designs) that can also help to improve mobility. Conversions of roads from five to three lanes (for motorized traffic) or two-lanes with a median (a.k.a., road diets) are other measures that can reduce speeds and substantially reduce crashes in urban/suburban areas. Road diets may also improve traffic flow in some cases, while providing space for other uses such as sidewalks, bicycle lanes or on-street parking to encourage economic activity in the neighborhood. Access management measures such as raised medians can also reduce the numbers of conflicts that may contribute to speeding-related crashes along complex corridors and improve safety for all users. Such measures will not necessarily reduce operating speeds.

The Plan's action steps should foster inter-agency collaboration and implementation of these and other effective strategies to speed management, including enhanced enforcement and educational strategies. Starting with effective measures that have multiple benefits could be another way to facilitate a successful program.

Challenging some of the existing beliefs about speed may also be important to maximize potential success. For example, widespread, low-level speeding may be as much of a safety issue as flagrant, but less frequent, speeding by large amounts. The Highway Safety Manual (HSM) estimates that a 2 mi/h reduction in average operating speed from 30 mi/h will yield a reduction in fatal crashes of 34 percent.[19]

1.4 Organization of this Document

The following descriptions of organization and content should aid users of this document.

Chapter 1 – Overview of the Plan. Chapter 1 describes the purpose of the Plan, safety goals, need, the general Plan approaches, a summary of Action Items of the Plan to be implemented, and describes evaluation and update of the Plan.

Chapter 2 – Speeding-related Safety Issues. Chapter 2 describes Statewide speeding-related and severe crash issues. It also describes general speed management issues that may affect implementation or effectiveness of speed management countermeasures.

In addition, Chapter 2 describes focus routes identified through data analysis and screening that may be good candidates for a systematic approach to further problem diagnosis and treatment.

[19] AASHTO (2010). Highway Safety Manual, 1st edition. American Association of State Highway and Transportation Officials: Washington, D.C.

Chapter 3 Speed Management Action Items, Strategies, and Countermeasures. Chapter 3 describes the solutions to safety and speed management issues described in Chapter 2.

- ***Statewide Speed Management Actions and Strategies.*** This subsection describes the alternate types of proactive and comprehensive action steps and strategies that may be used to address Statewide safety and speed management issues.
- ***Actions, Strategies, and Countermeasures to Address High Crash Corridors.*** This subsection describes systematic and comprehensive actions and countermeasures that may be used to target specific existing speeding-related safety issues.

Chapter 4 – Multi-year Implementation Plan. Chapter 4 outlines the detailed proposed implementation actions and specific strategies that may be implemented within each Action Item, selection and ranking of countermeasures, additional implementation steps, evaluation, and Plan renewal processes (Action Plan Update).

Appendix A. Appendix A contains Supplemental Material for Chapter 2, including more details of analysis methods and results.

Appendix B. Appendix B contains supplemental information for Chapter 4 to assist with cost-benefit analyses and developing performance measures.

1.5 Action Plan Summary

Speed limit review, engineering and design strategies, enforcement, and educational measures may all be implemented using the information contained in this Plan. The three complementary approaches to implementing all types of strategies are as follows:

1. ***Systematic Approach.*** A systematic approach is used to identify issues and coordinate treatment of existing speeding and safety issues with cost-effective countermeasures of all types, and to integrate this approach with other safety plans and safety focus areas.
2. ***Proactive Approach.*** A proactive approach aims to foster creation of self-enforcing, self-explaining roadway designs appropriate to the land use and user needs (e.g., actual functions or purposes of the road) to reduce future speeding and injury risk. The approach aims to develop collaborative and consistent policies, procedures and safety guidance in speed-limit setting and design for new projects and roadway improvements.
3. ***Comprehensive Approach.*** The overarching objectives of comprehensive approaches are to:
    a. Seek community support for the program.
    b. Coordinate various stakeholders and engage the community in setting and enforcing appropriate speed limits.
    c. Complement and enhance the effectiveness of design and engineering measures with locally-tailored communications and educational measures.

1.5.1 Systematic Approach

For implementing the systematic approach, the Plan uses problem screening based on prior crashes and follow-up diagnosis to identify and prioritize route sections with speeding-related safety issues. See Action Items 4 and 6 in Table 3 for actions using a systematic process for problem identification and treatment prioritization. Action Items 5 and 6 in Table 2 also use a systematic screening process and a coordinated approach to countermeasure targeting. The systematic process within the current five-year period identifies the following main road types to be treated:

- Rural, non-access-controlled routes.
  - Two- to three-lanes undivided.
  - Four- to five-lanes, both divided and undivided.
- Rural, four- to five-lane, access-controlled (freeway) routes.
- Urban, non-access-controlled routes, both divided and undivided.
  - Two- to three-lanes, undivided.
  - Four to five lanes, both divided and undivided.
- Urban, four- to six-lane freeways.

The objective of the systematic approach is to conduct speed and safety reviews, and identify appropriate treatments/treatment packages for 432 urban and rural routes in all types of jurisdictions across Alabama. This effort will require outreach and support by ALDOT and other State road safety agencies to county and city road owners and local law enforcement agencies, but is essential to address speeding-related and severe crashes across the State. In addition, the systematic approach for speeding and safety problem diagnosis will be integrated into identification and problem diagnosis through the HSIP spot safety program, including development of an HSIP manual, the horizontal curve signage program, and the Roadway Departure Plan and program.

The systematic approach aims to make use of the following strategies:

- Reviewing speed limits, improving the relationship among speed limits, target operating speeds, and road design.
- Setting appropriate limits considering area land use and user needs for safety as well as mobility.
- Implementing appropriate safety improvements and design changes to the roadway.
- Seeking support from enforcement, the courts, public health professionals, and communications experts to support reasonable and safe limits, and speed compliance by drivers. Coordination with enforcement is another key to this approach, especially when the road design cannot be changed easily or quickly, or when roadway changes can not achieve the desired operating speeds.
- Determining the need for more extensive improvements, such as major redesign.

1.5.2 Proactive Approach

The proactive approach makes use of similar processes as the systematic approach, with some changes, and implements these strategies for new projects and major upgrades. Thus, planning and design stakeholders, as well as other road safety stakeholders, should be engaged early in the process of planning a new road or upgrade that operates at the desired speeds and satisfies safety and operational goals of the community or State. Two Action Items (items 2 and 3 in Table 3) relate to the proactive approach.

1.5.3 Comprehensive Approach

The comprehensive approach may frame the issues in an injury prevention context in order to improve decision-making and use of effective laws, policies, and speed management practices (enforcement, engineering, design, and communications and education). Action items 1, 2, and 5 explicitly incorporate comprehensive approaches; others make use of coordinating a comprehensive approach, as well.

1.5.4 Action Items

Table 3 outlines the Speed Management Plan Action Items available to address issues identified through crash analysis and stakeholder input. Each Action Item consists of processes, coordinated actions, and policies to develop and implement the most appropriate types of countermeasures, and to sustain an ongoing and effective speed management program. Table 3 also identifies potential agency roles and prospective timelines. Chapter 3 describes available strategies in more detail, along with specific countermeasures that may be used. The Chapter 4 section on *Detailed Proposed Implementation Actions* describes specific strategies selected by Alabama in more detail.

Table 3. Action Items and Implementation Timeline.

Action Items	Stakeholder Roles	Type of Approach and Timeline for Startup
1. **Frame the speeding and safety issues through a public information and education program to build support for effective policies and comprehensive strategies, to seek and leverage funding, and to improve effectiveness of enforcement and engineering countermeasures.**	• Lead: Injury prevention experts (e.g., State or local public health department, injury prevention office). • Others: DOT communications and safety offices, court representatives, law enforcement agencies, emergency responders and medical professionals, insurance agencies, and other business and private partners.	• Approach: Compre-hensive • Timeline for startup: 1-3 years; ongoing.
2. **Develop a State task force on the subject of setting speed limits to improve safety, make outcomes more consistent, and improve the credibility of speed limits. This Action Item may address training and outreach, data collection, policies and design guidance.**	• Lead: State/local DOTs and injury prevention offices. • Others: Elected officials, law enforcement agencies, judiciary officials, public and private stakeholders as appropriate. • Support also needed from: Local elected and other public officials.	• Approach: Proactive and Compre-hensive (supports systematic) • Timeline for startup: 2-5 years.
3. **Develop an inter-agency / department speed and safety review process to assess land use and transportation plans, designs, and implemented projects to check that new and improved roads meet sound speed management design and safety principles for the area land uses and intended purposes of the street or highway. Conduct a trial of this approach and compare to outcomes using the traditional planning and design process.**	• Lead: Liaison group such as a regional or metropolitan planning organizations (potential lead role). • Others: Roadway designers, safety and mobility engineers, bicycle and pedestrian divisions, county and local planning staff, elected officials, law enforcement agencies, and injury prevention offices.	• Approach: Proactive. • Timeline for startup: 1-3 years.
4. **Review existing speed limits, conduct additional diagnoses, and develop treatment plans for lists of prioritized corridors as identified through network screening.**	• Lead: ALDOT Office of State Safety Operations. • Others: Municipal staff (city streets), county staff (rural routes), law enforcement agencies, judiciary officials, health officials, regional planning organizations, and municipal planning organizations. • Support may also be needed from: Local elected officials.	• Approach: Systematic. • Timeline for startup: 2-5 years.

Table 3. Action Items *continued*

Action Items	• Stakeholder Roles	Type of Approach and Timeline for Startup
5. **Implement a sustainable, highly visible enforcement and adjudication program. Target more of the network where serious crashes occur.**	• Lead: State public safety/highway patrol agencies, local law enforcement agencies, others; DOT units may assist with prioritization through systematic data analysis and review process, judiciary officials, injury prevention partners, and communications experts.	• Approach: Compre-hensive treatment combined with Systematic approach. • Timeline for startup: 2-5 years.
6. **Implement speed and safety reviews of sections or intersections within the HSIP (spot safety program), and coordinate with other transportation safety plans and programs.**	• Lead: DOT safety and mobility offices and units. • Others: Law enforcement agencies, traffic engineers, bicycle and pedestrian transportation offices, (especially for urban areas), and county and city transportation agency staff.	• Approach: Systematic. • Timeline for startup: 2-5 years.

The partners needed for implementing the Plan include at a minimum the following:

- ALDOT, in particular the Office of State Safety Operations, which is the lead agency for outreach and coordinating implementation of most aspects of the Plan.
- Alabama Department of Economic and Community Affairs, Law Enforcement and Traffic Section.
- Alabama Department of Public Safety, in particular the Motor Carrier Safety Unit.
- City and county road managers.
- Local law enforcement agencies.
- Federal Highway Administration (FHWA)
- National Highway Traffic Safety Administration (NHTSA).
- University of Alabama, Center for Advanced Public Safety (CAPS).
- Alabama's unified judicial system.
- Alabama Sheriff's Association.

The next step will be to have a high-level stakeholder working group review the entire Plan, further develop the Action Items, and set the timelines and champions. See Tables 20 through 26 for detailed Action Items.

1.6 Plan Evaluation Measures

Evaluation measures will include interim process measures and safety outcome measures consistent with the safety strategies and goals of the Plan. Since the goals of the Plan are to reduce fatal and injury crashes and to improve speed compliance, the primary measures of program effectiveness will be:

- Changes in crash frequency and severity.
- Changes in operating speed distributions.

Implementation process measures will also be used to track and link program efforts to safety outcomes, and to improve and sustain the program. As feasible, specific countermeasures may be evaluated to determine treatment effects in the local context.

See the Evaluation Plan section of Chapter 4 for more information.

1.7 Sustaining and Updating the Plan

As the stakeholders continue to meet and prioritize the Action Items and particular strategies, consider the following:

- The implementation timeline for this initial Plan is five years. Depending on the Action Items advanced, some strategies will likely require a longer timeframe to fully develop and implement, or may become ongoing strategies to sustain.
- The Plan is a working document, and may be updated and revised as actions or strategies are refined and revised.
- As already mentioned, a Plan evaluation using relevant performance measures is part of the implementation. Plan implementation and safety progress should be monitored with appropriate measures throughout the implementation period. The Plan should be fully evaluated around the end of the implementation period as to how much of the Plan was implemented and whether safety goals were met.
- To sustain and build the program, the Plan should be updated near the end of the initial Plan period. The update should incorporate input from the Plan evaluation, updated problem identification, and consider any new proven countermeasures.

2 Speeding-related Safety Issues

This chapter describes speeding-related safety and speed management issues. Actions, strategies, and countermeasures for the issues identified are described in Chapter 3.

2.1 Problem Identification

This section briefly describes the types of analyses and other methods used to identify safety issues and speed management problems.

2.1.1 Data Used

All analyses made use of Statewide crash data for the years 2010 - 2012. The data were provided by the University of Alabama's Center for Advanced Public Safety (CAPS).

2.1.2 Analysis Methods

Statewide Descriptive Analyses. Cross-tabulations were used to identify general characteristics of the Statewide speeding and severe crash problems.

Spatial Analyses. Spatial analyses in a GIS platform (ARCMAP10) were used to assess the frequency distribution of severe crashes by County as well as severe crash rates normalized by population.

Network Screening. The entire road network was screened using crash data only, making use of roadway characteristics included in the crash data to help with problem localization. Since a majority of speeding-related and severe crashes occurred on county and city roads, it is critical to analyze, identify, and treat the problems on these road types in addition to treating State-managed routes to have a large impact on the overall problem. Roadway inventory data were not available in a useable format for non-State owned roads. The screening grouped roads by shared characteristics (regardless of ownership), and made use of the following measures in prioritization:

- At least 5 total crashes for roads of less than 4 lanes, and at least 10 total crashes for corridors of four or more lanes.
- Proportion of total crashes that were speeding-related.
- Proportion of total crashes that were severe.

More details on the screening approach are provided in Appendix A. The road types of focus are shown in the screening results (see section High *Crash Routes for Systematic Treatment*).

2.1.3 Other Problem Identification Processes

State and federal transportation professionals provided additional input about speed-management issues and solutions during an internet-supported stakeholder teleconference, an

in-person workshop, and follow-up reviews and discussions. The following Alabama agency stakeholders were represented:

- ALDOT.
  - Office of Safety Operations.
  - Maintenance Bureau.
  - Traffic Operations.
  - Modal Programs.
  - Modal Safety.
  - Policy and Planning.
- Alabama Department of Public Safety.
- Alabama Department of Economic and Community Affairs, Law Enforcement and Traffic Section (ADECA).
- Alabama Department of Public Health, Emergency Medicine Section.
- University of Alabama Center for Advanced Public Safety.
- Consultant for the *Alabama Speed Management Manual.*
- Federal Highway Administration (FHWA), Alabama Division.

The above agencies will continue to be important for implementation.

The State had previously cooperated with FHWA to develop a draft roadway departure safety action plan for systematic treatment of roadway and lane departure types of crashes. Analyses for that plan identified that speeding was frequently an issue in roadway and lane departure crash types, corroborating findings for this Plan. The roadway departure plan is currently in the process of being implemented.

2.2 Statewide Issues

This section characterizes crashes and injuries related to speeding, and identifies where and when crashes are concentrated or other significant aspects of speeding-related and severe crashes Statewide that should be targets for treatment in order to have the greatest impact.

2.2.1 Crashes and Injuries

More than 386,000 crashes over three years, or an average of nearly 129,000 crashes per year, resulted in 2,637 fatalities in three years, 741 of which involved speeding. Nearly 116,000 people were injured, with more than 13,400 injuries resulting from speeding-related crashes. The following major crash characteristics were noted:

- Seven percent of all crashes were indicated to involve speeding by one or more drivers in the crash (see Table 4).
- A total of 741 (28 percent) of fatal crashes were indicated to involve speeding (see Table 4).
- Fifteen percent (56,927) of all crashes were severe (i.e., involved fatalities, incapacitating injuries, or non-incapacitating injuries) (see Table 4).

- Combined, highways under State management (Interstates, Federal, and State highways) accounted for 41 percent of speeding-related, and 48 percent of severe crashes.
- County roads accounted for 41 percent of speeding-related and 26 percent of severe crashes.
- Municipal streets accounted for 18 percent of speeding-related and 25 percent of severe crashes (Table 28, Appendix A, section Statewide Speeding-related Crash Descriptors).

Table 4. Crash Severity by Speeding-related Crash Indications, 2010-2012 Crash Years.

Crash Severity Indicator	Number Not-Speeding-related	Not Speeding-related Percent	Number Speeding-related	Speeding-related Percent	Total
Fatal Injury	1,746	72.0%	741	28.0%	2,424
Incapacitating Injury	18,712	84.5%	3,438	15.5%	22,150
Non-Incapacitating	28,030	86.6%	4,323	13.4%	32,353
Possible Injury	27,498	93.4%	1,931	6.6%	29,429
Property Damage Only	273,461	94.3%	16,495	5.7%	289,956
Unknown	9,483	94.6%	541	5.4%	10,024
Total	358,930	92.9%	27,406	7.1%	386,336

Other characteristics of speeding-related and severe crashes include:

- Both speeding-related crashes (61 percent) and severe crashes (44 percent) are over-represented in rural areas compared with the proportion of total crashes that occurred in rural areas (25 percent) (Table 5). Very similar percentages were also indicated to occur in areas of open country (data not shown).
- Although severe crashes are proportionally over-represented in rural areas, over half (56 percent) of severe crashes occurred in urban areas, and nearly 40 percent of speeding-related crashes occurred in urban areas of the State (see Table 27 in appendix A).
- Sixty-seven percent of speeding-related crashes and 57 percent of severe crashes occurred on two-lane roads (see Table 5).
- County roads were the most over-represented for speeding-related crashes (41 percent) compared to total crashes on county roads (16 percent). Severe crashes were also over-represented on county roads (24 percent), but to a much lower degree (see Table 5).
- Speeding-related and severe crashes are also widely dispersed across the different State and county roads, and municipal streets. Combining Interstate, federal, and State highways, 45 percent of speeding-related crashes and 48 percent of severe crashes occurred on highways under State management. Forty-one percent of

speeding-related and 26 percent of severe crashes occurred on county roads; 18 percent of speeding-related and 25 percent of severe crashes occurred on municipal streets (see Table 28 in Appendix A).

- Although the smallest numbers of speeding-related and severe crashes occurred on Interstate highways, they too were over-represented for both speeding-related (15 percent of the total) and severe crashes (14 percent) in proportion to their total crashes (9 percent) (Table 5).
- Curve locations were highly over-represented among speeding-related crashes (42 percent) compared with total crashes (11 percent). Curves were also over-represented among severe crashes, but to a much lower extent (19 percent).
- Speeding was only slightly over-represented in work zone crashes or in crashes related to the presence of a work zone (2.4 percent) with respect to total work zone crashes (2.2 percent). Work zone crashes include a small portion related to detours. Crashes related to work zones were severe a slightly lower proportion of the time (2 percent) compared to the proportion of total crashes that occurred at work zones.
- Speeding-related crashes were over-represented on wet roads (46 percent) compared to total crashes (16 percent) on wet roads; however, severe crashes were a somewhat lower proportion (15 percent) compared to the total proportion of crashes on wet roads. More than expected speeding-related crashes occurred on icy and other slick roads, yet the numbers were relatively small (see Table 31 in Appendix B).
- Speeding-related crashes occurred at a higher rate on dark, unlighted roads (26 percent) compared to total crashes on such roads (12 percent). Severe crashes (19 percent) were also over-represented at night on unlighted roads compared to total crashes.
- Single vehicle crashes of all types accounted for two-thirds (67 percent) of speeding-related crashes, and 38 percent of severe crashes compared with 20 percent of total crashes (see Table 5).
- Several other types of crashes (manner of collision) were over-represented for severe crashes, but not for speeding-related crashes. More severe types included head-on, angle (front to side—opposite direction), and right angle side impacts (see Table 34 in appendix B). These crash types may warrant additional speed management consideration.

Table 5. Crash Characteristics Highly Associated with Speeding-related and Severe Crashes Statewide for 2010-2012 Crash Years (total n = 386,336).

Crash Characteristic	Speeding-related Crashes	Severe Crashes	Total Crashes
Rural Location	16,689	24,842	95,707
Rural Location %	61%	44%	25%
Two-lane Road	18,376	32,433	180,703
Two-lane Road %	67%	57%	47%
Interstate Highway	4,101	5,235	36,313
Interstate Highway %	15%	14%	9%
County Road	11,278	14,808	62,791
County Road %	41%	(24%)	16%
Crash at Curve, Curve / Grade Combination	11,460	10,793	42,540
Crash at Curve, Curve / Grade Combination %	42%	19%	11%
Straight with Down Grade	3,357	6,255	38,162
Straight with Down Grade %	12%	11%	10%
Work Zone-related	654	1,150	8,389
Work Zone-related %	2.4%	2%	2.2%
Dry Roads	12,460	46,083	304,397
Dry Roads %	46%	81%	79%
Wet Roads	12,473	8,305	59,829
Wet Roads %	46%	15%	16%
Dark (non-lighted roadways)	7,027	11,021	48,044
Dark (non-lighted roadways) %	26%	19%	12%
Manner of Crash = Single vehicle (all types)	18,217	21,757	78,675
Manner of Crash = Single vehicle (all types) %	67%	38%	20%
Alcohol-involved	2,155	5,878	16,958
Alcohol-involved %	8%	10%	4%
Total	27,406	56,927	386,336

Among driver factors:

- Alcohol presence was over-represented among speeding-related crashes (8 percent), and to a greater degree among severe crashes (10 percent) compared with total alcohol-related (4 percent, Table 5).
- Younger drivers are over-represented to varying degrees in speeding-related crashes, but to a lesser degree in more severe collisions (see Table 36, Appendix A).
- In addition, there were 1,871 collisions between motor vehicles and pedestrians or bicyclists. Although only 2 percent were indicated to involve speeding, 68 percent of these collisions were severe. Fully one-third of severe crashes were reported to involve fatal or incapacitating injuries, with the remainder involving non-incapacitating injuries. These crash types may also warrant additional speed management measures.

2.2.2 Driver Speeding

Operating speed surveys or studies were not available for the State of Alabama. Baseline data are desirable to better understand where and when speeding above limits is most problematic in relation to crashes to improve enforcement targeting and to assist with measures of program effectiveness. Speed data in conjunction with traffic, environmental, and time of day measures, can also be used to help identify speeding too fast for conditions problems that may warrant roadway improvements.

2.2.3 Other Issues

Other speed management or policy issues affect the safety, credibility, and enforceability of speed limits. These issues may also negatively impact the improvement, design, safe operation, and maintenance of roads in ways to help reduce speeding-related injurious crashes and support strategic highway safety goals.

Speed Limit Setting Issues. Appropriately set speed limits represent a concerted effort to balance safety and travel efficiency for all modes of travel. This section describes current policies, practices and other issues that may limit effectiveness of speed limits as a safety measure.

A number of different rural and urban statutory maximums are used. These include:

- Urban: 30; residential 25; school zone 15 (or 15 < normal).
- Rural: County – paved 45; unpaved 35.
- Highways (unless four+ lanes/Interstate): 55.
- Interstates: 70.
- Other highways with 4+ lanes: 65.
- Special vehicles (hazardous cargo): 55.

Although a variety of statutory maximums are available, whether they are always well-matched to the environment including land use, road functions, user needs, or other safety conditions

present is unclear. If statutory limits are not well-applied, they could contribute to both safety and speed limit credibility issues.

Engineering studies are typically used to assess the need to post speed limits different from the statutory maximums. The need for speed limit review must, however, be prioritized through a systematic process or regular schedule. At present, reactive processes are more often the norm than a systematic screening or scheduled process to identify and prioritize areas meriting speed and safety review. There must also be sufficient resources to conduct those reviews and to make changes to the roadways, to limits, and/or to enforcement to support appropriate limits.

Stakeholders mentioned the need for more consistency in setting "credible speed limits" across the State, but the situation is complex. A variety of State and local statutory limits may be applied, and posted limits may be determined differently by varied jurisdictions and practitioners. At present, there is no statewide guidance, training, or outreach on speed-limit setting, although a guide is under development for ALDOT. Traffic speed studies for changing limits at the State level typically rely strongly on the current 85th percentile operating speed. Operating speed methods begin with the assumption that a majority of drivers adopt a reasonable or "safe speed." Adjustments may be made based on other factors (e.g., number of junctions, presence of pedestrians, crash history, and sight distance) and engineering judgment is usually required. However, the high design speeds often used for both urban streets and rural highways (see next section), as well as current enforcement levels and enforcement thresholds, influence the speeds drivers adopt. Considerable research also shows that drivers have many non-safety reasons for choosing operating speed. These documented reasons include drivers who will operate at the speed at which they think they can avoid being ticketed, adopting a speed that provides other perceived rewards such as time savings, and other non-safety-related reasons.[20] In addition, drivers may not always know the speed limit and, as mentioned, the roadway environment does not always send the right cues about safe speed. Therefore, caution is advised before raising limits to improve credibility, especially without taking other safety measures to ensure that the road will support higher speeds and drivers will comply with the new limits. Speeds are likely to creep up and settle around the new limit[21] and higher speeds are very likely to lead to more severe crashes over time.[22] In addition, it may send a message to the drivers who were compliant before, that the 35 percent (and more) who were speeding were correct in doing so, which could ultimately work against improving speed limit credibility.

[20] Schroeder, P., Kostyniuk, L., and Mack, M. (2013). *2011 National Survey of Speeding Attitudes and Behaviors*. Report No. DOT HS 811 865, Washington, DC: NHTSA.
Mannering, F. (2009). An empirical analysis of driver perceptions of the relationship between speed limits and safety. Transportation Research Part F 12: 99-106.
Goldenbeld, C. and Schagen, I. van (2007). The credibility of speed limits on 80 km/h rural rods: The effects of road and person(ality) characteristics. *Accident Analysis and Prevention* 39, 1121-1130.

[21] Hauer, E. (2009). Speed and safety. *Transportation Research Record* 2103, 10-17.

[22] AASHTO (2010). Highway Safety Manual, 1st edition. American Association of State Highway and Transportation Officials: Washington, D.C.

In addition, Alabama road safety stakeholders were in agreement that work zone (highway construction) speed limits were put in place too far in advance of the actual work or new construction beginning, and observed to remain in place when workers are not present, including long after highway projects seem completed. Alabama stakeholders perceived that these practices undermine driver respect for speed limits in work zones, which could potentially carry over into disrespect for speed limits more generally. While a policy memo from March 2013 provides guidelines that require covering or removing signs when work is not going on (unless other conditions necessitate a continued lower limit), this policy is apparently not being uniformly implemented.

Planning, Design, and Other Engineering Issues. Some Alabama roads were designed for high speeds even though they are urban streets intended to operate at lower limits. Rather than providing an increased safety margin, such road designs can send a wrong message to drivers about safe operating speed, especially if designed without consideration to a statutory maximum or the land use and user needs.

Other roads have significant design exceptions (lower design speed features) that do not match the posted limits, which can result in safety issues at those locations. Roads that provide design consistency, in other words that minimize unexpected needs for speed reductions are preferable. It is more difficult to achieve safe operating speeds when high design speeds are combined with low-design features that require significant speed reductions.[23]

Problems that may result from design and speed limit mismatch include low credibility of speed limits leading to low levels of driver compliance, the need for frequent posting of advisory speeds (which may not be followed), challenges to enforcement because many drivers exceed limits, or speed limits that are higher than safe operating or design speed. Perceptual issues may also undermine speed limits as a safety measure, in general. For example, statutory limits may be perceived by drivers as too low for the road design and create challenges to enforcement, but be perceived locally as correct for the land use, number of conflict points, and purposes and users of the road.

Enforcement issues. There has been some supplemental overtime enforcement sponsored by the ALDOT Office of Safety Operation, using HSIP funds. Over $2 million, over a two-year period, has been allocated to this effort. Hot spot analysis of three prior years of crash data has been used to help target enforcement resources. However, the stakeholders acknowledge that the procedures could be improved. An evaluation of the supplemental enforcement program is underway; the evaluation will also help to show whether enforcement allocation matched the intended targeting.

In the counties, the primary enforcement agencies in rural areas are Sheriff Offices, which could do more traffic enforcement. Since 41 percent of speeding-related crashes and 24 percent of severe crashes occurred on county roads, a lack of rural enforcement stands out.

[23] Donnell, E.T., Himes, S.C., Mahoney, K. M., Porter, R.J., and McGee, H. (2009b). *Speed Concepts: Informational Guide.* Report No. FHWA-SA-10-001 Washington, D.C.: Office of Safety, Federal Highway Administration.

In addition, enforcement resources have not kept pace with vehicle miles traveled increases over time, and automated enforcement is not currently an option for the State system, although some local jurisdictions are using automated enforcement. These jurisdictions may, however, not be using best practices in terms of establishing and operating their programs.

Regarding the penalty system, traffic courts are often busy. Every court will be different in terms of prosecution and managing case loads. While about 50 to 60 percent of traffic offense fines may be paid automatically or are settled by pleading to a magistrate, in 40 to 50 percent of cases, the defendant may opt for a hearing before a judge. Reasons may include the defendant seeking a longer time to pay or to seek alternatives such as driving school and community service work that may result in a dismissal on conditions, rather than a finding of guilty.[24] Research indicates that alternatives that allow drivers to escape a guilty verdict may increase recidivism or at least do nothing to help deter future violations or crashes.[25] Additionally, consistency and certainty of punishment may be more important than degree of punishment for upholding deterrence principles.[26]

Public Information and Education Issues. There has been little recent use of publicity or education and awareness programs to leverage enforcement effectiveness or improve public demand for speed management measures. In particular, public media has been under-utilized in communicating safety messages to highway users.

A policy goal of Alabama's SHSP includes proposing appropriate legislation. Good communication is also critical to obtain public input and support of effective policies and laws, and to convince decision-makers to adopt effective policy solutions.

2.3 High Crash Routes for Systematic Treatment Approach

This section describes road types and safety issues that will be the focus of the Plan's systematic treatment approach as identified from the crash-based network screening.

Of the 64 different road type combinations used in the initial network screening, nine types were selected for further screening prioritization, but others may be added. (Note that not all of the initial road type combinations that resulted from crash data analysis are feasible combinations; some are most likely due to errors in the crash reporting determinations of the roadway variables used to characterize the road types.) The nine prioritized types combined accounted for 75 percent of all crashes, 83 percent of the reported speeding-related crashes, and 82 percent of severe crashes per the crash data (see Table 6). Rural, two and three lane

[24] Information provided by Terry J. Henderson, Highway Traffic Safety Manager, Law Enforcement and Traffic Safety Division, Alabama Department of Economic and Community Affairs based on interviews with courts officials.

[25] Masten, S. V. and Peck, R. C. (2004). Problem driver remediation: A meta-analysis of the driver improvement literature. *Journal of Safety Research 35,*403-425.

[26] Shinar, D. (2007). Traffic Safety and Human Behavior. Bingley, UK: Emerald Publishing Group, Ltd., 813 pp.

routes accounted for the largest numbers of speeding-related and severe crashes, followed by urban, two and three lane routes, owing in the urban case more to the larger total crashes on these roads than to high proportions of speeding or severe crashes. However, corridors with higher than normal speeding and severe crash proportions in all nine subsets were identified and prioritized for further review.

Table 6. Nine Road Types for Focused Approach.

Selected Road Types for Systematic Approach	Totals	Number of Speeding-related	Speed-related %[27]	Number of Severe	Severe %
Rural, Undivided, 2-3 Lanes	62,502	12,423	19.9%	18,164	33.4%
Rural, Undivided, 4-5 Lanes	2,718	208	7.7%	557	20.5%
Rural, Divided, 4-5 Lanes	9,249	1,104	11.9%	2,223	24.0%
Rural, Divided, 4-5 Lanes, Access-controlled (Main),	9,534	1,405	14.7%	1,901	19.9%
Urban, Undivided, 2-3 Lanes	92,339	4,114	4.5%	10,904	11.8%
Urban, Undivided, 4-5 Lanes	43,085	977	2.3%	4,480	10.4%
Urban, Divided, 4-5 Lanes	37,361	1,144	3.1%	4,501	12.0%
Urban, Divided, 4-5 Lanes, Access-controlled (Main)	10,207	624	6.1%	1,290	12.6%
Urban, Access-controlled (Main), Separated, 6+ lanes	8,751	592	6.8%	1,081	12.4%
Nine Road Types Subtotal	273,028	22,383	8.2%	44,544	16.3%
Nine Road Types Subtotal %	**74.5%**	**83%**	--	**82%**	--
All Other Road Types	84,526	4,378	--	9,234	--
[28]Defined Road Types Total	360,272	26,969	7.5%	54,335	15.1%
Not on a Roadway or Missing Data Definitions	26,064	437		2,592	
Total Crashes Reported	366,383	27,406	7.5%	56,927	15.5%

The following sections summarize results of the screening process and highlight the numbers of routes, crashes, speeding-related crashes, and severe crashes for each prioritized subset of road types. Note that unless route types are specified to be access-controlled, no access-control is implied. Other crash characteristics are described in Table 37 to Table 45 in Appendix A. Speeding-related safety issues that may be present are described following the tables in each section below. However, additional diagnosis steps must be completed for each route to determine the specific safety issues and factors that may be contributing to speeding-related

[27] Percent columns show the percent of the total crashes for that characteristic (the row total) that were speeding-related or severe.

[28] These numbers were used to calculate proportions of totals in screening results tables.

crashes. See Chapter 4, Action Item 4, step 5, *Selection and Ranking of Countermeasures* section, and Appendix A, section Diagnosis, for additional information.

Following the screening process, subsets of the nine above-listed road types were identified. The problem extent and characteristics are described in the next sections (sections 2.3.1 - 2.3.5, summary).

2.3.1 Rural, Non-freeway Routes

Rural, Undivided, 2- and 3-Lane routes. As shown in Table 7, an average of 37 percent of all crashes were speeding-related for the priority subset of 99 routes compared to 20 percent for all roads of this type. An average of 41 percent of all crashes were severe compared to 33 percent severe on all roads of this type. Each of the subsequent tables for different road types will describe this information. Ninety-three of the road sections that ranked highest by these criteria are county routes, with six being State roads. If these top 99 routes are treated, the following number and percentage of crashes would be targeted:

- 1,081 speeding-related crashes (4.0 percent of total crashes).
- 1,186 severe crashes (2.2 percent of total crashes).
- 2,898 (0.8 percent of total crashes) (see Table 7).

(Note that the selection of routes can be expanded to a larger number, or alternate ranking procedures might be used.)

Table 7. Priority Rural, Two-Three Lane, Undivided Routes (uniform sections).

Rural, Undivided, 2-3 Lanes	Number of Routes	All Crashes	Speeding-related Crashes	Average Speeding-related %	Severe Crashes	Average Severe %
Subset identified through screening	99	2,898	1,081	37.3%	1,186	40.9%
Subset identified through screening %	--	0.8%	4.0%	n/a	2.2%	--
All roads of this type with > 0 crashes	2,759	62,502	12,423	19.9%	18,164	33.4%
All roads of this type with > 0 crashes %	--		46.1%	n/a	29%	--
Totals for all routes	--	360,272	26,969	7.5%	54,335	15.1%

The overwhelming majority (82 percent) of speeding-related crashes on these routes were also road/lane departure crash types. Sixty-nine percent of reported speeding-related crashes on these corridors occurred at a curve.

Some typical problems include the following:

- Many rural two-lane routes are legacy roads, and were not designed to modern standards for operating at higher speeds. Problems may include narrow lanes, poor

shoulders, inadequate delineation, or trees and other fixed objects near the roadway.

- Travel speeds may exceed safe speed throughout or at particular sections with curves, grades, narrower road sections or areas with shoulder drop-offs, or on intersection or driveway approaches. Sight distance may be an issue relating to these and other potential features.
- There is no separation of opposing traffic.
- Delineation may be poor when roads are wet or during nighttime.
- There may be no space to separate bicyclists and pedestrians or slower motor vehicles (including turning vehicles) from higher speed traffic.
- Animal collisions are also typically common.
- Crashes are widely dispersed making treatment targeting a challenge.
- Enforcement levels may be low on these lower-volume, rural roads.

Rural, Undivided, 4- and 5-Lane Routes. Following the screening process, five routes were prioritized for further diagnosis. An average of 20 percent of all crashes were speeding-related compared with 7.7 percent for all routes of this type. An average of 35 percent of total crashes were severe compared with 21 percent severe for all routes of this type. All five routes were indicated to be State routes. The treatment target is as follows:

- 38 (0.14 percent) of all speeding-related.
- 65 (0.12 percent) of all severe.
- 188 (0.05 percent) of total crashes (see Table 8).

About 35 percent of crashes on the subset routes were lane departure types compared with 17 percent for all roads of this type. About 12 percent occurred at curves, compared with about 8 percent for all roads of this type (proportions calculated from data shown in Table 38). More travel lanes seems to result in a greater proportion of rear-end crash types compared to rural two-lane roads, although the prioritized set of roads has a lower average rate of rear-end collisions compared to these types in general.

Table 8. Priority Rural, 4-5 Lane Undivided, Routes (uniform sections).

Rural, Undivided, 2-3 Lanes	Number of Routes	All Crashes	Speeding-related Crashes	Average Speeding-related %	Severe Crashes	Average Severe %
Subset identified through screening	5	188	38	20.2%	65	34.6%
Subset identified through screening %	--	0.05%	0.14%	n/a	0.12%	n/a
All roads of this type > 0 crashes	211	2,718	208	7.7%	557	20.5%
All roads of this type > 0 crashes %	--	0.75%	0.77%	n/a	1.0%	n/a
Total for all routes	--	360,272	26,969	7.5%	54,335	15.1%

Problems on some rural, multi-lane, but undivided roads may include:

- High speed conflicts with turning and crossing traffic at intersections and other locations due to a lack of access control.
- Curves and other features that may violate driver expectancy for the posted limit.
- Stopping sight distance issues may be present.
- Low friction when road surfaces are wet.
- Lane/roadway delineation problems when roads are wet or during darkness.
- There may be a lack of separation of turning/slowing traffic on some routes with higher proportions of rear-end collisions.
- Delineation of lanes or curves during darkness, weather events, or other adverse conditions.

Additional diagnosis is needed to determine the specific speeding and safety issues on these roads.

Rural, Divided, 4-Lane Routes. There were 201 road sections with this group of characteristics with at least one reported crash; a subset of 54 routes had at least 10 crashes, the minimum threshold. Eight road sections were in the top 25thpercentile for both speeding-related and severe crash proportions. Five of the eight routes were indicated to be State routes; two were indicated to be County routes; with one indicated to be an Interstate. The inclusion of the Interstate in this group is likely due to crash reporting errors, as Interstates should all be access-controlled roads. If these top eight (or a similar set) of routes are treated, the following number and percentage of crashes would be targeted:

- 185 (0.7 percent) of speeding-related.
- 323 (0.6 percent) of severe.
- 1,062 (0.3 percent) of total crashes (see Table 9).

On this priority set of routes, an average of 17.4 percent of all crashes were speeding-related compared with about 12 percent for all routes of this type. An average of 30 percent of crashes were severe on the prioritized routes compared with 24 percent for all routes of this type. About 68 percent of speeding-related crashes were also lane departure type. Rear-end and intersection collisions accounted for about 26 percent and 11 percent of the total on this set of routes, respectively, but these are about normal for these road types. However, combined with high speeds, intersection designs and operations could be an issue. Lane departures on the priority subset accounted for 40 percent compared to 30 percent average for these road types. Curves were present for 15 percent of crashes in the priority subset compared to 9 percent average for these road types overall, but did not account for a higher than average proportion of the crashes definitely indicated as speeding-related (see Table 39 in Appendix A).

Table 9. Priority, Rural, Divided, 4-Lane Routes.

Rural, Divided, 4-Lanes (but not access-controlled)	Number of Routes	All Crashes	Speeding-related Crashes	Average Speeding-related %	Severe Crashes	Average Severe %
Subset identified through screening	8	1,062	185	17.4%	323	30.4%
Subset identified through screening %	--	0.3%	0.7%	n/a	0.6%	n/a
All roads of this type with > 0 crash	201	9,249	1,104	11.9%	2,223	24.0%
All roads of this type with > 0 crash %	--	0.03	4.1%	n/a	4%	n/a
Total for all routes	--	360,272	26,969	7.5%	54,335	15.1%

A number of similar problems may be present on these roads as on rural undivided, multilane highways. Additional problems on divided, but not access-controlled, rural highways may include the following:

- The lane separation (as well as speed limits) may signal to drivers that these are high- speed roads, but numerous conflicts may be possible since the roads are not access-controlled.
- There may also be a lack of separation of turning/slowing traffic on some of the routes. (High proportions of rear-end collisions were indicated on a couple of the routes with a high percentage of speeding.)

Additional diagnosis is needed to determine the specific speeding and safety issues on each road and alternative potential countermeasures.

2.3.2 Rural, Access-controlled Routes (4 or 5 Lanes)

Diagnosis and treatment of the two prioritized routes would target the following number and percentage of crashes:

- 400 (1.5 percent) of speeding-related.
- 567 (1.0 percent) of severe.
- 2,288 (0.6 percent) of total crashes (see Table 10).

An average of 17.5 percent of crashes involved speeding on the priority subset of roads compared with about 15 percent for all routes of this type. An average of 25 percent of crashes were severe compared with 20 percent for all routes of this type. Lane departure crash types again comprised a significant portion of the total crashes at 47 percent, compared to the already high average of 43 percent for this road type. Rear end collisions also comprised a significant portion (about 19 percent), but were not over-represented compared with all roads of this type (see Table 40).

Table 10. Priority Rural, 4-5 Lane, Divided and Access-controlled Routes.

Rural, Access-controlled (Main), Divided, 4-5 lanes	Number of Routes	All Crashes	Speeding-related Crashes	Average Speeding-related %	Severe Crashes	Average Severe %
Subset identified through screening	2	2,288	400	17.5%	567	24.8%
Subset identified through screening %	--	0.6%	1.5%	n/a	1.0%	n/a
All roads of this type > 0 crashes	69	9,534	1,405	14.7%	1,901	19.9%
All roads of this type > 0 crashes %	--	2.6%	5.2%	n/a	3.5%	n/a
Total for all routes	--	360,272	26,969	7.5%	54,335	15.1%

Although access-controlled highways are generally intended for high speeds, there may treatable speed management issues on some of these roads:

- Designs such as entrance/exit ramp designs or merge areas that affect the performance of the road at high speeds.
- Inadequate lighting or delineation at merge areas and entrance/exit ramps.
- Low friction when roads are wet.
- Curves or other design issues that violate driver expectation.
- Significant variation in flows that contribute to speed variation over time and different road sections, either due to intermittent or recurring causes.

Finally, since "inferred design speed" may significantly exceed actual design speed and the speed limit on wide, straight sections,[29] there may be insufficient enforcement to keep most drivers within posted limits. An additional group of routes that were in the top 25th percentile for severity and top half for speeding-related crashes could also be considered for further diagnosis.

2.3.3 Urban, Non-freeway Routes

Undivided, 2- and 3-Lane Routes. Following the screening process, 256 routes were prioritized for further diagnosis. Nineteen of the routes were State roads with the rest being local streets. The treatment target for this (or similar) set of routes is as follows:

- 782 (2.9 percent) of speeding-related.
- 1,241 (2.3 percent) of severe.
- 5,304 (1.5 percent) of total crashes (see Table 11).

[29] Donnell, E.T., Himes, S.C., Mahoney, K. M., Porter, R.J., and McGee, H. (2009b). *Speed Concepts: Informational Guide.* Report No. FHWA-SA-10-001 Washington, D.C.: Office of Safety, Federal Highway Administration, 59 pp.

On this priority subset of routes, an average of 15 percent of all crashes were speeding related compared with 4.5 percent for all routes of this type. About 23 percent of all crashes were severe compared with 12 percent for all routes of this type. Lane departure crash types comprised a large proportion (42 percent) of all crashes for the subset compared with an average of 19 percent for all roads of this type (data from Table 41). Crashes at curves were also over-represented (28 percent) compared with all roads of this type (11 percent).

Table 11. Priority Urban, Undivided, 2-3 Lane Routes.

Urban, Undivided, 2-3 Lane Routes	Number of Routes	All Crashes	Speeding-related Crashes	Average Speeding-related %	Severe Crashes	Average Severe %
Subset identified through screening	256	5,304	782	14.7%	1,241	23.4%
Subset identified through screening %	--	1.5%	2.9%	n/a	2.3%	n/a
All roads of this type > 0 crashes	5,164	92,339	4,114	4.5%	10,904	11.8%
All roads of this type > 0 crashes %	--	25.6%	15.3%	n/a	20.1%	n/a
Total for all routes	--	360,272	26,969	7.5%	54,335	15.1%

Speeding-related safety issues on these roads may include:

- The street design and configuration may not change sufficiently from rural to urban areas so that drivers perceive the appropriate driving speed. The urban portions may be striped and look like rural highways. If so, roads/lanes may also be narrow, with little recovery opportunity if vehicles run off edge of the road or encroach on the opposite lane. Changes in land use and access density may also be gradual and difficult for drivers to perceive.
- In rural to urban high to low-speed transitions, speed transition area treatments may be lacking or speed transition zones and signing may be insufficient.
- There may be a lack of separation for turning/slowing traffic or a lack of infrastructure for bicyclists, pedestrians, and transit uses to walk/ride along the street or cross the street. Risk of fatalities and injuries to pedestrians rises steeply as impact speeds rise above 20-23 mph.
- Curves and grades, or buildings or other objects near roadways may result in inadequate sight distance at intersections and driveways, especially if vehicles are speeding or limits are set too high.
- Skewed angle intersections may lead to high turning speeds and add to visibility issues.
- Delineation and signing may be insufficient to guide drivers, especially at night, during adverse weather, or for those unfamiliar with the area.
- Lighting may be inadequate in areas of high activity.
- Local enforcement resources may be focused on higher-volume corridors.

Urban, Undivided, 4- and 5-Lane Routes. There were 1,553 route sections with this group of characteristics with at least one reported crash; a subset of 414 routes had at least 10 crashes.

Following the screening process, 29 routes were in the top 25thpercentile for each of speeding-related and severe crash proportions and may be good candidates for further diagnosis and potential treatment. Twelve of these were indicated to be State routes; 17 were local routes; with one indicated to be an Interstate. (The inclusion of the Interstate in this group may be due to errors in the reporting of certain roadway elements in the crash data, as Interstates should all be access-controlled roads.)

If these top 29 routes are treated, the following number and percentage of crashes would be targeted:

- 126 (0.5 percent) of speeding-related.
- 337 (0.6 percent) of severe.
- 2,068 (0.6 percent) of total crashes (see Table 12).

More than six percent of crashes on the priority subset were speeding-related compared with about two percent for all routes of this type. More than 16 percent of crashes were severe compared with about 10 percent for all routes of this type. About one-fourth of crashes occurred at or related to an intersection, although this proportion was lower for the subset than for all roads of this type. Lane departure types were again over-represented (about twice as high as normal for the subset). About 34 percent of crashes were rear-end types, but these were not over-represented for the subset compared to all urban, undivided multi-lane routes (data in Table 42).

Table 12. Priority Urban Undivided, 4-5 Lane Routes.

Urban, Undivided, 4 – 5 Lanes	Number of Routes	All Crashes	Speeding-related Crashes	Average Speeding-related %	Severe Crashes	Average Severe %
Subset identified through screening	29	2,068	126	6.1%	337	16.3%
Subset identified through screening %	--	0.6%	0.5%	n/a	0.6%	n/a
All roads of this type > 0 crashes	1,553	43,085	977	2.3%	4,480	10.4%
All roads of this type > 0 crashes %	--	1.2%	3.6%	n/a	8.2%	n/a
Total for all routes	--	360,272	26,969	7.5%	54,335	15.1%

Typical speeding-related safety issues on urban, undivided, multi-lane roads may include:

- Signing of speed limits or speed limit transitions may be inadequate or obscured by complex backgrounds.

- Rural to urban high to low-speed transitions: signs, land use, and road designs, may not signal to drivers that lower speeds are needed or force drivers to adopt lower speeds.
- Land use, access (intersection and driveway density) and road design may not convey appropriate speed to drivers even in non-transition areas.
- Excess capacity may be present and could lead to excessive speeding.
- Inadequate separation of opposite direction traffic and different speeds of traffic (e.g. turning vehicles) may lead to serious conflicts/crashes.
- Lack of access management may lead to additional conflicts with turning and crossing maneuvers.
- There may be inadequate separation and infrastructure for bicyclists, pedestrians, and transit users (places to cross or walk/ride along the roadway). Risk of fatal injury for pedestrians rise sharply as impact speeds increase above about 20 mph, more than doubling by impacts speeds of 30 mi/h. [30,31]
- There may be inadequate sight distance at intersections and driveways, especially if vehicles are speeding or limits are set too high.
- Presence of skewed angle intersections may lead to high turning speeds and add to sight distance and visibility issues.
- Delineation and signing may be insufficient to guide drivers at certain times or under certain conditions (darkness, adverse weather).
- Slick roads may also be an issue.

Urban, Divided, 4- and 5-Lane. There were 1,023 road sections with this group of characteristics and at least one reported crash; a subset of 240 routes had at least 10 crashes.

Twenty-two routes made up the top 25thpercentile for both speeding-related and severe crash proportions. Nineteen of the routes were State roads with three being local streets. If this set (or a similar set) of routes are treated, the following number and percentage of crashes would be targeted:

- 54 (0.2 percent) of speeding-related.
- 129 (0.2 percent) of severe.
- 580 (1.5 percent) of total crashes (see Table 13).

More than nine percent of all crashes for the priority subset were speeding-related compared with about three percent for all routes of this type. More than 22 percent of crashes were severe compared with about 12 percent for all routes of this type. Lane departure crash types

[30] Rosén, E., and Sander, U. (2009). Pedestrian fatality risk as a function of car impact speed. *Accident Analysis & Prevention 41,* 536-542.

[31] Tefft, B. (2011). Impact Speed and a Pedestrian's Risk of Severe Injury or Death. Washington, D.C.: AAA Foundation for Traffic Safety.

comprised 22 percent of all crashes for the subset compared with an average of 9 percent for all roads of this type (data from Table 43).

Table 13. Urban, Divided, 4-5 Lane Routes.

Urban, Divided, but Not access-controlled, 4-5 Lanes	Number of Routes	All Crashes	Speeding-related Crashes	Average Speeding-related %	Severe Crashes	Average Severe %
Subset identified through screening	22	580	54	9.3%	129	22.2%
Subset identified through screening %	--	0.2%	0.2%	n/a	0.2%	n/a
All roads of this type > 0 crashes	1,023	37,361	1,144	3.1%	4,501	12.0%
All roads of this type > 0 crashes %	--	--	4.2%	n/a	8.3%	n/a
Total for all routes	--	360,272	26,969	7.5%	54,335	15.1%

There may be similar problems on urban, divided four- to five-lane routes as among other urban (undivided) routes with some additional issues:

- The separation of opposite direction lanes may indicate to drivers that these are high-speed roads, yet there is still significant potential for conflicts and crashes since the roads are not access-controlled.
- If vulnerable users are present, there may be inadequate provision for crossing and using the road.
- Barriers, rumble strips, and other devices could need updating for higher operating speeds.

2.3.4 Urban, Access-controlled Routes

4- and 5-Lane Access-controlled Urban Routes. Following the screening and ranking process, six routes were identified that may be good candidates for further diagnosis and potential treatment. Only one of the top six routes was indicated to be an Interstate highway, with the remainder indicated to be State or local routes. However, the single Interstate accounted for three-fourths of crashes in this subset. If these top six routes are treated, the following number and percentage of crashes would be targeted:

- 84 (0.3 percent) of speeding-related,
- 171 (0.3 percent) of severe,
- 871 (0.2 percent) of total crashes (see Table 14).

Nearly 10 percent of total crashes were speeding-related compared with 6 percent for all routes of this type. Nearly 20 percent of crashes in the subset were severe compared with nearly 13 percent for all routes of this type. Again, lane departures and curves seem to be over-represented, particularly on the non-Interstate routes. (Some of the findings may be affected

by errors in the data. It is possible that some of the codes in the crash data indicating that crashes occurred on access-controlled, but non-Interstate road types were in error.) Some of the crash problems associated with these routes may be associated with intersections related to ramps as opposed to interchanges (and may result from misclassification of the road type where the crash actually occurred - that is on a ramp versus main road).

Table 14. Priority, Urban, Access-controlled 4-Lane Routes.

Urban, Access-controlled, 4-5 lanes	Number of Routes	All Crashes	Speeding-related Crashes	Average Speeding-related %	Severe Crashes	Average Severe %
Subset identified through screening	6	871	84	9.6%	171	19.6%
Subset identified through screening %	--	0.2%	0.3%	n/a	0.3%	n/a
All roads of this type > 0 crashes	549	10,207	624	6.1%	1,290	12.6%
All roads of this type > 0 crashes %	--	2.8%	2.3%	n/a	2.4%	n/a
Total for all routes	--	360,272	26,969	7.5%	54,335	15.1%

6+ Lanes, Access-controlled Routes. Following the screening and ranking process, four Interstate routes (and one unknown route) were in the top 25thpercentile for each of speeding-related and severe crash proportions. If these top five routes are treated, the following number and percentage of crashes would be targeted:

- 143 (0.5 percent) of speeding-related.
- 188 (0.3 percent) of severe.
- 1,021 (0.3 percent) of total crashes (see Table 15).

On the priority subset of routes, 14 percent of crashes were speeding related compared with an average of 7 percent for all routes of this type. More than 18 percent of all crashes were severe on the subset identified compared with the average of 12 percent for all routes of this type. Again, lane departure crashes were prevalent, comprising about one-third of the crashes on these roads, although curves were less prevalent.

Table 15. Priority Urban, Access-controlled, 6+ Lanes.

Urban, Access-controlled, 6+ lanes	Number of Routes	All Crashes	Speeding-related Crashes	Average Speed-related %	Severe Crashes	Average Severe %
Subset identified through screening	5	1,021	143	14.0%	188	18.4%
Subset identified through screening **%**	--	0.3%	0.5%	n/a	0.3%	n/a
All roads of this type > 0 crashes	201	8,751	592	6.8%	1,081	12.4%
All roads of this type > 0 crashes %	--	2.4%	2.2%	n/a	2.0%	n/a
Total for all routes	--	360,272	26,969	7.5%	54,335	15.1%

As with rural freeways, access-controlled highways are typically designed for higher speeds but may have design features (e.g., curves, entrance/exit ramps, merge areas) that violate driver expectancy for the general speed of the road. Higher numbers of travel lanes may result in additional opportunities for conflict. More travel lanes may also contribute to higher free flow travel speeds during uncongested conditions. Some pavements may have low-friction during rainy weather.

Enforcement may be insufficient to keep speeds at or below limits. Further diagnosis is needed to identify the nature of the speeding-related crash problems and appropriate treatments.

2.3.5 Problem Corridors Summary

Table 16 summarizes the numbers of total, speeding-related, and severe crashes on the 318 urban routes and 114 rural routes identified through the screening process. The total of 432 routes identified creates a treatment target group of crashes (current crashes) of approximately:

- 4.6 percent of total crashes.
- 10.7 percent of speeding-related crashes.
- 7.8 percent of severe crashes.
- 9.4 percent of fatal crashes.

Note that other ranking procedures could be used, and additional routes could be added to the lists to capture a larger (or smaller) treatment target. Also, note that while recent crashes are used to identify corridors with potential speeding-related crash issues, crashes on high crash routes may be lower in a subsequent period even if no treatment is applied.

Table 16. Summary of Target Subsets of Nine Road Types with High Proportions of Severe and Speeding-related Crashes.

Prioritized List	Number of Routes	Total Crashes	Speeding -related Crashes	Average Speed-related %	Severe Crashes	Average Severe %	Fatal Crashes
Subset - 5 types urban routes	318	9,919	1,186	12.0%	2,086	21.0%	107
Urban subset percent of total		**2.8%**	**4.4%**		**3.8%**		**4.4%**
Subset - 4 types Rural routes	114	6,436	1,704	26.5%	2,141	33.3%	122
Rural subset percent of total		**1.8%**	**6.3%**		**3.9%**		**5%**
Total - all routes		360,272	26,969	7.5%	54,335	15.1%	2,424
Combined subsets percent of totals	**432**	**4.6%**	**10.7%**		**7.8%**		**9.4%**

Chapter 3 describes action items, strategies, and countermeasures for addressing many of the problem types and crash problems described in this chapter.

3 Strategies and Countermeasures to Treat Identified Problems

This chapter describes actions that may be used to implement comprehensive and proactive strategies and countermeasures, and to systematically assess and treat prioritized routes identified through the network screening process. In addition, the chapter outlines alternate engineering and enforcement strategies that may be appropriate to treat identified problems. The Countermeasure Resource provides estimates of expected crash effects that may be used in cost-benefit estimates to help select the most cost-effective countermeasures.

3.1 Statewide Speed Management Actions and Strategies

The main focus of statewide proactive Plan actions will be to foster creation of land-use-appropriate and self-enforcing roadway designs over time by working collaboratively to develop effective and consistent policies, planning procedures and guidance in speed-limit setting and road design. Speed limit setting should be undertaken early in the planning and design process in conjunction with other major decisions about the purposes of the road. Careful attention should be given to the current and future land use and multimodal safety needs of the road and surrounding network before design begins.

The key focus of comprehensive strategies at a statewide level is to engage other stakeholders in setting appropriate limits and road design policies, and to build support among the public and law enforcement agencies and policy-makers for appropriate strategies including effective traffic speed enforcement methods. Strategies should include efforts to enforce close to established limits to help convey to the public that limits are maximum safe operating speeds, and to target enforcement and supporting publicity to have greater impacts where safety problems are greatest. Speeding-related crashes tend, however, to be widely dispersed. Therefore, a goal of comprehensive strategies should also be to increase the perception that speeds are enforced network-wide and that law enforcement may be encountered at any time, and at any location, to maximize population-wide deterrence of speeding.

Highly visible enforcement and related-publicity are also needed to supplement design and engineering when road designs or limits cannot be changed, or design and engineering measures are insufficient to achieve the desired operating speeds. It may also be desirable to engage with other stakeholders to seek changes in policies or decisions that may limit the use of effective tools such as automated enforcement or to make other policy changes (e.g., increase funding for enforcement in rural areas).

Table 17 describes three Action Items and related strategies that the State and local partners can use to address the problems identified in Chapter 2. The Action Item describes the process and/or some of the stakeholders needed to develop and implement the strategies (described in the second column) to address the issues (third column). Most of the strategies outlined in

Table 17 do not have proven crash reduction or safety effects, but flow from best practice principles or provide the framework for a sustainable speed management program.

Table 17. Proactive and Comprehensive Action Items and Strategies Available to Address Statewide Problems.

Frame the Speeding and Safety Problem through a Public Information and Education Program to build support for effective policies and comprehensive strategies, to seek and leverage funding, and to improve effectiveness of enforcement and engineering countermeasures (*Comprehensive Approach*).	
Strategies that May be Used	**Issues to be Addressed**
• **Conduct surveys or other data collection to gather information about speeding behavior and public attitudes and support for different types of strategies. (See Speed Management: Road Safety Manual for Decision-makers and Practitioners.[32])** • **Improve communications about the safety reasons for speed management efforts to increase support for effective policies and strategies. (See Adding Power to Our Voices: A Framing Guide for Communicating about Injury, by the Centers for Disease Control and Prevention.[33])** • **Seek support for technologies to improve enforcement reach and effectiveness (example automated enforcement methods; see Automated Enforcement for Speeding and Red Light Running. NCHRP Report 729, for more information).[34]** • **Use well-planned and tested publicity and communications to enhance speed-deterrent effects of enforcement at a Statewide level. (See Countermeasures That Work[35] and other resources for the types of programs that are likely to be effective, or seek technical assistance. See Keys to Communication Success tip sheets in the Countermeasures Resource).** • **Seek support from other public/private partners (injury prevention community, insurance industry) to implement effective programs.**	• Lack of support or consistency in setting or agreeing on appropriate limits, enforcement strategies, or engineering countermeasures. • Widespread speeding above limits. • Policies or funding priorities that limit speed enforcement (i.e. sheriffs' offices have other priorities, or fines from enforcement efforts do not return to speed management or traffic safety programs.) • Political and administrative challenges to implement consistent adjudication of speeding violations. • Legal barriers to implementing automated enforcement under current State law and other issues. • Specific prevalent types of speeding-related crashes.

[32] Speed Management: Road Safety Manual for Decision-makers and Practitioners. (2008). Geneva: Global Road Safety Partnership. http://www.who.int/roadsafety/projects/manuals/speed_manual/en/.

[33] National Center for Injury Prevention and Control. Adding Power to Our Voices: A Framing Guide for Communicating about Injury. Atlanta, GA: US Department of health and Human Services, Centers for Disease Control and Prevention; 2008 (revised March 2010). http://www.cdc.gov/injury/pdfs/CDCFramingGuide-a.pdf

[34] Eccles, K.A., R. Fiedler, B. Persaud, C. Lyon, and G. Hansen (2012). Automated Enforcement for Speeding and Red Light Running. NCHRP Report 729, Washington, D.C.: Transportation Research Board. http://www.trb.org/main/blurbs/167757.aspx.

[35] NHTSA (2011). Countermeasures that Work. Publication no. DOT HS 811 444, U.S. Department of Transportation, National Highway Traffic Safety Administration.

Table 17 (Proactive and Comprehensive Action Items) continued	
Develop a State and local task force to engage on speed limit setting and safety. Efforts may focus on speed limit setting goals and outcomes, methods (statutory and engineering), collaboration, processes, protocols, and guidance needed to improve outcomes (*Comprehensive and Proactive Approaches*).	
Strategies that May be Used	**Issues to be Addressed**
• **Develop a collaborative speed limit setting process among State and local stakeholders. Seek public input about safe and appropriate speeds for different area and road types.** • **Develop guidance and procedures for setting more uniform speed limits within different land uses and road types that account for safety as well as mobility. The *Alabama Speed Management Manual* is currently under development to provide a guide for consistent speed limit setting procedures. Consider incorporating a risk assessment process, using estimates of expected change in average speed, to estimate the safety effects of changing limits.** • **Conduct outreach/training to policy decision-makers and state and local practitioners.** **Resources:** • **Highway Safety Manual.**[36] • **Speed Concepts: Informational Guide.**[37] • **Methods and Practices for Setting Speed Limits: An Informational Report.**[38] • **US LIMITS 2.**[39]	• Varied methods, decision-processes, and outcomes in setting and enforcing speed limits, which affect credibility of limits as a safety measure. • Lack of agreement among jurisdictions about appropriate speed limits for roads with similar functions and design. • Urban or other streets that have design (too high design speed, for example) that is incompatible with user needs, current land uses, and speed limits, leading to significant speeding above limits and difficult enforcement scenario. • Road sections that were not designed to current standards for limits in place, or have many design exceptions that are below the intended operating speed for the corridor overall, leading to safety issues at those locations.

[36] AASHTO (2010). Highway Safety Manual, 1st edition. American Association of State Highway and Transportation Officials: Washington, D.C.

[37] Donnell, E.T., Himes, S.C., Mahoney, K. M., Porter, R.J., and McGee, H. (2009b). *Speed Concepts: Informational Guide.* Report No. FHWA-SA-10-001 Washington, D.C.: Office of Safety, Federal Highway Administration. http://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwasa10001/ .

[38] Forbes, G.J., Gardner, T., McGee, H., and Srinivasan, R. (2012). Methods and Practices for Setting Speed Limits: An Informational Report. http://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwasa12004/.

[39] USLIMITS2: A Tool to Aid Practitioners in Determining Appropriate Speed Limit Recommendations. Website. http://safety.fhwa.dot.gov/uslimits/.

Table 17 (Proactive and Comprehensive Action Items) continued	
Develop an inter-agency/department planning, design, and implementation process to ensure that new projects meet sound speed management design and operations principles for the area land uses and intended purposes of the road (*Proactive Approach*).	
Strategies that May be Used	**Issues to be Addressed**
• **Coordinate with transportation and land use plans in setting limits and designing roads.** • **Set or revise speed limits early in the new project planning process to provide adequate safety for the land use, road type, and expected users.** • **Consider specific designs, signs, and markings to apply to similar road types throughout jurisdiction (self-explaining designs).** • **Utilize tools such as the Interactive Highway Safety Design Model (IHSDM)[40] to evaluate design consistency and estimate safety and operational performance of design alternatives. Incorporate speed in prediction methods.** • **Conduct speed and safety reviews (such as a road safety audit) of designs, during construction and implementation of all new and pending projects, including maintenance and operations projects, to ensure that:** - **Design exceptions are minimized.** - **Designs aim to elicit operating speeds close to the intended speed limit (self-enforcing). (Note that even if design speeds close to the limit are used, the *inferred* design speed may be higher, leading to higher driver speed selection. Additional design features or traffic calming may be needed to counteract when inferred design speeds are much higher than the limit and intended operating speeds.)** - **Operations and traffic controls are coordinated with target speeds.** - **Facilities and operations separate different weight and speed of users on roads with moderate or high limits and target operating speeds.** • **Prioritize speed-managing designs (such as roundabouts, fewer lanes, narrower lanes, shifting alignments) and street elements that will have long-lasting effects when designing non-freeway roads.**	• Lack of self-enforcing roadway designs and safety problems relating to inappropriate speed for area types and road conditions. • Lack of credibility of speed limits due to incompatibility with land uses, design or operations, including during certain times or at certain locations (such as work zones with no workers). • Street and road designs and/or limits that are incompatible with each other or with current or future land uses or other transportation needs. • Design exceptions that contribute to unsafe speeds and crashes at those locations. • Reactive approach to managing speed and providing safety treatments not as effective as initial good design. • Difficulty in enforcing speed limits where inferred design speed or actual design speed is significantly higher than limit.

[40] Interactive Highway Safety Design Model (IHSDM). Available at http://www.fhwa.dot.gov/research/tfhrc/projects/safety/comprehensive/ihsdm/.

As mentioned, the *Alabama Speed Management Manual* is currently being developed to provide guidance on when as well as how to conduct an engineering review of speed limits. In an early draft of the Manual, the following guidance was suggested on when a review may be needed:

> *"One is a change in the roadway environment such as an increase in development, elimination of on-street parking, or a change in land-use. Another is a pre-determined reevaluation interval. Reevaluation should take place at the pre-determined interval unless a change to the roadway occurs during that interval, which will prompt the reassessment to be conducted at that time."*

In addition to those triggers, network screening for speeding-related safety problems, as undertaken in this Plan, may be used to identify and prioritize corridors for speed limit and safety review. This approach may be combined with the above approaches, or other triggers such as significant changes in traffic volume that may not be captured by adjacent land use change. Another trigger to review may be if some roadway functions are shifted from one roadway to another when a new or redeveloped roadway is opened.

New processes may be implemented on a trial basis in order to assess outcomes before wider implementation.

3.2 Actions, Strategies, and Countermeasures to Address High Crash Routes

As mentioned, the systematic approach is the process used to identify, prioritize, and treat existing safety and speed management problems by corridors or other areas. Table 18 describes Action Items and strategies to implement a systematic approach to treating the priority routes identified through screening. A similar process may be used to address other areas of concern (such as locations identified through HSIP processes, or school or work zones). These actions also address some of the barriers and challenges in a local speed management program by providing a systematic method for prioritization and speed and safety review based on evidence. As in Table 17, the Action Items provide the organizational framework for selecting and developing a cost-effective treatment package of countermeasures. Countermeasures available for the different route types are described in sections following Table 18.

Table 18. Systematic Actions to Address Speeding and Related Crashes on High Crash Corridors.

Organize team and schedule to develop and implement systematic speed and safety prioritization, diagnosis, and treatment (*Systematic Approach*).	
Strategies that May be Used	**Issues to be Addressed**

• **Following network screening or other processes to identify and prioritize roads (corridors, road segments, intersections) with potential speeding-related safety issues.**
  - **Crash and roadway data are the primary data sources. Existing plans and programs, law enforcement input or citation data, public input, traffic volume change, change in function of the road, are other potential sources of information to trigger review.**
• **Conduct speed and engineering studies and additional diagnosis steps for prioritized list.**
• **Conduct Road Safety audit as part of diagnosis. As part of the safety audit process**:
  - **Involve law enforcement and other local stakeholders.**
  - **Determine the area (land use) and roadway context (purposes and users of the road); identify what types of conflicts and severity of crashes may occur based on existing design.**
  - **Assess credibility of the speed limit to drivers and other stakeholders.**
  - **Determine what changes can be made to the roadway to improve safety and support the proposed limit.**
  - **Determine timeline (short-, long-term) for engineering, other improvements.**
  - **Determine what other safety improvements are needed. For example, on higher speed roads, are safer pedestrian crossings needed?**
  - **Determine whether enhanced enforcement is needed to improve compliance with limits (including any changed limits).**
  - **Determine whether a lower or higher limit would improve safety and credibility of the limit. If changing the limit is an option, determine the appropriate limit and implementation needs.**
• **Apply similar designs, and markings to similar location/problem types.**
• **Take advantage of maintenance and operations opportunities to reconfigure or make design or engineering improvements.**
	• This systematic approach should be used to address high crash routes (speeding-related and severe) of all types as prioritized through network screening.

Table 18 (Systematic Actions) continued

Develop and implement a sustainable, high visibility enforcement and adjudication program. Target more of the network where serious crashes occur (*Comprehensive treatment in conjunction with Systematic Approach*).

Strategies that may be Used	Issues to be Addressed

• **Use the network screening approach or the Data Driven Approach to Crime and Traffic Safety (DDACTS) to prioritize enforcement allocation. Coordinate with engineering and include a focus on roads where engineering changes cannot be implemented right away or are insufficient to achieve speeding and crash reduction targets.**
• **Develop a sustainable, but randomly allocated, high visibility enforcement to target corridors with high frequencies of severe crashes and speeding.**
  - **Publicize the enforcement.**
  - **Cover as much of the network where serious crashes occur as feasible.**
• **Engage both State and local law enforcement community, including sheriffs' departments and municipal agencies to enhance enforcement. An example is to hold a sheriff's summit on traffic and speed enforcement importance and best practices and to enhance enforcement at high priority locations.**
• **Supplement highly visible enforcement with covert methods. Publicize these to increase perception that enforcement may be encountered anywhere, anytime.**
• **Improve conviction rates and consistency of adjudication of citations for targeted corridors and publicize the effort.**
• **Enhance deterrent effects of any type of speed enforcement program with publicity. Engage injury prevention and other partners in this process at Statewide and local levels. (See Keys to Communication Success tip sheet in Countermeasures Resource.)**
• **Implement automated enforcement methods.**
• **Consider an automatic (with due appeals processes) civil penalty system for some speeding violations to enhance population-wide deterrence, and to enhance ability to identify repeat and flagrant violators for more in-depth treatment.**
Resources
• **NCHRP Report 500, Volume 23: A Guide for Reducing Speeding-Related Crashes.**
• **Countermeasures that Work.**[41]
• **Effectiveness of Behavioral Highway Safety Countermeasures.**[42]
	• Widespread speeding above limits.
	• Difficulty maintaining special or enhanced enforcement programs due to resource limitations.
	• Impact of short-term, high-visibility efforts diminishes soon after enforcement ends.
	• Insufficient enforcement resources; low enforcement presence in many areas.
	• Widespread plea agreements and low conviction rate for many violators who contest charges in court.

[41] NHTSA (2011). *Countermeasures that Work.* Publication no. DOT HS 811 444, U.S. Department of Transportation, National Highway Traffic Safety Administration. http://www.ghsa.org/html/publications/countermeasures.html.

Table 18 (Systematic Actions) continued	
Implement speed and safety reviews within the HSIP program, and coordinate with other transportation safety plans (*Systematic Approach*).	
Strategies that may be Used	**Issues to be Addressed**
• **Incorporate routine review of speed limits and diagnosis of speeding issues into other safety programs and transportation plans including modal plans and long-range transportation plans.** • **Assess whether corridor-level speed management issues are contributing to spot safety problems.** • **Implement corridor or area-wide speed reviews and speed management countermeasures, if needed, to supplement spot safety improvements.** • **Coordinate with law enforcement to supplement or provide enhanced enforcement as needed.**	• Speeding at intersections. • Roadway/lane departure crashes (frequent speeding-related types). • Design speed, speed limit, and operating speed mismatches. • Pedestrian and bicyclist safety and mobility problems; inappropriate speeds in pedestrian areas; few places to cross roads safely.[43, 44] • Spot safety problems related to speeding.

The next sections describe effective alternate countermeasures that may be appropriate to address speeding-related and speed management problems on the nine road types. In addition, consult the Countermeasure Resource *or* approved State resources for more information on the specific countermeasures or solutions that have substantial, strong evidence of safety effectiveness.

To determine appropriate treatments, conduct a sound engineering speed and traffic study using established protocols for each corridor:

- As part of diagnosis, consider using a multi-disciplinary team to perform an RSA in conjunction with the speed engineering study to identify issues and most feasible and cost-effective countermeasures.

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[42] Preusser, D.F., Williams, A.F., Nichols, J.L., Tison, J., and Chaudhary, N.K. (2008). *Effectiveness of Behavioral Highway Safety Countermeasures. N*CHRP Report 622, Washington, D.C: Transportation Research Board. http://www.nap.edu/openbook.php?record_id=14195.

[43] See relevant safety plans. Also see Nabors et al., 2007. *Pedestrian Road Safety Audit Guidelines and Prompt Lists.* Report no. FHWA-SA-07-007, Washington, D.C.: FHWA. http://safety.fhwa.dot.gov/intersection/resources/fhwasa09027/190.html.

[44] See relevant safety plans. Also see Nabors et al., 2012. *Bicycle Road Safety Audit Guidelines and Prompt Lists.* Report no. FHWA-SA-12-018, Washington, D.C.: FHWA. http://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa12018/.

- Consider whether the speed limit should/can be changed to fit the environment and roadway purposes, whether design or operations changes are needed, or enforcement improvements are needed.
- Consider the network context of the road and the availability of alternate routes for different user types.
- In conjunction with any change in the limits, including possible changes in the extent of a speed zones or transition areas, and determine what changes to the roadway are needed to support the new limit.

Although individual review of speed limits and problem diagnosis should be performed *for each corridor or area,* application of more uniform speed limits, designs, markings, and other proven treatments for similar area and road types may be helpful toward achieving more self-enforcing and self-explaining road designs. As in the proactive approach to designing future roads, such treatment could improve consistency of the message to drivers about safe speeds in similar land use and roadway contexts and help improve overall driver perceptions of safe and appropriate speeds. Applying the same speed limits, within reason, to the same road types, regardless of jurisdiction, may also be more comprehensible to drivers. In addition, for any of the route types, ensure that speed limits are properly conveyed to drivers through appropriate signs and markings, and potentially other types of communications.

3.2.1 Countermeasures for Rural, Non-freeway Routes

Rural, Two-Lane Routes. Calming speeds on rural, two-lane roads and conveying safe speed for conditions is a significant challenge, given the many miles of roadway and the relatively widely dispersed nature of the problem. Since only routes with the most severe crash histories and higher traffic volumes are likely to receive significant upgrades and redesign, or even receive spot safety treatments in any given year, enforcement and publicity campaigns are important components of a comprehensive approach to reduce speeding-related crashes on rural roads.

Since a large proportion of the speeding-related crashes on these road types are also road/lane departures and/or occurred at curves, this Plan should coordinate speed and safety review of the prioritized corridors with guidance for implementation of roadway/lane departure and curve treatment countermeasures.

- Consider whether limits are appropriately set.
- Consider whether speed zones and advisory limits are appropriate.
- Consider when and how to target increased enforcement to rural routes with speeding and severe crash problems.

In addition, although it is not always clear from the crash data whether speeding was an issue, 10 percent of all crashes in this subset of roads occurred at intersections. High approach speeds, sight distance issues and others design problems, such as skewed angle intersections, are often present. Treatments that manage the speed and flow of traffic on approaches to and through intersections may also help to improve the speed management and safety of the corridor overall.

Alternate design and engineering countermeasures for rural two-lane routes and their intersections include, but are not limited to:

- Replace two-way, stop-controlled intersection with one-lane roundabout.
- Replace signal-controlled intersection with one-lane roundabout.
- Install lane-narrowing treatments (transverse in-lane rumble strips and painted median) on major road approaches to intersections with smaller, two-lane, stop-controlled roads. Narrowing treatment may be warranted on the larger roads to slow drivers on the main road, uncontrolled approaches, especially where speeding and sight distance issues may be present.
- Implement gateway treatments, lateral shift/chicane, lane narrowing, or raised traffic calming measures at high to lower-speed transition areas (such as near residential areas, schools).
- Consider other traffic calming measures such as speed tables at appropriate locations (rural villages, school zones).
- Implement the Safety edge treatment to mitigate, improve recovery of road departures.
- Implement other treatments intended to reduce or mitigate road departure, nighttime, or curve-related crashes such as rumble strips, improved curve or lane delineation, warning signs, and barriers as appropriate. Coordinate with the Alabama Roadway Departure Safety Implementation Plan to review speed limits for the corridor and/or sections to ensure limits are appropriate and assess the need for other safety treatments.
- Add paved shoulders, bike lanes, or separated paths to accommodate other (slower) users.
- Alternatively, incorporate spot treatments, such as the systematic addition of paved shoulder width and edge treatments on and near curves, to complement other systematic improvements that may be implemented through Alabama's Roadway Departure (crash reduction) Plan. Such an approach may be implemented more widely than corridor-long shoulder improvements, and may have the added advantage of not leading to higher speeds that could occur if shoulders were widened for an entire corridor. However, crash modification factors and speed effects for this type of addition of shoulder width seem to be unavailable. Such treatments and other innovative treatments should be piloted on a smaller scale and evaluated before widespread implementation.
- Consider lowering speed limits and enhancing speed enforcement for routes with issues that cannot be sufficiently treated through a spot safety approach.
- Implement other countermeasures, such as improving shoulders and delineation without widening pavement, visually narrowing the road by eliminating the centerline (low-volume, low-speed roads), or other experimental treatments, that may help to slow speeds and reduce crashes. Work with FHWA for experimental approval.
- Enhance enforcement presence and driver perception of enforcement on rural two-lane highways. Target a larger number of rural routes that have higher than average

frequencies of severe and speeding-related crashes for high-visibility enforcement by randomly allocating existing resources and publicizing the effort. The goal is to deter speeders, so using publicity or other means to enhance effectiveness is essential.

Rural, Undivided, 4-5 Lane and Rural, Divided, 4-5 Lane Routes. The problem subsets for both rural, undivided, and rural, divided four-lane roads seem to have greater than average proportions of road departure crashes than others of their type. Since these are likely higher volume routes, these routes may be good candidates for speed limit review and further diagnosis and potential implementation of Roadway Departure Plan treatments. See the Countermeasure Resource for expected crash effects for some of these treatments including curve delineation treatments, rumble strips and stripes, and the Safety Edge treatment.

In addition, undivided routes are subject to head-on (opposite direction crash types) and both divided and undivided types are subject to angle and turning collisions since they are not access controlled. Thus, speed limit review and safety reviews should consider the types of severe collisions that are possible, and the extent of conflict areas, when determining appropriate limits. Intersections should also be reviewed for safe operations at normal operating speeds. More countermeasures are described in the *Speed Management Toolkit* document prepared for FHWA. Assess the need for shoulder improvements, bicycle and pedestrian facilities, or other treatments to separate different speeds of traffic.

3.2.2 Countermeasures for Rural, Access-controlled Routes

Speed-controlling measures, other than speed limits and enforcement, are generally lacking for freeways. However, treatments may include measures that target crash types that are frequently speeding-related such as friction and lane departure treatments. In addition, there may be design problems or design exceptions that reduce the safety of the highways for the intended (or actual) operating speeds, including at ramps and merge areas.

Rural, 4-5 Lane Access-controlled, Divided Freeways. More analysis is needed to determine why certain freeways identified for ALDOT had higher proportions of both severe and speeding-related crashes than others. Lane-departure and speeding-related crash types were somewhat higher than average for these routes. Other factors may include darkness, low friction (wet pavements), and potentially others, which have not yet been analyzed or identified. Roadway Safety Audits (RSAs) may uncover design problems or other conditions not readily apparent in the crash data.

3.2.3 Countermeasures for Urban, Non-freeway Routes

Although urban, non-access-controlled corridors may have far lower overall proportions of severe crashes and speeding-related crashes compared to total crashes than rural roads, some roads in each sub-type have much higher rates of severe and speeding-related crashes and may be good candidates for treatment. In addition, the crashes may also be condensed over a relatively smaller number of miles of roadway, although the corridors may carry higher volumes

of traffic. Speed management measures applied to these roadways may be cost-effective per mile of roadway treated, even if speeding crash rates (per vehicle miles) are lower than on other types of roads. The availability of speed-controlling and crash-reducing countermeasures for urban or small town situations also increases the feasibility of treating the problems on these routes. Some of these streets also tend to serve a variety of important functions from carrying through traffic to providing local access to homes, schools and businesses.

Urban, Two-lane Corridors. Design and engineering countermeasures for these urban two-lane routes include, but are not limited to:

- Use roundabout (or mini-roundabout) intersection designs. Raised crosswalks or other intersection treatments might also be used.
- Add gateway treatments at rural to urban transition areas.
- Traffic calming measures (lateral or vertical shifts or narrowing such as chicanes or shifting parking from side to side, curb extensions, bulb-outs at intersections where curbs are present – creative design approaches may be needed).
- Consider chevron pavement markings or optical speed bars at gateway or speed transition areas (intersection or curve approaches) until designs can be changed.
- Increase pavement friction and/or improve drainage to reduce wet surface-related crashes.
- Improve delineation (various treatments).
- Realign skewed intersections.
- Turn lanes may be needed at some locations.
- Provide separated space for pedestrians and bicycle facilities (space to walk or ride) and crossing treatments on busier and/or higher-speed corridors.
- Re-channelization (narrower travel lanes) can help to reduce speeds and may provide space for other uses, while wider lanes may be needed in some situations (bus and large vehicle traffic or if the road is intended to operate at a higher speed).
- Add paved shoulders or separated pedestrian and bicycle facilities in developed areas where curb and gutter may not be appropriate.
- Lighting can help to address nighttime crashes, and sidewalks, bike facilities, parking lanes, and other treatments can not only provide space for other uses, but signal that the road is in an urban area where lower speeds are warranted.
- Enhance and target enforcement and related publicity to corridors with high numbers and proportions of severe and speeding-related crashes; especially focus on corridors where engineering measures cannot be implemented right away or are insufficient to bring speeds in compliance with limits.

Measures that reduce travel speeds may be expected to have effects on reducing the occurrence of more severe crashes of all types, and in some cases (roads with frequent crashes), may help to improve traffic flows.

Urban, Undivided 4-5 Lane Routes. Design and engineering countermeasures for urban four-five lane, undivided routes include, but are not limited to:

- Implement road diets (conversions of regular traffic lanes to other uses such as parking or bike lanes).
- Change from signal or two-way stop-controlled intersection to roundabout intersection design.
- Narrow the road or travel lanes through markings or physical measures.
- Realign skewed intersections/narrow turning radii.
- Implement gateway treatments for speed transition areas.
- Review speed transitions and ensure proper signing and speed zones.
- Consider installing medians or median islands and potentially other access management measures; however, this measure may sometimes increase speeds, so ensure proper context, speed limits, and provision for pedestrians and bicyclists.
- Traffic calming measures may be appropriate for some areas.
- Test coordinated traffic signal progression along a signalized corridor.
- Implement other design elements (lighting, sidewalks, street trees) that highlight the urban nature of the corridor.
- Provide separated turning lanes, sidewalks and bikeways, and controlled crossing opportunities on roads that carry higher volume and speed of traffic.
- Install new/more conspicuous signals and signs for better visibility on multi-lane corridors.

Urban, Divided, Four- To Five-Lane Routes. Many of the countermeasures are in general the same as for urban, undivided, four- to five-lane routes. Since these routes are already divided, there is likely to be lower access to adjacent land uses, so conflicts should be lower, and limits may be higher on divided roads than undivided corridors. However, ensure that the design fit with the land uses and desired operating speeds and provision for all user types. It is imperative that proper provision be made for all users, including drivers, pedestrians, and bicyclists to safely access and cross these routes and that enforcement is sufficient to keep speeds to the desired level for safety.

Further diagnosis will include intersections as well as corridor-wide issues. Other intersection improvements such as improved signal timing or protected phasing, enhanced signal conspicuity with larger size and reflective back plates (an FHWA proven safety countermeasure), or provision of separated turn lanes, may be needed in addition to more direct speed-managing improvements.

3.2.4 Countermeasures for Urban, Access-controlled Routes

Four- To Five-Lane and 6+ Lane Urban Freeways. The engineering treatments for these routes are largely limited to those that address frequent speeding-related crash types as opposed to treatments that might reduce operating speeds, with the exception of enhanced enforcement and publicity measures. Engineering treatments include:

- Pavement friction treatments.
- Curve and road-departure treatments such as rumble strips and stripes, wider edge lines, signs/other delineation treatments, and roadside barriers.
- Enhanced lighting.
- Merge areas re-design.

Speed limits that are appropriately and consistently set for the area type and roadway design, enhanced by supporting enforcement and public information and communications strategies, are important components of managing speed on urban freeways. Urban freeways may have more variation in peak and non-peak flows, and non-recurring congestion related to weather, crashes, or other traffic events that can affect safe operating speeds. Freeways may benefit from the following measures that provide information to drivers about appropriate speeds under varying conditions:

- Variable speed limits, backed up by automated enforcement.
- Variable message signs with information about the conditions affecting safe speed.
- Automated speed enforcement. Point-to-point automated enforcement (of average speed over distance) is being tried internationally with promising results. Speed over distance measures may also be perceived as fairer to drivers than enforcement based on point speed measurement.

3.2.5 Coordination with Spot Safety and Other Safety Plans and Programs

A pragmatic approach to speed management will use all possible ways to systematically implement speed and safety review and speed managing improvements within other safety programs, including the HSIP program. In addition, it may be prudent to incorporate speed and safety, along with multi-modal user assessments, into planned maintenance and operations improvement programs. Law enforcement and other local stakeholders may have important insights about problems and their treatment.

Other transportation plans and safety action plans, including modal plans, should be consulted to ensure that speed management measures and priorities are coordinated with overall safety and mobility goals for each jurisdiction/area. Speed management countermeasures may serve multiple goals through good coordination.

Again, enforcement and related communications will complement design and engineering improvements.

3.2.6 High Crash Routes Crash Reduction Targets

This section describes initial crash reduction targets and expected crash cost savings for developing and implementing treatment plans for a prioritized list of approximately 430 prioritized routes. More than 16,000 crashes of all severities including more than 4,200 severe crashes (assuming that the prior three-year of crashes are representative of future crashes)

could be prevented with treatments with average effects of 15 to 25 percent crash reductions. Nearly 320 million in crash-related costs could be saved (Table 19).

Estimates of effect are general, but based on expected crash reductions that may be achieved with engineering and enforcement countermeasures included in the *Speed Management Toolkit* document prepared for FHWA. These estimates assumed that future crashes will be similar to crashes during the analysis period in the absence of treatment. However, while three recent years of crashes were used to identify corridors with potential speeding-related safety issues, crashes on high crash routes could be lower in a subsequent period even if no treatment is applied. Actual treatment effects may also be lower or higher, depending on the specific issues and locations treated and the package of countermeasures implemented.

Table 19. Matrix of Estimates of Crash Savings from Treating the Nine Road Type Subsets.

Route Types subsets	Crash Severities	Crashes on Priority Corridors	% Crash Reduction Target	5-year Crash Savings	5-year Crash-cost Savings*
Rural, Undivided, 2-3 Lane	Severe	1,186	25%	296.5	$187,625,200
Rural, Undivided, 2-3 Lane	Possible	220	20%	44.0	$1,629,835.20
Rural, Undivided, 2-3 Lane	PDO	1,492	15%	223.8	$1,655,844.72
Rural, Undivided, 2-3 Lane	All Severity Crashes	2,898	19%	564.3	$190,910,880
Rural, Undivided, 4-5 Lanes	Severe	65	25%	16.2	$2,570,750
Rural, Undivided, 4-5 Lanes	Possible	15	20%	3.0	$135,059
Rural, Undivided, 4-5 Lanes	PDO	108	15%	16.2	$119,836
Rural, Undivided, 4-5 Lanes	All Severity Crashes	188	19%	35.5	$2,825,645
Rural, Divided, 4-5 Lanes	Severe	323	25%	80.8	$12,774,650
Rural, Divided4-5 Lanes	Possible	87	20%	17.4	$782,014
Rural, Divided, 4-5 Lanes	PDO	652	15%	97.8	$723,627
Rural, Divided, 4-5 Lanes	All Severity Crashes	1,062	20%	212.4	$14,280,291

Table 19. Estimates of Crash Savings for Treating Nine Road Type Subsets *continued.*

Route Types subsets	Crash Severities	Crashes on Priority Corridors	% Crash Reduction Target	5-year Crash Savings	5-year Crash-cost Savings*
Rural, Access-Controlled, 4-5 Lanes	Severe	56s7	20%	113.4	$17,939,880
Rural, Access-Controlled, 4-5 Lanes	Possible	130	15%	19.6	$878,352
Rural, Access-Controlled, 4-5 Lanes	PDO	1,591	15%	238.6	$1,765,548
Rural, Access-Controlled, 4-5 Lanes	All Severity Crashes	2,288	16%	371.6	$20,583,780
Urban, Undivided, 2-3 Lanes	Severe	1,241	25%	310.2	$49,081,550
Urban, Undivided, 2-3 Lanes	Possible	403	20%	80.6	$3,619,874
Urban, Undivided, 2-3 Lanes	PDO	3,660	15%	549.0	$4,062,485
Urban, Undivided, 2-3 Lanes	All Severity Crashes	5,304	18%	939.9	$56,763,908
Urban, Undivided, 4-5 Lanes	Severe	357	25%	89.3	$14,119,350
Urban, Undivided, 4-5 Lanes	Possible	165	20%	33.1	$1,481,799
Urban, Undivided, 4-5 Lanes	PDO	1,621	15%	243.2	$1,799,298
Urban, Undivided, 4-5 Lanes	All Severity Crashes	2,143	17%	365.5	$17,400,447
Urban, Divided, , 4-5 Lanes	Severe	129	25%	32.2	$5,101,950
Urban, Divided, , 4-5 Lanes	Possible	45	20%	8.9	$401,047
Urban, Divided, , 4-5 Lanes	PDO	406	15%	61.0	$451,037
Urban, Divided, , 4-5 Lanes	All Severity Crashes	580	18%	102.1	$5,954,034
Urban, Access-Controlled, 4-5 Lanes	Severe	171	15%	25.6	$4,057,830
Urban, Access-Controlled, 4-5 Lanes	Possible	50	20%	9.9	$445,830

Table 19. Estimates of Crash Savings for Treating Nine Road Type Subsets *continued.*

Route Types subsets	Crash Severities	Crashes on Priority Corridors	% Crash Reduction Target	5-year Crash Savings	5-year Crash-cost Savings*
Urban, Access-Controlled, 4-5 Lanes	PDO	650	15%	97.6	$721,892
Urban, Access-Controlled, 4-5 Lanes	All Severity Crashes	871	15%	133.1	$5,225,552
Urban, Access-Controlled, 6+ Lanes	Severe	188	15%	28.2	$4,461,240
Urban, Access-Controlled, 6+ Lanes	Possible	59	20%	11.72108	$526,276
Urban, Access-Controlled, 6+ Lanes	PDO	774	15%	116.1592	$859,578
Urban, Access-Controlled, 6+ Lanes	All Severity Crashes	1,021	15%	156.0803	$5,847,094
Total Target and Potential Crash Savings	**Severe**	**4,227**	**23%**	**992.5**	**$297,732,400**
Total Target and Potential Crash Savings	**All Severity Crashes**	**16,355**	**18%**	**2880.3**	**$319,791,631**

*It may be reasonable to include more years of savings if the countermeasures will have a longer useful life.

Larger long-term reductions may be achieved by implementation of proactive strategies over time. In addition, a fully comprehensive approach may be able to achieve larger reductions in fatalities and injuries.

Chapter 4 describes the implementation plan and steps to implement general speed management strategies Statewide, and to prioritize locations and select appropriate countermeasures to treat specific problem locations.

4 Multi-year Implementation Plan

Speeding is a complex issue and problem that interacts with varied social, economic, political, environmental, and roadway issues. Because of the inherent relationship between speed and severe crashes and fatalities, speed management should be a central tenet of a road safety program that aims to reduce fatalities and injuries. This chapter describes a plan of Action Items to enable State and local stakeholders to arrive at locally acceptable solutions to reduce speeding, crashes, and serious injuries, and to sustain a cooperative approach to speed management that balances safety and mobility goals. Commitment to the process and consideration of varied points of view by all partners is essential to success. Input from non-traditional partners such as injury prevention experts and two-way communications with public stakeholders may also be essential to communicate the need for speed management, to build support, and to implement strategies that a majority of the public (all transportation stakeholders) deems appropriate. The sections following the Action Items outline more details for ranking and selecting specific countermeasures, and for implementing, evaluating and renewing the Plan.

4.1 Detailed Proposed Implementation Actions

This section outlines systematic, proactive, and comprehensive speed management actions and strategies that ALDOT, county and city partners, law enforcement, injury prevention experts, and other partners identified to reduce speeding-related and serious injury crashes. Tables 20, 21, 22, 23, 25, and 26 describe the six Action Items. The issues that could be addressed by the strategies and countermeasures within each of the Action Items were detailed in Chapter 3. Potential implementation steps are also described, with additional implementation steps for the systematic actions (Action Items 4 and 6) following Action Item 4 (see Table 24).

Further outreach and coordination will be led by ALDOT and designees. Implementation of some of the strategies herein will require longer than five years and the support of policy-makers.

Table 20. Strategies and Implementation Steps for Action Item 1.

Action Item 1	**Frame the speeding and safety problem through a public information and education program to build support for effective policies and comprehensive strategies, to seek and leverage funding, and to improve effectiveness of enforcement and engineering countermeasures (*Comprehensive Approach*).**
Leadership	Injury prevention (e.g., State Public Health Dept., Injury Prevention office)
Others needed	Others: DOT Communications and Safety Offices, courts representatives DA's office, law enforcement, emergency responders and medical profession, insurance industry, other business and private partners
Timeline	5-8 years
Strategies ***(Comprehensive Approach)***	• Improve and increase communications about the safety reasons for effective policies and strategies, to improve public and political support. • Enhance knowledge by collecting and analyzing data on operating speeds, and survey drivers about reasons for speeding and attitudes toward speeding and safety countermeasures. • Ensure that speed limits, including statutory maximums, are well-communicated to drivers. • Seek additional funding to increase enforcement in rural and urban areas. • Increase visibility/publicity of enforcement to enhance deterrent effects. • Work toward gaining State authorization to utilize automated (photo) speed enforcement or other speed enforcement technologies and tools. High level champions may be needed. • Promote and draw on local creativity and resources (schools, businesses, injury-prevention partners, insurance industry) to develop locally-tailored education, awareness, and enforcement strategies enhance speed-deterrent effects of enforcement programs, and potentially, to target some of the top crash issues (e.g. rural, curves, nighttime).
Implementation steps	1. Recruit appropriate stakeholder partners, in particular, the injury prevention community, for communications task force. 2. Schedule first meeting. 3. Set future meeting schedule and agenda. 4. Coordinate with other Action Item Planning groups. 5. Set objectives and determine related performance measures. 6. Determine strategies and programs. 7. Implement strategies and programs. 8. Document outcomes.

Table 21. Strategies and Implementation Steps for Action Item 2.

Action Item 2	**Develop a State task force to engage on speed limit setting to improve safety, consistency of outcomes, and credibility of speed limits *(Proactive and Comprehensive Approaches)*. Training and outreach, data collection, and policies and guidelines may be addressed through this action item *(Proactive Approach).***
Leadership	State/local DOTs and Injury Prevention offices
Others needed	Law enforcement, judicial officials, public and private stakeholders, and elected officials, as appropriate
Schedule	1-5 years
Strategies *(Comprehensive and Proactive Approaches)*	• Set appropriate speed limits for the roadway design, context, and users to improve safety, enforceability and credibility of speed limits on new and existing roads. - Develop a collaborative speed limit setting process with local governments and law enforcement. - Take public concerns into consideration to *balance* safety and mobility in different areas and area-types. - Finalize the *Alabama Speed Management Manual* on speed limit setting procedures. - Conduct outreach and training of engineers and other practitioners as needed to implement the guidance. - Consider safety risk of likely changes in operating speed when assessing whether to change limits. - Coordinate decisions about speed limits with decisions about design and engineering treatments and enforcement.
Implementation steps	1. Recruit appropriate stakeholder representatives to task force. a. Evaluate safety effects of the prior statutory change of rural speed limits from 55 to 45 mi/h. b. Consider work zone limits and training and implementation of existing policy. c. Review speed setting requirements/guidelines/strategies in literature and in use by other States, cities, counties, countries, including any written procedures or manuals before finalizing the *Speed Management Guidance* document. d. Ensure that speed transition zones are addressed in *Guidance* and implementation of zoning, signing, and other treatments. e. Include adequate public and varied safety stakeholder input to increase support for the program. 2. Schedule first meeting. 3. Set future meeting schedule and agenda. 4. Coordinate with Action Items 1 and 3 Planning Groups (potentially others). 5. Determine strategies and processes. 6. Set objectives. Determine performance measures. 7. Implement strategies and processes. 8. Document outcomes.

Table 22. Strategies and Implementation Steps for Action Item 3.

Action Item 3	**Develop an inter-agency/department planning, design, and implementation process to ensure that new projects meet sound speed management design and operations principles for the area land uses and intended purposes of the road. Conduct a trial of this approach and compare to outcomes using the traditional planning and design process (*Proactive Approach*).**
Leadership	Centralized transportation planning office or regional planning organizations
Others needed	DOT: Transportation design, division or regional traffic engineering and planning offices, safety and mobility offices, bicycle and pedestrian planning/safety; city/county and local planning staffs; elected officials; law enforcement representatives; and injury prevention experts
Timeline	Ongoing
Work underway	Incorporate into existing road planning or improvement projects processes.
Strategies ***(Proactive Approach)***	• Coordinate with transportation and land use plans in setting limits and designing roads. • Set or revise speed limits early in the new project planning process to provide adequate safety for the land use, road type, and users expected, and to determine appropriate design. • Conduct design, construction, and implementation reviews such as through an RSA of all new and pending projects, including maintenance and operations projects, to ensure that: - Design is matched to elicit speeds close to the intended speed limit (self-enforcing). - Operations features are coordinated with target speeds. - Facilities are provided to separate different weight and speed of users in time and space on roads with intended speeds much above 20-25 mi/h. • Prioritize designs in new projects that manage speeds such as narrower and fewer lanes, roundabout intersection designs, tight turn radii at intersections, and shifts in travel ways (context-dependent traffic calming). • Consider variable speed limits and automated enforcement for freeways. • Longer term, consider Intelligent Speed Adaptation and other measures; the impacts of more automation/self-driving vehicles, and more.
Implementation steps	1. Recruit appropriate stakeholder partners for communications task force. 2. Schedule first meeting. 3. Set future meeting schedule and agenda. 4. Coordinate with Action Items 1 and 2 Planning Groups. 5. Determine strategies and programs. 6. Set objectives. Determine performance measures. 7. Implement strategies and programs. 8. Document performance outcomes.

Table 23. Strategies and Implementation Steps for Action Item 4.

Action Item 4	**Review existing speed limits, conduct additional diagnosis, and develop treatment plans for prioritized lists of problem corridors identified through network screening (*Systematic Approach*).**
Leadership	Engineering - safety and mobility regional/divisional field units
Others needed	DOT Division, municipal staffs, and decision-makers, regional planning organizations, municipal planning organizations, local law enforcement/law enforcement liaison, elected officials, and court officials
Timeline	5 years
Strategies *(Systematic Approach)*	• Continue and refine network screening for potential speeding-related crash issues. • Conduct speed and engineering studies, RSAs, and additional diagnosis steps as per other safety programs, to bring a systematic approach to speed management. • Consider an injury minimization approach to speed limit setting. • Assess whether limits should be changed (lowered or raised), whether the roadway be changed through re-design or other engineering measures, whether enforcement should be changed, or a combination of measures. • Apply greater separation by weight and speed of traffic along higher-speed road and at access points (protecting crossings, signal phasing, etc.). • Use advisory limits (based on engineering study), when design exceptions are rare. • Identify alternate, feasible countermeasures *from Speed Management Toolkit* and other sources. • Determine speed limit, engineering, and enforcement plan for the corridor.
Implementation steps	1. Recruit appropriate stakeholder partners for task force. 2. Schedule first meeting. 3. Prioritize corridors for further diagnosis. 4. Establish diagnosis procedures – for example determine if independent RSA teams will be used to conduct safety audits. 5. *See Action Item 4, step 5: *Selection and Ranking of Countermeasures* and other steps following Action Item 6. 6. Coordinate with Planning Groups for Action Items 1, 3, 4, and 5, as appropriate. 7. Set objectives. Define performance measures. 8. Implement strategies and programs. 9. Document performance outcomes.

**Action Item 4, Step 5. Selection and Ranking of Countermeasures*

Detailed steps for Selection and Ranking of Countermeasures for Action Item 4, (systematic diagnosis and treatment of existing problems) include the steps shown in Table 24.

Table 24. Detailed Overview of Action Item 4, Step 5, Selection and Ranking of Countermeasures

Action Item 4, Step Number 5	Detailed Overview of Action Item 4, Step 5
5.1	In coordination with other owners/stakeholders, finalize priority list of routes or areas for speed and safety review. The lists for different corridor types and area types (such as sections and intersections in the HSIP list, Road Departure Plan, and others) could be coordinated with or even combined into one prioritization list if appropriate. In addition, more routes may be added if some on the lists have already been treated or upgrades are pending. (However, consider an audit of planned improvements.)
5.2	Diagnose the problems for each corridor or focus area (also see Appendix A, section Diagnosis).
5.2.1	*Along with speed and engineering studies, diagnosis may involve conducting RSAs in cooperation with local government and law enforcement, conducting speed studies and other engineering assessments. Consider hiring independent audit teams to conduct RSAs.*
5.2.2	*Determine the area (land use) and roadway context (purposes and users of the road, what types of conflicts and crashes may occur based on existing design). If changing the limit is an option, determine the speed limit to set based on the roadway context, types of conflicts and crashes that may occur (injury/fatality risk), or other approved method.*
5.2.3	*Assess whether speed limits are adequately conveyed to drivers through signs, road designs, and other information.*
5.2.4	*Assess rural to urban transition areas or other speed zone changes, if relevant. Consider speed transition zone length, signing (frequency and size), and the need for changes in design, operations, and traffic calming measures that support the transitions.*
5.2.5	*Assess credibility of the speed limit to drivers.*
5.3	In collaboration with other stakeholders, determine appropriate speed limit and whether changes in limits for the corridor, or portions of the corridor, are warranted. Consider safety concerns, the road design and environmental context, enforcement needs, and other issues regarding speed limit safety and credibility. Coordinate with local agency representatives.
5.4	Complete diagnosis and identify alternate countermeasures. If the recommendation is to change speed limits, consult and coordinate with local governments, stakeholder groups, law enforcement, judiciary, and educators to implement the new speed limit.
5.4.1	*Determine what design and engineering changes can be made to the roadway to improve effectiveness of the limit, and bring operating speeds more in line with desired limits (self-enforcing designs), reduce speed variance, or achieve other speed management objectives.*
5.4.2	*Determine what other engineering safety improvements are needed.*
5.4.3	*Determine whether enforcement enhancements are needed to increase compliance with limits (including any changed limits).*
5.5	Conduct feasibility assessments on alternate measures.
5.6	Finalize the list of feasible countermeasures for the corridor or area. Combinations of multiple countermeasures may be needed.

Action Item 4, Step Number 5	Detailed Overview of Action Item 4, Step 5
5.7	Identify funding sources and levels and perform economic assessments for alternate, feasible treatment options and priorities within each program/funding area.
5.8	Identify the most appropriate set of countermeasures for each corridor or location.

These steps are discussed in Chapters 5, 6, 7, and 8 of the *Highway Safety Manual (HSM)*.[45]

Step 5.6 Feasibility Assessments. The intent of a feasibility assessment is to consider how likely the measure is to be implemented, and implemented well, taking financial and non-financial constraints and issues into consideration. This is also a time to consider whether opportunities exist to facilitate implementation. Some of the considerations may include:

- Barriers to implementation, local acceptability.
- Funding sources available.
- Current and future land uses along and near the corridor.
- Lifespan of the project.
- Applicability to multiple locations or need for consistent application of low-cost signs, markings, and design elements to improve driver comprehension and acceptance of limits.
- Potential for long-term improvement of compliance with speed limits (self-enforcing designs).
- Need for additional enforcement to supplement engineering measures.

Stakeholders may conduct feasibility assessment early in the Plan implementation process. For example, Plan implementers could select countermeasures and strategies that might be applied on a widespread basis to improve driver perceptions of appropriate speeds to drive on different types of roads. Such measures could then receive priority in selection.

Step 5.7 Economic Assessments. The intent of the economic analysis is to compare the benefits and costs of alternative countermeasures using the most appropriate estimates of expected safety effects available, once the problems and feasible alternate solutions have been identified. Chapter 7 of the HSM[46] has a detailed discussion on how economic assessments can be conducted. An example is provided in Table 46, Appendix B.

Other economic considerations include overall funding allocation among different types and programs. In addition, consider the ability to implement speed management measures through

[45] AASHTO (2010). Highway Safety Manual, 1st edition. American Association of State Highway and Transportation Officials: Washington, D.C.

[46] AASHTO (2010). Highway Safety Manual, 1st edition. American Association of State Highway and Transportation Officials: Washington, D.C.

planned maintenance or operations projects. Non-traditional funding sources may also be available to implement some types of improvements or programs.

Finally, the systematic approach may be strengthened by considering overall objectives of the program and whether systematic application of similar measures to similar locations (if appropriate) may increase effectiveness of certain types of measures. As an example, greater consistency across a jurisdiction in application of speed limits, signs, markings, and designs may help to strengthen creation of self-enforcing, self-explaining roadways. Thus, measures for individual locations are perhaps best considered, not in isolation, but as part of an overall approach. Linkage of the systematic approach with proactive strategies and decisions may also be important.

Step 6. Implementation Steps following Project Approval

Once treatment locations and countermeasures are approved, the following process steps should be performed:

6.1 Design project(s) and allocate appropriate funding sources and/or pursue grants or private funding.

6.2 Develop implementation schedule, assign tasks.

6.3 Finalize safety targets or other goals.

6.4 Identify measures of effectiveness and develop evaluation plan.

6.5 Implement and complete evaluation.

6.6 Communicate results to decision-makers and the public.

More details of these and other implementation processes are described in the *NCHRP Guide for Reducing Speeding-Related Crashes*, section VI.[47]

Action Items 5 (Table 25) and 6 (Table 26) are presented next.

[47] NCHRP. (2009). Guidance for Implementation of the AASHTO Strategic Highway Safety Plan. Volume 23: A Guide for Reducing Speeding-Related Crashes. Washington, DC: Transportation Research Board. onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v23.pdf.

Table 25. Strategies and Implementation Steps for Action Item 5.

Action Item 5	**Implement a sustainable, high visibility enforcement and adjudication program. Target more of the network where serious crashes occur (*Comprehensive treatment in conjunction with Systematic Approach*).**
Leadership	State and local Departments of Public Safety
Others needed	Others: CAPS or DOT offices may assist with prioritization through systematic data analysis and review process, court officials, injury prevention branch/agency, and communications experts
Timeline	1-2 years to start-up/ongoing
Strategies ***(Comprehensive Approach)***	• Develop a sustainable, but randomly allocated high visibility enforcement program to target more corridors with high frequencies of severe crashes and speeding. • Publicize the enforcement. • Cover as much of the network where serious crashes occur as feasible. • Use the network screening approach or a Data Driven Approach to Crime and Traffic Safety (DDACTS) to prioritize enforcement allocation. Coordinate with engineering and include a focus on roads where engineering changes cannot be implemented right away, or are insufficient to address the problems. • Engage Sheriff Departments and municipal agencies to enhance enforcement. An example is to hold a sheriff's summit on traffic and speed enforcement importance and best practices in targeting resources. • Supplement highly visible enforcement with covert methods. Publicize these to increase perception that enforcement may be encountered anywhere, anytime. • Improve conviction rates and consistency of adjudication of citations for targeted corridors and publicize the effort. • Enhance deterrent effects of any type of speed enforcement program with publicity. Engage injury prevention and other partners in this process at a local level (in addition to any Statewide efforts). (See Keys to Communication Success tip sheets in *Speed Management Toolkit*.) • Implement automated enforcement with civil penalties for auto owners. • Consider an automatic (with due appeals processes) civil penalty system for some speeding violations both to increase consistency of adjudication and enhance ability to identify repeat and flagrant violators for more in-depth treatment. (Consider evaluating the deterrent effects of current adjudication practices.)
Implementation steps	1. Recruit or build on existing stakeholder partners for task force. 2. Schedule first meeting. 3. Set future meeting schedule and agenda. 4. Coordinate with Action Item Planning Groups 1, 4, and 5. 5. Review results of current supplemental enforcement program evaluation. 6. Determine strategies, policies, and procedures and implementation needs. 7. Set objectives. Define performance measures. 8. Implement new or revised strategies and programs. 9. Document outcomes.

Table 26. Strategies and Implementation Steps for Action Item 6.

Action Item 6	**Implement speed and safety reviews of sections or intersections within the HSIP (spot safety program), and coordinate with other transportation safety plans and programs (*Systematic Approach*).**
Leadership	DOT safety and mobility offices/units
Others Involved	Others: traffic engineers, law enforcement agencies, bicycle and pedestrian transportation offices (esp. for urban areas), county/city transportation agency staff
Schedule	3-5 years/longer term
Strategies ***(Systematic Approach)***	• Incorporate routine diagnosis of speeding issues into the HSIP program, Pedestrian and Bicycle safety programs, and the Alabama Roadway Departure Safety Plan implementation program. • Assess whether corridor-level speed management issues are contributing to spot safety, pedestrian, or other safety issues.
Implementation steps	1. Identify existing and needed opportunities for coordination. 2. Schedule meetings as needed or piggy-back on existing meetings 3. Identify needs including but not limited to: a. Speed studies. b. Data and project plan sharing. c. Law enforcement assistance for particular corridors or areas. d. Coordinating with the systematic approach (Action Item 4). e. Innovative strategies. f. Research/evaluation needs. 4. Set objectives. Define performance measures. 5. Implement strategies and programs. 6. Document outcomes.

4.2 Evaluation Plan

Since the goals of the Plan are to reduce fatal and injury crashes and to improve speed compliance, the primary measures of program effectiveness are safety measures:

- Changes in frequency of severe crashes.
- Changes in operating speed distributions (average speed, 85th percentile speed), and the percentage of speeders exceeding limits.

The program will be evaluated with respect to changes in crashes, especially more severe crashes, and potentially speeding-related crashes, compared with trends absent the program. Speed measurements provide earlier feedback than crash trends and are a good indicator of safety risk. See more about Safety Effectiveness Measures below.

Other measures are needed to evaluate the goal of improving speed management knowledge and practices, which helps to support the safety goals. Performance measures for this goal may be a challenge, but could include assessments of practitioner knowledge, as well as multi-stakeholder assessments of speed limits established using the new procedures. For the longer-

term, the safety performance of roads receiving speed limit reviews, road safety audits, and other new practices compared with traditional methods will be the best measure. Speed limits should not be changed in isolation from the other strategies, so additional measures may be needed to ascertain appropriate implementation.

For all strategy objectives adopted, tailored process measures may be needed to provide evidence of implementation and additional support for program effects, and to provide knowledge to help sustain and improve program efforts. These measures may include:

- The type, number and locations of trainings, numbers and dates of treatments implemented, amounts of enforcement, etc.
- Program processes instituted, policies adopted or other institutional changes implemented (all approaches).
- At a program level, changes in public attitudes toward speed limits, to enforcement, or acceptance of new types of countermeasures could be useful measures.

Table 47 in Appendix B. presents potential measures of effectiveness for various program elements to help track Plan implementation and measure safety outcomes.

Safety Effectiveness Measures. Speed measurements will be performed at baseline (before any countermeasures are implemented) and used throughout the Plan Implementation period to track progress and provide early indications of safety effects. Speed measurements may include:

- On-going speed monitoring of a representative sample of the roads covered by the Plan.
- Speed measurements, taken before and after countermeasures are implemented on specific corridors.

The timing of crash-based evaluations will depend on when and how many measures are implemented, and the availability of sufficient years and number of crashes for evaluation. Additional technical assistance is available to help determine appropriate evaluation methods to control for other trends and safety programs.

Countermeasures Evaluation. Specific countermeasures will be evaluated to provide information about effectiveness of specific measures, and how they contributed toward program outcomes. Table 48 in Appendix B provides more information on potential countermeasure evaluation.

Plan Evaluation. Near the end of the implementation period, perform an assessment of whether safety goals of the overall Plan were met. As mentioned above, while crash trends should be examined, documenting plan actions and timing of implementations, and interim measures (such as changes in operating speed) as well as crash effects of particular countermeasures are keys to providing evidence of program effects. Communicate results to decision-makers and the public, and use results to help develop ambitious targets for an updated Plan.

Some program actions will not be fully realized for a longer time period, but documenting steps and changes in policies and practices can provide support for future improvements in safety.

Consult with the FHWA technical assistance team if help is needed in developing appropriate measures of effectiveness and evaluation protocols.

4.3 Action Plan Update

This Plan will be a working document, with additional implementation actions, schedules, and other updates incorporated as needed during the five-year plan period.

At the end of five years, following plan evaluation, update the Plan incorporating lessons learned from the evaluation and implementation experiences, as well as from an updated problem assessment. Sustaining and improving the speed management program is needed to continue to achieve maximal benefits.

5 Appendix A

This Appendix contains Supplemental Material for Chapter 2; more details of analysis methods and results.

5.1 Data Used

Data for three complete years, 2010-2012, of reported crashes were obtained from the University of Alabama, Center for Advanced Public Safety (CAPS), which manages the State's "Critical Analysis and Reporting Environment" (CARE) crash and roadway data system. Roadway inventory data were also acquired in a shapefile format, from CAPS, and in an Access database format, from Alabama DOT's Office of Safety Operations. The roadway inventory data available at the time did not cover locally-owned roads, and lacked the format and sufficient descriptive attributes to be useful to perform network-wide screening. Although crashes could be mapped to State-managed roadway sections, traffic volume data and other characteristics of the roadways were unavailable in a linearly referenced format that could be linked to sections and crashes to undertake a comparative network screening. The State is currently developing a new roadway inventory database. Do to these limitations, a crash-data based screening method that can be used for all of road types was developed.

A county shapefile was also obtained from the State. County population data were obtained from the U.S. Census website to provide a proxy for travel exposure.

Statewide operating speed data were unavailable to assist with identifying characteristics of the problem.[48]

5.2 Analysis Methods

All analyses were completed using crash data to characterize the crash issues, including to identify and screen the routes the crashes occurred on.

Statewide Descriptive Analyses. Cross-tabulations were used to identify general characteristics of the speeding and severe crash problems Statewide.

Spatial Analyses. Spatial analyses in a GIS platform (ARCMAP10) were used to assess the frequency distribution of severe crashes by county as well as severe crash rates normalized by population. Annual vehicle miles traveled could also be used to provide a rate-based comparison of speeding-related crashes.

Network screening. The start of a systematic process to effectively allocate resources is to identify locations that have more than expected or a higher than average proportion of speeding-related or severe crashes for the type of road or road section. The roads or areas identified through screening may be good candidates for further assessment of speeding-

[48] AASHTO (2010).

related safety problems and treatment prioritization.[49] Since the roadway inventory data lacked essential elements and structure, the screening approach used location information available from the crash data (only). (This approach may be somewhat less accurate than network screening that makes use of crashes linked to roadway sections since officers may not always correctly indicate the characteristics of the road where the crash occurred. In addition, traffic volume data is not available in crash data, which limits the types of analyses that can be performed.)

The screening made use of the following roadway characteristics, which were reported with each crash and included in the crash database:

- Rural or urban (inside a municipality) crash location.
- Whether or not the road where the crash occurred was access controlled.
- Whether or not the road was physically divided (such as by a barrier, or paved, or grassy median).
- Number of through travel lanes (grouped into one-lane, two- or three-lanes, four- or five-lanes, or six or more through-lanes).

For the analysis, roads identified by distinct route numbers, were grouped by variations in the above characteristics. The comparisons should facilitate identification of routes with potential speeding-related crash problems that are higher than the norm for the same general types of roads.

More resources on network screening methods in general are available in *Speed Management Toolkit*.

The key measures used for screening analysis included:

- At least 5 total crashes for roads of less than 4 lanes and at least 10 total crashes for corridors of 4 or more lanes.
- Proportion of crashes that were speeding-related.
- Proportion of crashes that were severe.

In addition, a few other crash types were included in the screening results to aid in diagnosis of the type of problems. These crash types or factors included:

- Intersection crash location (number and proportion).
- Curve crash location (number and proportion).
- Road/lane departure crash type (number and proportion).
- Rear end crash type (number and proportion).
- Speeding-related in combinations with the above crash traits.

[49] AASHTO (2010).

5.3 Statewide Speeding-related Crash Descriptors

All of the tables below were produced using crash data for 2010 through 2012 for the State of Alabama. The speeding-related indicator reflects either a crash-based or a driver-based assessment of speeding, as coded in the crash data:

- Primary_contributing_circumstance in (6,7) or CU contributing circumstance [CU = contributing unit] in (6,7)
- 6 = Over the speed limit
- 7 = Driving too fast for conditions

The definitions of speeding-related *and* severe crashes are described in Chapter 1, section 9.

The descriptors used in the following tables, Table 27 through Table 36, are based on coded variables from the CARE database. Cells highlighted in yellow in each of the tables indicate factors that are over-represented for speeding or severe crashes compared to total crashes. A summary of the main findings from these tables is provided in the main text in Chapter 2.

Table 27. Rural or Urban Location and Speeding-related and Severe Crash Distributions.

Rural or Urban location	Not Speeding-related	Speeding-related	Speeding-related %	Not Severe [50]	Severe	% Severe	Total
Rural	79,021	16,686	17.4%	70,865	24,842	26.0%	95,707
Rural %	22.0%	60.9%	n/a	21.5%	43.6%	n/a	24.8%
Urban	279,909	10,720	3.7%	258,544	32,085	11.0%	290,629
Urban %	78.0%	39.1%	n/a	78.5%	56.4%	n/a	75.2%
Total	358,930	27,406	7.1%	329,409	56,927	14.7%	386,336

[50] Note that crashes of unknown severity are included with "Not Severe" in all of these tables.

Table 28. Highway Classification and Speeding-related and Severe Crash Distributions.

Highway Classification	Not Speeding-related	Speeding-related	Speeding-related %	Not Severe	Severe	Severe %	Total
Interstate	32,212	4,101	11.3%	31,078	5,235	14.4%	36,313
Interstate %	9.0%	15.0%	n/a	9.4%	9.2%	n/a	9.4%
Federal	60,379	3,174	5.0%	53,422	10,131	15.9%	63,553
Federal %	16.8%	11.6%	n/a	16.2%	17.8%	n/a	16.5%
State	67,781	3,822	5.3%	59,646	11,957	16.7%	71,603
State %	18.9%	13.9%	n/a	18.1%	21.0%	n/a	18.5%
County	51,513	11,278	18.0%	47,983	14,808	23.6%	62,791
County %	14.4%	41.2%	n/a	14.6%	26.0%	n/a	16.3%
Municipal	141,322	4,961	3.4%	131,967	14,316	9.8%	146,283
Municipal %	39.4%	18.1%	n/a	40.1%	25.1%	n/a	37.9%
Private Property and Other	5723	70	1.2%	5313	478	8.3%	5,793
Private Property and Other %	1.6%	0.3%	n/a	1.6%	0.8%	n/a	1.5%
Total	358,930	27,406	7.1%	329,409	56,927	14.7%	386,336

Table 29. Intersection Location and Speeding-related and Severe Crash Distributions.

Intersection Related	Not Speeding-related	Speeding-related	Speeding-related %	Not Severe	Severe	Severe %	Total
No, Crash Was Not Intersection Related	283,006	25,046	8.1%	262,838	45214	14.7%	308,052
	78.8%	91.4%	n/a	79.8%	79.4%	n/a	79.7%
Yes, Crash Was Intersection Related	75,924	2360	3.0%	66,571	11713	15.0%	78,284
	21.2%	8.6%	n/a	20.2%	20.6%	n/a	20.3%
Total	358,930	27,406	7.1%	329,409	56,927		386,336

Table 30. Curve and Grade and Speeding-related and Severe Crash Distributions.

Curve and Grade	Not Speeding-related	Speeding-related	Speeding-related %	Not Severe	Severe	Severe %	Total
Straight and Level	239,802	9,913	4.0%	217,426	32,289	12.9%	249,715
Straight and Level %	66.8%	36.2%	n/a	66.0%	56.7%		64.6%
Straight with Down Grade	34,805	3,357	8.8%	31,907	6,255	16.4%	38,162
Straight with Down Grade %	9.7%	12.2%	n/a	9.7%	11.0%	n/a	9.9%
Straight with Up Grade	28,069	1,783	6.0%	25,470	4,382	14.7%	29,852
Straight with Up Grade %	7.8%	6.5%	n/a	7.7%	7.7%	n/a	7.7%
Straight at Hillcrest	2,743	312	10.2%	2,424	631	20.7%	3,055
Straight at Hillcrest %	0.8%	1.1%	n/a	0.7%	1.1%	n/a	0.8%
Sag (Bottom)	119	20	14.4%	114	25	18.0%	139
Sag (Bottom)%	0.0%	0.1%		0.0%	0.0%		0.0%
Curve/Grade combinations - electronic records	31,080	11,460	26.9%	31,747	10,793	25.4%	42,540
Curve/Grade combinations - electronic records %	8.7%	41.8%	n/a	9.6%	19.0%	n/a	11.0%
Curve/Grade combinations - paper records	4,232	401	8.7%	3,942	691	14.9%	4,633
Curve/Grade combinations - paper records %	1.2%	1.5%	n/a	1.2%	1.2%	n/a	1.2%
Unknown, Missing, Not Applicable	18,080	160	0.9%	16,379	1,861	10.2%	18,240
Unknown, Missing, Not Applicable %	5.0%	0.6%	n/a	5.0%	3.3%	n/a	4.7%
Total	358,930	27,406	7.1%	329,409	56,927	14.7%	386,336

Table 31. Speeding-related and Severe Crashes by Road Surface Conditions.

Roadway Conditions	Not Speeding-related	Speeding-related	Speeding-related %	Not Severe	Severe	Severe %	Total
Dry	291,937	12,460	4.1%	25,8314	46,083	15.1%	304,397
Dry %	81.3%	45.5%		78.4%	81.0%		78.8%
Wet	47356	12,473	20.8%	51,524	8,305	13.9%	59,829
Wet %	13.2%	45.5%		15.6%	14.6%		15.5%
Ice, Snow or Slush	1678	2,001	54.4%	3055	624	17.0%	3,679
Ice, Snow or Slush %	0.5%	7.3%		0.9%	1.1%		1.0%
Other (Sand, dirt, water buildup, etc.)	419	317	43.1%	583	153	20.8%	736
Other (Sand, dirt, water buildup, etc.) %	0.1%	1.2%		0.2%	0.3%		0.2%
Unknown, Missing, Not Applicable	17540	155	0.9%	15,933	1,762	10.0%	17,695
Unknown, Missing, Not Applicable %	4.9%	0.6%		4.8%	3.1%		4.6%
Total	358,930	27,406	7.1%	329,409	56,927	14.7%	386,336

Table 32. Speeding-related and Severe Crashes by Roadway Lighting Conditions.

Lighting Conditions	Not Speeding-related	Speeding-related	Speeding-related %	Not Severe	Severe	Severe %	Total
Daylight	262,506	16,602	5.9%	241,736	37,372	13.4%	279,108
Daylight %	73.1%	60.6%	n/a	73.4%	65.6%	n/a	72.2%
Dusk	9,512	789	7.7%	8,791	1,510	14.7%	10,301
Dusk %	2.7%	2.9%	n/a	2.7%	2.7%	n/a	2.7%
Dawn	3,696	472	11.3%	3,400	768	18.4%	4,168
Dawn %	1.0%	1.7%	n/a	1.0%	1.3%	n/a	1.1%
Dark, Lighted Roadway	39,768	2,413	5.7%	36,141	6,040	14.3%	42,181
Dark, Lighted Roadway %	11.1%	8.8%	n/a	11.0%	10.6%	n/a	10.9%
Dark, Roadway Not Lighted	41,017	7,027	14.6%	37,023	11,021	22.9%	48,044
Dark, Roadway Not Lighted %	11.4%	25.6%	n/a	11.2%	19.4%	n/a	12.4%
Other/Unknown, Not Applicable/Missing	2,431	103	4.1%	2,318	216	8.5%	2,534
Other/Unknown, Not Applicable/Missing %	0.7%	0.4%	n/a	0.7%	0.4%	n/a	0.7%
Total	358,930	27,406	7.1%	329,409	56,927	14.7%	386,336

Table 33. Speeding-related and Severe Crashes by Work Zone.

Work Zone	Not Speeding -related	Speeding-related	Speeding -related %	Not Severe	Severe	Severe %	Total
In/Related to Work Zone	7,735	654	7.8%	7,239	1,150	13.7%	8,389
In/Related to Work Zone %	2.2%	2.4%		2.2%	2.0%		2.2%
Not In/Related to Work Zone	331,434	26,390	7.4%	304,249	53575	15.0%	357,824
Not In/Related to Work Zone %	92.3%	96.3%		92.4%	94.1%		92.6%
Missing/ Unknown/NA	19,761	362	1.8%	17,921	2202	10.9%	20,123
Missing/ Unknown/NA %	5.5%	1.3%		5.4%	3.9%		5.2%
Total	358,930	27,406	7.1%	329,409	56,927	14.7%	386,336

Table 34. Manner of Crash and Speeding-related or Severe Crash Indications.

Manner of Crash	Not Speeding -related	Speeding -related	Speeding-related %	Not Severe	Severe	Severe %	Total
Single Vehicle Crash (all types)	60,458	18,217	23.2%	56,918	21757	27.7%	78,675
Single Vehicle Crash (all types) %	16.8%	66.5%		17.3%	38.2%		20.4%
Head-On (front to front only)	6,252	581	8.5%	4,636	2,197	32.2%	6,833
Head-On (front to front only) %	1.7%	2.1%		1.4%	3.9%		1.8%
Angle Oncoming (frontal)	7419	327	4.2%	6,008	1738	22.4%	7,746
Angle Oncoming (frontal) %	2.1%	1.2%		1.8%	3.1%		2.0%
Angle (front to side) Same Direction	9190	287	3.0%	8,586	891		9,477
Angle (front to side) Same Direction %	2.6%	1.0%		2.6%	1.6%		2.5%
Angle (front to side) Opposite Direction	11302	358	3.1%	9,698	1962	16.8%	11,660
Angle (front to side) Opposite Direction %	3.1%	1.3%		2.9%	3.4%		3.0%
Rear End	116,523	3928	3.3%	110,377	10074	8.4%	120,451
Rear End %	32.5%	14.3%		33.5%	17.7%		31.2%
Side Impact (angled)	25,704	690	2.6%	22,956	3,438	13.0%	26,394
Side Impact (angled) %	7.2%	2.5%		7.0%	6.0%		6.8%
Side Impact (90 degrees)	30,652	504	1.6%	24,444	6,712	21.5%	31,156
Side Impact (90 degrees) %	8.5%	1.8%		7.4%	11.8%		8.1%
Sideswipe - Same	22,450	487	2.1%	21,761	1,176	5.1%	22,937
Sideswipe - Same %	6.3%	1.8%		6.6%	2.1%		5.9%
Sideswipe - Opposite	5,185	255	4.7%	4,897	543	10.0%	5,440
Sideswipe - Opposite %	1.4%	0.9%		1.5%	1.0%		1.4%
Backing	7,136	6	0.1%	7,043	99	1.4%	7,142
Backing %	2.0%	0.0%		2.1%	0.2%		1.8%
Non-collision, Other /Unknown &Missing	56,659	1766	3.0%	52,085	6,340	10.9%	58,425
Non-collision, Other /Unknown & Missing %	15.8%	6.4%		15.8%	11.1%		15.1%
Total	358,930	27,406	7.1%	329,409	56,927	14.7%	386,336

Table 35. Alcohol Involvement and Speeding-related or Severe Crash Indications.

Officer Opinion Alcohol	Not Speeding-related	Speeding-related	Speeding-related %	Not Severe	Severe	Severe %	Total
Alcohol or both alcohol and drugs	14,803	2,155	12.7%	11,080	5,878	34.7%	16,958
Alcohol or both alcohol and drugs %	4.1%	7.9%		3.4%	10.3%		4.4%
Driver Was Not Under Influence of Alcohol	294,710	22,302	7.0%	272,995	44,017	13.9%	317,012
Driver Was Not Under Influence of Alcohol %	0.4%	81.4%		82.9%	77.4%		82.1%
Unknown/Not Applicable/Missing	49,417	2,949	5.6%	45,334	7,032	13.4%	52,366
Unknown/Not Applicable/Missing %	13.7%	10.8%		13.8%	12.3%		13.6%
Total	358,930	27,406	7.1%	329,409	56,906	14.7%	386,336

Table 36. Driver Age Group (critical unit) and Speeding-related or Severe Crash indications.

Critical Unit Drivers' Age Group	Not Speeding-related	Speeding-related	Speeding-related %	Not Severe	Severe	Severe %	Total
< 15	301	43	12.5%	237	62	18.0%	344
< 15 %	0.1%	0.2%		0.1%	0.1%		0.1%
15-16	10,512	1,559	12.9%	10,088	1,983	16.4%	12,071
15-16 %	2.9%	5.7%		3.1%	3.5%		3.1%
17-19	36,152	4648	11.4%	34,573	6,227	15.3%	40,800
17-19 %	10.1%	17.0%		10.5%	10.9%		10.6%
20-24	50,711	5,399	9.6%	47,656	8,454	15.1%	56,110
20-24 %	14.1%	19.7%		14.5%	14.9%		14.5%
25-34	66,716	5,993	8.2%	61,360	11,349	15.6%	72,709
25-34	18.6%	21.9%		18.6%	19.9%		18.8%
35-44	49,472	3,615	6.8%	44,955	8132	15.3%	53,087
35-44 %	13.8%	13.2%		13.6%	14.3%		13.7%
45-54	44,294	2,690	6.3%	39,790	7,194	15.3%	46,984
45-54	12.3%	9.8%		12.1%	12.6%		12.2%
55-64	33,294	1,393	4.0%	29,691	4,996	14.4%	34,687
55-64	9.3%	5.1%		9.0%	8.8%		9.0%
65+	38,050	837	2.2%	33,513	5374	13.8%	38,887
65+	10.6%	3.1%		10.2%	9.4%		10.1%
CU Not a Vehicle	1,271	0	0.0%	315	956	75.2%	1,271
CU Not a Vehicle %	0.4%	0.0%		0.1%	1.7%		0.3%
Unknown/missing /null	28,157	1,229	4.2%	27,231	2,155	7.3%	29,386
Unknown/missing /null %	7.8%	4.5%		8.3%	3.8%		7.6%
Total	358,930	27,406	7.1%	329,409	56,927	14.7%	386,336

5.4 Network Screening using Crash Data

There are many ways to screen a network to identify corridors or sections that may need safety treatment. The more advanced methods make use of safety performance functions and the empirical Bayes method in order to identify segments. These advanced methods are intended to address potential bias due to regression to the mean (RTM). To use such methods, there is a need for traffic volume data for all segments in the network as well as other roadway characteristics. For this Plan, the screening approach used crash data since roadway inventory data lack traffic volume, and other characteristics needed in a format that could be linked to crashes.

5.4.1 Establish Focus

This step identified the intended outcome of the network screening. In our context, the intent is to identify locations with a high number or excess of speeding or speed-involved crashes that

could benefit from different types of treatments. The definitions used for screening focus in this Plan include:

- **Speeding-related** crashes include those where exceeding a safe speed for conditions and/or exceeding limits were indicated. The definitions included were:
    - Primary contributing circumstance (crash variable) = over the speed limit (value 6) or driving too fast for conditions (value 7 in data provided by CAPS), ***or***
    - Contributing unit contributing circumstance (variable) = over the speed limit (value 6) or driving too fast for conditions (value 7 in database).
- **Severe** crashes (includes fatal, disabling injury, and evident injury crash types). An excess of severe crashes may indicate a mismatch between operating speeds and roadway and environmental characteristics (land use, etc.), suggesting problems with speed limits or other potentially treatable problems.

In addition, indicators for several other types of crashes or crash location description were created and included with screening results. These indicators were intended to provide assistance with further diagnosing the potential problems on individual corridors. These indicators included:

- **Lane /road departure crash type** indicator, if any of the following were true:
    - First Harmful Event (crash) = E Ran Off Road Right, E Ran Off Road Straight, E Ran off Road Left, E Crossed Centerline/Median, Collision with Bridge Abutment/Rail, Collision with Bridge Support/Column, Collision with Overhead Object/Bridge/Tr, Collision with Culvert Headwall, Collision with Ditch, E Collision with Embankment, E Collision with Curb/Island/Raised Median, E Collision with Guardrail Face, E Collision with Guardrail End, E Collision with Concrete Barrier, E Collision with Cable Barrier, E Collision with Other Traffic Barrier, Collision with Tree, Collision with Utility Pole, Collision with Light Pole (Breakaway), Collision with Light Pole (Non-Breakaway), Collision with Traffic Signal Pole, Collision with Sign Post, E Collision with Other Post/Pole/Support, Collision with Fence, Collision with Mailbox, E Collision with Impact Attenuator, Collision with Other Fixed Object, E Crossed Centerline, E Crossed Median; ***or***
    - Primary Contributing Circumstance = E Crossed Centerline, E Crossed Median, E Ran off Road; ***or***
    - Contributing Unit Contributing Circumstance = E Crossed Centerline, E Crossed Median, E Ran off Road; ***or***
    - E Most Harmful Event = Ran Off Road Right, Ran Off Road Straight, Ran off Road Left, Crossed Centerline/Median, Collision with Bridge Abutment/Rail, Collision with Bridge Support/Column, Collision with Overhead Object/Bridge/Tr, Collision with Culvert Headwall, Collision with Ditch, Collision with Embankment, Collision with Curb/Island/Raised median, Collision with Guardrail Face, Collision with Guardrail End, Collision with Concrete Barrier, Collision with Cable Barrier, Collision with Other Traffic

Barrier, Collision with Tree, Collision with Utility Pole, Collision with Light Pole (Breakaway), Collision with Light Pole (Non-Breakaway), Collision with Traffic Signal Pole, Collision with Sign Post, Collision with Other Post/Pole/Support, Collision with Fence, Collision with Mailbox, Collision with Impact Attenuator, Collision with Other Fixed Object, Crossed Centerline, Crossed Median.

- **Rear-end crash type** indicator, if the following were true:
  - E Manner of Crash = Rear End (front to rear).
- **Curve location** indicator, if any of the following were true:
  - Contributing Unit Roadway Curvature and Grade = E Curve Left and Level, E Curve Left and Down Grade, E Curve Left and Up Grade, E Curve Left at Hillcrest, E curve Right and level, E Curve Right and Down Grade, E Curve Right and Up Grade, E Curve Right at Hillcrest, P Curve and Level, P Curve with Down Grade, P Curve with Up Grade, P Curve at Hillcrest; or
  - Contributing Unit Vehicle Maneuvers = Negotiating a Curve.
- **Intersection/interchange-related crash** indicator, if any of the following were true:
  - Contributing Unit First Harmful Event Location = E Intersection with Crosswalk and Pedestrian Signal, E Intersection with Crosswalk and No Pedestrian Signal, At Intersection No Crosswalk, or P Intersection; ***or***
  - E Type of Roadway Junction/Feature = On Segment but Intersection Related, Four-Way Intersection, T-Intersection, Y-Intersection, Five-Leg or More, offset Four-Way Intersection, Intersection with Ramp, At Intersection-Related, Traffic Circle, Roundabout, On Ramp Merge Area, Off Ramp Merge Area, Off Ramp Diverge Area, Other Intersection, Unknown Interchange, Unknown Junction.
  - Location of First Harmful Event (relative to the roadway) = E Intersection with Crosswalk and Pedestrian Signal, E Intersection with Crosswalk and No Pedestrian Signal, At Intersection No Crosswalk, or P Intersection.

5.4.2 Identify Network and Establish Reference Populations

Sites were divided as follows:

- Routes were identified by their route number IDs and by sections with uniform characteristics. (As long as cross-sectional characteristics used and rural/urban location did not change, sections were continued through intersections or interchanges.)
- In the Alabama crash data, each crash is identified to a unique route ID. Each route ID is confined to a single city or county if it is a city or county route. Higher order State, federal, and Interstate routes may, however, cross jurisdictional (county or municipal) boundaries. For this screening effort, crashes on State, federal, and Interstate corridors were divided into separate urban and rural categories, but were not divided by county. Ideally, crashes on routes grouped by the above

characteristics will have similar traffic volumes and generally similar features. However, crashes on non-contiguous segments may be grouped together on one route. For example, crashes on the rural segments of a U.S. highway that passes from a rural area into a town and continues on the other side of the town will be grouped together on the same "corridor" as long as the crash data did not indicate changes in the route number, the number of lanes, access control, or divided/undivided values. There were initially 64 different road type combinations available for screening. However, not all of the combinations that appeared in the crash data are feasible combinations, reflecting potential errors in the data.

5.4.3 Select Performance Measures

The performance measures used were:

- Proportion of speeding-related and proportion of severe crashes.
- Other crash types were included in the tables of results for assistance in further diagnosing the problems for each route.

5.4.4 Select Screening Method

The *Highway Safety Manual* indicates that corridors are recommended to be approximately 5-10 miles long to provide more stable results. This method may be the only option for roads that do not have mileposts; hence, it is not possible to precisely locate a crash without reviewing individual crash reports. Although the Alabama data could be located on the road network through GIS-based spatial coding, the network inventory itself had no indications of roadway characteristics or traffic volume. Therefore, roadways of different characteristics were screened for speeding-related crash problems using route identifiers associated with each crash within the crash database. Route lengths and traffic volumes are still unknown, however, since crash data used for screening contain no indications of corridor length of traffic volume. In consultation with ALDOT, minimum crash thresholds were established of at least five crashes for roads of less than four lanes and at least ten crashes for roads of four or more lanes.

Each route was first uniquely defined by the following variable:

- NC005_Street Code variable.

Below are the attributes that would divide routes and an individual route into different "road types" based on variables available in the crash data:

- Var. name: Rural_or_Urban – two levels:
  - Rural.
  - Urban.
- Var. name: Controlled_Access – four levels:
  - Main (includes main road at interchange).
  - Not access-controlled.
  - Frontage.

  - Ramp (on- or off-ramp).
- Var name: CU_Opposing_Lane_Separation – two levels:
  - Divided or "Separated" =
    - Paved surface.
    - Unpaved surface.
    - Concrete barrier.
    - Metal guard rail.
    - E cable barrier.
    - Fence.
- Undivided or Not Separated =
  - None.
  - Broken painted line.
  - Solid painted lines.
- Not used in screening) "Unknown if Separated" =
  - Other.
  - Unknown.
  - Not applicable.
  - CU is unknown.
- Var.: CU_Trafficway_Lanes = four levels:
  - 1.
  - 2-3.
  - 4-5.
  - 6+ number of through-lanes.

Routes with the same sets of characteristics were combined for screening using the methods and ranking procedures described in Chapter 2.

5.4.5 Screen and Evaluate Results

The results of the screening process are lists of sites/corridors ordered based on the selected performance measures. Those high on the list may need further review and diagnosis to determine if they will benefit from specific treatments. Diagnosis will be discussed in the following sections.

5.5 Results of Network Screening

There were initially 64 different road type combinations available for screening. A matrix showing the overview of these results is provided separately to ALDOT. Not all of the combinations that appeared in the crash data are feasible combinations, however, reflecting potential errors in the crash data coding of the variables used to distinguish different types of routes for screening. Thus, the actual configuration of some of the numbered routes could not be ascertained. The final prioritized lists considered the numbers and proportions of severe and speeding-related crashes on each set of feasible road types. The following tables are summaries from the lists of routes ranked according to the performance measures noted. The results are based on routes with uniform characteristics as defined in the crash data, again, however, there

is no way to know whether these sections are defined accurately, or whether they are contiguous. They may be separated by sections of routes with the same route identification number, but that have different characteristics.

The detailed lists containing the ranked routes resulting from screening were provided separately to ALDOT. Different ranking procedures, as well as different thresholds for prioritization, may be applied to the lists to finalize the target population of routes. Crash reduction targets may be adjusted accordingly.

Each table (Table 37 through Table 45) shows the number of priority routes in the ranked subset, the total crashes for all of the priority routes, the speeding-related crashes, severe crashes, fatal crashes, crashes that occurred at or related to an intersection (or interchange area), lane/roadway departure crashes, rear-end crashes, or the crash occurred at a curve location. In addition, some of the tables show the number of crashes that were both speeding-related and lane-departure type. The percentages below the number of crashes are the proportion of the total crashes of that type (column total), whereas the speeding-related percent or severe percent are the percentage of the total crashes on that set of routes that were speeding-related or severe. Similar percentages can be calculated for the other crash types by divided the number for that type by total crashes, but are not shown because of space limitations.

5.5.1 Rural, Non-freeway Routes

There were 2,759 rural, two- and three-lane roads with at least one crash. Of these, 1,046 had at least five crashes, the minimum threshold. Following the screening process, a subset of 99 routes had at least five crashes and were in the top 25th percentile of routes for both speeding-related proportion to total crashes and severe proportion to total crashes.

Table 37. Rural, 2-3 Lane, Undivided, Not Access Controlled. Routes with at Least Five Crashes, and in Top 25th Percentile for Proportions of Both Speeding-related and Severe Crashes.

Rural, 2-3 Lanes, Undivided	No. of Routes	Total	Speed.-rel.	Avg. Spd.-rel. %	Severe	Avg. Severe %	Fatal	Intrsec.	Lane Depart.	Ln Dep. and Spd-rel.	Rear-end	Curve Location
Subset identified through screening	99	2,898	1,081	37.3%	1,186	40.9%	55	283	1,873	885	164	1,346
	--	0.8%	4.0%	n/a	2.2%	n/a	2.3%	--	--	--	--	--
All roads of this type > 0 crashes	2,759	62,502	12,423	19.9%	18,164	33.4%	1,044	9,757	29,454	9,577	10,177	18,281
	--	--	41.8%	n/a	33.4%	n/a	43.1%	--	--	--	--	--
Totals for all routes	--	360,272	26,969	7.5%	54,335	15.1%	2,424	--	--	--	--	--

Note: Forty-seven routes were in the top 10 percent for severity, compared with the 99 routes based on those that were in the top 25 percent for both severity and speeding. The number of severe crashes targeted would be somewhat higher for the smaller group of routes, but the number of speeding-related would be significantly lower if the priority ranking were based on the top 10 percent for severity only.

There were 211 rural, four- to five-lane, undivided road sections with at least one reported crash; a subset of 47 routes had at least 10 crashes. Following the screening process, five road sections were in the top 25th percentile for both speeding-related and severe crash proportions.

Table 38. Rural, 4-5 Lanes, Undivided, Not Access-Controlled. Routes with at Least 10 Crashes, and in the Top 25th Percentile for Proportions of Both Speeding-related and Severe Crashes.

Rural, 4-5 Lanes, Undivided	No. of Routes	Total	Speed.-rel.	Avg. Spd.-rel. %	Severe	Avg. Severe %	Fatal	Intrsec.	Lane Depart.	Ln Dep. & Spd-rel.	Rear End	Curve location
Subset identified through screening	5	188	38	20.2%	65	34.6%	9	29	65	26	35	22
Subset identified through screening %	--	0.05%	0.14%	n/a	0.12%	n/a	0.37%	--	--	--	--	--
All roads of this type > 0 crashes	211	2,718	208	7.7%	557	20.5%	31	592	457	111	860	211
All roads of this type > 0 crashes %	--	0.75%	0.77%	n/a	1.0%	n/a	1.28%	--	--	--	--	--
Total for all routes	--	360,272	26,969		54,335		2,424	--	--	--	--	--

There were 201 rural, four- to five-lane, divided, but not access-controlled road sections with this group of characteristics with at least one reported crash; a subset of 54 routes had at least 10 crashes, the minimum threshold. Eight road sections were in the top 25th percentile for both speeding-related and severe crash proportions.

Table 39. Rural, 4-5 Lane, Divided, Not Access-Controlled. Routes with at Least 10 Crashes, and in the Top 25th Percentile for Proportions of Both Speeding-related and Severe Crashes.

Rural, 4-5 Lane, Divided	No. of Routes	Total	Speed.-related	Avg. Spd.-rel %	Severe	Avg. Severe %	Fatal	Intrsec.	Lane Depart.	Ln Dep. & Spd-rel.	Rear-end Crash	Curve Location
Subset identified through screening	8	1,062	185	17.4%	323	30.4%	20	115	420	126	280	162
	--	0.3%	0.7%	n/a	0.6%	n/a	0.8%	--	--	--	--	--
All roads of this type with > 0 crash	201	9,249	1,104	11.9%	2,223	24.0%	125	1,474	2,730	749	2,474	831
	--	0.03	4.1%	n/a	4%	n/a	5.2%	--	--	--	--	--
Total for all routes	--	360,272	26,969	n/a	54,335	n/a	2,424	--	--	--	--	--

5.5.2 Rural, Access-controlled Freeways

There were 69 rural, four- to five-lane, divided, and access-controlled routes with at least one reported crash; a subset of 15 routes had at least 10 total crashes. Following the screening process, two road sections, one Interstate and one State route were in the top 25th percentile for both speeding-related and severe crash proportions.

Table 40. Rural, 4-5 Lane, Divided and Access-controlled Priority Routes. Routes with at Least 10 Crashes and in Top 25 Percentile for Proportions of Both Speeding-related and Severe Crashes.

Rural, 4-5 Lane, Divided and Access-controlled	No. of Routes	Total	Spd-rel.	Avg. Spd-Rel. %	Severe	Avg. Severe %	Fatal	Inter-change/ Intrsec.	Lane Depart.	Ln-dep. and Spd.-Rel.	Rear-end	Curve Location
Subset identified through screening	2	2,288	400	17.5%	567	24.8%	38	20	1,076	317	439	165
	--	0.6%	1.5%	n/a	1.0%	n/a	1.6%	--	--	--	--	--
All roads of this type > 0 crashes	69	9,534	1,405	14.7%	1,901	19.9%	118	127	4,099	981	2,061	643
	--	2.6%	5.2%	n/a	3.5%	n/a	4.9%	--	--	--	--	--
Total for all routes	--	360,272	26,969	7.5%	54,335	15.1%	2,424	--	--	--	--	--

5.5.3 Urban, Non-freeway Routes

Undivided, 2- and 3-Lane Routes. There were 5,164 urban, two- and three- lane routes with at least one reported crash; a subset of 2,288 routes had at least five crashes, the minimum threshold. Following the screening process, 256 routes were in the top 25th percentile for both speeding-related and severe crash proportions.

Table 41. Urban, 2-3 Lane, Undivided, Not Access-Controlled. Routes with at Least 5 Crashes, and in Top 25th Percentile for Proportions of Both Speeding-related and Severe Crashes.

Urban, 2-3 Lane, Undivided	No. of Routes	Total	Spd-Rel.	Avg. Spd-Rel. %	Severe	Avg. Severe %	Fatal	Intrsec.	Lane Depart.	Rear-End	Curve Location
Subset identified through screening	256	5,304	782	14.7%	1241	23.4%	60	1184	2216	1221	1467
Subset identified through screening %	--	1.5%	2.9%	n/a	2.3%	n/a	2.5%	--	--	--	--
All roads of this type > 0 crashes	5,164	92,339	4,114	4.5%	10,904	11.8%	389	--	--	--	--
All roads of this type > 0 crashes %	--	25.6%	15.3%	n/a	20.1%	n/a	16.0%	--	--	--	--
Total for all routes	--	360,272	26,969	7.5%	54,335	15.1%	2,424	--	--	--	--

Urban, Undivided, 4- and 5-Lane Routes. There were 1,553 urban, undivided, four- and five-lane routes with at least one reported crash; a subset of 414 routes had at least 10 crashes. Following the screening process, 29 routes were in the top 25th percentile for each of speeding-related and severe crash proportions and may be good candidates for further diagnosis and potential treatment.

Table 42. Urban, Undivided, 4-5 Lane, Routes. Routes with at Least 10 crashes, and in Top 25th Percentile for Proportions of Both Speeding-related and Severe Crashes.

Urban, Undivided, 4-5 Lane	No. of Routes*	Total	Spd-Rel.	Avg. Spd-Rel. %	Severe	Avg. Severe %	Fatal	Intrsec.	Lane Depart.	Rear-End	Curve Location
Subset identified through screening	29	2,143	123	5.7%	357	16.7%	13	567	274	774	130
Subset identified through screening %	--	0.6%	0.5%	n/a	0.7%	n/a	--	--	--	--	--
All roads of this type > 0 crashes	1,553	43,085	977	2.3%	4,480	10.4%	119	13,139	2,869	16,820	2,461
All roads of this type > 0 crashes %	--	12.0%	3.6%	n/a	8.2%	n/a	--	--	--	--	--
Total for all routes	--	360,272	26,969	7.5%	54,335	15.1%	2,424	--	--	--	--

*Initially, an Interstate highway was identified in the priority subset. The Interstate was assumed to be in the group due to errors in the data and was replaced.

Urban, Divided, 4- and 5-Lane Routes. There were 1,023 urban, divided, but not access-controlled routes and at least one reported crash; a subset of 240 routes had at least 10 crashes. Twenty-two routes were in the top 25th percentile for both speeding-related and severe crash proportions.

Table 43. Urban, 4-5 Lane, Divided, but Not Access-Controlled. Routes with at Least 10 Total Crashes, and in Top 25th Percentile for Both Speeding-related and Severe Crashes.

Urban, Divided, 4-5 Lanes	No. of Routes	Total	Spd-Rel	Avg. Spd-Rel %	Severe	Avg. Severe %	Fatal	Inter-Change/ Intrsec.	Lane Depart.	Rear-End	Curve Location
Subset identified through screening	22	580	54	9.3%	129	22.2%	7	108	129	151	47
Subset identified through screening %	--	0.2%	0.2%	n/a	0.2%	n/a	0.3%	--	--	--	--
All roads of this type > 0 crashes	1,023	37,361	1,144	3.1%	4,501	12.0%	144	10,617	3,208	18,799	2,261
All roads of this type > 0 crashes %	--	10.4%	4.2%	n/a	8.3%	n/a	5.9%	--	--	--	--
Total for all routes	--	360,272	26,969	7.5%	54,335	15.1%	2,424	--	--	--	--

5.5.4 Urban, Access-controlled Routes

4- and 5-Lane Access-controlled Urban Routes. There were 551 route sections with this group of characteristics with at least one reported crash; a subset of 87 routes had at least 10 crashes. Following the screening and ranking process, six routes were in the top 25th percentile for each of speeding-related and severe crash proportions and may be good candidates for further diagnosis and potential treatment.

Table 44. Urban, Access-controlled, 4-5 Lane. Roads with at Least 10 Crashes, and in the Top 25th Percentile for Both Speeding-related and Severe Crashes.

Urban, Access-Contrl, 4-5 Lanes	No. of Routes*	Total	Spd-Rel.	Avg. Spd-Rel %	Severe	Avg. Severe %	Fatal	Inter-Change/ Intrsec.	Lane Depart.	Rear-End	Curve Location
Subset identified through screening	6	871	84	9.6%	171	19.6%	15	45	320	250	62
Subset identified through screening %	--	0.2%	0.3%	n/a	0.3%	n/a	0.6%	--	--	--	--
All roads of this type > 0 crashes	549	10,207	624	6.1%	1,290	12.6%	61	1,442	2,259	4,039	739
All roads of this type > 0 crashes %	--	2.8%	2.3%	n/a	2.4%	n/a	--	--	--	--	--
Total for all routes	--	360,272	26,969	7.5%	54,335	15.1%	2,424	--	--	--	--

6+ Lanes Access-controlled Routes. There were 201 route sections with this group of characteristics with at least one reported crash; a subset of 38 routes had at least 10 crashes. Following the screening and ranking process, four Interstate routes (and one unknown route) were in the top 25th percentile for each of speeding-related and severe crash proportions.

Table 45. Urban, Access-controlled, 6+ lanes. Roads with at Least 10 Crashes, and in the Top 25th Percentile for Both Speeding-related and Severe Crashes.

Urban, Access-controlled, 6+ lanes	No. of Routes	Total	Spd-Rel	Avg. Spd-Rel %	Severe	Avg. Severe %	Fatal	Inter-Change/ Intrsec.	Lane Depart.	Rear-End	Curve Location
Subset identified through screening	5	1,021	143	14.0%	188	18.4%	12	51	346	311	71
Subset identified through screening %	--	0.3%	0.5%	n/a	0.3%	n/a	0.5%	--	--	--	--
All roads of this type > 0 crashes	201	8,751	592	6.8%	1,081	12.4%	123	906	1,696	3,162	733
All roads of this type > 0 crashes %	--	2.4%	2.2%	n/a	2.0%	n/a	5.1%	--	--	--	--
Total for all routes	--	360,272	26,969	7.5%	54,335	15.1%	2,424	--	--	--	--

5.6 Diagnosis

The intent of diagnosis is the identification of the causes of collisions and other treatable safety issues.

Steps in Diagnosis (from the HSM):

Step 1 – Assess Crash Patterns

This step includes descriptive statistics of crash conditions including counts by crash type, severity, and roadway/environmental conditions. It also includes the examination of collision patterns by location.

Step 2 – Assess Supporting Documentation

This goal of this step is to obtain and review documented information or input from local transportation professionals that provides additional perspective to the crash data review described in the previous step. The documentation reviewed may include traffic volumes for the study years, as-built plans, design criteria, maintenance logs, adverse weather conditions, and records of public comments and concerns.

Step 3 – Assess Field Conditions

This step will involve a review of roadway as well as traffic and other roadway user conditions including speed limits and operating speeds.

Most importantly, there will be a need to collect data on traffic speeds and to conduct an assessment of posted speed limits. The pending *Alabama Speed Management Manual* will outline procedures. USLIMITS2 could be used to provide an additional quality check. USLIMITS2 provides a recommendation for speed limits for speed zones based on information about operating speed (85^{th} and 50^{th} percentile speed), site characteristics (the list of site characteristics depend on the type of facility; i.e., freeway, roads in undeveloped areas, and roads in developed areas) but may not be suitable for all situations. Crash information is also used when available. If, for a particular section, the rate of crashes (both total, and injury and fatal) are higher than the average for similar sections, the system asks the user to conduct an investigation to determine whether the crash and injury rates could be reduced by engineering countermeasures. Depending on the user's response, the system recommends a speed limit for the speed zone. USLIMTS2 can be accessed at the following website being maintained by the Federal Highway Administration: http://safety.fhwa.dot.gov/uslimits/.

Information on other speed limit setting approaches is provided in *Methods and Practices for Setting Speed Limits: An Informational Report,* sponsored by ITE and FHWA, accessible at: http://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwasa12004/.

Step 4 – Determine Recommendations

Are changes needed to the roadway, to enforcement and/or publicity, to speed limits, or some combination?

Changing limits if needed. Most States establish some speed limits by default through statutory limits. These limits are typically established and changed by legislative action. Limits on road sections may typically be changed through speed limit and engineering studies and posting of zoned limits on sections of such roads. Sometimes concurrent local and State agreements or ordinances may also be needed to post different than statutory limits on various types of roads.

6 Appendix B.

This Appendix contains supplemental information for Chapter 4.

6.1 Cost-benefit Performance Measures for Evaluations

Table 46 provides an example of an economic analysis, using expected crash reduction effects of road diets that would be used to assess feasible countermeasure alternatives to help in countermeasure prioritization.

Table 46. Example Cost-benefit analysis of Road Diet Implementations.

Crash Injury Severity	Expected Crashes with No Treatment	Exp. Crash Reds	Exp. Five Yr. Crash Savings	Avg. Monetary Costs per Crash	Exp. 5-yr Crash Cost Savings	Countermeasure Costs	Estimated Crash Costs Saved
All	190	19% (low est.)	36	$15,000	$540,000	Minimal – if through resurfacing*	$540,000 low range
Severe K A B	2 2 11 14	47% (high est.)	0.9 0.9 5.1	$1,600,000 $85,000 $32,000	$1,504,000 79,900 165,440 $1,749,340	Minimal – if through resurfacing	$1,749,340 high range (not including PDO crashes)
***Assuming corridors with indicated number of crashes can be treated, with low range and high-range estimates of effect.[51] Other improvements such as medians or refuge islands could further reduce crashes, but would add to costs. Note that a longer useful life may suggest using a longer time period for estimating crash benefits and costs.**							

6.2 Potential Process and Performance Measures

Table 47 outlines documentation to track Plan implementation and performance outcomes, as well as implantation issues and resolution.

[51] CMF estimates from Crash Reduction Factors for Traffic Engineering and ITS Improvements", NCHRP Project 17-25 Final Report, Washington, D.C., National Cooperative Highway Research Program, Transportation Research Board, (2008)Delineation." Report No. FHWA-HRT-09-045, Federal Highway Administration, Washington, D.C., (2009).

Table 47. Example Program Actions Evaluation Matrix.

Program Elements	Intermediate Process or Outputs Measures	Safety Performance Measures	Barriers to Implementation Issues and Resolution
Proactive process: e.g. Coordinate among stakeholder agencies, including comprehensive land use and transportation planning stakeholders to set appropriate speed limits on urban roads that will be/are managed by the State.	▪ Processes and policies put in place. ▪ Design practices /guidelines updated. ▪ Number of in-process and new plans for which speed limits are determined early in the planning process. ▪ Number of new projects with speed and safety reviews at key stages. ▪ Changes / potential crash savings made as a result of speed limit and safety review of new projects.	**Shorter term** ▪ Driver speeding or speed compliance on roads implemented (compared with other similar roads that did not go through the process). ▪ Other road user measures of satisfaction (safety perception, level or quality of service, etc.). **Longer term** Improvements in stakeholder perceptions of consistency between road designs and speed limits.	e.g. Change to existing practice or policy.
Systematic Process measures: **e.g. review existing speed limits and conduct roadway safety assessments for prioritized lists of corridors.**	▪ Organizational structure, screening or other procedures developed or enhanced. ▪ Integration with existing programs. ▪ Number of corridors with speed and safety assessments. ▪ Number and proportion of locations warranting changed limits that were changed. ▪ Number and proportion of locations identified for safety improvements that had treatments (engineering or enforcement).	**Shorter Term** ▪ Operating speed measures. **Longer Term** ▪ Crash effects.	e.g. Time, staffing limitations.

Program Elements	Intermediate Process or Outputs Measures	Safety Performance Measures	Barriers to Implementation Issues and Resolution
	implemented.		
Comprehensive process: Frame the injury prevention problem; improve public acceptance of speed management measures	▪ Public and policy-maker attitudes to speeding and/or speeding countermeasures. ▪ New legislation or policy change. ▪ Additional partners and supporting efforts.	**Longer Term** Crash effects.	e.g. State laws prohibiting use of effective technologies; Lack of public support.

Table 48 describes potential evaluation measures of specific countermeasures. Evaluation of specific countermeasures will important to providing estimates of overall program effects. While long-term speeding-related crash trends should be monitored for program effects, evaluating countermeasures provides additional support for program effects as well as local estimates of countermeasure effectiveness. However, sufficient years of crash data and perhaps multiple sites are required for robust evaluation. Overall program effects may need to be summed based on estimates of program components/individual countermeasures.

If average or other operating speed measures are used, it will also be easier to attribute crash outcomes to action plan effects.

Table 48. Example Countermeasure Safety Evaluation Matrix.

Countermeasure	Short-term Measures	Longer-term measures	Crash Cost Outcome
Speed and crash-lowering countermeasures (e.g., road diet).	▪ Before and after speed measurements at target and comparison sites (Identify similar untreated control/ reference locations).	▪ Follow-up speed measurements over time. ▪ Crash-based evaluation (at least three years after crash data).	▪ Crash cost savings over useful life compared with countermeasure cost.
Other countermeasures (e.g., signal upgrade, change in phasing).	▪ Other safety surrogate measures (e.g., compliance, conflicts). ▪ (Identify control/reference sites for crash evaluation.)	▪ Crash-based evaluation (at least three years after crash data). *May be difficult to evaluate treatments implemented at only a few locations.	▪ Crash cost savings over useful life compared with countermeasure cost,
Targeted enforcement.	▪ Percentage of drivers complying with limit at target and comparison sites. ▪ Number of citations and time spent enforcing at target and comparison sites (process measures).	▪ Percentage of drivers complying with limit. ▪ Change in frequency or severity of crashes (if sufficient years, sites available).	▪ Crash cost savings.

For More Information:

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

FHWA, Office of Safety

Guan Xu
gxu@dot.gov

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