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Report No. UT-22.17

AN EVALUATION OF THE SAFE SPEED LIMIT SETTING PROCEDURE AND TOOL FOR UTAH

Prepared For:

Utah Department of Transportation
Research & Innovation Division

Final Report
August 2022

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ACKNOWLEDGMENTS

The authors acknowledge the Utah Department of Transportation (UDOT) for funding this research, and the following individuals from UDOT on the Technical Advisory Committee for helping to guide the research:

- Vincent Liu, UDOT Research & Innovation
- David Stevens, UDOT Research & Innovation
- Adam Lough, UDOT Traffic & Safety
- Jeff Lewis, UDOT Traffic & Safety
- Robert Miles, UDOT Traffic & Safety
- Doug Bassett, UDOT Region 3 Traffic
- Anne Ogden, UDOT Region 4 Traffic
- Jeremy Searle, WCG

TECHNICAL REPORT ABSTRACT

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UT- 22.17	N/A	N/A

4. Title and Subtitle AN EVALUATION OF THE SAFE SPEED LIMIT SETTING PROCEDURE AND TOOL FOR UTAH	5. Report Date August 2022 6. Performing Organization Code R0402368
7. Author(s) Grant G. Schultz, Ph.D., P.E., PTOE; Cory K. Ward; Shannon Andersen	8. Performing Organization Report No.
9. Performing Organization Name and Address Brigham Young University Department of Civil and Construction Engineering 430 Engineering Building Provo, UT 84602	10. Work Unit No. 5H088 46H 11. Contract or Grant No. 21-9058
12. Sponsoring Agency Name and Address Utah Department of Transportation 4501 South 2700 West P.O. Box 148410 Salt Lake City, UT 84114-8410	13. Type of Report & Period Covered Final Report May 2021 to August 2022 14. Sponsoring Agency Code PIC UT19.324

15. Supplementary Notes

Prepared in cooperation with the Utah Department of Transportation and the U.S. Department of Transportation, Federal Highway Administration

16. Abstract

The purpose of the research project is to evaluate the Speed Limit Setting Procedure (SLS-Procedure) found in National Cooperative Highway Research Program (NCHRP) Project 17-76 for implementation on Utah roadways with the goal of aiding the agency in overall road safety surrounding speed limits. The Speed Limit Setting Tool (SLS-Tool) automates the SLS-Procedure and displays the process in a transparent way. The Procedure and Tool emphasize the importance of context by classifying roadway segments into one of four Speed Limit Setting Groups (SLSGs). The research team analyzed 29 locations that were divided into 66 uniform segments that could be individually analyzed with the SLS-Tool. Then, the suggested speed limits that resulted from the SLS-Tool were compared to the recommendations presented in the UDOT speed studies. Using the SLS-Tool, the closest 85th percentile speed was only suggested in 18 percent of segments, rounded-down 85th percentile speed was suggested for 21 percent of segments, and the closest 50th percentile was used in 54 percent of the segment suggestions. When compared to the UDOT speed study, 62 percent of the segments shared the same result as the SLS-Tool suggestion, 23 percent were a lower suggestion, and 15 percent were a higher suggestion. A high crash rate and the lack of bike lanes on urban streets were the most common reasons for a closest 50th percentile speed suggestion. The research team recommends that UDOT use the SLS-Procedure and SLS-Tool as a reference when performing future speed studies. The use of these resources can aid an analyst in complying with the Utah guidelines on when to depart from a traditional 85th percentile speed.

17. Key Words	18. Distribution Statement	23. Registrant's Seal
Speed limit, Speed Limit Setting Procedure, SLS-Procedure, Speed Limit Setting Tool, SLS-Tool, 85th percentile, 50th percentile	Not restricted. Available through: UDOT Research Division 4501 South 2700 West P.O. Box 148410 Salt Lake City, UT 84114-8410 www.udot.utah.gov/go/research	N/A

19. Security Classification (of this report)	20. Security Classification (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	136	N/A

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LIST OF ACRONYMS

AADT	Average Annual Daily Traffic
C50	Closest 50th percentile speed
C85	Closest 85th percentile speed
FHWA	Federal Highway Administration
HSIS	Highway Safety Information System
MP	Mile Point
MPH	Miles per hour
MUTCD	Manual on Uniform Traffic Control Devices
MVM	Million Vehicle Miles
MVMT	Million Vehicle Miles Traveled
NACTO	National Association of City Transportation Officials
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PDO	Property Damage Only
RD50	Rounded-down 50th percentile speed
RD85	Rounded-down 85th percentile speed
SLSG	Speed Limit Setting Group
SLS-Procedure	Speed Limit Setting Procedure
SLS-Tool	Speed Limit Setting Tool
SR	State Route
SW	Shoulder Width
TAC	Technical Advisory Committee
TRB	Transportation Research Board
TWLTL	Two-Way Left-Turn Lane
UDOT	Utah Department of Transportation
UVC	Uniform Vehicle Code

EXECUTIVE SUMMARY

The setting of speed limits is an important responsibility that public agencies have to serve residents and promote safety for all roadway users. The purpose of this research project is to evaluate the Speed Limit Setting Procedure (SLS-Procedure) and Speed Limit Setting Tool (SLS-Tool) found in the National Cooperative Highway Research Program (NCHRP) Project 17-76 for implementation on Utah Department of Transportation (UDOT) roadways. The proposed implementation of the research is anticipated to contribute to the overall safety of road users and ultimately reduce the number of road-related fatalities across the state.

For the past century in the United States, speed limits have been established for safety, but also with the goal to aid in efficiency and traffic service. The 85th percentile rule emerged as a standard that has been used as both allowing drivers to operate at a speed that is comfortable and safe around other vehicles. Public agencies around the United States, and around the world, have adopted various approaches to setting speed limits. The context of the roadway and the safety of both vehicle occupants and surrounding pedestrians and other roadway users at high speeds, can play a role in selecting a posted speed. It is common for professionals to follow the guidance in the Manual on Uniform Traffic Control Devices (MUTCD) that specifies that a posted speed should be set close to the 85th percentile speed of current traffic. Although this guidance is followed by a large number of professionals, many professionals refer to other guidance in making such decisions. In Utah, state code codifies the guidance of the MUTCD while allowing for special considerations to be made that justify a posted speed lower than the 85th percentile.

The SLS-Procedure and corresponding SLS-Tool is a decision-rule-based decision procedure aimed at identifying a suggested speed that can be used in selecting a posted speed limit. The NCHRP research team conducted an extensive investigation on the factors that influence operating speed and affect crashes. The SLS-Tool was developed to automate the SLS-Procedure and explain the process in a transparent way. The Procedure and Tool emphasize the importance of context by classifying roadway segments into one of four Speed Limit Setting Groups (SLSGs). The process of analysis differs for each SLSG to apply the applicable research.

The research team evaluated the applicability of the SLS-Procedure and SLS-Tool by comparing a list of sites that have recently been analyzed using UDOT's traditional speed study methods. The research team identified 29 locations and collected data to analyze these locations using the SLS-Tool. The 29 locations were divided into 66 uniform segments that could be individually analyzed with the SLS-Tool. The suggestion that resulted from the SLS-Tool was compared to the recommendations presented in a previously completed UDOT speed study. The segments were grouped into three categories: primarily undeveloped SLSG locations, primarily developed SLSG locations, and transition zone mixed SLSG locations.

Of the segments that were analyzed using the SLS-Tool, 43 percent resulted in no change from the posted speed limit, 21 percent resulted in a lower speed limit suggestion, and 36 percent resulted in a higher speed limit suggestion. When comparing the SLS-Tool results to the UDOT speed studies, 62 percent of the segments shared the same result as the SLS-Tool suggestion, 23 percent were a lower suggestion, and 15 percent were a higher suggestion. Using the SLS-Tool, the closest 85^{th} percentile speed was only suggested in 18 percent of segments, rounded-down 85^{th} percentile speed was suggested for 21 percent of segments, and the closest 50^{th} percentile was used in 54 percent of the segment suggestions. A high crash rate and the lack of bike lanes on urban streets were the most common reasons for a closest 50^{th} percentile speed suggestion when analyzing segments using the SLS-Tool. Inadequate shoulder width and insufficient sidewalk and bike facilities were the leading cause of a rounded-down 85^{th} percentile speed limit suggestion.

The research team recommends that UDOT use the SLS-Procedure and SLS-Tool as a reference when performing future speed studies. The use of these resources can aid the analyst in following the state's guidelines to depart from a traditional 85^{th} percentile posted speed. It can help set threshold values on when crash rates should impact the posted speed limit below the 85^{th} percentile speed. Using the SLS-Tool as part of analysis can also aid in treating road segments based off their context characteristics and when those characteristics can call for adopting the 50^{th} percentile speed as the posted speed limit.

1.0 INTRODUCTION

1.1 Problem Statement

In 2021 there were 328 lives lost on Utah roadways. This represents a sustained two-year increase of fatalities across the state. Of the 328 lives lost, 109 fatalities were crashes that involved excessive speed. These trends have followed an upward trend since 2019 (Zero Fatalities, 2022). The Utah Department of Public Safety reported more than 123,000 speed citations in 2021, with 4,700 of the citations issued for speeds over 100 miles per hour (mph) (UDPS, 2022). According to the National Highway Traffic Safety Administration (NHTSA), speeding is a factor in an estimated one-third of all fatal crashes (Warren et al., 2013). To minimize the number of crashes that involve speed, states must use great caution in the setting of speed limits.

To assist states in setting speed limits, the National Cooperative Highway Research Program (NCHRP) funded Project 17-76 to investigate the factors that influence operating speed and safety through a review of the literature and an analysis of the relationships for speed, safety, and roadway characteristics on urban and suburban streets. The knowledge gained through this process led to the development of a Speed Limit Setting Procedure (SLS-Procedure) along with a user manual to explain the SLS-Procedure. In addition, the SLS-Procedure was automated via a spreadsheet-based Speed Limit Setting Tool (SLS-Tool). These products are designed to allow users to make informed decisions about the setting of speed limits. The procedure is based on decision rules that consider both driver speed choice and safety associated with the roadway and can be applied to a variety of roadway types and contexts. The procedure allows users to utilize a fact-based, transparent set of decision rules to determine the suggested speed limit for roadways.

1.2 Objectives

The purpose of this research project was to evaluate the SLS-Procedure and SLS-Tool from NCHRP Project 17-76 for implementation by the Utah Department of Transportation (UDOT). The proper setting of speed limits is anticipated to contribute to UDOT's effort to reduce the total number of fatalities, and ultimately to achieve the goal of ZERO Fatalities across the state.

1.3 Scope

The first task for this project involved holding a kickoff meeting with the technical advisory committee (TAC) to discuss and review the scope and schedule. The second task was to complete a comprehensive literature review to train and inform new research assistants regarding the general topic of speed limits and safety. The third task was to identify locations with high speed-related crashes and other areas of concern. The fourth task was to apply the SLS-Procedure and SLS-Tool to determine the safe speed limit for locations identified in Task 3. The last task was to compile the results of the research and limited conclusions and recommendations into this report.

1.4 Outline of Report

This report is organized as follows:

- Chapter 1 includes the problem statement, objectives, scope, and outline of report.
- Chapter 2 contains the literature review regarding the history of speed limit setting in the United States, speed limit setting approaches and Utah policy, and trends in speed-related crashes and the COVID-19 pandemic.
- Chapter 3 covers the development of the SLS-Procedure and SLS-Tool.
- Chapter 4 includes a summary of the methodology employed during this study.
- Chapter 5 includes descriptions of locations analyzed with the SLS-Tool.
- Chapter 6 discusses the results of the research.
- Chapter 7 summarizes the results of the study and the research team's recommendations for UDOT regarding the SLS-Procedure and SLS-Tool.

2.0 LITERATURE REVIEW

2.1 Overview

The review of the literature regarding the setting of speed limits in the United States is presented in this chapter. First, a brief history of setting speed limits and the reasoning behind these laws is explored. A common rule for setting speed limits, the 85th percentile rule, is explained and the justifications and challenges are presented. Then, the chapter describes different speed-limit-setting approaches that are common in the United States and around the world. The next section includes a description of common guidelines that are followed amongst various agencies that have authority to set speed limits, including UDOT. Information on the practices of professionals and agencies is explained in context of the available references and guidance. Finally, initial findings from drivers' speeds during the COVID-19 pandemic are discussed.

2.2 History of Speed Limit Setting in the United States

A speed limit is defined as the posted speed on any given roadway. In the early days of carriages and primitive automobiles, speed limits were set by governing bodies by statute. For example, the colony of New Amsterdam in 1652 prohibited that a wagon, cart, or sleigh be driven at a gallop pace (Wade, 2010). In the United Kingdom, the English Parliament passed a set of statutes in 1861 to limit the speed of steam-powered locomotive automobiles on public highways and city streets. In recognition of the danger posed to pedestrians in city streets, a person was required to walk ahead of the vehicle with a flag to warn pedestrians of the oncoming vehicle (Department of Transport, 2011). In the United States, the state of Connecticut was the first known state to pass a statute that attached a number to a speed limit for motor vehicles. The speed inside city limits was "twelve miles an hour" and outside the city limits was "fifteen miles an hour" (State of Connecticut, 1901, p. 1220).

The modern purpose of speed limits "is to advise drivers of the maximum reasonable safe operating speed under favorable conditions." In addition, maximum speed limits are "set for the protection of the public and the regulation of unreasonable behavior" (Forbes et al., 2012, p. 9). In the United States, state and local governments have the unrestricted authority to set speed limits in their jurisdiction. The federal government interrupted that authority during World War II and from 1974 to 1995 when the National Maximum Speed Law restricted the maximum permissible speed limit to 55 mph (Friedman et al., 2009). Every state has basic speed statutes that require drivers to operate at a speed "that is reasonable and prudent for conditions" (Forbes et al., 2012, p. 6). The Uniform Vehicle Code (UVC) contains a basic rule that encourages the adoption of statutes that authorize maximum speed limits that may vary by highway type (TRB, 1998).

Since the repeal of the National Maximum Speed Law in 1995, states have changed their maximum speed limits at different times and rates in comparison with each other. The states in the west that have vast miles of rural highways, have speed limits as high as 80 mph (NTSB, 2017). This is an example of the state using statutes to set de facto speed limits on their fastest highways. To provide justification for changing speed limits in locations that are not set by statute, each state has adopted methodologies for setting speed limits that are oriented to achieve specified outcomes. Such outcomes may be that the speed limit is consistent with the likelihood of crash risk, in alignment with the traffic law, accepted as reasonable by the majority of road users, and can provide a reasonable basis for enforcement (Forbes et al., 2012). The most common and well-known metric that is used when setting speed limits is the 85th percentile rule. The rule gained popularity in an era of rapid highway expansion, has been adopted into national standards, and has been used extensively to set speed limits in the United States. The current body of transportation professionals are evaluating the challenges to the rule to establish a process that is more in line with promoting safety for all users. The usage and justification for the 85th percentile rule as well as the challenges associated with the rule are discussed in the following subsections.

2.2.1 Usage and Justification for the 85th Percentile Rule

The 85th percentile rule establishes that the posted speed should be set at the rounded speed that is closest to the speed selected by the driver who is traveling faster than 85 percent of all other vehicles (Shill and Bronin, 2021). This information is obtained by conducting a speed survey that meets the engineering study guidelines that have been set by a state department of transportation or local jurisdiction (NTSB, 2017). The rule is based on the fundamental assumption that the majority of drivers will select a speed that is appropriate for the place and condition in which they are traveling.

Setting the speed limit based on the 85th percentile speed is thought to originally be based on the primary justification for safety. In the late 1950s, researchers found that 15 percent of the fastest drivers had a disproportional high rate of crash risk (Forbes et al., 2012). Therefore, the 85th percentile was meant to represent an upper bound of acceptable driving speed. This early highway safety research indicated that traveling one standard deviation above the mean of the operating speed yields the lowest crash risk for drivers. In addition, crash risk increases as a driver selects a speed that is two standard deviations above or below the mean of the operating speed (Solomon, 1964). Although the justification for the 85th percentile rule has traditionally been attributed to safety concerns, the context of the era must also be considered. Taylor and Hwang (2020) have traced back early thinking about speed regulation in the early 20th century and concluded that the primary motivation for establishing speed regulation was to smooth the flow of traffic. From their research, they concluded that the "85th percentile rule actually emerged decades earlier amidst the nascent traffic engineering profession's preoccupation with 'traffic service' to increase vehicular throughput; and with respect to safety, the rule was explicitly intended as a starting point in speed limit setting, and not the last word" (Taylor and Hwang, 2020, p. 346).

The observational data used to establish the 85th percentile of vehicle speeds is thought to be taken to "encourage compliance and effectively manage risk; many agencies set speed limits to reflect the 'reasonable and prudent' behavior of the majority of motorists acting in an appropriate manner" (TRB, 1998, p. 80). Allowing the collective behavior of the majority of motorists to have a part in selecting the posted speed limit is thought to encourage drivers to obey the posted speed. The strategy is also thought to be a reasonable metric that can be used by law enforcement agencies with limited resources to target the occasional violator who is contributing to a high crash risk to the vehicles around it (Forbes et al., 2012).

Automobile users bring their social attitudes with them in their vehicles and their behavior on the road reflects their behavior in other aspects of their life. A reasonable person is thought to be careful and competent in their actions around others on the road. A majority of drivers do act in a reasonable manner because they are incentivized to make good decisions for their own safety and maintaining favorable driving records. (Forbes et al., 2012).

Additional justification for the 85th percentile rule comes from the notion that laws cannot be effectively enforced without the consent and voluntary compliance of the reasonable public majority. Attempting to enforce a speed limit that a majority of motorists do not feel natural using can lead to distrust of roadway directions and unrealistic enforcement by authorities. In many settings, assuming drivers do not dramatically change their choices, setting the speed limit 5 mph lower than the 85th percentile would cause around half of the drivers to drive at an illegal speed (Forbes et al., 2012).

2.2.2 Challenges with the 85th Percentile Rule

The 85th percentile rule has come under scrutiny from a variety of perspectives. Despite the rule being included in the Manual on Uniform Traffic Control Devices (MUTCD) (FHWA, 2009), the Federal Highway Administration (FHWA) concedes that the research that links safety with driving one standard deviation above the mean operating speed is dated and “may not be valid under scrutiny” (Forbes et al., 2012, p. 12). Current thinking on the relationship between speed and safety holds closer to the effects of speed on a vehicle crash rather than the speed selection of a driver attempting to prevent a crash. The laws of physics “make it very clear that speed and crash severity are inextricably linked” with severity increasing as speed increases (Forbes et al., 2012, p. 4). Although the change in speed limit does not typically change the mean speed of traffic proportionally to the decrease or increase, evidence shows that lowering the mean speed reduces crash risk and severity while an increase of the mean speed will increase them (Rune et al., 2004).

In 2021, an article in the Harvard Law Review was published to argue that the MUTCD is written with a systematic bias for the mobility of the automobile above the mobility and safety of all other users (Shill and Bronin, 2021). The authors of the article note that future revisions of the MUTCD need to take a new approach that removes outdated research and assumptions. Chief among the recommendations of the Harvard Law Review article is that the MUTCD should stop the procedure of justifying speed limit setting based on the 85th percentile of speeds. The rule delegates the setting of the speed limit to the advantage of those who break the law while the users with the least power to set the law are the most vulnerable to its potentially deadly consequences. The rule permits "the most reckless 15 [percent] of drivers to trigger an increase in the speed limit simply by breaking it" (Shill and Bronin, 2021). The proposed revision of the MUTCD that was recently released for public comment in 2021, continues to lean heavily on the 85th percentile rule. Shill and Bronin (2021) find the effects of this rule to be so alarming that they urge the FHWA to revoke it using emergency powers granted by the Administrative Procedures Act.

Perhaps one of the biggest flaws noted in the literature regarding the 85th percentile rule is the failure to predict the effect of posted speed limits on the collective behavior of drivers. The National Transportation Safety Board (NTSB) made the straightforward observation that "raising the speed limit to match the 85th percentile speed may lead to higher operating speeds, and hence a higher 85th percentile speed. This generates an undesirable cycle of speed escalation and reduced safety" (NTSB, 2017, p. 24). Chasing the moving target of 85th percentile speeds can only lead to speed limits that continue to creep up. For example, Texas Transportation Code allows the Texas Department of Transportation to increase the speed limit as long as it is supported by an engineering study. Because the study requirements lean so heavily on the 85th percentile rule, an increase was easily accepted. In a period from 2011 to 2017 on state highway 130 in Texas, the original 70 mph speed limit is now 80 mph with portions of the tolled segment being posted at 85 mph (NTSB, 2017). Because of these challenges, the NTSB recommends that "the FHWA revise Section 2B.13 of the MUTCD to, at a minimum, incorporate the safe system approach for urban roads to strengthen protection for vulnerable road users" (NTSB, 2017, p. 29).

Another critique of the 85th percentile rule comes from the National Association of City Transportation Officials (NACTO). The 2020 publication of "City Limits: Setting Safe Speed Limits on Urban Streets" characterizes the rule as "designed to fail" (NACTO, 2020, p. 18). The document characterizes the rule further as letting vehicles traveling at high speed become the top priority of the nation's transportation system, allowing a small number of those who exceed the posted speed to trigger raising the speed limit. In their document, NACTO describes a cycle of drivers choosing to drive faster than they would naturally when they pass a posted speed that is faster than what they would naturally drive. Increasing speed limits on the same road will naturally increase over time. More studies indicate that drivers do keep in mind the speed limit when choosing their speed. NACTO goes further in recommending that any percentile-based justification of reevaluating a speed limit should be discouraged, especially in urban settings where safety and mobility of non-vehicle users should be given higher priority. A number of state legislatures have passed, or are considering passing, legislation to empower localities to establish different criteria for changing maximum speed limits. The guidance in City Limits provides examples of how cities may adopt speed limit setting procedures that would respond differently to mismatches in the operating speed and the posted speed. If a posted speed limit does not match operating speeds, agencies may consider tools such as improved signage, adding traffic calming design features, and automatic enforcement (NACTO, 2020).

2.3 Summary of Common Speed-Limit-Setting Approaches

For the professional that is recommending a speed limit, it is important to recognize that all approaches to choosing a speed limit are tools intended to assist in the decision. The guidance in the approach must be applied with engineering judgment. The application of such judgment may result in treatments such as variable speed limits, seasonal speed limits, minimum speed limits, and advisory speed limits. Outside of these special considerations, there are four general approaches to setting speed limits within traffic engineering practice: engineering approach, injury minimization or safe system approach, optimization, and expert system approach (Forbes et al., 2012). This section will provide an explanation of each approach.

2.3.1 Engineering Approach

First, in the traditional engineering approach to setting speed limits there can be one of two methods used: the engineering operating speed approach and the engineering road risk approach. The engineering operating speed approach is a simple method of taking the 85^{th} percentile speed and using it as a basis for making decisions. It may be adjusted depending on infrastructure, traffic conditions, or roadside development. Ideally, at the beginning of the road design process, it is important for the designer to specify the target speed limit so that the design can accommodate or control such a limit. This is the most common method used in the United States (Forbes et al., 2012).

The engineering road risk approach begins by starting at a speed limit according to the designated functional classification of the road. Then, further adjustments are considered based on the relative risk from roadside design features. The most important factor in this method is roadside development, which usually takes priority over the roadway geometry because it is assumed that the roadway geometry was designed with a target speed in mind. If higher speeds are desired in locations with greater roadside development, access control techniques should be used to accommodate these speeds. Canada and New Zealand currently employ the road risk method, assigning speed limits to the functional classification of a road (Forbes et al., 2012). The Oregon Department of Transportation relies heavily on a context-based system of speed zones. A posted speed limit can be established by a road authority if a street meets the context description requirements. While the 85th and 50th percentile speeds are collected as part of the speed study process, the posted speed limit in urban areas is nearly always set below the 85th percentile speed "because of the desire to improve safety" (ODOT, 2020).

2.3.2 Injury Minimization Approach

With the knowledge of how the human body is affected by the speed at which a crash occurs, the injury minimization or safe system approach to setting speed limits attempts to select speed limits that manage crash energy so that a driver is less likely to be exposed to forces that will cause serious injury or death. Under this approach, 60 mph is the fastest that vehicles should travel to minimize the risk of death on an average interstate highway or median separated freeway. For an undivided roadway where head-on crashes are possible, 45 mph is the recommended maximum speed limit. Roadways with a greater number of access points would require a speed limit of 30 mph, and any street with a mix of pedestrians and cyclists would require it to be 20 mph. Adopting an injury minimization approach to speed limits in the United States would result in speeds substantially lower than existing speed limits; drivers would likely not comply unless there is constant enforcement or a dramatic change in the geometry and texture of pavements, interpretation of traffic control devices, public education campaigns, and an overall paradigm shift in driver expectations (Forbes et al., 2012).

2.3.3 Optimization Approach

Recognizing that injury minimization approaches have significant trade-offs, an optimized approach to setting speed limits attempts to balance the impact of speed based on various societal objectives. The cumulative effects of the speed that a driver chooses is unlikely to mirror the effects that are optimal for a community body. Examples of such effects include cost to operate a vehicle, the cost of vehicle crashes, the cost of travel time, impact on the taxpayer, and cost to the local residents in metrics such as noise. An optimized speed-limit-setting approach would consider all these costs and express them in cost per mph of a posted speed limit. Although this approach is useful in locations where motorists have difficulties becoming aware of the externalities of their speed for pedestrians and cyclists, it remains challenging to encourage drivers to change their behavior when roadway design is not aligned with the speeds of the optimized approach, and there are not measures in place to prevent a high percentage of drivers from exceeding posted speed limits (Forbes et al., 2012).

2.3.4 Expert Systems Approach

In an acknowledgment that all approaches to setting speed limits can be arbitrary in their decisions and contain human bias, Transportation Research Board (TRB) Special Report 254 argues that an expert system approach should "[provide] a systematic and consistent method of examining and weighing factors other than vehicle operating speeds in determining an appropriate speed limit" (TRB, 1998, p. 208). The Australian Road Research Board was the first agency to pioneer an expert system from field data, and panels of experts came up with decisions on how the data are treated. The user is prompted with a series of questions that are coded into a program and given a recommended speed limit. In the United States, the FHWA developed a similar expert system for recommending speed limits from previous research and lessons learned from the Australian expert system. The Tool, known as USLIMITS2, can determine speed on all functional classifications of roadways except where speed limits are set by statute, temporally reduced, or changed based on weather or seasonal variability. USLIMITS2 uses an algorithm to advise the setting of speed limits and issues warnings based on the inputs (Forbes et al., 2012).

2.4 Speed Limit Setting Procedures in Use by Professionals

Several public agencies have reported that many of their facilities are found to have a 50th percentile operating speed that exceeds the posted speed limit. These agencies note that setting the posted speed based on current traffic flow characteristics would be both unsafe and unfeasible. Because of this dilemma, these agencies often depart from their own guidelines. The problem is further exacerbated by the observation that setting a posted speed below the 85th percentile speed does not typically encourage compliance (Fitzpatrick et al., 2003). Some agencies have added guidelines to adjust a speed study recommendation by relying on other important metrics. These metrics may include road geometry, crash history, pavement conditions, weather visibility, traffic volumes, non-vehicle users, vehicle characteristics, and driver experience. The State of Utah and UDOT have adopted the standards of the MUTCD and codified them into state code that includes additional metrics to be considered when setting a speed limit. Furthermore, UDOT is beginning a speed management study approach to aid in lowering operating speed in locations that exceed the posted speed limit. A summary of speed limit setting procedures among professionals and Utah speed limit setting policy is provided in this section.

2.4.1 Speed Limit Setting Procedures Among Professionals

In the guidance in the latest edition of the MUTCD, posted speed limits are set within "5 miles per hour of the 85th percentile speed of free-flowing traffic" (FHWA, 2009, p. 58). The guidance was first added to the 1971 edition of the MUTCD. In 2000, the guidance was advanced to include the word "should" (Fitzpatrick et al., 2019). In reality, it is less common for the guidance to receive strict adherence. A survey that gathered data in 2018 from a diverse group of consultants, city employees, and county/regional agency employees with a wide variety of years of experience doing speed studies observed the references that are used when conducting a speed study. The survey found the MUTCD was the most referenced document, albeit 27 percent of the professionals never referred to the guidance in the MUTCD. Furthermore, 17 percent of professionals only used state and local guidelines. Only 16 percent of the professionals surveyed reported having some experience with the expert system USLIMITS2, with very few relying on it extensively. The survey also inquired about the criteria that professionals use when conducting speed studies. Among professionals with the most experience, the current speed distribution of the vehicles, crash history, the statutory requirements, road geometry, location context, and access management were the criteria most considered. Those that had the least amount of experience tended to use crash history, location context, and pedestrian and bicycle activity with higher weighting in their analysis than the professionals with more experience. The difference may represent a divide among engineers and consultants that have more experience and urban planners and government employees that do fewer speed studies as a part of their profession (Fitzpatrick et al., 2019).

2.4.2 Utah Speed Limit Setting Policies

The laws that govern the setting of speed limits in the state of Utah are established in section 41-6A-601 and section 41-6A-602 of the Utah Code Annotated. The statute established states that "each speed limit shall be based on a traffic engineering and safety study consistent with the requirements and recommendations in the most current version of the 'Manual on Uniform Traffic Control Devices'" (State of Utah, 2022, 41-6a-602-1b). In addition to the MUTCD, the law states that traffic engineering and safety studies "shall include: the design speed, prevailing vehicle speeds, accident history, highway, traffic, and roadside conditions; and other highway safety factors" (State of Utah, 2022, 41-6a-602-1c).

To follow the statutes that are established by Utah state law, the "UDOT Policy and Procedure Book" set a standard for what information shall be included in a traffic engineering speed study when establishing speed limits on state highways. UDOT Policy 06C-25 states: "The posted speed limit is based on the 85^{th} percentile speed giving consideration to:

1. Road surface characteristics, shoulder condition, grade, alignment, and sight distance.
2. Roadside development, culture, and roadside friction.
3. Safe speeds for curves or hazardous locations within the zone.
4. Pedestrian activity, parking practices, and other traffic.
5. Reported crash experience for the most recent three-year period.
6. Statutory speed limits.

Consideration may be given for a speed limit below the 85th percentile when the 85th percentile speed appears inappropriate based on the six factors above. Any reduction beyond rounding based on the 85th percentile speed should not exceed 5 mph" (UDOT, 2022). UDOT policy takes an engineering and operating speed approach because it uses the 85th percentile speed as the base speed limit and then has a list of road characteristics that could lower the speed limit in a small way.

Managing the speed of vehicles is an important tool that helps UDOT accomplish its goal of Zero Fatalities on Utah roads. "It is the intent of the department to review every speed limit every five years" (UDOT, 2022). These speed studies help address concerns over safety from the recent crash history as well as analyze recent changes including the number of travel lanes, signal coordination, or roadside development that may affect the operating speed. The primary purpose of a speed study is to identify the 85th percentile speed as well as analyze the additional factors that are identified in Utah Code which may necessitate that UDOT "may establish different speed limits on a highway or section of highway" (State of Utah, 2022, 41-6a-602-1c).

UDOT is also conducting research into speed management. Speed management studies may be used in addition to or in replacement of traditional speed studies. "These studies may indicate that the 85th percentile speed is much greater than the posted speed limit, but instead of raising the speed limit, speed management should be considered to instead lower the 85th percentile speed" (UDOT, 2021). A speed management study is especially helpful when "there is a disconnect between vehicle speeds and the roadway context or when 85th percentile speeds are higher than recommended for safety" (UDOT, 2021).

In locations where setting the 85th percentile speed appears inappropriate to be adopted as the posted speed limit, special attention is given to non-motorists, the adjacent land use, roadway characteristics, and geometric design to determine a safer posted speed. This type of "speed management is considered within the framework of the Safe System Approach, which means designing a roadway in which impacts on the human body are kept at tolerable levels" (UDOT, 2021).

The speed management measures that UDOT has chosen to pursue include radar speed signs, pavement speed limit markings, optical speed bars, road diets, median islands, roundabouts, curb extensions, roadway narrowing for bike lanes or parking, and various types of roadside gateway features. In other cases, the solution may not be to slow traffic, therefore it may be necessary to accommodate these higher speeds by considering wider shoulders, median barriers, consolidated accesses, and improved alignment to increase overall mobility. Any improvements to slow traffic or to accommodate higher speeds must be "applicable in communities where the treatment supports local initiatives and is consistent with land use and street plans" (UDOT, 2021).

2.5 Trends in Speed-Related Crashes and the COVID-19 Pandemic

Crashes typically result from multiple factors, but studies indicate that speeding "is a primary crash causation factor across the globe" (Forbes et al., 2012). Strong physical relationships exist between speed and crash frequency. The faster a vehicle travels, the less time the driver has to react to their surroundings and the greater distance needed to stop the vehicle. Speed also affects crash severity due to having a greater kinetic energy. According to a study done by NACTO on vehicle-pedestrian crashes, increasing vehicle speed by 27 mph caused the pedestrian fatality rate to increase by 65 percent (NACTO, 2020). The authors argue that decreasing speed-related fatalities in the United States is possible and necessary. NACTO reports, "We cannot reduce traffic fatalities on US city streets without reducing speeds. More than 35,000 people die in traffic crashes on US roads each year, and millions more are seriously and often permanently injured. The United States has the highest fatality rate in the industrialized world; double the rate in Canada and quadruple that in Europe" (NACTO, 2020, p. 6).

At the beginning of the COVID-19 pandemic, traffic volumes sharply decreased as a large percentage of daily commuters were taken off the roadways. A portion of drivers began to feel comfortable traveling at very high speeds in such conditions. Although additional research is necessary to fully understand the trends in traffic data observed during the COVID-19 pandemic, preliminary studies indicate that driving during the year 2020 was more dangerous than previous years due to increased speeding and reckless behavior (Bomey, 2021). For instance, in April of 2020 an unidentified team broke the cross-country Cannonball Run record by driving from New York to Los Angeles in 26 hours and 38 minutes. Making the normally 41-hour trip in nearly half the time required the team to travel an average of 106 mph (Belvins, 2020). This team was just one of many cases of drivers taking advantage of lower traffic volumes by traveling at excessive and unsafe speeds. California reported an 87 percent increase in citations for speeding in excess of 100 mph during the onset of the pandemic (Caltrans, 2020). State troopers in Colorado and Nebraska also reported relative increases in the number of speeding tickets issued for drivers traveling over 100 mph during that time (AASHTO Journal, 2020; Belvins, 2020). With higher speeds came increased fatality rates. California, Minnesota, Missouri, and Ohio all reported more speed-related fatalities, despite lower traffic volumes (AASHTO Journal, 2020; Bergal, 2020; Reeve, 2020).

2.6 Summary

The first speed limits in the United States were imposed primarily for the protection of pedestrians and drivers. Later, a common method for setting speed limits has been to follow the 85th percentile rule. The justifications for the rule have relied on assumptions of lower crash rates for vehicles who travel at this place in the speed distribution, maximizing vehicle throughput on the roadway, and ease of enforcement by authorities. Professionals recognize that drivers are influenced heavily by geometric and psychological constraints that allow them to drive at a speed that feels natural to them. In recent decades, a growing body of professionals have voiced concerns related to the blind application of the 85th percentile rule and recognize how it can decrease safety. They also point out that the original research that justified this rule does not hold up to scrutiny and the language supporting the rule in national or local standards ought to be changed. Some professional organizations have advocated for radically rethinking how the policies of setting speed limits and the enforcement from authorities are approached. Approaches to setting speed limits can be defined by the desired outcome of posting a maximum speed limit. Such outcomes can include selecting a speed limit that reflects the current speed of its drivers, the speed that is best fit for the road’s geometric design, the speed that minimizes the injury to the human body in the event of a crash, or the speed that is consistent with the characteristics of similar roadways. A survey from professionals that conduct speed studies reveals that most professionals rely on the guidance from many reference materials and rarely apply the 85th percentile rule without other considerations. The state of Utah has a policy that uses the 85th percentile rule as a starting point and then lists other considerations that may be used to recommend a posted speed. The COVID-19 pandemic has made apparent that drivers are less likely to obey the posted speed and the crash severity rate is prone to raising when traffic volumes are decreased.

3.0 DEVELOPMENT OF A SPEED LIMIT SETTING PROCEDURE AND TOOL

3.1 Overview

To help address the growing concerns expressed in Chapter 2 surrounding the setting of speed limits, the NCHRP issued a research project to recommend an informed decision-making process for the setting of speed limits. The results of the project are reported in the document: “Development of a Posted Speed Limit Setting Procedure and Tool” (Fitzpatrick et al., 2021a). In addition, the research team also produced a document titled: “Posted Speed Limit Setting Procedure and Tool: User Guide” (Fitzpatrick et al., 2021b). This chapter will provide a summary of both documents. First, information about the purpose of the research in the resulting NCHRP Project 17-76 is discussed. Next, information about the key factors that influence operating speed and safety are presented. These factors were used as key variables in the decision-making process for the SLS-Procedure and SLS-Tool. Then, the decision-rule-based procedure that was selected for the research project is described followed by a discussion on how the SLS-Procedure and SLS-Tool categorize all road segments into four speed limit setting groups (SLSGs). The research established different requirements for each SLSG for analysis with consideration of the roadway context and type. Finally, a summary of the SLS-Tool User Guide that describes the process of using the Tool to apply the SLS-Procedure to uniform road segments is presented.

3.2 Project Purpose

The purpose of the NCHRP Project 17-76 was to investigate the factors that influence operating speed and safety of vehicles on public roads. This knowledge was used to recommend an informed decision-making process for the setting of speed limits to engineers. The result of the project was the development of the SLS-Procedure and its automated product, the SLS-Tool. “Several factors are considered within engineering studies when determining the posted speed limit for a speed zone” (Fitzpatrick et al., 2021a). With the backdrop of concerns over the predominant method of relying on the 85th percentile speed, the behavior of vehicle drivers under threat of speed limit enforcement, and a renewed interest to consider the safety of all potential users, the research team considered a breadth of approaches for the setting of posted speed limits.

Posted speed limits could be the same as the statutory speed set by a state legislature or may be determined independently by an engineering speed study. Figure 3.1 illustrates the range of speed limits that the SLS-Procedure and SLS-Tool can analyze and influence.

Source: Federal Highway Administration, *Speed Limit Basics*, page 1 (*1*).

Figure 3.1 Examples of speed limits addressed by the SLS-Procedure (Fitzpatrick et al., 2021a).

The NCHRP Project 17-76 research team focused on developing a methodology that could be used and adapted for any roadway type and context. As the key component of the SLS-Procedure, the research team recommended that operating speed be used as a starting point for a posted speed limit. Then, the speed is adjusted based on roadway conditions and consideration of crash experience on the segment. The following items are the guiding principles that were included as part of the development of the SLS-Procedure (Fitzpatrick et al., 2021a):

- Use a data-driven approach with research-based decision rules.
- Produce consistent results for a given set of conditions.
- Incorporate contemporary policies, guidelines, and practices.
- Consider drivers' speed choice and roadway safety.
- Provide transparency in the decision-making process.
- Consider all roadway types and roadway contexts.
- Vary the decision rules to account for the diverse characteristics of each SLSG.
- Consider agency data and human resource constraints.
- Include inputs and outputs on the same screen to demonstrate the relationship between each roadway characteristic and selection of the suggested speed limit.

- Allow for future modifications to accommodate new knowledge.
- Create efficiencies in the decision process, where possible.

The NCHRP Project 17-76 research team investigated speed limit setting procedures across the United States and recent recommendations from the NTSB and NACTO that call for removing guidance in the MUTCD that requires speed limits to be set near the 85th percentile speed. The team considered the different speed-limit-setting approaches explained in section 2.3 of this report and how they were implemented from the USLIMITS2 Tool; the city of Portland, Oregon; and from guidance in New Zealand and Canada.

3.3 Factors That Influence Speed and Safety

The NCHRP Project 17-76 research team gathered data from two sources: a review of relevant literature and from original research they performed in Texas and Michigan. The research team gathered roadway segment characteristics that were known or suspected to affect crashes and operating speed. For urban and suburban streets in general, operating speeds decrease as access density increases, roadside attractions become denser, and human activity is located closer to vehicle traffic. In both urban, but especially rural areas, operating speed is lower where there are horizontal curves with small radii or deflection angles. In addition, the research team concluded that operating speed does increase with a higher posted speed limit (Fitzpatrick et al., 2021a).

The following tables in this section come from the conclusions of the NCHRP 17-76 Project research team. The tables outline the factors that affect crash frequency or operating speed. The tables list each factor as being positively associated, negatively affected, or having a mixed effect on crash frequency or operating speed. Table 3.1 lists the factors that are most associated with crash frequency for urban and suburban streets. The major factors that affect crashes are the presence of traffic control devices, traffic congestion, access density, and certain geometric features. Table 3.2 lists the factors that are most associated with operating speed for urban and suburban streets. The major factors that positively affect operating speed are the posted speed limit, the percentage of trucks, geometric characteristics of the lane configuration, and the presence of a one-way road. Table 3.3 lists the factors that are most associated with crash frequency for high-speed highways. The major factors that positively affect crashes on highways are traffic congestion and certain geometric features. Table 3.4 lists the factors that are most positively associated with operating speed for high-speed highways. The major factors that positively affect operating speed on highways are the posted speed limit and the geometric characteristics of the lane configuration (Fitzpatrick et al., 2021a).

Table 3.1 Factors of Urban/Suburban Streets That Affect Crashes

Positively associated	Mixed effect	Negatively associated
AADT	Posted Speed Limit	Schools
Congestion	Operating Speed	Bike Lanes
Percent trucks	Lane Width	Intersection Lighting
Access density	Horizontal Alignment	Shoulder Width
Liquor stores	Vertical Alignment	
Parking		
Intersection Angle		
Median Width		
Number of Lanes		
Segment Length		
Presence of Signalized Intersection		

Table 3.2 Factors of Urban/Suburban City Streets That Affect Operating Speed

Positively associated	Mixed effect	Negatively associated
Posted Speed Limit	Horizontal Alignment	Access Density
Percent Trucks	Vertical Alignment	Surroundings
Lane Width	Bike Routes	Hazard Ratings
Medium Width	Shoulder or Curb	Sidewalk Presence
Number of Lanes	Functional Classification	Schools Zones
Segment Limits		Parking
One-Way Roads		Weather
Nighttime Driving		

Table 3.3 Factors of High-Speed Highways That Affect Crashes

Positively associated	Mixed effect	Negatively associated
Percent Trucks	Posted Speed Limit	Driveways and Intersections
AADT	Operating Speed	Median Width
Development	Median Type	Lane Width
Horizontal Alignment		Paved Shoulder Width
Vertical Alignment		
Number of Lanes		

Table 3.4 Factors of High-Speed Highways That Affect Operating Speed

Positively associated	Mixed effect	Negatively associated
Posted Speed Limit	AADT	Driveways and Intersections
Lane Width	Median Type	Development
Median Width		Horizontal Alignment
Number of Lanes		Vertical Alignment
Paved Shoulder Width		
Nighttime Driving		

3.4 Decision-Rule-Based Procedures

The NCHRP Project 17-76 research team selected a decision-rule-based procedure to develop a speed limit setting methodology that could be used for any roadway type and functional classification. An overview of the SLS-Procedure decision-making flowchart is displayed in Figure 3.2. The procedure begins with consideration of context and setting as the beginning point of the analysis. The roadway context and setting determine what variables will affect the suggested speed limit on a uniform section of roadway. Additional information about categorizing roadways is explained in section 3.5 of this report. Following the determination of the roadway context and type, the procedure simultaneously considers the existing speed distribution and safety statistics. The data collected and used as part of the procedure is subject to various thresholds that were determined using the research from the initial phases of the project. The factors that were considered are further explained in section 3.5 of this report. After considering both the operating speed distribution and then roadway safety conditions, a potential suggested speed limit is identified. That speed limit is either the closest 5-mph increment value or a rounded-down 5-mph value dependent on the speed distribution and safety thresholds set in the procedure.

As part of the research, the team found that "crashes were lowest when the operating speed was within five miles per hour of the average operating speed" (Fitzpatrick et al., 2021a). Therefore, the 50^{th} percentile speed was chosen as a benchmark for consideration within the SLS-Procedure. The data from the research performed in Austin, Texas, and Washtenaw, Michigan, supported the inclusion of variables such as signal density, access density, median type, and other roadway characteristics especially for suburban and urban roadways when selecting a posted speed limit. Other variables were considered from the data gathered in the review of literature which studied the influence of operating speed and roadway characteristics on posted speed limits and safety.

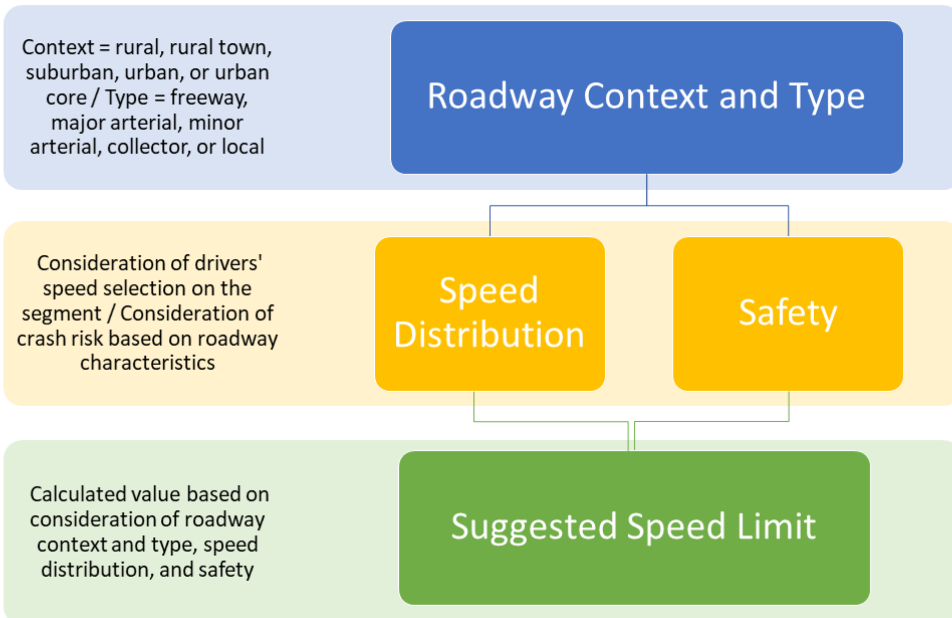

Figure 3.2 Overview of the decision-rule-based procedure used to calculate a suggested speed limit using the SLS-Procedure (Fitzpatrick et al., 2021a).

3.5 Speed Limit Setting Groups

With the backdrop of concerns over the predominant method of relying on the 85th percentile speed, the behavior of vehicle drivers under threat of speed limit enforcement, and a renewed interest to consider the safety of all of the potential users, the research team considered a breadth of approaches for the setting of speed limits. The research team focused on developing a methodology that could be used and adapted for any roadway type and context. The SLS-Procedure and SLS-Tool are a decision-rule-based procedure based off an expanded functional classification provided in NCHRP Report 855 (Stamatiadis et al., 2018). The five roadway types selected for the procedure are freeway, major arterial, minor arterial, collector, and local. The five road contexts are rural, rural town, suburban, urban, or urban core. For the development of the SLS-Procedure, “The roadway types and roadway contexts… were collapsed into four Speed Limit Setting Groups (SLSGs): Limited Access, Undeveloped, Developed, and Full Access”

(Fitzpatrick et al., 2021a). All 25 roadway combinations fall into one of these four SLSGs. A breakdown of the matrix that is used to determine the SLSGs is displayed in Table 3.5.

Table 3.5 Speed Limit Setting Groups (SLSGs)

Context and Type	Rural	Rural Town	Suburban	Urban	Urban Core
Freeways	Limited-Access	Limited-Access	Limited-Access	Limited-Access	Limited-Access
Principal Arterial	Undeveloped	Developed	Developed	Developed	Full-Access
Minor Arterial	Undeveloped	Developed	Developed	Developed	Full-Access
Collector	Undeveloped	Full-Access	Developed	Full-Access	Full-Access
Local	Undeveloped	Full-Access	Full-Access	Full-Access	Full-Access

For each SLSG, a unique set of rules are used for the recommendation of posted speed limits. The limited-access and undeveloped SLSGs retain an emphasis of mobility by having a stronger connection to the measured operating speed when it is appropriate to do so. After a review of the literature and much internal debate, the NCHRP 17-76 Project research team decided to maintain a closer reliance on operating speed for the developed SLSG— "with the knowledge that which measured operating speed would serve as the starting point (e.g., 85^{th} percentile or 50^{th} percentile)" (Fitzpatrick et al., 2021a). The limited-access, developed, and undeveloped SLSGs may rely on the closest 85^{th} percentile speed, the rounded-down 85^{th} percentile speed, the closest 50^{th} percentile speed, or rounded-down 50^{th} percentile speed. All of these percentiles are rounded within 5 mph. The full-access SLSG only uses the closest 50^{th} percentile speed as a benchmark for analysis in order to accommodate the anticipated users on the street.

3.6 SLS-Tool User Guide

The SLS-Tool User Guide details how a professional may use the SLS-Tool to apply the SLS-Procedure to a uniform section of roadway. Using the SLS-Tool consists of gathering data about a road segment and entering that data into the appropriate cell in the SLS-Tool Excel spreadsheet. The road segment data are subject to certain thresholds that determine the percentile that is chosen for a suggested speed limit. The thresholds in the support tables within the Tool can be adjusted dependent on local policies or desired outcome. The threshold values can be viewed and edited in the tabs labeled “Support Tables,” and “Default Values.” These two tables are displayed in Figure 3.3 and Figure 3.4.

Two versions of the SLS-Tool are available through NCHRP Project 17-76: macro-enabled and non-macro-enabled. The macro-enabled version simplifies the data-entry process and is generally recommended over the non-macro-enabled version (Fitzpatrick et al., 2021b). The SLS-Tool has four sections to enter data. Each cell that is used to enter data is colored according to the legend shown in Figure 3.5. The first category is for information about the site description. The second category is where information about the speed distribution data are entered. The third category is where the site characteristics are entered. The fourth and final category is a place to enter the crash data if it is available. The following subsections describe each of these categories. Finally, the section discusses how the SLS-Tool reports the results of the analysis. A screenshot of the SLS-Tool analysis tab that displays a sample roadway analysis and results is shown in Figure 3.6.

NCHRP 17-76 Speed Limit Setting Tool

75000	88.34	44.16	75000	25.15	14.41
100000	91.16	44.16	100000	27.69	14.41
150000	91.60	44.16	150000	29.25	14.41
200000	104.51	44.16	200000	30.75	14.41

Speed Limit Setting Groups

Type/Context	Rural	Rural town	Suburban	Urban	Urban core
Freeway	Limited access	Limited access	Limited access	Limited access	Limited access
Principal arterial	Undeveloped	Developed	Developed	Developed	Full access
Minor arterial	Undeveloped	Developed	Developed	Developed	Full access
Collector	Undeveloped	Full access	Developed	Full access	Full access
Local	Undeveloped	Full access	Full access	Full access	Full access

Upper and Lower Speed Limits by Group (mph)

Group	Lower	Upper
Limited access	50	80
Developed	25	55
Undeveloped	25	65
Full access	15	35

Minimum Segment Lengths by Speed Limit

Speed limit (mph)	Length (mi)
15	0.30
20	0.30
25	0.30
30	0.30
35	0.35
40	0.40
45	0.45
50	0.50
55	0.55
60	1.20
65	3.00
70	6.20
75	6.20
80	6.20
85	6.20

HSIS Crash Rates (crashes / 100 million vehicle-miles traveled)

HSIS KABCO crashes, undeveloped				HSIS KABC crashes, undeveloped			
AADTmax (veh/d)	2	MD	MU	AADTmax (veh/d)	2	MD	MU
0	206.56	102.55	153.35	0	65.21	28.93	50.00
1250	166.00	102.55	153.35	1250	54.01	28.93	50.00
2500	147.23	102.55	153.35	2500	47.73	28.93	50.00
3750	133.96	102.55	153.35	3750	43.89	28.93	50.00
5000	128.57	76.77	145.63	5000	43.29	22.14	42.08
6250	121.91	76.77	145.63	6250	41.46	22.14	42.08
7500	125.70	76.77	145.63	7500	44.14	22.14	42.08
8750	123.35	76.77	145.63	8750	43.46	22.14	42.08
10000	98.16	73.90	124.54	10000	35.60	20.77	41.14
15000	98.16	70.83	124.54	15000	35.60	20.79	41.14
20000	98.16	70.59	124.54	20000	35.60	23.11	41.14
25000	98.16	65.36	124.54	25000	35.60	21.28	41.14

HSIS Crash Rates (crashes / 100 million vehicle-miles traveled)

HSIS KABCO crashes, developed or full access					HSIS KABC crashes, developed or full access				
AADTmin (veh/d)	2	MD	MU	OW	AADTmax (veh/d)	2	MD	MU	OW
0	263.17	226.43	452.14	245.12	0	67.32	72.02	131.02	60.21
2500	209.14	226.43	452.14	245.12	2500	64.31	72.02	131.02	60.21
5000	205.37	226.43	452.14	139.27	5000	63.75	72.02	131.02	37.29
7500	229.55	226.43	452.14	139.27	7500	70.26	72.02	131.02	37.29
10000	246.62	202.46	452.26	72.18	10000	73.14	66.16	131.98	22.79
15000	253.25	202.46	452.26	58.31	15000	78.14	66.16	131.98	18.19
20000	225.17	228.69	431.09	57.36	20000	71.82	75.37	129.00	17.72
25000	225.17	228.69	431.09	63.87	25000	71.82	75.37	129.00	20.07
30000	225.17	228.37	431.25	54.63	30000	71.82	74.01	131.10	15.03
40000	225.17	205.73	431.25	54.63	40000	71.82	70.84	131.10	15.03
50000	225.17	158.17	431.25	54.63	50000	71.82	56.32	131.10	15.03

Figure 3.3 SLS-Tool Support Tables tab.

NCHRP 17-76 Speed Limit Setting Tool

Color-Coding Legend

Aqua = basic input cell
Denim = basic input cell with drop-down menu (menus are in Analysis worksheets only)

Default Values for Limited-access Segments (urban roadway context)

Urban	Roadway context
85	Maximum speed limit (mph)
83	85th-percentile speed (mph)
80	50th-percentile speed (mph)
7	Segment length (mi)
60,000	AADT (two-way total) (veh/d)
6	Number of lanes (two-way total)
200	Directional design-hour truck volume (trk/hr)
7	Number of interchanges
≥ 60 mph	Design speed (mph)
0	Grade (%)
10	Outside shoulder width (ft)
10	Inside shoulder width (ft)
No	Adverse alignment present?
3	Number of years of crash data
60,000	Average AADT for crash data period (veh/d)
27	All (KABCO) crashes for crash data period
7	Fatal & injury (KABC) crashes for crash data period

Default Values for Limited-access Segments (rural roadway context)

Rural	Roadway context
85	Maximum speed limit (mph)
83	85th-percentile speed (mph)
80	50th-percentile speed (mph)
7	Segment length (mi)
25,000	AADT (two-way total) (veh/d)
6	Number of lanes (two-way total)
200	Directional design-hour truck volume (trk/hr)
7	Number of interchanges
80	Design speed (mph)
0	Grade (%)
10	Outside shoulder width (ft)
10	Inside shoulder width (ft)
No	Adverse alignment present?
3	Number of years of crash data
25,000	Average AADT for crash data period (veh/d)
16	All (KABCO) crashes for crash data period
4	Fatal & injury (KABC) crashes for crash data period

Default Values for Undeveloped Segments

70	Maximum speed limit (mph)
68	85th-percentile speed (mph)
65	50th-percentile speed (mph)
7	Segment length (mi)
15,000	AADT (two-way total) (veh/d)
4	Number of lanes (two-way total)
Divided	Median type
15	Number of access points (total of both directions)
12	Lane width (ft)
10	Shoulder width (ft)
No	Adverse alignment present?
3	Number of years of crash data
15,000	Average AADT for crash data period (veh/d)
22	All (KABCO) crashes for crash data period
7	Fatal & injury (KABC) crashes for crash data period

Important Notice

Default values were developed by the Research Team based on the following principles:

- Maximum speed limit: maximum value allowed for the SLSG.
- 85th-percentile speed: maximum speed limit - 2 mph.
- 50th-percentile speed: maximum speed limit - 5 mph.
- Segment length: minimum value allowed for the maximum speed limit.
- AADTs: reasonable mid-range values for the SLSG.
- Site characteristics: limiting values that will allow the speed limit to be based on the closest 85th-percentile speed for limited-access, developed, or undeveloped segments, or the closest 50th-percentile speed for full-access segments.
- Crash counts: computed as the HSIS rates divided by three for limited-access, developed or undeveloped segments, or divided by eight for full-access segments.

The values are informational and are provided as advice for the rare cases where the user is not able to obtain a value for the segment of interest.

Default Values for Developed Segments

55	Maximum speed limit (mph)
53	85th-percentile speed (mph)
50	50th-percentile speed (mph)
1	Segment length (mi)
4	Number of lanes (two-way total)
Divided	Median type
3	Number of traffic signals
40	Number of access points (total of both directions)
Not high / Any type	Bicyclist activity / bike lane type
Adequate	Sidewalk presence / width
Present	Sidewalk buffer
Negligible	Pedestrian activity
Not high	On-street parking activity
No	Parallel parking permitted?
No	Angle parking present?
No	Adverse alignment present?
3	Number of years of crash data
30,000	Average AADT for crash data period (veh/d)
No	Is the segment a one-way street?
53	All (KABCO) crashes for crash data period
19	Fatal & injury (KABC) crashes for crash data period

Default Values for Full-access Segments

30	Maximum speed limit (mph)
25	50th-percentile speed (mph)
1	Segment length (mi)
4	Number of lanes (two-way total)
Divided	Median type
8	Number of traffic signals
60	Number of access points (total of both directions)
Not high / Any type	Bicyclist activity / bike lane type
Adequate	Sidewalk presence / width
Present	Sidewalk buffer
Negligible	Pedestrian activity
Not high	On-street parking activity
No	Angle parking present?
No	Adverse alignment present?
3	Number of years of crash data
10,000	Average AADT for crash data period (veh/d)
No	Is the segment a one-way street?
25	All (KABCO) crashes for crash data period
8	Fatal & injury (KABC) crashes for crash data period

Figure 3.4 SLS-Tool Support Default Values tab based off the sample results.

Color-Coding Legend
Aqua = basic input cell
Denim = basic input cell with drop-down menu
Orange = optional input cell (not needed for calculations)
Green = optional input cell (use if data for agency & region are available, leave blank otherwise)
Rose = intermediate calculations
Purple = final analysis results

Figure 3.5 SLS-Tool color-coding legend.

NCHRP 17-76 Speed Limit Setting Tool

Input Cells	Description	Output Cells	Color-Coding Legend
Site Description Data			
Suburban	Roadway context	Clear all data	Aqua = basic input cell
Principal arterial	Roadway type		Denim = basic input cell with drop-down menu
Yes	Are crash data available?		Orange = optional input cell (not needed for calculations)
Cory Ward	Analyst	Enter default data	Green = optional input cell (use if data for agency & region are available, leave blank otherwise)
5/30/2022	Date		Rose = intermediate calculations
US 189	Roadway name		Purple = final analysis results
Provo	Description	Test macros	
50	Current speed limit (mph)		
Segment 3	Notes		Note: The "Test macros" button provides a message to verify proper macro operation.

Analysis Results			Advisory, Calculated, or Warning Messages
	Speed limit setting group	Developed	
	Suggested speed limit (mph)	**55**	This value is determined by speed data & site characteristics.

Speed Data		Advisory, Calculated, or Warning Messages
55	Maximum speed limit (mph)	
56.3	85th-percentile speed (mph)	
51.4	50th-percentile speed (mph)	

Site Characteristics		Advisory, Calculated, or Warning Messages
3.02	Segment length (mi)	
4	Number of lanes (two-way total)	
TWLTL	Median type	
6	Number of traffic signals	1.99 signals / mi
35	Number of access points (total of both directions)	11.59 access points / mi
High / Separated	Bicyclist activity / bike lane type	Rounded-Down 85th
Wide	Sidewalk presence / width	
Present	Sidewalk buffer	
High	Pedestrian activity	
Not high	On-street parking activity	
No	Parallel parking permitted?	
No	Angle parking present?	
No	Adverse alignment present?	

Crash Data			Advisory, Calculated, or Warning Messages
3	Number of years of crash data		
29,223	Average AADT for crash data period (veh/d)		
No	Is the segment a one-way street?		
132	All (KABCO) crashes for crash data period		Observed KABCO crash rate = 136.59 crashes / 100 MVMT
87	Fatal & injury (KABC) crashes for crash data period		Observed KABC crash rate = 90.03 crashes / 100 MVMT
	Average KABCO crash rate (crashes / 100 MVMT)		HSIS average KABCO crash rate = 228.69 crashes / 100 MVMT
	Average KABC crash rate (crashes / 100 MVMT)		HSIS average KABC crash rate = 75.37 crashes / 100 MVMT
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	297.3	
	1.3 x average KABC crash rate (crashes / 100 MVMT)	98.0	
	Critical KABCO crash rate (crashes / 100 MVMT)	254.5	
	Critical KABC crash rate (crashes / 100 MVMT)	90.4	

Figure 3.6 SLS-Tool Analysis tab and sample results.

3.6.1 SLS Tool Input Variables: Site Description Data

The first category of variables in the SLS-Tool analysis tab is the site description data. The three primary variables that are required for performing the analysis are roadway context, roadway type, and a question asking if crash data are available. Clicking on one of these variables opens a drop-down menu from which the user selects the most appropriate option for the roadway segment under study. Illustrations and descriptions of each roadway type that are included in the SLS-Tool User Guide are provided in Table 3.6 for reference (Fitzpatrick et al., 2021b).

Table 3.6 Roadway Context Illustration and Description

Illustration	Description
Rural 	Ranges from no development (natural environment) to some light development (structures), with sparse residential and other structures mostly associated with farms. The land is primarily used for outdoor recreation, agriculture, farms, and/or resource extraction. In a rural setting, there are no or very few pedestrians, bicyclists are most likely of recreational nature, and transit is limited or nonexistent.
Rural Town 	Characterized by low density (low-rise—one or two story— structures) but a concentrated development of diverse uses— residential and commercial. Rural towns are generally incorporated but have limited government services. Rural towns usually have a roadway section that has a main street character (or even a town square) with on-street parking and sidewalks and in some cases bicycle lanes.
Suburban 	Diverse range of commercial and residential uses that have a medium density. The buildings tend to be multistory with off-street parking. Sidewalks are usually present, and bicycle lanes may exist. The range of uses encompasses health services, light industrial (and sometimes heavy industrial) uses, quick-stop shops, gas stations, restaurants, and schools and libraries. Typically, suburban areas rely heavily on passenger vehicles, but some transit may be present.
Urban 	High density, consisting principally of multistory and low- to medium-rise structures for residential and commercial use. Areas usually exist for light and sometimes heavy industrial use. Many structures accommodate mixed uses: commercial, residential, and parking. Streets have minimal on-street parking. Wide sidewalks and plazas accommodate more intense pedestrian traffic, while bicycle lanes and transit corridors are frequently present.
Urban Core 	Highest level of density with its mixed residential and commercial uses accommodated in high-rise structures. While there may be some on-street parking, it is usually very limited and time restricted. Most parking is in multilevel structures attached or integrated with other structures. The area is accessible to automobiles, commercial delivery vehicles, and public transit. Sidewalks and pedestrian plazas are present along with multilevel pedestrian bridges connecting commercial and parking structures. Bicycle facilities and transit corridors are typically common.

Roadway type follows the Expanded Functional Class system as outlined in NCHRP Report 855 (Stamatiadis et al., 2018). Descriptions of each roadway type are provided in Table 3.7. The macro-enabled SLS-Tool automatically determines the SLSG based on the inputs for roadway context and type and lists the SLSG directly above the suggested speed limit. Section 3.5 of this chapter describes the process of determining the SLSG of a roadway. The SLSG is displayed in the Analysis Results category below the site description data as shown previously in Figure 3.4.

Table 3.7 Roadway Type Characteristics

Roadway Type	Characteristics
Limited-Access Freeways	Corridors of national importance connecting large centers of activity over long distances
Principal Arterials	Corridors of regional importance connecting large centers of activity
Minor Arterials	Corridors of regional or local importance connecting centers of activity
Collectors	Roadways of lower local importance providing connections between arterials and local roads
Locals	Roads with no regional or local importance for local circulation and access only

The next cell in the site description data category asks, “Are crash data available?” which is a “yes” or “no” question that acts as a mechanism to hide or open the crash data category input cells depending on data availability. The remaining six input cells are not required for the analysis, but are available for recording the analyst’s name, study date, roadway name, study description, current speed limit, and additional notes. Figure 3.7 shows the cells in the site description data category as well as a portion of the Analysis results category that displays the SLSG determination.

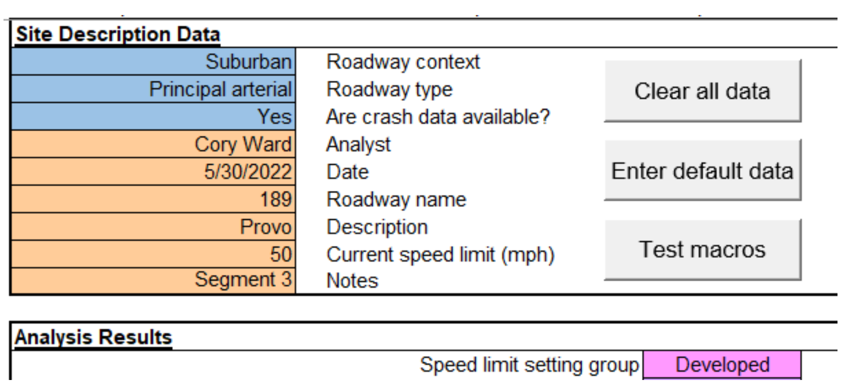

Figure 3.7 SLS-Tool Site Description Data.

3.6.2 SLS Tool Input Variables: Speed Data

The types of speed data required by the SLS-Tool analysis tab in the speed data category are maximum speed limit, 85th percentile speed, and 50th percentile speed. Figure 3.8 displays the input cells in the speed data category of the SLS-Tool. The maximum speed limit is defined as the highest allowable speed limit that may be set for the given roadway (Fitzpatrick et al., 2021b). The value may be set by the user or align with the SLSG upper speed limit as set in the Support Tables tab. The default upper and lower speed limits by SLSG were previously shown in Figure 3.3.

Speed Data	
55	Maximum speed limit (mph)
56.3	85th-percentile speed (mph)
51.4	50th-percentile speed (mph)

Figure 3.8 SLS-Tool Speed Data.

At the end of the analysis, the suggested speed limit will be based off either the maximum speed limit, the 85th percentile speed, or the 50th percentile speed. The limited-access SLSG only considers the 50th percentile speed. The suggestion may be rounded to the closest 5-mph increment or automatically rounded down. The options for the suggested speed limit are described in Table 3.8.

Table 3.8 Suggested Speed Limits and Circumstances for Use

Suggested Speed Limit	Abbreviation	Circumstances for Use
85^{th} percentile speed rounded to the closest 5-mph increment	C85	- Optimal roadway conditions for Limited-Access, Undeveloped, or Developed SLSGs
85^{th} percentile speed rounded down to the closest 5-mph increment	RD85	- Conditions are between C85 and C50 for Limited-Access, Undeveloped, or Developed SLSGs
50^{th} percentile speed rounded to the closest 5-mph increment	C50	- Optimal roadway conditions for Full-Access SLSG - Unfavorable roadway conditions for some or all users for Limited-Access, Undeveloped, or Developed SLSGs - Crashes are a significant concern for Limited-Access, Undeveloped, or Developed SLSGs
50^{th} percentile speed rounded down to the closest 5-mph increment	RD50	- Unfavorable roadway conditions for some or all users for Full-Access SLSG - Crashes are a significant concern for Full-Access SLSG

3.6.3 SLS-Tool Input Variables: Site Characteristics

In the site description category of the SLS-Tool Analysis tab, the quantity and type of data that are asked for depend on the SLSG that is being used. The developed SLSG asks for information about traffic signals, bicycles, pedestrians, and parking. Figure 3.9 SLS-Tool Site Characteristics of a Developed SLSG. displays the site characteristic category of the SLS-Tool for the Developed SLSG. The undeveloped SLSG does not require information about traffic signals, bicycles, pedestrians, or parking because they are presumed to be non-existent or minimal in rural areas. Instead, the undeveloped SLSG requires information about the lane and shoulder widths. Figure 3.10 displays the site characteristics category of the SLS-Tool for the Undeveloped SLSG. A summary of input variables required for all four of the SLSGs and their potential data sources is listed in Table 3.9.

Site Characteristics	
3.02	Segment length (mi)
4	Number of lanes (two-way total)
TWLTL	Median type
6	Number of traffic signals
35	Number of access points (total of both directions)
High / Separated	Bicyclist activity / bike lane type
Wide	Sidewalk presence / width
Present	Sidewalk buffer
High	Pedestrian activity
Not high	On-street parking activity
No	Parallel parking permitted?
No	Angle parking present?
No	Adverse alignment present?

Figure 3.9 SLS-Tool Site Characteristics of a Developed SLSG.

Site Characteristics	
3.02	Segment length (mi)
1,867	AADT (two-way total) (veh/d)
4	Number of lanes (two-way total)
Undivided	Median type
25	Number of access points (total of both directions)
12	Lane width (ft)
2	Shoulder width (ft)
No	Adverse alignment present?

Figure 3.10 SLS-Tool Site Characteristics of an Undeveloped SLSG.

Table 3.9 Site Characteristics Input Variables and Sources for Each SLSG

		SLSG			
Roadway Segment Variable	**Sources**	**Limited-Access**	**Undeveloped**	**Developed**	**Full-Access**
Annual Average Daily Traffic (AADT) (veh/d)	Department records	✓	✓		

Table 3.9 continued

Roadway Segment Variable	Sources	SLSG Limited-Access	SLSG Undeveloped	SLSG Developed	SLSG Full-Access
Adverse alignment present (yes or no)	Site study; Department records; Google Maps	✓	✓	✓	✓
Angle parking present (no, yes for at least 40 percent of the segment, or yes for less than 40 percent of the segment)	Site study; Department records; Google Maps			✓	✓
Bicyclist activity (high or not high)	Site study; Department records			✓	✓
Design speed (mph), used with grade to identify mountainous terrain	Design records; current speed limit	✓			
Directional design-hour truck volume (trk/hr)	Site study; Design records	✓			
Grade (%), used with design speed to identify mountainous terrain	Site study; Department records	✓			
Shoulder width (SW) (ft)	Site study; Department records	✓	✓		
Lane width (ft)	Site study; Google maps		✓		
Median type (undivided, two-way left-turn lane (TWLTL), or divided)	Site study; Department records; Google maps		✓	✓	✓
Number of access points (total of both directions)	Site study; Department records; Google maps		✓	✓	✓
Number of interchanges	Site study; Department records; Google maps	✓			
Number of lanes (two-way total)	Site study; Department records; Google maps	✓	✓	✓	✓
Number of traffic signals	Site study; Department records; Google maps			✓	✓
On-street parking activity (high or not high)	Site study; Department records; Google maps			✓	✓
Parallel parking permitted (yes or no)	Site study; Department records; Google maps			✓	
Pedestrian activity (high, some, or negligible)	Site study; Department records; Google maps			✓	✓
Segment length (mi)	Site study; Google maps	✓	✓	✓	✓
Sidewalk buffer (present or not present)	Site study; Department records; Google maps			✓	✓
Sidewalk presence/width (none, narrow, adequate, or wide)	Site study; Department records; Google maps			✓	✓

3.6.4 SLS-Tool Input Variables: Crash Data

The final category of input data in the SLS-Tool analysis tab is crash data. This category is not necessary to complete the analysis. The category will not appear if the analyst indicated that the crash data are not available in the site distribution category. The input cells from the SLS-Tool are shown in Figure 3.11. It may be helpful to exclude this category from the analysis if crash data are unavailable or difficult to obtain. Crash data are considered by comparing the crash rate [crashes/100 million vehicle miles (MVM)] for the segment with crash rates from the Highway Safety Information System (HSIS). The HSIS values may be replaced with crash rates from similar road sections in the jurisdiction if desired (Fitzpatrick et al., 2021b). Crash severity is determined by taking measure of both the KABCO and KABC values where:

- K = fatal
- A = incapacitating injury (suspected serious injury)
- B = non-incapacitating injury (suspected minor injury)
- C = possible injury
- O = no injury, property damage only (PDO)

Crash Data		
3	Number of years of crash data	
29,223	Average AADT for crash data period (veh/d)	
132	All (KABCO) crashes for crash data period	
87	Fatal & injury (KABC) crashes for crash data period	
	Average KABCO crash rate (crashes / 100 MVMT)	
	Average KABC crash rate (crashes / 100 MVMT)	
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	161.9
	1.3 x average KABC crash rate (crashes / 100 MVMT)	53.5
	Critical KABCO crash rate (crashes / 100 MVMT)	143.7
	Critical KABC crash rate (crashes / 100 MVMT)	52.4

Figure 3.11 SLS-Tool crash data.

The calculated crash rate from the SLS-Tool is shown in Figure 3.12. A summary of crash data inputs for each SLSG and potential data sources is provided in Table 3.10.

Advisory, Calculated, or Warning Messages

Observed KABCO crash rate = 136.59 crashes / 100 MVMT
Observed KABC crash rate = 90.03 crashes / 100 MVMT
HSIS average KABCO crash rate = 124.54 crashes / 100 MVMT
HSIS average KABC crash rate = 41.14 crashes / 100 MVMT

Figure 3.12 SLS-Tool crash data calculations example.

Table 3.10 Input Variables and Sources When Crash Data are Available

Crash Data Variable	Sources	SLSG			
		Limited-Access	Undeveloped	Developed	Full-Access
Number of years of crash data	Site records	✓	✓	✓	✓
Average AADT (two-way total) for crash data period (veh/d)	Department records	✓	✓	✓	✓
All (KABCO) crashes for crash data period	Site records	✓	✓	✓	✓
Fatal and injury (KABC) crashes for crash data period	Site records	✓	✓	✓	✓
Average KABCO crash rate (crashes/100 MVM) and average KABC crash rate (crashes/100 MVM) If not provided, the KABCO and KABC crash rates from HSIS are used	Site records	✓	✓	✓	✓
Is the segment a one-way street?	Site study; Department records			✓	✓
Number of lanes (pulled from the Site Characteristics section)	Site study; Department records	✓	✓	✓	✓
Median type (pulled from the Site Characteristics section)	Site study; Department records		✓	✓	✓

3.6.5 SLS-Tool Results

Once all required fields are filled, the SLS-Tool calculates a suggested speed limit based on the data and support tables. The options for the suggested speed limit were described previously in Table 3.8. On the rare occasion when the 85th and 50th percentile speeds are within 1 mph of each other, the rounded-down 85th percentile speed may be lower than the closest 50th percentile speed and should be interpreted with caution (Fitzpatrick et al., 2021b).

In addition to the suggested speed limit, the SLS Tool also generates advisory, calculated, and warning messages. The messages appear on the right column of the SLS-Tool analysis tab as shown previously in Figure 3.4. Advisory messages are used to call attention to issues that are not errors but could be improved. One such message that may show up indicates that a segment may be too short as defined by the minimum segment lengths by speed limit in the support tables tab as shown in Table 3.11. It is still possible to calculate a suggested speed limit, however, the result is less reliable. The segment should be combined with an adjacent segment that shares similar site characteristics. Otherwise, the segment could be considered a transition segment where a roadway is changing contexts and the speed limit needs to rapidly decrease (Fitzpatrick et al., 2021b).

Table 3.11 SLS-Tool Minimum Segment Length by Speed Limit

Speed Limit (mph)	Minimum Length (mi)
20	0.30
25	0.30
30	0.30
35	0.35
40	0.40
45	0.45
50	0.50
55	0.55
60	1.20
65	3.00
70	6.20
75	6.20
80	6.20
85	6.20

The advisory messages also indicate which variables trigger the type of suggested speed limit as defined in Table 3.8. Calculated messages describe calculation results that fall below the threshold of suggesting a speed limit that is not the closest 85th percentile speed. The results can be compared to the threshold values in the support tables and default values Excel sheet tab. Warning messages call attention to erroneous input data. Warning messages should be avoided in the final analysis. A list of possible advisory, calculated, and warning messages is provided in Table 3.12. It should also be noted that although the suggested speed limit produced by the SLS-Tool is based on approved procedures and practices, the results are merely intended as a guide and should be subject to the professional judgment of a practicing engineer or other professional (Fitzpatrick et al., 2021b).

The suggested speed limit appears in the purple box in the analysis results category of the SLS-Tool analysis tab. Although the suggested speed limit will change as the data are entered, the suggested result is final when the data are correct, and any warning messages are resolved (Fitzpatrick et al., 2021b).

Table 3.12 SLS Tool Advisory, Calculated, and Warning Messages

Condition	Message
Missing required data	Enter values for all variables marked with O. (An O will appear to the right of empty input cells.)
Missing roadway context or roadway type	Specify roadway context and roadway type in cells B5 and B6.
Completed calculations	This value is determined by <x> (The quantity x is specified as the maximum speed limit, speed data, site characteristics, and/or crash data, depending on which variables governed the setting of the speed limit.)
Completed calculations but with maximum speed limit out of range (too high)	The calculated value exceeds the upper value for this speed limit setting group; therefore, the suggested speed limit reflects the assumed upper value.
Completed calculations but with maximum speed limit out of range (too low)	The calculated value is below the lower value for this SLSG; therefore, the suggested speed limit reflects the assumed lower value.
Maximum speed limit out of range (too high)	The assumed upper value for this SLSG is <min> mph.
Maximum speed limit out of range (too low)	The assumed lower value for this SLSG is <min> mph.

Table 3.12 Continued

Condition	Message
50th percentile speed is greater than 85th percentile speed	The 85th percentile must be greater than the 50th percentile.
85th percentile speed is only 1 mph greater than 50th percentile speed (suggesting a very tight speed distribution)	The 85th percentile is only 1 mph greater than the 50th percentile. Interpret results with caution.
Segment length < Minimum_Segment_Length	For a suggested speed limit of x mph, minimum segment length = y mi.
Adverse alignment present	Consider location-specific advisory speed warnings.
Less than 1 year of crash data	Calculations based on 1 year of crash data or less and should be interpreted with caution.
Less than 3 years of crash data	Consider collecting at least 3 years of crash data.
Average crash rates are greater than computed critical crash rates	Critical rates should be higher than average rates.
The entered number of KABC crashes is greater than the entered number of KABCO crashes	The number of KABC crashes must be less than or equal to the number of KABCO crashes.
Crash rates are calculated from input data	Observed/average KABCO/KABC crash rate = x crashes/100 MVM. (For average crash rates, the message will also specify "from User" if the user provided the rate or "from HSIS" if the user did not provide the rate.)
Input data value justifies lowering the speed limit below the closest 85th percentile value	Rounded-down 85th, closest 50th, or rounded-down 50th percentile value.

3.7 Summary

Information about the research in the NCHRP Project 17-76 report was described in this chapter. The chapter summarized both documents from the report: "Development of a Posted Speed Limit Setting Procedure and Tool" (Fitzpatrick et al., 2021a) and "Posted Speed Limit Setting Procedure and Tool: User Guide" (Fitzpatrick et al., 2021b). An important goal of the research project was to investigate the key factors that influence operating speed and safety in relation to the roadway context and location. The NCHRP Project 17-76 research team created a decision-rule-based procedure that can be used to get suggested speed limits on uniform road segments. Five road contexts and five road types form a matrix that categorizes any road segment into one of four SLSGs. The type of data that are considered for each SLSG varies based on the factors that are mostly likely to influence the operating speed and crash frequency. Finally, a summary of the SLS-Tool User Guide was included in this chapter. The SLS-Tool

User Guide informs users about the process of running the Tool to apply the SLS-Procedure to individual road segments with uniform characteristics.

4.0 METHODOLOGY

4.1 Overview

This chapter provides a description of the methodology for assessing the viability of applying the SLS-Procedure and SLS-Tool on Utah roads. The UDOT TAC met with the research team to present their goals and express how NCHRP Project 17-76 could aid in the development of an overall speed limit setting approach in Utah. The TAC sent copies of recent speed studies to evaluate using the SLS-Tool and compare the results to the recommendations in the speed study. This chapter lists the locations that were analyzed with the SLS-Tool. Then, the chapter describes data collection that was required to apply the SLS-Tool. Finally, the chapter describes how the results were recorded and compared.

4.2 Selection of Locations Analyzed

The SLS-Procedure and SLS-Tool has the capability to provide a quantitative approach to measuring how prevailing vehicle speeds, roadside conditions, and crash history should influence the selection of a speed limit that may depart from the 85^{th} percentile speed. Members of the TAC noted that the research into the application of the SLS-Procedure and SLS-Tool on existing UDOT roads could aid in helping identify a speed limit that they should want to attain on a road segment. Once that speed is identified, a speed management study could help determine how to achieve that speed goal. In most cases, artificially lowering speed limits does not lead to vehicles lowering their speeds. If the results of the SLS-Procedure and SLS-Tool show that speed limits should be lowered on these roadway segments, then speed management strategies do more to help encourage driving at the posted speed limit.

Members of the TAC and the research team decided that to assess the viability of applying the NCHRP Project 17-76 SLS-Procedure and SLS-Tool on Utah roads, the process should be applied to a wide range of locations. The locations should be representative of various differences in geography, context, functional classification, and speed. Initially, the TAC members suggested a few specific locations that had specific concerns. However, to ascertain the effect of the SLS-Procedure and SLS-Tool on a wide range of roads, the members of the TAC sent the research team a collection of speed studies that were conducted between November of 2020 and September of 2021. The TAC was interested in learning how the result of an analysis using the SLS-Tool compared to the traditional speed study recommendations. The research team analyzed 29 speed studies provided by UDOT TAC members. A list of these locations is found in Table 4.1. Chapter 5 describes each of these studies, how they were analyzed, the data that were collected, and the results of the SLS-Tool compared with the results of the speed studies recommendations.

Table 4.1 List of Speed Study Locations Analyzed

Name	Location	Mile Points
Primarily Undeveloped SLSG Locations		
SR 147	West Mountain	0.00-3.80
SR 65	East of Salt Lake City	0.00-8.38
SR 14	Cedar City to Duck Creek Village	17.00-27.70
SR 191	Duchesne County	269.00-294.50
SR 87	Duchesne	6.00-10.00
SR 78	Levan	0.00-9.40
US Highway 6	West of Santaquin	155.75-159.00
SR 13	Elwood	17.30-18.70
Primarily Developed SLSG Locations		
SR 164	Spanish Fork	1.60-2.73
SR 85	Mountain View Corridor	2.673-20.248
SR 85	Mountain View Corridor	20.248-22.300
SR 92	Highland	3.50-7.50
SR 60	South Weber	5.91-7.42
US Highway 89	Springville	329.63-330.79
SR 115	Spanish Fork	7.25-8.25
SR 113	Midway	3.30-3.90
SR 222	Midway	0.225-0.450
US Highway 189	Provo	3.42-7.42
SR 129	Pleasant Grove and Lindon	0.492-2.998
SR 135	Pleasant Grove and Lindon	0.000-0.731
SR 126	Roy	8.267-9.223
SR173	Kearns and Salt Lake City	2.77-5.00
Transition Zone Mixed SLSG Locations		
US Highway 89/89A	Kanab	62.20-65.50, 0.00-2.94
US Highway 40	Roosevelt to Gusher	115.50-126.30
US Highway 40	Vernal	62.2-65.5
US Highway 89	Orderville	85.00-87.20
SR 121	Roosevelt	0.00-3.00
SR 10	Ferron	24.20-27.20
SR 73	Eagle Mountain	29.50-35.40

4.3 Data Collection

Much of the data needed to analyze the road segments recommended by UDOT were provided in the speed studies provided to the research team. Any data not available in the studies was obtained through websites such as the UDOT Open Data Portal (https://data-uplan.opendata.arcgis.com/), UDOT Roadview Explorer (https://roadview.udot.utah.gov/utah/index.php), Google Maps (https://www.google.com/maps), Iteris ClearGuide (https://auth.iteris-clearguide.com), and AASHTOWare Safety (https://udot.aashtowaresafety.com). A list of the specific data inputs and the sources used by the research team to locate the data are presented in Table 4.2. No limited-access road segments were studied during this project, so inputs specific to the Limited-Access SLSG are not represented.

Table 4.2 SLS Tool Data and Sources

Source	Max Speed Limit	85th Percentile Speed	50th Percentile Speed	Segment Length	AADT	Number of Lanes	Median Type	Number of Access Types	Lane Width	Shoulder Width	Number of Interchanges	Number of Traffic Signals	Bicyclist Activity	Sidewalk Presence Width	Sidewalk Buffer	Pedestrian Activity
UDOT Speed Study	✓	✓	✓	✓			✓						✓			✓
Iteris ClearGuide		✓	✓													
Google Maps						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Roadview Explorer						✓	✓	✓				✓	✓		✓	✓
UDOT Open Data Portal					✓				✓	✓						

4.4 Recording Results

The data gathered to fill the requirements for the SLS-Tool analysis were recorded in one central spreadsheet. This allowed for revisions in the analysis without the need of verifying all of the data that were already gathered. The final recommendation for a posted speed limit on each uniform section was gathered and recorded on this spreadsheet. In addition, a screenshot was taken of the SLS-Tool with the data filled in the applicable cells and the advisory messages available. A screenshot of the SLS-Tool is shown in Figure 4.1. The advisory messages indicate what data or site characteristics required the closest 50th percentile speed or the rounded-down 85th percentile speed to be used for the suggested speed limit recommendation. The research team did not alter any of the thresholds in the default values and support tables of the SLS-Tool. The data, the type of speed percentile used, and the suggested speed limit for each segment that was analyzed is summarized in section 5.2 through section 5.4 of this report.

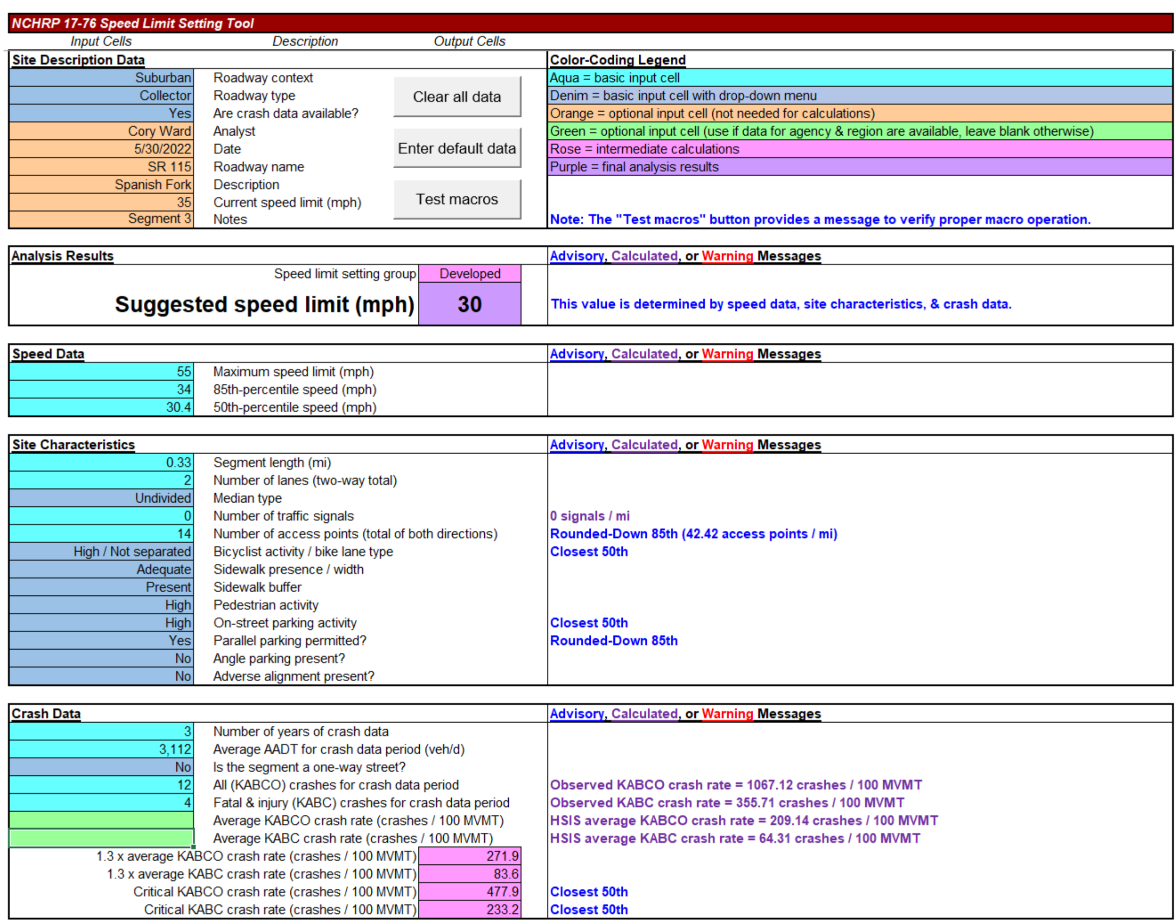

Figure 4.1 SLS Tool screenshot from SR 115 in Spanish Fork.

4.5 Summary

Under advisement from the TAC, the research team was provided with details for several locations across Utah where speed studies were recently conducted by UDOT to analyze using the SLS-Tool. Data used in the SLS-Tool analyses were gathered from UDOT speed studies and online resources such as the UDOT Open Data Portal, Google Maps, and AASHTOWare Safety. The results from each analysis were recorded in an Excel spreadsheet and compared with the results from previous speed studies performed by UDOT.

5.0 DESCRIPTION OF LOCATIONS ANALYZED

5.1 Overview

This chapter provides a description of the 29 speed studies that were evaluated using the SLS-Tool. A brief description each roadway, how it was broken into segments for analysis using the SLS-Tool, and the justification for the suggested speed limit is summarized in each location description and accompanying table. The total number of segments analyzed is 66. To aid in the analysis, each location was grouped into primarily undeveloped SLSG, developed SLSG, and transition or mixed SLSG locations. The results are described in the following sections.

5.2 Primarily Undeveloped SLSG Locations

This section contains the speed studies that are primarily located in rural areas that have little or no development nearby. All of the segments in this section are located in rural and rural town areas. A summary of the list of the speed study locations analyzed was provided previously in Table 4.1.

5.2.1 SR 147: West Mountain (MP 0.00-3.80)

The 3.8-mile segment of SR 147 near the unincorporated community of West Mountain in Utah County is a major collector road set in a rural context with a posted speed of 50 mph for the entire segment. A 2020 UDOT speed study found that the 85th percentile speed on this segment exceeds the posted speed by 5 to 8 mph. Based on UDOT policy 06C-25, the speed study recommends the region consider increasing the speed limit to 55 mph.

Because of the uniformity of the segment, the road was analyzed as one segment in the SLS-Tool. Due to the high crash rate combined with the relatively low volume on the segment, the suggested speed limit based on the SLS-Tool procedure is 50 mph. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.1.

Table 5.1 SR 147 Summary of Results

Analysis Recommendations			
Posted Speed	50 mph	**SLS-Tool Result**	50 mph
UDOT-Study Recommendations	Increase to 55 mph	**SLS-Tool Suggestion**	No Change
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	September 24, 2020	**Reason for Suggestion:**	High KABCO Crash Rate
Input Data			
Functional Class	Collector	**AADT**	578 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	0.00-3.80	**85th Percentile**	55.7 mph
Segment Length	3.8 mi	**50th Percentile**	48.6 mph
Travel Lanes	2	**Years of Crash Data**	3.6
Access Points	58	**Average AADT**	578 vpd
Lane Width	11 ft	**All Crashes**	12
Shoulder Width	1 ft	**KABC Crashes**	1

5.2.2 SR 65: East of Salt Lake City (MP 0.00-8.38)

The 8.38-mile segment of SR 65 east of Salt Lake City near the Little Dell Reservoir is a major collector road set in a rural context with posted speeds of 50 mph, 45 mph, and 35 mph. A 2021 UDOT speed study found that the 85th percentile speed on these segments exceeds the posted speed by 7 to 15 mph. Based on UDOT policy 06C-25, the speed study recommends the region consider increasing the speed limits to 60 mph, 50 mph, and 40 mph. In addition, the results of a ball bank study recommended multiple places that advisory speed signing at horizontal curves needs to be updated.

The road was analyzed in three segments in the SLS-Tool. The suggested speed limits based on the SLS-Tool procedure are 60 mph, 55 mph, and 45 mph. Because of satisfactory road conditions, the Tool suggests speed limits at the 85th percentile. If crash rates were to increase in the future, the SLS-Tool would likely suggest speed limits closer to the 50th percentile. Furthermore, the UDOT speed study recommendation was likely more conservative than the SLS-Tool suggestion due to the data that they received from the ball bank study, which was not considered in the SLS-Tool. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.2 through Table 5.4.

Table 5.2 SR 65 Segment 1 Summary of Results

Analysis Recommendations			
Posted Speed	50 mph	**SLS-Tool Result**	60 mph
UDOT-Study Recommendations	Increase to 60 mph	**SLS-Tool Suggestion**	Increase to 60 mph
		Speed Percentile Used	Closest 85th Percentile Speed
UDOT Study Date	May 25, 2021	**Reason for Suggestion:**	Satisfactory Conditions
Input Data			
Functional Class	Collector	**AADT**	1506 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	0.00-2.47	**85th Percentile**	60.7 mph
Segment Length	2.47 mi	**50th Percentile**	54.0 mph
Travel Lanes	3	**Years of Crash Data**	5
Access Points	24	**Average AADT**	1506 vpd
Lane Width	12 ft	**All Crashes**	10
Shoulder Width	5 ft	**KABC Crashes**	4

Table 5.3 SR 65 Segment 2 Summary of Results

Analysis Recommendations			
Posted Speed	45 mph	**SLS-Tool Result**	55 mph
UDOT-Study Recommendations	Increase to 50 mph	**SLS-Tool Suggestion**	Increase to 55 mph
		Speed Percentile Used	Closest 85th Percentile Speed
UDOT Study Date	May 25, 2021	**Reason for Suggestion:**	Satisfactory Conditions
Input Data			
Functional Class	Collector	**AADT**	746 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	2.47-5.26	**85th Percentile**	54.1 mph
Segment Length	2.47 mi	**50th Percentile**	47.0 mph
Travel Lanes	2	**Years of Crash Data**	5
Access Points	4	**Average AADT**	746 vpd
Lane Width	11 ft	**All Crashes**	6
Shoulder Width	1.5 ft	**KABC Crashes**	4

Table 5.4 SR 65 Segment 3 Summary of Results

Analysis Recommendations			
Posted Speed	35 mph	**SLS-Tool Result**	45 mph
UDOT-Study Recommendations	Increase to 40 mph	**SLS-Tool Suggestion**	Increase to 45 mph
		Speed Percentile Used	Closest 85th Percentile Speed
UDOT Study Date	May 25, 2021	**Reason for Suggestion:**	Satisfactory Conditions
Input Data			
Functional Class	Collector	**AADT**	746 vpd
Context	Rural	**Adverse Alignment**	Yes
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	5.26-8.38	**85th Percentile**	44.3 mph
Segment Length	2.47 mi	**50th Percentile**	38.1 mph
Travel Lanes	2	**Years of Crash Data**	5
Access Points	3	**Average AADT**	746 vpd
Lane Width	11 ft	**All Crashes**	6
Shoulder Width	1.7 ft	**KABC Crashes**	5

5.2.3 SR 14: Cedar City to Duck Creek Village (MP 17.00-27.70)

The 10.5-mile segment of SR 14 east of Cedar City to Duck Creek Village is a minor arterial road set in a rural context with a posted speed of 40 mph from mile point (MP) 17.00 to 17.20 and a posted speed of 50 mph from MP 17.20 to 27.70. A 2021 UDOT speed study found that the 85th percentile speed on these segments exceeds the posted speed by 9 to 19 mph. Based on UDOT policy 06C-25, the speed study recommends the region consider increasing the speed limit to 60 mph from MP 17.20 to 27.70.

The road was analyzed in one segment with the SLS-Tool. The 0.20-mile section from MP 17.00 to 17.20 is typically considered too small for the SLS-Procedure as defined in Table 3.11. An analysis of this segment should include additional road miles adjacent to this segment. Therefore, only the 10.5-mile segment was analyzed with the SLS-Tool. The suggested speed limit on this segment based on the SLS-Tool procedure is 60 mph. Because of satisfactory road conditions, the Tool suggested speed limits at the 85th percentile. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.5.

Table 5.5 SR 14 Summary of Results

Analysis Recommendations			
Posted Speed	50 mph	**SLS-Tool Result**	60 mph
UDOT-Study Recommendations	Increase to 60 mph	**SLS-Tool Suggestion**	Increase to 60 mph
		Speed Percentile Used	Closest 85th Percentile Speed
UDOT Study Date	May 4, 2021	**Reason for Suggestion:**	Satisfactory Conditions
Input Data			
Functional Class	Minor Arterial	**AADT**	2188 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	17.20-27.70	**85th Percentile**	62.6 mph
Segment Length	10.50 mi	**50th Percentile**	56.3 mph
Travel Lanes	2	**Years of Crash Data**	3.3
Access Points	12	**Average AADT**	2188 vpd
Lane Width	11 ft	**All Crashes**	36
Shoulder Width	2 ft	**KABC Crashes**	3

5.2.4 SR 191: Duchesne County (MP 269.00-294.50)

The 24.23-mile segment of SR 191 in Duchesne County is a minor arterial road set in a rural context with a posted speed of 55 mph from MP 269.75 to 293.98. The speed study also includes a 0.75-mile section from MP 269.00 to 269.75 with a posted speed of 40 mph which includes a number of horizontal curves. A 2021 UDOT speed study found that the 85th percentile speed on these segments exceeds the posted speed by 12 to 21 mph. Based on UDOT policy 06C-25, the speed study recommends the region consider increasing the speed limit to 60 mph from MP 269.50 to 293.98.

The SLS-Tool is not able to advise on advisory speed limits found on horizontal curves. The study area also includes a 0.52-mile segment from MP 293.98 to 294.5 with a posted speed of 40 mph that transitions to and from residential streets in Duchesne. These two segments were not considered appropriate for the SLS-Tool because the segments serve as a transition segment between contexts. The suggested speed limit based on the SLS-Tool procedure is 65 mph. Because of satisfactory road conditions, the Tool suggests speed limits at the 85th percentile. Because Utah State Code and the SLS-Tool both cap undeveloped segments at 65 mph, the SLS-Tool suggestion cannot be 70 mph. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.6.

Table 5.6 SR 191 Summary of Results

Analysis Recommendations			
Posted Speed	55 mph	**SLS-Tool Result**	65 mph
UDOT-Study Recommendations	Increase to 60 mph	**SLS-Tool Suggestion**	Increase to 65 mph
		Speed Percentile Used	N/A
UDOT Study Date	January 14, 2021	**Reason for Suggestion:**	Maximum Speed Permitted
Input Data			
Functional Class	Minor Arterial	**AADT**	2167 vpd
Context	Rural	**Adverse Alignment**	Yes
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	269.75-293.98	**85th Percentile**	70.8 mph
Segment Length	24.23 mi	**50th Percentile**	63.0 mph
Travel Lanes	2	**Years of Crash Data**	4
Access Points	55	**Average AADT**	2167 vpd
Lane Width	12 ft	**All Crashes**	59
Shoulder Width	2.1 ft	**KABC Crashes**	6

5.2.5 SR 87: Duchesne (MP 6.00-10.00)

The 4.00-mile segment of SR 87 near Duchesne is a major collector road set in a rural context with a posted speed of 60 mph from MP 6.00 to 9.45 and 55 mph from MP 9.45 to 10.00. A 2021 UDOT speed study found that the 85th percentile speed on these segments exceeds the posted speed by 7 to 13 mph. Based on UDOT policy 06C-25, the speed study recommends the region consider increasing the speed limit on both segments to 65 mph.

The road was analyzed as one segment with the SLS-Tool. The suggested speed limit based on the SLS-Tool procedure is 65 mph. Because of the small shoulder width, the Tool suggests a speed limit that is rounded down from the 85th percentile. The Tool caps undeveloped SLSG segments at 65 mph, as does Utah State Code. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.7.

Table 5.7 SR 87 Summary of Results

Analysis Recommendations			
Posted Speed	60 mph	**SLS-Tool Result**	65 mph
UDOT-Study Recommendations	Increase to 65 mph	**SLS-Tool Suggestion**	Increase to 65 mph
		Speed Percentile Used	Closest 85th Percentile Speed
UDOT Study Date	January 13, 2021	**Reason for Suggestion:**	Satisfactory Road Conditions
Input Data			
Functional Class	Collector	**AADT**	1867 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	6.00-10.00	**85th Percentile**	66.9 mph
Segment Length	4.00 mi	**50th Percentile**	60.5 mph
Travel Lanes	2	**Years of Crash Data**	4
Access Points	25	**Average AADT**	1897 vpd
Lane Width	12 ft	**All Crashes**	3
Shoulder Width	2.0 ft	**KABC Crashes**	1

5.2.6 SR 78: Levan (MP 0.00-9.40)

The 9.40-mile segment of SR 78 east of Levan is a major collector road set in a rural context with posted speeds of 45 mph and 60 mph. The 0.31-mile segment in the town of Levan is set in a rural town context with a posted speed of 35 mph. A 2020 UDOT speed study found that the 85th percentile speed on most of the segments exceeds the posted speed by 6 to 18 mph. Based on UDOT policy 06C-25, the speed study recommends the region consider increasing the speed limit in the largest segment to 65 mph; the other segments are recommended to remain the same.

The road was analyzed in three segments in the SLS-Tool. The suggested speed limits based on the SLS-Tool procedure support the study recommendations. Because of satisfactory road conditions, the Tool suggests speed limits at the 85th percentile for the rural segments. The rural town segment in Levan (segment 3) was analyzed as a Full-Access SLSG, which only considers the 50th percentile speed. It should be noted that the functional class of major collector does not exist in the SLS-Tool; the segment may have also been analyzed as a minor arterial and a Developed SLSG. However, classifying the segment as Full Access was determined to be more appropriate. The resulting analysis recommends a 40-mph speed limit in this segment. This suggestion derives from a lack of sidewalk presence, resulting in recommending the rounded-down 85th percentile speed. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.8 through Table 5.10.

Table 5.8 SR 78 Segment 1 Summary of Results

	Analysis Recommendations		
Posted Speed	45 mph	**SLS-Tool Result**	45 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 85th Percentile Speed
UDOT Study Date	December 7, 2020	**Reason for Suggestion:**	Satisfactory Road Conditions
	Input Data		
Functional Class	Collector	**AADT**	803 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	0.00-0.62	**85th Percentile**	46.8 mph
Segment Length	0.62 mi	**50th Percentile**	38.3 mph
Travel Lanes	2	**Years of Crash Data**	3.9
Access Points	4	**Average AADT**	803 vpd
Lane Width	12 ft	**All Crashes**	0
Shoulder Width	5 ft	**KABC Crashes**	0

Table 5.9 SR 78 Segment 2 Summary of Results

	Analysis Recommendations		
Posted Speed	60 mph	**SLS-Tool Result**	65 mph
UDOT-Study Recommendations	Increase to 65	**SLS-Tool Suggestion**	Increase to 65
		Speed Percentile Used	N/A
UDOT Study Date	December 7, 2020	**Reason for Suggestion:**	Maximum Speed Permitted
	Input Data		
Functional Class	Collector	**AADT**	803 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	0.62-9.09	**85th Percentile**	71.4 mph
Segment Length	8.47 mi	**50th Percentile**	61.8 mph
Travel Lanes	2	**Years of Crash Data**	3.9
Access Points	20	**Average AADT**	803 vpd
Lane Width	12 ft	**All Crashes**	5
Shoulder Width	4 ft	**KABC Crashes**	0

Table 5.10 SR 78 Segment 3 Summary of Results

Analysis Recommendations			
Posted Speed	35 mph	**SLS-Tool Result**	35 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	December 7, 2020	**Reason for Suggestion:**	Full Access only considers 50th percentile speed
Input Data			
Functional Class	Collector	**AADT**	803 vpd
Context	Rural Town	**Adverse Alignment?**	No
SLSG	Full Access	**Max Speed Limit**	30 mph
Mile Points (MP)	9.09-9.40	**85th Percentile**	N/A
Segment Length	0.31 mi	**50th Percentile**	36.5 mph
Bicyclist Activity/ Bike Lane Type	Not High/ Any Type	**On-street Parking Activity**	Not High
Sidewalk Presence / Width	None	**Parallel Parking Permitted?**	No
Sidewalk Buffer	None	**Angle Parking Present?**	No
Pedestrian Activity	Negligible	**Years of Crash Data**	3.9
Median Type	Undivided	**Average AADT**	803 vpd
Travel Lanes	2	**One-way Street?**	No
Access Points	8	**All Crashes**	0
Traffic Signals	0	**KABC Crashes**	0

5.2.7 US 6: West of Santaquin (MP 155.75-159.00)

The 3.25-mile segment of U.S. 6 west of Santaquin is a minor arterial road set in a rural context with posted speeds of 60 mph and 50 mph. A 2020 UDOT speed study found that the 85^{th} percentile speed matches closely to the posted speeds. Based on UDOT policy 06C-25, the speed study recommends no changes to the segment.

The road was analyzed in two segments in the SLS-Tool with the mile marker separations between posted speed limit segments. The suggested speed limits based on the SLS-Tool procedure support the study recommendations. Because of satisfactory road conditions, the Tool suggests speed limits at the rounded-down 85^{th} percentile speed. It should be noted that this 50-mph segment is too short for an adequate analysis as defined previously in Table 3.11. Nevertheless, the measured 85^{th} percentile speed matches the current posted speed and the segment was analyzed anyway. The large segment has a small average shoulder width; the short segment has a high crash rate. Should the rounded-down 85^{th} percentile speed differ from the closest 85^{th} percentile speed, the results may have been different than the UDOT speed study.

The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.11 and Table 5.12.

Table 5.11 US 6 Segment 1 Summary of Results

Analysis Recommendations			
Posted Speed	60 mph	**SLS-Tool Result**	60 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Rounded-down 85^{th} Percentile Speed
UDOT Study Date	December 7, 2020	**Reason for Suggestion:**	Satisfactory Road Conditions
Input Data			
Functional Class	Minor Arterial	**AADT**	4790 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	155.75-158.74	**85^{th} Percentile**	62.0 mph
Segment Length	2.99 mi	**50^{th} Percentile**	50.4 mph
Travel Lanes	2	**Years of Crash Data**	3.9
Access Points	3	**Average AADT**	4790 vpd
Lane Width	12 ft	**All Crashes**	13
Shoulder Width	4.0 ft	**KABC Crashes**	7

Table 5.12 US 6 Segment 2 Summary of Results

Analysis Recommendations			
Posted Speed	50 mph	**SLS-Tool Result**	50 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Rounded-Down 85^{th} Percentile Speed
UDOT Study Date	December 7, 2020	**Reason for Suggestion:**	High KABCO Crash Rate
Input Data			
Functional Class	Minor Arterial	**AADT**	4790 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	158.74-159.00	**85^{th} Percentile**	51.0 mph
Segment Length	0.26 mi	**50^{th} Percentile**	46.3 mph
Travel Lanes	2	**Years of Crash Data**	3.9
Access Points	0	**Average AADT**	4790 vpd
Lane Width	12 ft	**All Crashes**	5
Shoulder Width	6 ft	**KABC Crashes**	1

5.2.8 SR 13: Elwood (MP 17.30-18.70)

The 1.4-mile segment of SR 13 near Elwood is both a major collector and a minor arterial road set in a rural context with posted speeds of 55 mph. A 2021 UDOT speed study found that the 85th percentile speed matches closely to the posted speeds. However, due to the increasing development of commercial land near the I-15 interchange, the study recommends lowering the posted speed to 50 mph for a 0.5-mile segment near the interchange.

The road was analyzed as one segment in the SLS-Tool. The suggested posted speed limit based on the SLS-Tool is 50 mph. The Tool suggests the posted speed limit at the closest 50th percentile speed for the whole segment. This is mostly due to the high KABCO crash rate. The inadequate shoulder width in several locations is also a concern that would result in a suggestion that uses the rounded-down 85th percentile speed. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.13.

Table 5.13 SR 13 Summary of Results

Analysis Recommendations			
Posted Speed	55 mph	**SLS-Tool Result**	50 mph
UDOT-Study Recommendations	Decrease to 50 mph in the segment near the interchange	**SLS-Tool Suggestion**	Decrease to 50 mph
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	April 13, 2021	**Reason for Suggestion:**	High KABCO Crash Rate
Input Data			
Functional Class	Collector	**AADT**	4869 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	17.30-18.70	**85th Percentile**	56.6 mph
Segment Length	1.40 mi	**50th Percentile**	51.5 mph
Travel Lanes	2	**Years of Crash Data**	3.3
Access Points	18	**Average AADT**	4869 vpd
Lane Width	12 ft	**All Crashes**	24
Shoulder Width	2.3 ft	**KABC Crashes**	5

5.3 Primarily Developed SLSG Locations

This section contains the speed studies that are primarily located in developed areas. Most of the segments in this section are in suburban and urban areas. A summary of the list of the speed study locations analyzed was provided previously in Table 4.1.

5.3.1 SR 164: Spanish Fork (MP 1.60-2.73)

The 1.13-mile segment of SR 164 in Spanish Fork is a major collector road set in a suburban context with posted speeds of 55 mph and 45 mph. A 2020 UDOT speed study found that the 85th percentile speed matches the posted speeds within 2 or 3 mph. Based on UDOT policy 06C-25, the speed study recommends that portions of the 55-mph segment be lowered to 45 mph at MP 1.74. This change will allow a better transition from rural to suburban conditions.

The road was analyzed in two segments in the SLS-Tool based off the existing speed limit segments. The Tool suggests speed limits at the rounded-down 85th percentile speed for both segments based off the absence of a sidewalk in this suburban area. The Tool suggests a 50-mph speed limit on segment 1 and a 45-mph speed limit on segment 2. The traffic signal density in segment 2 is also a factor for the suggested speed limit. Analyzing the proposed segments with the SLS-Tool would require additional data collection. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.14 and Table 5.15.

Table 5.14 SR 164 Segment 1 Summary of Results

	Analysis Recommendations		
Posted Speed	55 mph	**SLS-Tool Result**	50 mph
UDOT-Study Recommendations	Lower to 45 mph in some segments	**SLS-Tool Suggestion**	Decrease to 50 mph
		Speed Percentile Used	Rounded-Down 85th Percentile Speed
UDOT Study Date	September 21, 2020	**Reason for Suggestion:**	Lack of Sidewalk
	Input Data		
Functional Class	Collector	**AADT**	8334 vpd
Context	Suburban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	1.60-2.10	**85th Percentile**	53.0 mph
Segment Length	0.50 mi	**50th Percentile**	48.3 mph
Bicyclist Activity/ Bike Lane Type	Not High/ Any Type	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	None	**Parallel Parking Permitted?**	No
Sidewalk Buffer	None	**Angle Parking Present?**	No
Pedestrian Activity	Negligible	**Years of Crash Data**	4
Median Type	TWLTL	**Average AADT**	8334 vpd
Travel Lanes	2	**One-Way Street?**	No
Access Points	10	**All Crashes**	15
Traffic Signals	0	**KABC Crashes**	6

Table 5.15 SR 164 Segment 2 Summary of Results

	Analysis Recommendations		
Posted Speed	45 mph	**SLS-Tool Result**	45 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Rounded-Down 85th Percentile Speed
UDOT Study Date	September 21, 2020	**Reason for Suggestion:**	Lack of Sidewalk, Traffic Signal Density
	Input Data		
Functional Class	Collector	**AADT**	8334 vpd
Context	Suburban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	2.10-2.73	**85th Percentile**	48 mph
Segment Length	0.63 mi	**50th Percentile**	42 mph
Bicyclist Activity/ Bike Lane Type	Not High/ Any Type	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	None	**Parallel Parking Permitted?**	No
Sidewalk Buffer	None	**Angle Parking Present?**	No
Pedestrian Activity	Negligible	**Years of Crash Data**	4
Median Type	TWLTL	**Average AADT**	8334 vpd
Travel Lanes	2	**One-Way Street?**	No
Access Points	22	**All Crashes**	6
Traffic Signals	2	**KABC Crashes**	3

5.3.2 SR 85: Mountain View Corridor (MP 2.673-20.248)

The 17.29-mile segment of SR 85 (Mountain View Corridor) in Salt Lake County is a principal arterial road set in a suburban context with posted speeds of 55 mph and 65 mph. A 2021 UDOT speed study found that the 85th percentile speed on this segment exceeds the posted speed by 8 to 16 mph. Although the 85th percentile speed exceeds the posted speed limit, the speed study did not recommend any changes to the posted speed due to the high number of crashes, which is consistent with UDOT policy 06C-25.

The road was analyzed in two segments in the SLS-Tool based off the existing speed limit segments. For the 55-mph segment, the Tool suggests increasing the speed limit to 60 mph. This recommendation is based off the 50th percentile speed and is justified by the high KABC crash rate and the presence of a non-separated bike lane on the side of vehicle traffic. It should be noted that 65 mph is the normal maximum speed limit set by Utah code for state roads (State of Utah, 2022, 41-6a-602-3a). Any increase in speed limit beyond 65 mph requires additional evaluation of the impacts from increasing the speed limit (State of Utah, 2022, 41-6a-602-3c). In addition, the normal maximum speed limit for developed roads in the SLS-Tool default settings is 55 mph. For the analysis of these segments, the maximum speed limit was changed to 65 mph. This exception is justified by the fact that the current posted speed limit is 65 mph. For the northern segment with the posted speed of 65 mph, the Tool found that the road conditions were satisfactory. On this segment, there is no bicycle lane next to traffic. Both pedestrians and bicycles are presumed to use the Mountain View Corridor trail. If the Tool did not cap the speed limit at 65 mph, the suggestion would follow the 85^{th} percentile speed, which is 75 mph. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.16 and Table 5.17.

Table 5.16 SR 85 Segment 1 Summary of Results

Analysis Recommendations			
Posted Speed	55 mph	**SLS-Tool Result**	60 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	Increase to 60
		Speed Percentile Used	50^{th} Percentile Speed
UDOT Study Date	July 6, 2021	**Reason for Suggestion:**	High KABC Crash Rate, Non-Separated Bike Lane
Input Data			
Functional Class	Principal Arterial	**AADT**	20061 vpd
Context	Suburban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	65 mph
Mile Points (MP)	2.96-11.95	**85^{th} Percentile**	64.3 mph
Segment Length	8.99 mi	**50^{th} Percentile**	58.5 mph
Bicyclist Activity/ Bike Lane Type	High/Not Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Wide	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3
Median Type	Divided	**Average AADT**	20061 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	23	**All Crashes**	267
Traffic Signals	11	**KABC Crashes**	185

Table 5.17 SR 85 Segment 2 Summary of Results

Analysis Recommendations			
Posted Speed	65 mph	**SLS-Tool Result**	65 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	N/A
UDOT Study Date	July 6, 2021	**Reason for Suggestion:**	Maximum Speed Permitted
Input Data			
Functional Class	Principal Arterial	**AADT**	14208 vpd
Context	Suburban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	65 mph
Mile Points (MP)	11.95-20.248	**85th Percentile**	75.5 mph
Segment Length	8.289 mi	**50th Percentile**	69.3 mph
Bicyclist Activity/ Bike Lane Type	Not High/ Any Type	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Wide	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3
Median Type	Divided	**Average AADT**	14208 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	10	**All Crashes**	199
Traffic Signals	5	**KABC Crashes**	82

5.3.3 SR 85: Mountain View Corridor (MP 20.248-22.300)

The 2.016-mile segment of SR 85 (Mountain View Corridor) in West Valley City is a principal arterial road set in a suburban context with a posted speed of 65 mph. A 2021 UDOT speed study found that the 85th percentile speed on this segment exceeds the posted speed by 6 to 10 mph. The segment opened on June 17, 2021, and the data were collected on June 30, 2021. Although the 85th percentile speed exceeds the posted speed limit, the speed study did not recommend any changes to the posted speed because of the lack of crash data available.

The road was analyzed as one segment in the SLS-Tool. The Tool suggests keeping the posted speed limit at 65 mph. It should be noted that 65 mph is the normal maximum speed limit set by Utah code for state roads (State of Utah, 2022, 41-6a-602-3a). Any increase in speed limit beyond 65 mph requires additional evaluation of the impacts from increasing the speed limit (State of Utah, 2022, 41-6a-602-3c). In addition, the normal maximum speed limit for developed roads in the SLS-Tool default settings is 55 mph. For analysis of these segments, the maximum speed limit was set at 65 mph. This exception is justified by the fact that the current posted speed limit is 65 mph. The Tool found that the roadway conditions are satisfactory on this segment, in part because there is no bicycle lane next to traffic. Both pedestrians and bicycles are presumed to use the Mountain View Corridor trail. If the Tool did not cap the speed limit at 65 mph, the suggestion would follow the 85th percentile speed, which is 75 mph. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.18.

Table 5.18 SR 85 Segment 3 Summary of Results

Analysis Recommendations			
Posted Speed	65 mph	**SLS-Tool Result**	65 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	N/A
UDOT Study Date	July 2, 2021	**Reason for Suggestion:**	Maximum Speed Permitted
Input Data			
Functional Class	Principal Arterial	**AADT**	10000 vpd (estimate)
Context	Suburban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	65 mph
Mile Points (MP)	20.248-22.300	**85th Percentile**	73.7 mph
Segment Length	2.016 mi	**50th Percentile**	66.6 mph
Bicyclist Activity/ Bike Lane Type	Not High/ Any Type	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Wide	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	-
Median Type	Divided	**Average AADT**	-
Travel Lanes	4	**One-Way Street?**	No
Access Points	8	**All Crashes**	-
Traffic Signals	2	**KABC Crashes**	-

5.3.4 SR 92: Highland (MP 3.50-7.50)

The 4-mile segment of SR 92 in Highland is a principal arterial road set in a suburban context with posted speeds of 50 mph, 45 mph, 50 mph, and 40 mph. A 2021 UDOT speed study found that the 85th percentile speed on this segment exceeds the posted speed by 5 mph at one location only, not including the 40-mph segment that serves as a transition into American Fork Canyon. The speed study did not recommend any changes to the posted speed.

The road was analyzed as three segments in the SLS-Tool. The 40-mph segment was excluded for being too short. For the westernmost segment, the Tool suggests raising the posted speed limit from 50 mph to 55 mph due to the higher 85th percentile speed. The remaining segments resulted in suggestions consistent with the speed study recommendations. In the 45-mph segment, the 50th percentile speed was suggested due to the high crash rate, access point density, and lack of a separated bike lane. The 50-mph segment also suggested using the 50th percentile speed due to the lack of sidewalks along most of the segment as well as the lack of a separated bike lane. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.19 through Table 5.21.

Table 5.19 SR 92 Segment 1 Summary of Results

Analysis Recommendations			
Posted Speed	50 mph	**SLS-Tool Result**	55 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	Increase to 55
		Speed Percentile Used	Closest 85th Percentile Speed
UDOT Study Date	June 18, 2021	**Reason for Suggestion:**	Satisfactory Road Conditions
Input Data			
Functional Class	Principal Arterial	**AADT**	22850 vpd
Context	Suburban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	3.50-5.23	**85th Percentile**	53.5 mph
Segment Length	1.73 mi	**50th Percentile**	49.4 mph
Bicyclist Activity/ Bike Lane Type	Not High/ Any Type	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3.4
Median Type	TWLTL	**Average AADT**	22850 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	13	**All Crashes**	83
Traffic Signals	3	**KABC Crashes**	44

Table 5.20 SR 92 Segment 2 Summary of Results

Analysis Recommendations			
Posted Speed	45 mph	**SLS-Tool Result**	45 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	June 18, 2021	**Reason for Suggestion:**	High Crash Rate, Access Density, Lack of Bike Lane
Input Data			
Functional Class	Principal Arterial	**AADT**	19476 vpd
Context	Suburban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	5.23-6.67	**85th Percentile**	48.0 mph
Segment Length	1.44 mi	**50th Percentile**	44.5 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	Yes
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3.4
Median Type	TWLTL	**Average AADT**	19476 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	65	**All Crashes**	136
Traffic Signals	2	**KABC Crashes**	60

Table 5.21 SR 92 Segment 3 Summary of Results

		Analysis Recommendations	
Posted Speed	50 mph	**SLS-Tool Result**	50 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	June 18, 2021	**Reason for Suggestion:**	Lack of Sidewalk and Separated Bike Lane
		Input Data	
Functional Class	Principal Arterial	**AADT**	15683 vpd
Context	Suburban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	6.67-7.38	**85th Percentile**	54.5 mph
Segment Length	0.71 mi	**50th Percentile**	51.1 mph
Bicyclist Activity/ Bike Lane Type	Not High/ Any Type	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	No
Sidewalk Buffer	None	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3.4
Median Type	Undivided	**Average AADT**	15683 vpd
Travel Lanes	2	**One-Way Street?**	No
Access Points	15	**All Crashes**	4
Traffic Signals	0	**KABC Crashes**	3

5.3.5 SR 60: South Weber (MP 5.91-7.42)

The 1.51-mile segment of SR 60 in South Weber is a major collector road set in a suburban context with posted speeds of 40 mph and 45 mph. A 2021 UDOT speed study found that the 85th percentile speeds are within 5 mph of the posted speed limits. The speed study did not recommend any changes to the posted speed.

The road was analyzed as two segments in the SLS-Tool. The Tool recommended adopting the 50th percentile speed as the posted speed limit for both segments. The Tool recommended that the 40-mph segment remain at 40 mph due to lack of a separated bike lane and the on-street parking activity. The Tool recommended that the 45-mph segment be lowered to 40 mph due to lack of a separated bike lane and the high KABCO crash rate. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.22 and Table 5.23.

Table 5.22 SR 60 Segment 1 Summary of Results

		Analysis Recommendations	
Posted Speed	40 mph	**SLS-Tool Result**	40 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	June 3, 2021	**Reason for Suggestion:**	Lack of Separated Bike Lanes, On-street Parking
		Input Data	
Functional Class	Collector	**AADT**	3629 vpd
Context	Suburban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	5.91-6.17	**85th Percentile**	45.5 mph
Segment Length	0.26 mi	**50th Percentile**	41.2 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	High
Sidewalk Presence / Width	Narrow	**Parallel Parking Permitted?**	Yes
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3.3
Median Type	Undivided	**Average AADT**	3629 vpd
Travel Lanes	2	**One-Way Street?**	No
Access Points	11	**All Crashes**	2
Traffic Signals	0	**KABC Crashes**	1

Table 5.23 SR 60 Segment 2 Summary of Results

		Analysis Recommendations	
Posted Speed	45 mph	**SLS-Tool Result**	40 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	Decrease to 40 mph
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	June 3, 2021	**Reason for Suggestion:**	Lack of Bike Lanes, High KABCO Crash Rate
		Input Data	
Functional Class	Collector	**AADT**	3629 vpd
Context	Suburban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	6.17-7.42	**85th Percentile**	44.5 mph
Segment Length	1.25 mi	**50th Percentile**	40.7 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	Yes
Sidewalk Buffer	Not Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3.3
Median Type	TWLTL	**Average AADT**	3629 vpd
Travel Lanes	2	**One-Way Street?**	No
Access Points	15	**All Crashes**	20
Traffic Signals	1	**KABC Crashes**	7

5.3.6 US 89: Springville (MP 329.63-330.79)

The 1.16-mile segment of US 89 in Springville is a principal arterial set in a suburban context with posted speeds of 40 mph and 50 mph. A 2021 UDOT speed study found that the 85th percentile speeds on the 50-mph segment are less than 5 mph over the posted speed limits and the 85th percentile speed in the 40-mph segment is more than 5 mph greater than the posted speed limit. The speed study did not recommend any changes to the posted speed.

The road was analyzed as two segments in the SLS-Tool. To obtain a better analysis, segment 1 was extended an additional 0.34 mi outside the original study area to encompass a uniform segment of roadway. The Tool recommended adopting the 50th percentile speed as the posted speed limit for both segments. The Tool recommended that the 40-mph segment remain at 40 mph due to lack of a separated bike lane and the on-street parking activity. The Tool recommended that the 45-mph segment be lowered to 40 mph due to lack of a separated bike lane and the high KABCO crash rate. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.24 and Table 5.25.

Table 5.24 US 89 Segment 1 Summary of Results

Analysis Recommendations			
Posted Speed	40 mph	**SLS-Tool Result**	45 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	Increase to 45
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	May 6, 2021	**Reason for Suggestion:**	High On-Street Parking Activity, High Crash Rate
Input Data			
Functional Class	Principal Arterial	**AADT**	29094 vpd
Context	Suburban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	329.31-329.81	**85th Percentile**	47.5 mph
Segment Length	0.50 mi	**50th Percentile**	45.5 mph
Bicyclist Activity/ Bike Lane Type	High/ Separated	**On-Street Parking Activity**	High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	Yes
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	High	**Years of Crash Data**	3.3
Median Type	TWLTL	**Average AADT**	29094 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	30	**All Crashes**	52
Traffic Signals	1	**KABC Crashes**	20

Table 5.25 US 89 Segment 2 Summary of Results

Analysis Recommendations			
Posted Speed	50 mph	**SLS-Tool Result**	50 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Rounded-down 85th Percentile Speed
UDOT Study Date	May 6, 2021	**Reason for Suggestion:**	On-street parking permitted, Bike Lane Present
Input Data			
Functional Class	Principal Arterial	**AADT**	27972 vpd
Context	Suburban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	329.81 - 330.79	**85th Percentile**	53 mph
Segment Length	0.98 mi	**50th Percentile**	46.8 mph
Bicyclist Activity/ Bike Lane Type	High/ Separated	**On-Street Parking Activity**	High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	Yes
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	Not High	**Years of Crash Data**	3.3
Median Type	TWLTL	**Average AADT**	27972 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	28	**All Crashes**	40
Traffic Signals	2	**KABC Crashes**	13

5.3.7 SR 115: Spanish Fork (MP 7.25-8.25)

The 1.00-mile segment of SR 115 in Spanish Fork is a major collector set in a suburban context with posted speeds of 40 mph, 35 mph, and 30 mph. A 2021 UDOT speed study found that the 85th percentile speeds on the 50-mph segment are within 5 mph of the posted speed limits. The speed study did not recommend any changes to the posted speed.

The road was analyzed as three segments using the SLS-Tool. The Tool suggests adopting the 50th percentile speed for the entire segment. The Tool suggests that the 40-mph segment be lowered to 35 mph, due to the lack of a separated bike lane, the permitted on-street parking, and high KABC crash rate. The remaining two segments have posted speed limits that already align with the 50th percentile speed. The justifications for these posted speeds include lack of a separated bike lane, high crash rate, on-street parking activity, and driveway access density. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.26 through Table 5.28.

Table 5.26 SR 115 Segment 1 Summary of Results

Analysis Recommendations			
Posted Speed	40 mph	**SLS-Tool Result**	35 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	Decrease to 35 mph
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	March 31, 2021	**Reason for Suggestion:**	No Separated Bike Lane, High KABC Crashes, Parallel Parking Permitted
Input Data			
Functional Class	Collector	**AADT**	3112 vpd
Context	Suburban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	7.25-7.64	**85th Percentile**	39.5 mph
Segment Length	0.38 mi	**50th Percentile**	35.9 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	Yes
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3
Median Type	Undivided	**Average AADT**	3112 vpd
Travel Lanes	2	**One-Way Street?**	No
Access Points	15	**All Crashes**	6
Traffic Signals	0	**KABC Crashes**	2

Table 5.27 SR 115 Segment 2 Summary of Results

Analysis Recommendations			
Posted Speed	35 mph	**SLS-Tool Result**	35 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	March 31, 2021	**Reason for Suggestion:**	No Separated Bike Lane, High Crash Rate, Parallel Parking Permitted
Input Data			
Functional Class	Collector	**AADT**	3112 vpd
Context	Suburban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	7.64-7.92	**85th Percentile**	39.5 mph
Segment Length	0.29 mi	**50th Percentile**	35.5 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	Yes
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	High	**Years of Crash Data**	3
Median Type	Undivided	**Average AADT**	3112 vpd
Travel Lanes	2	**One-Way Street?**	No
Access Points	15	**All Crashes**	8
Traffic Signals	0	**KABC Crashes**	3

Table 5.28 SR 115 Segment 3 Summary of Results

Analysis Recommendations			
Posted Speed	30 mph	**SLS-Tool Result**	30 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	March 31, 2021	**Reason for Suggestion:**	No Separated Bike Lane, High Crash Rate, On Street Parking Activity, Access Point Density
Input Data			
Functional Class	Collector	**AADT**	3112 vpd
Context	Suburban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	7.92-8.25	**85th Percentile**	34.0 mph
Segment Length	0.33 mi	**50th Percentile**	30.5 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	Yes
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	High	**Years of Crash Data**	3
Median Type	Undivided	**Average AADT**	3112 vpd
Travel Lanes	2	**One-Way Street?**	No
Access Points	14	**All Crashes**	12
Traffic Signals	0	**KABC Crashes**	4

5.3.8 SR 113: Midway (MP 3.30-3.90)

The 0.60-mile segment of SR 113 in Midway is a minor arterial set in a rural town context with a posted speed of 35 mph. A 2021 UDOT speed study found that the 85th percentile speed exceeds the posted speed limit in the southern portion of the segment. The speed study recommended that the region could consider lowering the speed limit to better match the setting of the roadway.

The road was analyzed as one segment using the SLS-Tool. The Tool suggests adopting the 50th percentile speed for the entire segment. However, the closest 50th percentile speed already matches the posted speed limit. The Tool suggests a posted speed of 35 mph, due to the lack of a separated bike lane and the permitted on-street parking. Although the SLS-Tool does not suggest counting single family home driveways as part of the access point count, the number of driveways comes close to justifying rounding down the 85th percentile speed. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.29.

Table 5.29 SR 113 Summary of Results

	Analysis Recommendations		
Posted Speed	35 mph	**SLS-Tool Result**	35 mph
UDOT-Study Recommendations	Reduce to 30 mph	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	March 31, 2021	**Reason for Suggestion:**	No Separated Bike Lane, On Street Parking Activity
	Input Data		
Functional Class	Minor Arterial	**AADT**	3587 vpd
Context	Rural Town	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	3.30-3.90	**85th Percentile**	38.8 mph
Segment Length	0.60 mi	**50th Percentile**	34.5 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	High
Sidewalk Presence / Width	Narrow	**Parallel Parking Permitted?**	Yes
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3
Median Type	Undivided	**Average AADT**	3587 vpd
Travel Lanes	2	**One-Way Street?**	No
Access Points	20	**All Crashes**	4
Traffic Signals	1	**KABC Crashes**	1

5.3.9 SR 222: Midway (MP 0.225-0.450)

The 0.225-mile segment of SR 222 in Midway is a major collector set in a rural town context with a posted speed of 35 mph. A 2021 UDOT speed study found that the 85th percentile speed matches closely with the posted speed limit. The speed study recommended that the region could consider lowering the speed limit to 30 mph to better fit the level of pedestrian activity and access density.

The road was analyzed as one segment using the SLS-Tool as a Full-Access SLSG. Full-Access SLSGs only consider the closest 50th percentile speeds, which is 30 mph. Furthermore, the data justify this speed based off the high access point density, nearby bicycle activity, on-street parking, and high KABCO crash rate. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.30.

Table 5.30 SR 222 Summary of Results

	Analysis Recommendations		
Posted Speed	35 mph	**SLS-Tool Result**	30 mph
UDOT-Study Recommendations	Decrease to 30 mph	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	March 8, 2021	**Reason for Suggestion:**	High Access Point Density, Bicycle Activity, On-street Parking, High KABCO crash rate
	Input Data		
Functional Class	Collector	**AADT**	4085 vpd
Context	Rural Town	**Adverse Alignment?**	No
SLSG	Full Access	**Max Speed Limit**	35 mph
Mile Points (MP)	0.225-0.450	**85th Percentile**	N/A
Segment Length	0.225 mi	**50th Percentile**	31.8 mph
Bicyclist Activity/ Bike Lane Type	High/ Separated	**On-Street Parking Activity**	High
Sidewalk Presence / Width	Wide	**Parallel Parking Permitted?**	Yes
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	High	**Years of Crash Data**	3.9
Median Type	Undivided	**Average AADT**	4085 vpd
Travel Lanes	2	**One-Way Street?**	No
Access Points	15	**All Crashes**	3
Traffic Signals	0	**KABC Crashes**	0

5.3.10 US 189: Provo (MP 3.42-7.42)

The 4.00-mile segment of US 189 in Provo is a principal arterial set in an urban context with posted speeds of 35 mph, 45 mph, and 50 mph. A 2021 UDOT speed study found that the 85th percentile speeds exceed the posted speeds by 4 mph to 10 mph. The speed study recommends raising the short 35-mph segment to 45 mph. It also recommends raising the northern portion of the 45-mph segment to 55 mph from MP 3.95 to 4.40. Finally, the study recommended the remaining segments be raised from 50 mph to 55 mph.

The road was analyzed as three segments using the SLS-Tool. The segments were divided to reflect the mile points from the speed study recommendations. The Tool's suggestion mostly aligned with the results of the speed study. However, the SLS-Tool suggests 50 mph on segment 2, which is the closest 50th percentile speed. The distance between the traffic signals was the cause of this suggestion. The separated bike lane on the road resulted in the Tool choosing the rounded-down 85th percentile speed throughout the roadway. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.31 through Table 5.33.

Table 5.31 US 189 Segment 1 Summary of Results

	Analysis Recommendations		
Posted Speed	45 mph	**SLS-Tool Result**	45 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Rounded-Down 85^{th} Percentile Speed
UDOT Study Date	March 31, 2021	**Reason for Suggestion:**	Adjacent to Bike Lane, Traffic Signal Density
	Input Data		
Functional Class	Principal Arterial	**AADT**	25357 vpd
Context	Urban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	3.42-3.95	**85^{th} Percentile**	47.5 mph
Segment Length	0.53 mi	**50^{th} Percentile**	42.6 mph
Bicyclist Activity/ Bike Lane Type	High/ Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Wide	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Not Present	**Angle Parking Present?**	No
Pedestrian Activity	High	**Years of Crash Data**	3
Median Type	TWLTL	**Average AADT**	25357 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	13	**All Crashes**	26
Traffic Signals	2	**KABC Crashes**	9

Table 5.32 US 189 Segment 2 Summary of Results

		Analysis Recommendations	
Posted Speed	45 mph	**SLS-Tool Result**	50 mph
UDOT-Study Recommendations	Increase to 55 mph	**SLS-Tool Suggestion**	Increase to 50 mph
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	March 31, 2021	**Reason for Suggestion:**	Traffic Signal Density Adjacent to Bike Lane,
		Input Data	
Functional Class	Principal Arterial	**AADT**	31950 vpd
Context	Urban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	3.95-4.40	**85th Percentile**	54 mph
Segment Length	0.45 mi	**50th Percentile**	50.2 mph
Bicyclist Activity/ Bike Lane Type	High/ Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Wide	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Not Present	**Angle Parking Present?**	No
Pedestrian Activity	High	**Years of Crash Data**	3
Median Type	TWLTL	**Average AADT**	31950 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	6	**All Crashes**	23
Traffic Signals	2	**KABC Crashes**	10

Table 5.33 US 189 Segment 3 Summary of Results

Analysis Recommendations			
Posted Speed	50 mph	**SLS-Tool Result**	55 mph
UDOT-Study Recommendations	Increase to 55 mph	**SLS-Tool Suggestion**	Increase to 55 mph
		Speed Percentile Used	Rounded-Down 85th Percentile Speed
UDOT Study Date	March 31, 2021	**Reason for Suggestion:**	Adjacent to Bike Lane
Input Data			
Functional Class	Principal Arterial	**AADT**	29223 vpd
Context	Urban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	4.40-7.42	**85th Percentile**	56.3 mph
Segment Length	3.02 mi	**50th Percentile**	51.4 mph
Bicyclist Activity/ Bike Lane Type	High/ Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Wide	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	High	**Years of Crash Data**	3
Median Type	TWLTL	**Average AADT**	31950 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	35	**All Crashes**	132
Traffic Signals	6	**KABC Crashes**	87

5.3.11 SR 129: Pleasant Grove and Lindon (MP 0.492-2.998)

The 2.506-mile segment of SR 129 in Pleasant Grove and Lindon is a minor arterial and principal arterial set in an urban context with posted speeds of 45 mph. A 2021 UDOT speed study found that the 85th percentile speeds exceed the posted speeds by 4 mph to 6 mph. The speed study recommends the region could increase the posted speeds to 50 mph in all segments.

The road was analyzed as two segments using the SLS-Tool. The Tool suggests that the posted speed remain at 45 mph, which is the closest 50th percentile speed. The suggestion was due to inconsistent presence of a sidewalk along the corridor as well as lack of a bike lane. In addition, the KABCO crash rate is high for segment 2. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.34 and Table 5.35.

Table 5.34 SR 129 Segment 1 Summary of Results

	Analysis Recommendations		
Posted Speed	45 mph	**SLS-Tool Result**	45 mph
UDOT-Study Recommendations	Increase to 50 mph	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	February 23, 2021	**Reason for Suggestion:**	Lack of Sidewalks and Bike Lanes
	Input Data		
Functional Class	Minor Arterial	**AADT**	20881 vpd
Context	Urban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	0.492-1.79	**85th Percentile**	50.3 mph
Segment Length	1.298 mi	**50th Percentile**	46.4 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	None	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Not Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3
Median Type	TWLTL	**Average AADT**	20881 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	14	**All Crashes**	62
Traffic Signals	2	**KABC Crashes**	14

Table 5.35 SR 129 Segment 2 Summary of Results

	Analysis Recommendations		
Posted Speed	45 mph	**SLS-Tool Result**	45 mph
UDOT-Study Recommendations	Increase to 50 mph	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	February 23, 2021	**Reason for Suggestion:**	Lack of Sidewalks and Bike Lanes, High KABCO Crash Rate
	Input Data		
Functional Class	Principal Arterial	**AADT**	14120 vpd
Context	Urban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	1.79-2.998	**85th Percentile**	50.5 mph
Segment Length	1.208 mi	**50th Percentile**	46.4 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	None	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Not Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3
Median Type	Divided	**Average AADT**	14120 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	17	**All Crashes**	80
Traffic Signals	2	**KABC Crashes**	19

5.3.12 SR 135: Pleasant Grove and Lindon (MP 0.000-0.731)

The 0.731-mile segment of SR 135 in Pleasant Grove and Lindon is a principal arterial set in an urban context with a posted speed of 40 mph. A small segment from MP 0.00 to 0.08 is posted at 30 mph. The segment serves as an early transition to a two-lane rural road. A 2021 UDOT speed study found that the 85th percentile speeds match closely to the 40-mph posted speed. The 85th percentile speed on the 30-mph segment is 40 mph. The speed study recommends the short 30-mph segment be raised to 40 mph.

The road was analyzed as one segment using the SLS-Tool. The Tool suggests that the posted speed be changed to 35 mph, which is the closest 50th percentile speed. The suggestion was due to lack of a bike lane and a high KABCO crash rate. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.36.

Table 5.36 SR 135 Summary of Results

		Analysis Recommendations	
Posted Speed	40 mph	**SLS-Tool Result**	35 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	Decrease to 35 mph
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	February 23, 2021	**Reason for Suggestion:**	Lack of Bike Lanes, High KABCO Crash Rate
		Input Data	
Functional Class	Principal Arterial	**AADT**	32457 vpd
Context	Urban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	0.000-0.731	**85th Percentile**	42.3 mph
Segment Length	0.731 mi	**50th Percentile**	37.2 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3
Median Type	Divided	**Average AADT**	32457 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	11	**All Crashes**	138
Traffic Signals	3	**KABC Crashes**	19

5.3.13 SR 126: Roy (MP 8.267-9.223)

The 0.956-mile segment of SR 126 in Roy is a principal arterial set in an urban context with a posted speed of 45 mph. A 2021 UDOT speed study found that the 85th percentile speed matches closely to the 45-mph posted speed. The speed study recommends keeping the 45-mph posted speed.

The road was analyzed as one segment using the SLS-Tool. The Tool recommended that the posted speed be changed to 40 mph, which is the closest 50th percentile speed. The suggestion was due to the traffic signal and access point density, the presence of a non-separated bike lane, and a high KABCO crash rate. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.37.

Table 5.37 SR 126 Summary of Results

		Analysis Recommendations	
Posted Speed	45 mph	**SLS-Tool Result**	40 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	Decrease to 40 mph
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	February 22, 2021	**Reason for Suggestion:**	Traffic Signal Density, Access Point Density, Bike Lane Not Separated, High KABCO Crash Rate
		Input Data	
Functional Class	Principal Arterial	**AADT**	31334 vpd
Context	Urban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	8.267-9.223	**85th Percentile**	44.3 mph
Segment Length	0.956 mi	**50th Percentile**	40.0 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	High	**Years of Crash Data**	3
Median Type	TWLTL	**Average AADT**	31334 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	52	**All Crashes**	340
Traffic Signals	5	**KABC Crashes**	21

5.3.14 SR 173: Kearns and Salt Lake City (MP 2.77-5.00)

The 1.23-mile segment of SR 173 Kearns and Salt Lake City is a principal arterial set in an urban context with posted speeds of 40 mph and 45 mph. The eastbound and westbound directions have different mile point boundaries for the posted speeds. A 2021 UDOT speed study found that the 85th percentile speeds are within 6 mph of the posted speed limits. The speed study recommends lowering portions of the 45-mph segments to 40 mph in the center of the speed study segment area.

The road was analyzed as two segments using the SLS-Tool with the dividing point being the intersection at 4800 West, which is where the road transitions from two travel lanes to three. Because the eastbound and westbound speed limit boundaries are different, the posted speed on these segments is both 40 mph and 45 mph. In order to use the SLS-Tool to analyze the road in two uniform segments, the road was divided at the intersection with 4500 W. The Tool suggests the posted speed be changed to 40 mph for the entire study area, which is the closest 50th percentile speed. The suggestion on the west segment was due to the number of driveways on the segment and the lack of a bike lane. In addition to these factors, the east segment suggestion was also justified due to the lack of sidewalk buffer and high KABC and KABCO crash rate. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.38 and Table 5.39.

Table 5.38 SR 173 Segment 1 Summary of Results

Analysis Recommendations			
Posted Speed	40 and 45 mph	**SLS-Tool Result**	40 mph
UDOT-Study Recommendations	Lower additional segments to 40 mph	**SLS-Tool Suggestion**	Decrease all segments to 40 mph
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	January 6, 2021	**Reason for Suggestion:**	Access Point Density, Lack of Bike Lane
Input Data			
Functional Class	Principal Arterial	**AADT**	43218 vpd
Context	Urban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	2.77-3.77	**85th Percentile**	45.5 mph
Segment Length	1.00 mi	**50th Percentile**	40.6 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	High	**Years of Crash Data**	3
Median Type	TWLTL	**Average AADT**	43218 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	62	**All Crashes**	76
Traffic Signals	2	**KABC Crashes**	16

Table 5.39 SR 173 Segment 2 Summary of Results

Analysis Recommendations			
Posted Speed	40 and 45 mph	**SLS-Tool Result**	40 mph
UDOT-Study Recommendations	Lower a small segment to 40 mph	**SLS-Tool Suggestion**	Decrease all segments to 40 mph
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	January 6, 2021	**Reason for Suggestion:**	Traffic Signal and Access Point Density, Lack of Bike Lane and Sidewalk Buffer, High Crash Rates
Input Data			
Functional Class	Principal Arterial	**AADT**	43218 vpd
Context	Urban	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	3.77-5.00	**85th Percentile**	43.3 mph
Segment Length	1.23 mi	**50th Percentile**	38.9 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Not Present	**Angle Parking Present?**	No
Pedestrian Activity	High	**Years of Crash Data**	3
Median Type	TWLTL	**Average AADT**	43218 vpd
Travel Lanes	6	**One-Way Street?**	No
Access Points	70	**All Crashes**	278
Traffic Signals	7	**KABC Crashes**	70

5.4 Transition Zone Mixed SLSG Locations

This section contains the speed studies that are primarily located in areas that transition from rural to populated. Nearly all of the segments in this section are located in rural and rural town areas. A summary of the list of speed study locations analyzed was provided previously in Table 4.1.

5.4.1 US 89A: Kanab (MP 0.00-2.94) And US 89: Kanab (MP 62.20-65.50)

The 2.57-mile segment of US 89 and 2.94-mile segment of US 89A in Kanab are a principal arterial and a minor arterial set in a rural context that transitions into a rural town. A 2020 UDOT speed study found that the 85th percentile speeds exceed the posted speed limits by as much as 9 mph. The speed study recommends raising various sections of the segment by 5 mph where the 85th percentile speed exceeds the posted speed limit by 5 mph or more. The study recommends raising the speed in the main arterials of Kanab from 30 mph to 35 mph. The study further recommends adjusting the transition into and out of the rural town context into the rural context road sections.

US 89A was analyzed as two segments using the SLS-Tool. US 89 was analyzed as three segments. The segments were divided by rural and rural town context boundaries. Because the Tool is used to study uniform segments, the Tool cannot provide recommendations on how, where, or if the transition sections from low to high speeds are divided. The segments used for analysis were chosen based off the physical characteristics, not necessarily the posted speed limits. The Tool suggests that the posted speed remain largely unchanged for the rural segments. In the rural town segments, the Tool largely agrees that the current speed limits could be raised 5 mph, which matches the closest 50th percentile speed. The lack of a bike lane, on-street parking activity, and high crash rates were the cause of these suggestions. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.40 through Table 5.44.

Table 5.40 US 89A Segment 1 Summary of Results

Analysis Recommendations			
Posted Speed	55 mph	**SLS-Tool Result**	55 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Rounded-Down 85th Percentile Speed
UDOT Study Date	September 8, 2020	**Reason for Suggestion:**	Inadequate Shoulder Width
Input Data			
Functional Class	Minor Arterial	**AADT**	4950 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	0.00-1.79	**85th Percentile**	57.5 mph
Segment Length	1.79 mi	**50th Percentile**	52.2 mph
Travel Lanes	2	**Years of Crash Data**	3.7
Access Points	19	**Average AADT**	4950 vpd
Lane Width	12 ft	**All Crashes**	12
Shoulder Width	5 ft	**KABC Crashes**	6

Table 5.41 US 89A Segment 2 Summary of Results

Analysis Recommendations			
Posted Speed	45, 35, and 30 mph	**SLS-Tool Result**	40 mph
UDOT-Study Recommendations	Increase 35 to 40 mph and Increase 30 to 35 mph	**SLS-Tool Suggestion**	Increase to 40 mph for all segments
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	September 8, 2020	**Reason for Suggestion:**	Lack of Bike Lanes
Input Data			
Functional Class	Minor Arterial	**AADT**	4950 vpd
Context	Rural town	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	1.79-2.94	**85th Percentile**	43.1 mph
Segment Length	1.15 mi	**50th Percentile**	38.7 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Not Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3.7
Median Type	TWLTL	**Average AADT**	4950 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	28	**All Crashes**	12
Traffic Signals	1	**KABC Crashes**	2

Table 5.42 US 89 Segment 1 Summary of Results

Analysis Recommendations			
Posted Speed	45 and 35 mph	**SLS-Tool Result**	40 mph
UDOT-Study Recommendations	Increase the 45 mph area	**SLS-Tool Suggestion**	Increase to 40 mph for all segments
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	September 8, 2020	**Reason for Suggestion:**	Lack of Bike Lanes, High KABCO Crash Rate, Parallel Parking Permitted
Input Data			
Functional Class	Principal Arterial	**AADT**	2380 vpd
Context	Rural town	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	62.93-63.99	**85th Percentile**	42.6 mph
Segment Length	1.06 mi	**50th Percentile**	38.0 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	Yes
Sidewalk Buffer	Not Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3.7
Median Type	TWLTL	**Average AADT**	2380 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	34	**All Crashes**	13
Traffic Signals	1	**KABC Crashes**	4

Table 5.43 US 89 Segment 2 Summary of Results

Analysis Recommendations			
Posted Speed	30 and 35 mph	**SLS-Tool Result**	35 mph
UDOT-Study Recommendations	Increase all segments to 35 mph	**SLS-Tool Suggestion**	Increase to 35 mph for all segments
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	September 8, 2020	**Reason for Suggestion:**	Lack of Bike Lanes, High KABCO Crash Rate, Parallel Parking Permitted
Input Data			
Functional Class	Principal Arterial	**AADT**	10503 vpd
Context	Rural town	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	63.99-65.06	**85th Percentile**	37.8 mph
Segment Length	1.07 mi	**50th Percentile**	33.3 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	Yes
Sidewalk Buffer	Present	**Angle Parking Present?**	No
Pedestrian Activity	High	**Years of Crash Data**	3.7
Median Type	TWLTL	**Average AADT**	10503 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	60	**All Crashes**	27
Traffic Signals	2	**KABC Crashes**	10

Table 5.44 US 89 Segment 3 Summary of Results

Analysis Recommendations			
Posted Speed	45 and 55 mph	**SLS-Tool Result**	55 mph
UDOT-Study Recommendations	Increase to 50 mph and 60 mph	**SLS-Tool Suggestion**	Increase all segments to 55 mph
		Speed Percentile Used	Rounded Down 85th Percentile Speed
UDOT Study Date	September 8, 2020	**Reason for Suggestion:**	Access Point Density, High KABCO crash rate
Input Data			
Functional Class	Principal Arterial	**AADT**	2844 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	65.06-65.50	**85th Percentile**	56.8 mph
Segment Length	0.44 mi	**50th Percentile**	52.0 mph
Travel Lanes	2	**Years of Crash Data**	3.7
Access Points	8	**Average AADT**	2844 vpd
Lane Width	12 ft	**All Crashes**	4
Shoulder Width	8 ft	**KABC Crashes**	1

5.4.2 US 40: Roosevelt to Gusher (MP 115.50-126.30)

The 10.8-mile segment of US 40 between Roosevelt and Gusher is a principal arterial that passes through a rural town context. A 2021 UDOT speed study found that the 85th percentile speeds exceed the posted speed limits by as much as 12 mph. The speed study recommends raising various sections of the segment by 5 mph where the 85th percentile speed exceeds the posted speed limit by 5 mph or more.

The road was analyzed as five segments using the SLS-Tool. The 35-mph segment was not analyzed due to missing data that would be required to analyze the full segment. The Tool suggested that the segments set in a rural context use the rounded-down 85th percentile speed due to inadequate average shoulder width or a moderately high crash rate. The center segment was analyzed as a rural town context due to the presence of a traffic light. The Tool suggested the rounded-down 85th percentile due to the lack of a sidewalk. It should be noted that in all the segments, the rounded-down 85th percentile speed matched the closest 85th percentile speed. The inadequacies on the road segment did not result in a suggestion that would change the traditional UDOT speed study. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.45 through Table 5.49.

Table 5.45 US 40 Segment 1 Summary of Results

	Analysis Recommendations		
Posted Speed	50 mph	**SLS-Tool Result**	55 mph
UDOT-Study Recommendations	Increase to 55 mph	**SLS-Tool Suggestion**	Increase to 55 mph
		Speed Percentile Used	Rounded-down 85th Percentile Speed
UDOT Study Date	June 17, 2021	**Reason for Suggestion:**	High KABCO crash rate
	Input Data		
Functional Class	Principal Arterial	**AADT**	11146 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	115.79-116.89	**85th Percentile**	56.6 mph
Segment Length	1.10 mi	**50th Percentile**	51.2 mph
Travel Lanes	2	**Years of Crash Data**	3.4
Access Points	13	**Average AADT**	11146 vpd
Lane Width	12 ft	**All Crashes**	21
Shoulder Width	6 ft	**KABC Crashes**	5

Table 5.46 US 40 Segment 2 Summary of Results

Analysis Recommendations			
Posted Speed	60 mph	**SLS-Tool Result**	65 mph
UDOT-Study Recommendations	Increase to 65 mph	**SLS-Tool Suggestion**	Increase to 65 mph
		Speed Percentile Used	Rounded-down 85th Percentile Speed
UDOT Study Date	June 17, 2021	**Reason for Suggestion:**	Short Shoulder Width in Some Locations
Input Data			
Functional Class	Principal Arterial	**AADT**	9826 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	115.79-116.89	**85th Percentile**	67.0 mph
Segment Length	1.10 mi	**50th Percentile**	61.4 mph
Travel Lanes	3	**Years of Crash Data**	3.4
Access Points	22	**Average AADT**	9826 vpd
Lane Width	12 ft	**All Crashes**	51
Shoulder Width	5 ft	**KABC Crashes**	7

Table 5.47 US 40 Segment 3 Summary of Results

Analysis Recommendations			
Posted Speed	50 mph	**SLS-Tool Result**	55 mph
UDOT-Study Recommendations	Increase to 55 mph	**SLS-Tool Suggestion**	Increase to 55 mph
		Speed Percentile Used	Rounded-down 85th Percentile Speed
UDOT Study Date	June 17, 2021	**Reason for Suggestion:**	Lack of Sidewalk
Input Data			
Functional Class	Principal Arterial	**AADT**	9826 vpd
Context	Rural town	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	121.40-121.87	**85th Percentile**	59.5 mph
Segment Length	0.47 mi	**50th Percentile**	52.7 mph
Bicyclist Activity/ Bike Lane Type	Not High/ Any Type	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	None	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Not Present	**Angle Parking Present?**	No
Pedestrian Activity	Negligible	**Years of Crash Data**	3.4
Median Type	TWLTL	**Average AADT**	9826 vpd
Travel Lanes	3	**One-Way Street?**	No
Access Points	9	**All Crashes**	8
Traffic Signals	1	**KABC Crashes**	2

Table 5.48 US 40 Segment 4 Summary of Results

Analysis Recommendations			
Posted Speed	60 mph	**SLS-Tool Result**	65 mph
UDOT-Study Recommendations	Increase to 65 mph	**SLS-Tool Suggestion**	Increase to 65 mph
		Speed Percentile Used	Rounded-down 85th Percentile Speed
UDOT Study Date	June 17, 2021	**Reason for Suggestion:**	Short Shoulder Width in Some Locations
Input Data			
Functional Class	Principal Arterial	**AADT**	7359 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	121.87-124.24	**85th Percentile**	67.0 mph
Segment Length	2.37 mi	**50th Percentile**	61.4 mph
Travel Lanes	2	**Years of Crash Data**	3.4
Access Points	11	**Average AADT**	7359 vpd
Lane Width	12 ft	**All Crashes**	30
Shoulder Width	5 ft	**KABC Crashes**	5

Table 5.49 US 40 Segment 5 Summary of Results

Analysis Recommendations			
Posted Speed	65 mph	**SLS-Tool Result**	65 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Rounded-down 85th Percentile Speed
UDOT Study Date	June 17, 2021	**Reason for Suggestion:**	Short Shoulder Width in Some Locations
Input Data			
Functional Class	Principal Arterial	**AADT**	7359 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	124.24-126.30	**85th Percentile**	68.0 mph
Segment Length	2.06 mi	**50th Percentile**	63.9 mph
Travel Lanes	2	**Years of Crash Data**	3.4
Access Points	5	**Average AADT**	7359 vpd
Lane Width	12 ft	**All Crashes**	14
Shoulder Width	5 ft	**KABC Crashes**	4

5.4.3 US 40: Vernal (MP 62.2-65.5)

The 2.07-mile segment of US 40 in Vernal is a principal arterial set in a rural context that transitions into a rural town context with posted speeds of 65 mph, 50 mph, and 45 mph. A 2021 UDOT speed study found that the 85th percentile speeds exceed the posted speed limits by as much as 12 mph. The speed study recommends raising a portion of the 50-mph segment to 55 mph. This change would result in a more gradual transition between the 50-mph segment and the 65-mph segment.

The road was analyzed as two segments using the SLS-Tool. The 65 mph and 45 mph segments were not analyzed due to the short length that is included in the study area. To better analyze these segments, the study area should be expanded to the full length of the posted speed. The Tool suggestion aligns with the speed study recommendation to raise the posted speed in the rural area from 50 mph to 55 mph, which is the closest 50th percentile speed. This suggestion was due to a high KABCO crash rate. The Tool suggests that the second 50-mph segment be decreased to 45 mph. This suggestion was due to the transition into a rural town context, the high KABCO crash rate, and the lack of a bike lane. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.50 and Table 5.51.

Table 5.50 US 40 Segment 6 Summary of Results

	Analysis Recommendations		
Posted Speed	50 mph	**SLS-Tool Result**	55 mph
UDOT-Study Recommendations	Increase to 55 mph	**SLS-Tool Suggestion**	Increase to 55 mph
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	June 8, 2021	**Reason for Suggestion:**	High KABCO Crash Rate
	Input Data		
Functional Class	Principal Arterial	**AADT**	6207 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	141.05-141.67	**85th Percentile**	60.5 mph
Segment Length	0.62 mi	**50th Percentile**	55.15 mph
Travel Lanes	4	**Years of Crash Data**	3.3
Access Points	6	**Average AADT**	6207 vpd
Lane Width	12 ft	**All Crashes**	28
Shoulder Width	8 ft	**KABC Crashes**	0

Table 5.51 US 40 Segment 7 Summary of Results

Analysis Recommendations			
Posted Speed	50 mph	**SLS-Tool Result**	45 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	Decrease to 45 mph
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	June 8, 2021	**Reason for Suggestion:**	High KABCO Crash Rate, Lack of Bike Lane
Input Data			
Functional Class	Principal Arterial	**AADT**	7884 vpd
Context	Rural town	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	141.67-142.15	**85th Percentile**	54.1 mph
Segment Length	0.48 mi	**50th Percentile**	44.4 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Not Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3.3
Median Type	TWLTL	**Average AADT**	7884 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	9	**All Crashes**	23
Traffic Signals	0	**KABC Crashes**	0

5.4.4 US 89: Orderville (MP 85.00-87.20)

The 2.20-mile segment of US 89 in Orderville is a principal arterial set in a rural context that transitions into and out of a rural town context with posted speeds of 55 mph, 45 mph, and 35 mph. A 2021 UDOT speed study found that the 85th percentile speeds exceed the posted speed limits by 5 to 11 mph in several locations. The speed study did not recommend any changes due to friction in the populated area coming from parking and business activities in the town center. In addition, the town of Orderville has an interest in reducing the posted speed in the town center. In response, UDOT's division of Traffic and Safety evaluated possible speed management measures for these segments of US 89. The study concluded that based off the exceptions listed in UDOT Policy 06C-25, the 85th percentile speed may not be appropriate for the study area. The study found the 50th percentile speeds and proposed that the speeds be lowered to better match these values. The study recommends expanding the length of the 35-mph segment in the town center and moving the 45 mph segments further from the town center. These changes could be made possible through a temporary Traffic Engineering Order that is subject to be revised later. The study further recommended two measures to address vehicles transitioning from a high-speed rural road into a slow-speed developed area. Those measures are radar speed signs and roadside gateway features. The temporary speed reductions may be considered in unison with the speed calming measures in partnership with the town of Orderville.

The road was analyzed as five segments using the SLS-Tool. The posted speeds flowing into both sides of the town are 55 mph. The Tool suggests decreasing the west approach to 50 mph and increasing the east approach to 60 mph. In both these segments, the Tool suggests the closest 50th percentile speed due to the high KABCO crash rate. The Tool suggests that the west 45 mph transition be raised to 50 mph, which is the closest 50th percentile speed. This is due to the lack of sidewalk in most locations and the lack of a bike lane. For the east 45-mph transition segment, the reasons for suggesting the 50th percentile speed are the same. In the town center, the Tool suggests not changing the 35-mph segment, which is also the 50th percentile speed. This is due to the access point density, lack of a bike lane, and the on-street parking activity. It should be noted that the Tool suggests higher speeds than the speed management study because the Tool rounds to the closest 5-mph increments. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.52 through Table 5.56.

Table 5.52 US 89 Segment 4 Summary of Results

	Analysis Recommendations		
Posted Speed	55 mph	**SLS-Tool Result**	50 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	Decrease to 50 mph
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	May 5, 2021	**Reason for Suggestion:**	High KABCO Crash Rate
	Input Data		
Functional Class	Principal Arterial	**AADT**	2639 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	83.97-85.20	**85th Percentile**	58 mph
Segment Length	1.23 mi	**50th Percentile**	52 mph
Travel Lanes	2	**Years of Crash Data**	3
Access Points	13	**Average AADT**	2639 vpd
Lane Width	12 ft	**All Crashes**	13
Shoulder Width	5.5 ft	**KABC Crashes**	2

Table 5.53 US 89 Segment 5 Summary of Results

	Analysis Recommendations		
Posted Speed	45 mph	**SLS-Tool Result**	45 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	May 5, 2021	**Reason for Suggestion:**	Lack of Sidewalks and Bike Lanes
	Input Data		
Functional Class	Principal Arterial	**AADT**	3751 vpd
Context	Rural town	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	85.20-85.71	**85th Percentile**	51.3 mph
Segment Length	0.51 mi	**50th Percentile**	45.5 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	None	**Parallel Parking Permitted?**	Yes
Sidewalk Buffer	Not Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3
Median Type	TWLTL	**Average AADT**	3751 vpd
Travel Lanes	2	**One-Way Street?**	No
Access Points	14	**All Crashes**	2
Traffic Signals	0	**KABC Crashes**	1

Table 5.54 US 89 Segment 6 Summary of Results

Analysis Recommendations			
Posted Speed	35 mph	**SLS-Tool Result**	35 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	May 5, 2021	**Reason for Suggestion:**	High Access Point Density, Lack of Bike Lanes, On-street Parking Activity, High KABC Crash Rate
Input Data			
Functional Class	Principal Arterial	**AADT**	3751 vpd
Context	Rural town	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	85.71-86.14	**85th Percentile**	43.3 mph
Segment Length	0.43 mi	**50th Percentile**	37.2 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	Yes
Sidewalk Buffer	Not Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3
Median Type	TWLTL	**Average AADT**	3751 vpd
Travel Lanes	2	**One-Way Street?**	No
Access Points	26	**All Crashes**	4
Traffic Signals	0	**KABC Crashes**	4

Table 5.55 US 89 Segment 7 Summary of Results

Analysis Recommendations			
Posted Speed	45 mph	**SLS-Tool Result**	45 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	May 5, 2021	**Reason for Suggestion:**	Inconsistent or Narrow Sidewalks and Lack of Bike Lanes
Input Data			
Functional Class	Principal Arterial	**AADT**	3751 vpd
Context	Rural town	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	86.14-86.65	**85th Percentile**	52.5 mph
Segment Length	0.51 mi	**50th Percentile**	45.5 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Narrow	**Parallel Parking Permitted?**	Yes
Sidewalk Buffer	Not Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3
Median Type	Undivided	**Average AADT**	3751 vpd
Travel Lanes	2	**One-Way Street?**	No
Access Points	16	**All Crashes**	2
Traffic Signals	0	**KABC Crashes**	1

Table 5.56 US 89 Segment 8 Summary of Results

Analysis Recommendations			
Posted Speed	55 mph	**SLS-Tool Result**	60 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	Increase to 60 mph
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	May 5, 2021	**Reason for Suggestion:**	High KABCO Crash Rate
Input Data			
Functional Class	Principal Arterial	**AADT**	2436 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	86.65-89.45	**85th Percentile**	63.8 mph
Segment Length	2.8 mi	**50th Percentile**	58.0 mph
Travel Lanes	2	**Years of Crash Data**	3
Access Points	20	**Average AADT**	2436 vpd
Lane Width	12 ft	**All Crashes**	22
Shoulder Width	6 ft	**KABC Crashes**	2

5.4.5 SR 121: Roosevelt (MP 0.00-3.00)

The 3.00-mile segment of SR 121 in Roosevelt is a minor arterial set in a rural town context that transitions into a major collector into a rural context with posted speeds of 35 mph, 45 mph, and 60 mph. A 2021 UDOT speed study found that the 85th percentile speeds exceed the posted speed limits by less than 5 mph. The speed study does not recommend any changes.

The road was analyzed as three segments using the SLS-Tool. The suggestion of the Tool aligns with the speed study recommendation to not make any changes. The 35-mph and 45-mph segments are set using the closest 50th percentile speed. The context of rural town segment is chosen due to the lack of bike lanes, the on-street parking activity, and the high KABC crash rate. The 45-mph segment is selected due to the high KABC crash rate. The Tool suggests that the second 60-mph segment remain the same, which is due to the inadequate shoulder width causing a rounded-down 85th percentile speed. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.57 through Table 5.59.

Table 5.57 SR 121 Segment 1 Summary of Results

Analysis Recommendations			
Posted Speed	35 mph	**SLS-Tool Result**	35 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	April 12, 2021	**Reason for Suggestion:**	Lack of Bike Lanes, On-street Parking Activity, High KABC Crash Rate
Input Data			
Functional Class	Minor Arterial	**AADT**	9169 vpd
Context	Rural town	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	0.00-0.73	**85th Percentile**	37 mph
Segment Length	0.73 mi	**50th Percentile**	35 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	High
Sidewalk Presence / Width	Adequate	**Parallel Parking Permitted?**	Yes
Sidewalk Buffer	Not Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3
Median Type	Undivided	**Average AADT**	9169 vpd
Travel Lanes	2	**One-Way Street?**	No
Access Points	26	**All Crashes**	16
Traffic Signals	2	**KABC Crashes**	11

Table 5.58 SR 121 Segment 2 Summary of Results

Analysis Recommendations			
Posted Speed	45 mph	**SLS-Tool Result**	45 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	April 12, 2021	**Reason for Suggestion:**	High Crash Rates
Input Data			
Functional Class	Collector	**AADT**	5758 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	0.73-1.60	**85th Percentile**	49.8 mph
Segment Length	0.87 mi	**50th Percentile**	45.8 mph
Travel Lanes	2	**Years of Crash Data**	3
Access Points	5	**Average AADT**	5758 vpd
Lane Width	12 ft	**All Crashes**	16
Shoulder Width	3.2 ft	**KABC Crashes**	11

Table 5.59 SR 121 Segment 3 Summary of Results

Analysis Recommendations			
Posted Speed	60 mph	**SLS-Tool Result**	60 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Rounded-down 85th Percentile Speed
UDOT Study Date	April 12, 2021	**Reason for Suggestion:**	Inadequate Shoulder Width
Input Data			
Functional Class	Collector	**AADT**	5758 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	1.60-3.00	**85th Percentile**	62.5 mph
Segment Length	1.4 mi	**50th Percentile**	58.7 mph
Travel Lanes	2	**Years of Crash Data**	3
Access Points	13	**Average AADT**	5758 vpd
Lane Width	12 ft	**All Crashes**	2
Shoulder Width	2.3 ft	**KABC Crashes**	0

5.4.6 SR 10: Ferron (MP 24.20-27.20)

The 3.00-mile segment of SR 10 in Ferron is a principal arterial set in a rural context that transitions into a rural town context with posted speeds of 65 mph, 55 mph, 45 mph, and 35 mph. A 2021 UDOT speed study found that the 85th percentile speeds exceed the posted speed limits by 6 mph to 12 mph. The speed study recognizes that it may be appropriate to raise the posted speed limit in some locations, but it does not recommend any specific changes.

The road was analyzed as four segments using the SLS-Tool. The Tool suggested raising the 55-mph segment to 65 mph due to satisfactory road conditions. It also suggested that the 45-mph segment be increased to 55 mph. The Tool suggests that the 35-mph segment in the rural town context not be changed due to the lack of bike lanes. On-street parking activity may also influence the Tool if more data were available. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.60 through Table 5.63.

Table 5.60 SR 10 Segment 1 Summary of Results

Analysis Recommendations			
Posted Speed	65 mph	**SLS-Tool Result**	65 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	N/A
UDOT Study Date	April 6, 2021	**Reason for Suggestion:**	Maximum Speed Permitted
Input Data			
Functional Class	Principal Arterial	**AADT**	4235 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	24.20-24.80	**85th Percentile**	72.3 mph
Segment Length	0.60 mi	**50th Percentile**	66.8 mph
Travel Lanes	2	**Years of Crash Data**	3
Access Points	0	**Average AADT**	4235 vpd
Lane Width	12 ft	**All Crashes**	1
Shoulder Width	8 ft	**KABC Crashes**	0

Table 5.61 SR 10 Segment 2 Summary of Results

Analysis Recommendations			
Posted Speed	55 mph	**SLS-Tool Result**	65 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	Increase to 65 mph
		Speed Percentile Used	Closest 85th Percentile Speed
UDOT Study Date	April 6, 2021	**Reason for Suggestion:**	Satisfactory Roadway Conditions
Input Data			
Functional Class	Principal Arterial	**AADT**	4235 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	24.80-25.25	**85th Percentile**	64.3 mph
Segment Length	0.45 mi	**50th Percentile**	57.5 mph
Travel Lanes	2	**Years of Crash Data**	3
Access Points	3	**Average AADT**	4235 vpd
Lane Width	12 ft	**All Crashes**	0
Shoulder Width	8 ft	**KABC Crashes**	0

Table 5.62 SR 10 Segment 3 Summary of Results

Analysis Recommendations			
Posted Speed	45 mph	**SLS-Tool Result**	55 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	Increase to 55 mph
		Speed Percentile Used	Closest 85th Percentile Speed
UDOT Study Date	April 6, 2021	**Reason for Suggestion:**	Satisfactory Road Conditions
Input Data			
Functional Class	Minor Arterial	**AADT**	4235 vpd
Context	Rural town	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	25.25-26.52	**85th Percentile**	56.5 mph
Segment Length	1.27 mi	**50th Percentile**	50.5 mph
Bicyclist Activity/ Bike Lane Type	Not High/ Any Type	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	Narrow	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Not Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3
Median Type	Undivided	**Average AADT**	4235 vpd
Travel Lanes	2	**One-Way Street?**	No
Access Points	40	**All Crashes**	4
Traffic Signals	0	**KABC Crashes**	0

Table 5.63 SR 10 Segment 4 Summary of Results

Analysis Recommendations			
Posted Speed	35 mph	**SLS-Tool Result**	35 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	April 6, 2021	**Reason for Suggestion:**	Lack of Bike Lanes
Input Data			
Functional Class	Principal Arterial	**AADT**	5554 vpd
Context	Rural town	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	26.52-27.20	**85th Percentile**	41.5 mph
Segment Length	0.68 mi	**50th Percentile**	36.0 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	High
Sidewalk Presence / Width	Narrow	**Parallel Parking Permitted?**	Yes
Sidewalk Buffer	Not Present	**Angle Parking Present?**	No
Pedestrian Activity	Some	**Years of Crash Data**	3
Median Type	TWLTL	**Average AADT**	5554 vpd
Travel Lanes	2	**One-Way Street?**	No
Access Points	24	**All Crashes**	3
Traffic Signals	0	**KABC Crashes**	0

5.4.7 SR 73: Eagle Mountain (MP 29.50-35.40)

The 5.90-mile segment of SR 73 in Eagle Mountain is a principal arterial set in a rural context that transitions into a suburban context with posted speeds of 65 mph, 55 mph, and 50 mph. A 2021 UDOT speed study found that the 85th percentile speeds exceed the posted speed limits by more than 5 mph in some locations. The speed recommended that the 55-mph segments be increased to 60 mph. In late 2021, UDOT began the process of decreasing a portion of the 65-mph segment to 55 mph. The motivation for this change was in response to an increase in crashes, especially from risky left turns (Egan, 2021).

The road was analyzed as three segments using the SLS-Tool. The first two segments are considered undeveloped, and the third segment is considered developed. The transition point between the undeveloped and developed section is characterized by the presence of a TWLTL. The short 50-mph segment included in the speed study was not analyzed with the SLS-Tool due to the short length that serves as a transition into the following road. The Tool suggests decreasing the 65-mph segment to 60 mph, which is the 50th percentile speed. It was suggested due to the high crash rates. The Tool also suggested that the 55-mph segment remain at 55 mph. Similarly, high crash rates in the rural segment called for the 50th percentile speed to be suggested. In the suburban segment, the lack of a bike lane caused the 50th percentile speed suggestion. The bicycle activity was presumed to be high because of the presence of “share the road” signs and the bike lanes near the intersection at Mountain View Corridor. The analysis results from the SLS-Tool and the associated input data are summarized in Table 5.64 through Table 5.66.

Table 5.64 SR 73 Segment 1 Summary of Results

Analysis Recommendations			
Posted Speed	65 mph	**SLS-Tool Result**	60 mph
UDOT-Study Recommendations	No Changes	**SLS-Tool Suggestion**	Decrease to 60 mph
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	March 4, 2021	**Reason for Suggestion:**	High Crash Rates
Input Data			
Functional Class	Principal Arterial	**AADT**	4159 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	29.50-31.26	**85th Percentile**	66.5 mph
Segment Length	1.76 mi	**50th Percentile**	62.4 mph
Travel Lanes	2	**Years of Crash Data**	3
Access Points	7	**Average AADT**	4159 vpd
Lane Width	12 ft	**All Crashes**	146
Shoulder Width	6.5 ft	**KABC Crashes**	39

Table 5.65 SR 73 Segment 2 Summary of Results

Analysis Recommendations			
Posted Speed	55 mph	**SLS-Tool Result**	55 mph
UDOT-Study Recommendations	Increase to 60 mph	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	March 4, 2021	**Reason for Suggestion:**	High Crash Rates
Input Data			
Functional Class	Principal Arterial	**AADT**	4159 vpd
Context	Rural	**Adverse Alignment**	No
SLSG	Undeveloped	**Max Speed Limit**	65 mph
Mile Points (MP)	31.26-32.86	**85th Percentile**	58.7 mph
Segment Length	1.60 mi	**50th Percentile**	54.0 mph
Travel Lanes	2	**Years of Crash Data**	3
Access Points	8	**Average AADT**	4159 vpd
Lane Width	12 ft	**All Crashes**	29
Shoulder Width	6 ft	**KABC Crashes**	12

Table 5.66 SR 73 Segment 3 Summary of Results

		Analysis Recommendations	
Posted Speed	55 mph	**SLS-Tool Result**	55 mph
UDOT-Study Recommendations	Increase to 60 mph	**SLS-Tool Suggestion**	No Changes
		Speed Percentile Used	Closest 50th Percentile Speed
UDOT Study Date	March 4, 2021	**Reason for Suggestion:**	Lack of Bike Lanes
		Input Data	
Functional Class	Principal Arterial	**AADT**	31276 vpd
Context	Rural town	**Adverse Alignment?**	No
SLSG	Developed	**Max Speed Limit**	55 mph
Mile Points (MP)	32.86-35.10	**85th Percentile**	60.6 mph
Segment Length	2.24 mi	**50th Percentile**	55.2 mph
Bicyclist Activity/ Bike Lane Type	High/ Not Separated	**On-Street Parking Activity**	Not High
Sidewalk Presence / Width	None	**Parallel Parking Permitted?**	No
Sidewalk Buffer	Not Present	**Angle Parking Present?**	No
Pedestrian Activity	Negligible	**Years of Crash Data**	3
Median Type	TWLTL	**Average AADT**	31276 vpd
Travel Lanes	4	**One-Way Street?**	No
Access Points	20	**All Crashes**	75
Traffic Signals	2	**KABC Crashes**	21

5.5 Summary

The chapter provided a description of the 29 speed studies that were reevaluated using the criteria of the SLS-Tool's automation of the SLS-Procedure. The total number of segments analyzed was 66. A brief description of the study area, the UDOT speed study recommendations, an explanation of the division into segments for analysis using the SLS-Tool, and the justification for the suggested speed limit is summarized for each location in this chapter. An analysis of the results from this chapter will be discussed in Chapter 6.

6.0 RESULTS OF SEGMENTS ANALYZED

6.1 Overview

This chapter provides a summary of the results from Chapter 5. First, a breakdown of the study site characteristics that describe how the segments were categorized into functional class, context, and SLSG is provided. Next, a comparison of the results of the UDOT speed study recommendations, and the results of the SLS-Tool suggested posted speed limit are summarized. Then, a breakdown of the types of percentile speeds used by the SLS-Tool is described and illustrated. Finally, site characteristics that led to the SLS-Tool suggestion for the type of posted speed limit are shown and presented.

6.2 Study Site Characteristics

For all the UDOT speed studies that were compared for this project, the roadway segments fell into three functional classes: major collector, minor arterial, and principal arterial. The functional classes as defined by UDOT fit well within three of the five road types as defined in the SLS-Tool: collector, minor arterial, and principal arterial. Over half (57 percent) of the segments analyzed were principal arterials. The breakdown of the functional classes analyzed during the project is shown in Figure 6.1. Note that local roads and freeway road types were not part of the segments evaluated in the project.

Four of the five SLS-Procedure contexts were analyzed for the project. None of the UDOT speed studies included a segment with an urban core context. The context for each segment was judged and applied by the research team using the guidance in the SLS-Tool User Guide (Fitzpatrick et al., 2021b). The majority (62 percent) of the segments fell within the rural and rural town contexts. The breakdown of the contexts that were analyzed is shown in Figure 6.2.

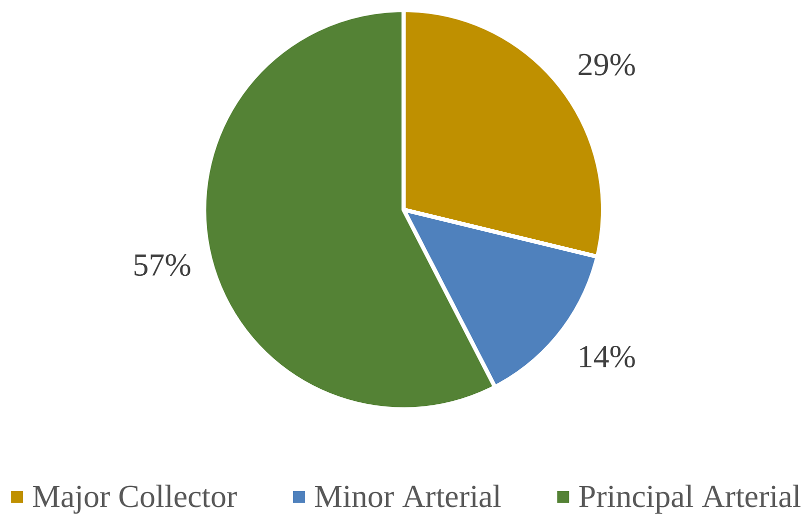

Figure 6.1 Breakdown of functional class analyzed.

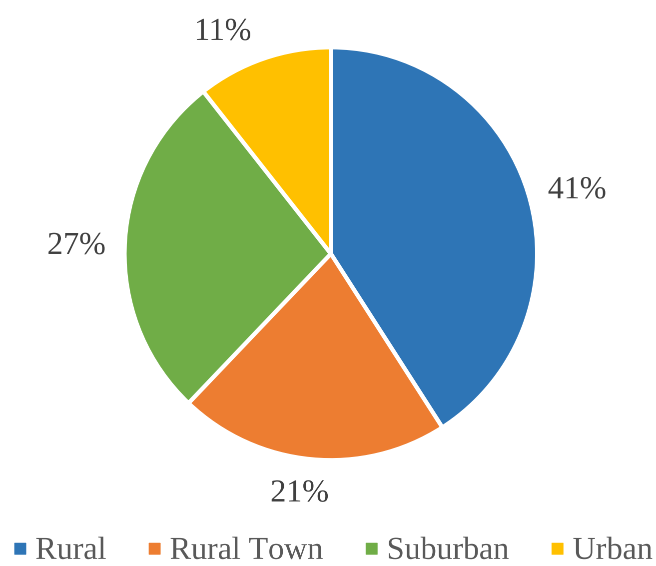

Figure 6.2 Breakdown of contexts analyzed.

In accordance with the categories established in the SLS-Procedure, the road contexts and types resulted in grouping the 66 segments into one of four SLSGs. An explanation of how each segment was classified into an SLSG was shown previously in Table 3.1. Because there were no freeway segments that were analyzed as part of the research, the limited access SLSG was not analyzed. Most of the segments fall within the developed (58 percent) or undeveloped (39 percent) SLSGs. Only two segments (3 percent) fall within the full-access SLSG, both of which are collectors in a rural town context. The breakdown of the SLSGs analyzed is shown in Figure 6.3.

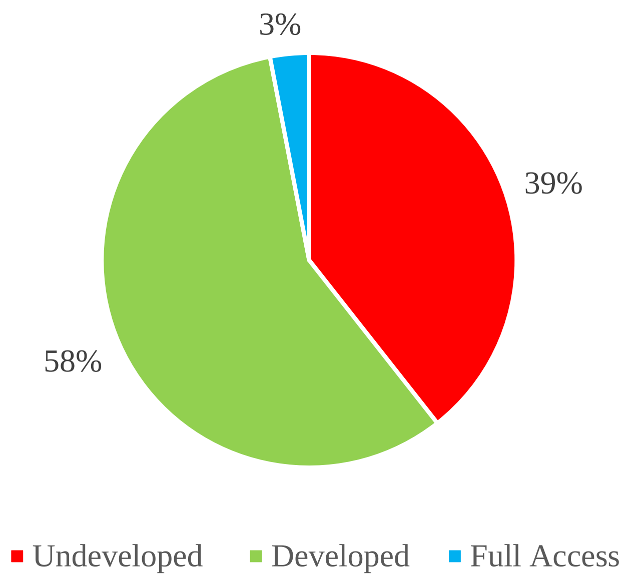

Figure 6.3 Breakdown of SLSG analyzed.

6.3 Comparison of UDOT Speed Studies and SLS-Tool Results

As part of the research, the UDOT speed study documents were categorized by the recommendations presented in the speed study. Of the 66 segments that were extracted from the speed study documents and compared to the SLS-Tool suggestions, no change was recommended on slightly more than half (53 percent) of the segments. Of the changes recommended, 38 percent of the segments were recommended to be set at a higher posted speed limit and 9 percent of the segments were recommended to be set at a lower posted speed. The breakdown of the speed study recommendations is shown in Figure 6.4.

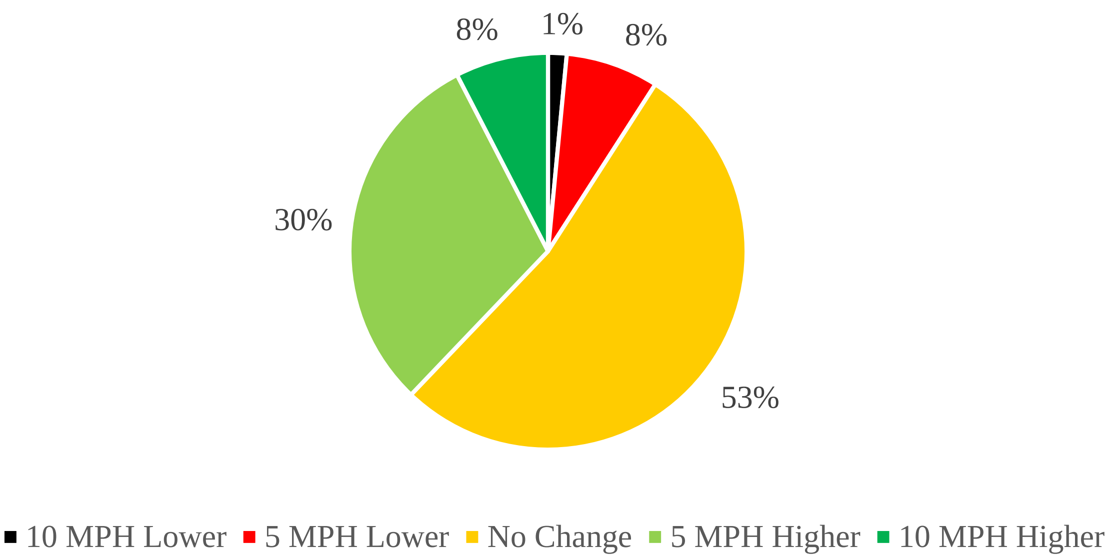

Figure 6.4 UDOT speed study posted speed limit recommendations.

Each of the 66 segments extracted from the speed study documents and deemed appropriate for the requirements of the SLS-Procedure, were reanalyzed using the SLS-Tool. The results from the SLS-Tool suggestions are shown in Figure 6.5. From this analysis, 43 percent of the segments resulted in no difference from the existing posted speed limit, while 36 percent of the segments were suggested to have a higher posted speed limit, and 21 percent were suggested to have a lower posted speed limit.

Of the 66 segments, 62 percent of the segments had the same result after analysis using the SLS-Tool than what occurred in the UDOT speed study. Furthermore, 23 percent of the segments resulted in a lower speed limit suggestion, and 15 percent resulted in a higher speed limit suggestion. It should be noted that several of the recommendations from the speed study involved a proposal to change the boundaries of the road segments. In these cases, the overall result was categorized as one of these three categories depending on the overall result of the recommendation. In some cases, the proposed segment divisions were analyzed with the SLS-Tool. The comparison of the UDOT speed study and the SLS-Tool is shown in Figure 6.6.

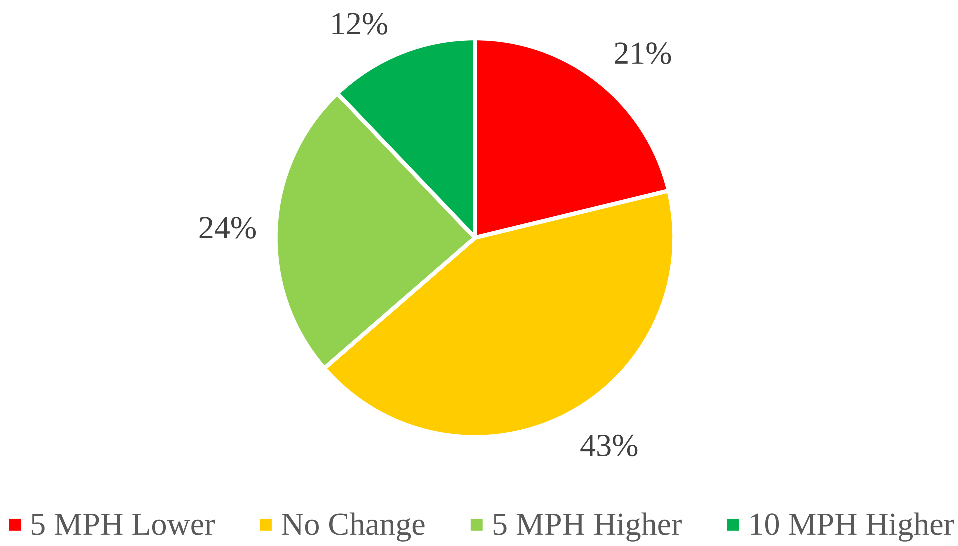

Figure 6.5 SLS-Tool posted speed limit suggestion.

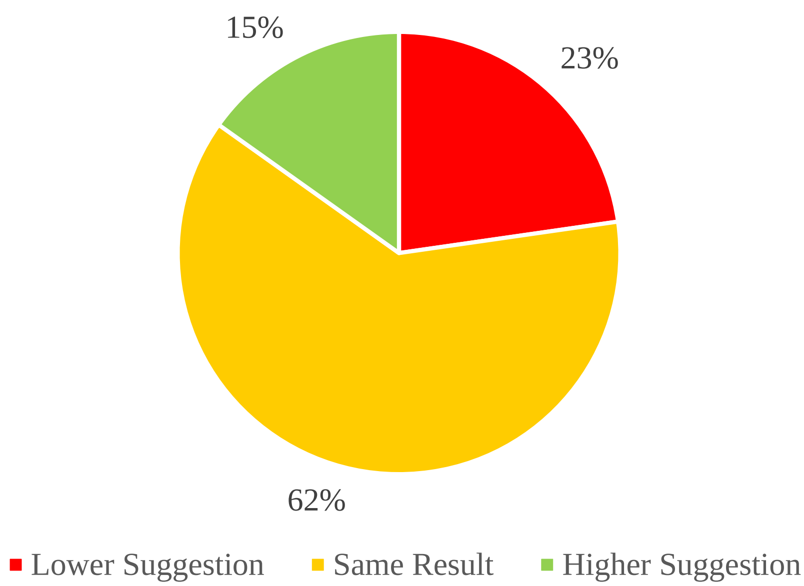

Figure 6.6 SLS-Tool suggestions compared to UDOT speed study.

6.4 Site Characteristics of SLS-Tool Posted Speed Limit Suggestions

For each segment analyzed using the SLS-Tool, the suggested speed limit was determined by an advisory message that indicated what speed percentile was guiding the suggestion. The SLS-Procedure results follow either the closest 85th percentile speed, the rounded-down 85th percentile speed, or the closest 50th percentile speed. Because only two segments were analyzed as a full-access SLSG, none of the segments resulted in a suggestion that was the rounded-down 50th percentile speed. Of the suggestions from the SLS-Tool, 54 percent of the segments adopted a posted speed suggestion at the closest 50th percentile speed, while 21 percent of the segments adopted the rounded-down 85th percentile speed. Only 18 percent of the suggestions were generated based off the closest 85th percentile speed, which is the standard established in the MUTCD. As previously shown in Figure 6.6, although 54 percent of the segments received a closest 50th percentile speed suggestion, only 23 percent resulted in a lower posted speed limit suggestion.

Each SLSG also has a maximum speed limit allowed. UDOT code sets the maximum speed limit for non-interstate roads at 65 mph, which matches the limit of the undeveloped SLSG. The Tool sets the maximum speed limit on developed SLSGs at 55 mph. An exception was made for the three segments of Mountain View Corridor to allow the maximum speed limit to be set at 65 mph and still be analyzed as a developed SLSG. The maximum allowed speed limit determined the posted speed limit suggestions for 7 percent of the segments. Had the SLS-Tool not capped the speed limit at 65 mph, the suggestion would have adopted the closest 85th percentile speed, which is higher than 65 mph. A summary of the results from the SLS-Tool posted speed limit advisory suggestion is shown in Figure 6.7.

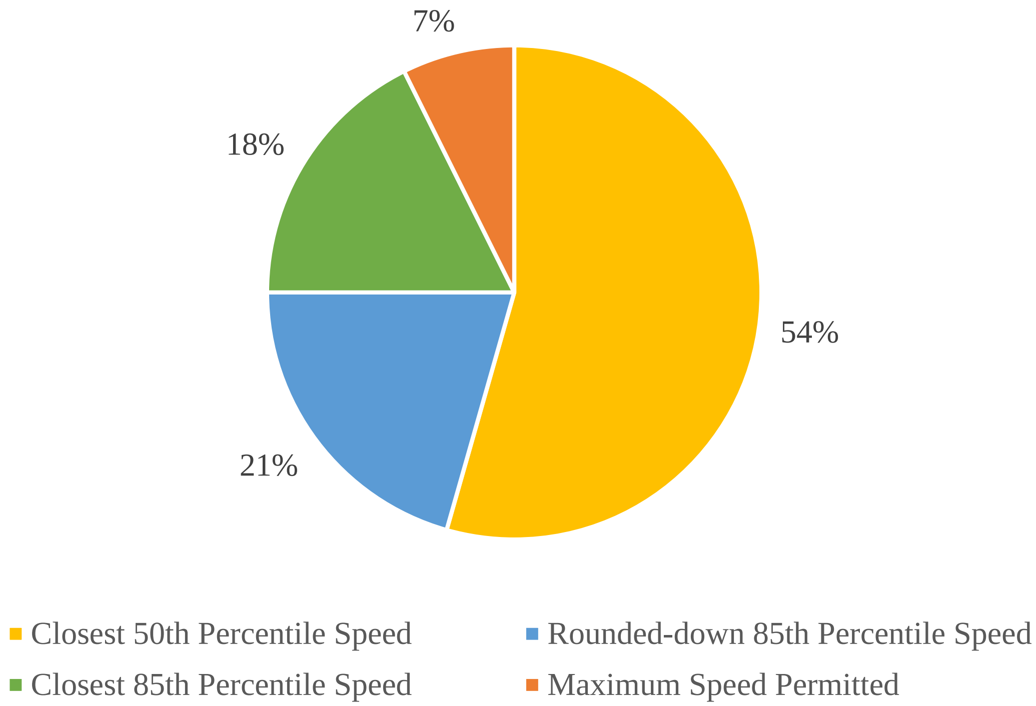

Figure 6.7 SLS-Tool posted speed limit advisory suggestion.

When the SLS-Tool suggested a speed limit determined by the closest 85th percentile speed, all the site characteristics were deemed satisfactory by the criteria and default settings of the SLS-Procedure and SLS-Tool. When a segment contained a characteristic that was not deemed satisfactory, the rounded-down 85th percentile speed or closest 50th percentile speed was used to base the posted speed limit suggestion. For each of the segments that were analyzed, the advisory message for each characteristic was recorded each time the rounded-down 85th percentile speed or closest 50th percentile speed was used as a basis of the suggested speed limit. For many segments, there were multiple reasons that the closest 50th percentile speed was suggested. Even if the closest 50th percentile speed was suggested, some of the segments contained site characteristics that would otherwise result in a rounded-down 85th percentile speed suggestion.

For the segments that resulted in a suggested speed limit based off the 50th percentile speed, the most common reason was the lack of bike lanes (34 percent). The next most common characteristic for these segments was high crash rate (32 percent). The presence of roadside parking, access point density, and lack of a sidewalk were reasons for the suggestions for many of the segments that were analyzed. The sample of developed SLSG segments set in a rural town, suburban area, or urban area made up most of the closest 50th percentile speed limit suggestions. A breakdown of the reasons for closest 50th speed advisory messages from the SLS-Tool is shown in Figure 6.8.

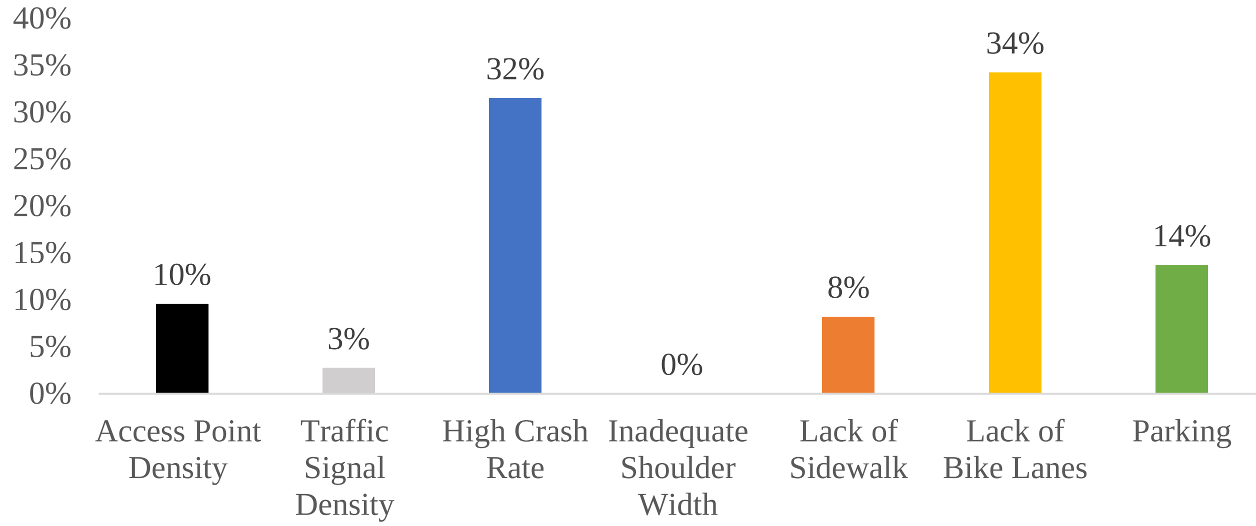

Figure 6.8 Site characteristics leading to a closest 50th percentile speed limit suggestion.

A suggestion for a posted speed based off the rounded-down 85th percentile speed was less common than a suggestion for a posted speed based off the closest 50th percentile speed. The most common reason was inadequate shoulder width (36 percent), which was typically defined as less than 6 feet. Another common reason was the presence of a bike lane with a buffer adjacent to vehicle traffic (20 percent). A lack of sidewalk next to the roadway also caused a rounded-down 85th percentile speed limit suggestion for 16 percent of the segments. A breakdown of the reasons for rounded-down 85th speed advisory messages from the SLS-Tool is shown in Figure 6.9.

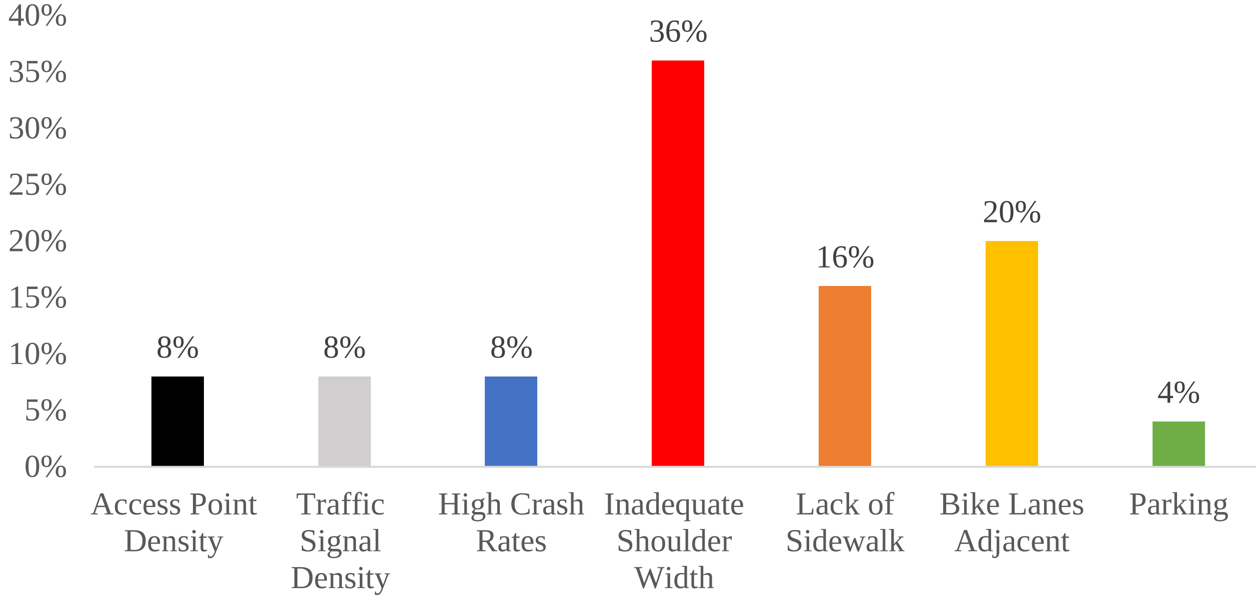

Figure 6.9 Site characteristics leading to a rounded-down 85th percentile speed suggestion.

6.5 Summary

This chapter provides a summary of the results that are presented in Chapter 5. The study segments were a mixture of collectors, minor arterials, and principal arterials. After assigning the context to each segment, the segments were divided into three SLSGs, with the majority falling within the developed and undeveloped SLSGs. Next, the chapter compared the results of the UDOT speed study recommendations with the results of the SLS-Tool suggested posted speed limit. In general, the SLS-Tool recommended more segments be set at a slightly lower rate than the UDOT speed study. Then, the type of percentile speed that was used by the SLS-Tool was presented. Although the Tool departed from the guidance in the MUTCD for 82 percent of the segments, only 23 percent of the segments resulted in a suggested speed limit lower than the recommendations in the UDOT speed study. Finally, site characteristics that caused the SLS-Tool to suggest the type of posted speed limit were presented and discussed. Lack of a bike lane and high crash rates were common reasons for suggesting a posted speed at the closest 50th percentile speed. The suggestions that followed the rounded-down 85th percentile speed commonly resulted due to inadequate shoulder width and the presence of an adjacent bike lane. A few segments (7 percent) were capped at the maximum allowed speed as determined by the SLS-Tool and UDOT policy.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Summary

This chapter includes the findings from the research performed on the roadway segments, the limitations and challenges that were experienced while using the SLS-Tool, suggestions for future research, and recommendations on how the SLS-Tool can be applied to UDOT speed studies going forward.

7.2 Findings

The NCHRP Project 17-76 project and report set an objective to identify and describe factors that influence operating speed and provide guidelines that can be used to make informed decisions about establishing posted speed limits on roadways. The research objectives paved the way for the creation of a procedure that incorporated data from applicable roadway characteristics that should be considered when selecting a posted speed limit. Of the most important characteristics identified in the research, the characteristics of most influence include geometric design, roadway condition, roadside development and culture, bicycle and pedestrian activity, access point density, on-street parking, traffic volume, and crash rate. In addition, the project analyzed the use of statistical measures other than the 85th percentile speed, namely the rounded-down 85th percentile speed and the closest 50th percentile speed, to set speed limits on lower functional classification roadways and where roadway characteristics do not meet ideal conditions. This research was used to create the SLS-Procedure, which was automated into the SLS-Tool for applications on uniform segments of roadways.

The purpose of the project was to explore the applicability of the SLS-Procedure and SLS-Tool for UDOT roads and explore the potential uses and impacts from the suggestions that result from analysis using the SLS-Tool. The research team analyzed 29 speed studies that were performed on UDOT roadways from 2020 to 2021. The speed studies were separated into 66 uniform segments that could be analyzed with the SLS-Tool and compared with the recommendations presented in the UDOT speed study. The UDOT speed studies follow the guidance established in Utah Code as outlined in UDOT policy 06C-25. The process includes identifying the 85^{th} percentile speed in various locations and identifying any possible reasons why that speed may not be appropriate for the segment that align with the exception listed in Utah Code 41-6a-602 (c) (State of Utah, 2022).

The SLS-Procedure and SLS-Tool analysis resulted in more suggested speed limits that were lower than the posted speed recommended in the UDOT speed studies. Of the 66 segments analyzed by the research team with the SLS-Tool, 21 percent resulted in a recommendation lower than the posted speed limit, compared to 9 percent in UDOT speed studies. The SLS-Tool suggested a lower speed limit than the UDOT speed study for 23 percent of the segments and a higher suggestion for 15 percent of the segments.

For the roadway segments analyzed, the most common suggested posted speed limit was the closest 50^{th} percentile speed (54 percent of the segments). An additional 21 percent of the suggested posted limits followed the rounded-down 85^{th} percentile speed. In contrast, only 25 percent of the posted speed limit suggestions followed the highest possible speed (closest 85^{th} percentile or maximum allowable speed). The segments following this suggestion were deemed to have satisfactory conditions for all of the site characteristics and crash data.

Within the scope of the roadway segments that were analyzed as part of this research project, several site characteristics were defined as deficient by the SLS-Tool's default parameters. For the 38 developed SLSG segments that were analyzed, 25 segments (68 percent) lacked a bike lane in a location where bicycle activity could be considered high, which was at least one of the reasons for suggesting the posted speed at the closest 50^{th} percentile speed. Of all segments that were analyzed, 32 percent had high crash rates that also supported a closest 50^{th} percentile speed suggestion. A fewer number of segments supported a closest 50^{th} percentile speed suggestion due to the access point density, the lack of a consistent sidewalk, or the type of on-street parking activity. The most common trigger for a rounded-down 85^{th} percentile speed was inadequate shoulder width along a rural highway (36 percent of segments). In addition, developed areas that had buffered bike lanes always received a suggestion of a rounded-down 85^{th} percentile speed.

Although 54 percent of the segments analyzed using the SLS-Tool suggested a posted speed based off the closest 50^{th} percentile speed and 21 percent based off the rounded-down 85^{th}

percentile speed, the SLS-Tool suggestions did not result in a large number of segments that justified a lower posted speed. There are a few explanations for this gap. First, the outcome of the rounded-down 85th percentile speed is not guaranteed to result in a suggested speed limit lower than the closest 85th percentile speed because the closest 85th percentile value may also round down to the nearest 5-mph increment. This was the case in six of the 14 (43 percent) rounded-down 85th percentile suggestions. Second, the closest 50th percentile speed may be the same as the rounded-down 85th percentile speed. This was the case in 19 of the 37 (51 percent) closest 50th percentile suggestions. The rounding results of these suggestions are shown in the following figures. Figure 7.1 compares the segments with a rounded-down 85th percentile speed limit suggestion with the closest 85th percentile speed. Figure 7.2 compares the segments with a closest 50th percentile suggestion with the rounded-down 85th percentile speed. Figure 7.3 compares the segments with a closest 50th percentile speed with the closest 85th percentile speed. These figures illustrate the result that selecting a speed limit based off closest 50th percentile speed nearly always resulted in a lower speed limit than the closest 85th percentile speed (97 percent of the time). A speed limit based off the rounded-down 85th percentile speed only resulted in a lower speed limit than the closest 85th percentile speed 57 percent of the time. Furthermore, for segments where a higher speed limit than the UDOT speed study was suggested, variables that were not analyzed in the SLS-Tool such as geometric curves or the amount of speed-related crashes may have influenced the outcome of the UDOT speed study. Third, many of the segments have posted speeds that are already closer to the 50th percentile than the 85th percentile. Therefore, the majority of suggestions that are not based off the closest 85th percentile did not differ from the existing posted speed. Setting a posted speed based off the suggestion from the default setting in the SLS-Procedure and SLS-Tool is more likely to stop or slow the phenomenon of “speed creep,” raising the speed limit to match the new 85th percentile speed every few years.

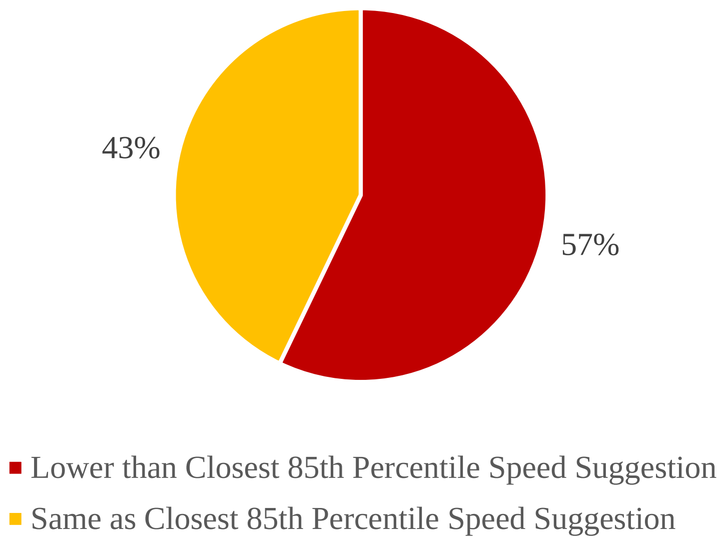

Figure 7.1 Rounding results of the rounded-down 85th percentile speed suggestion compared to the closest 85th percentile speed.

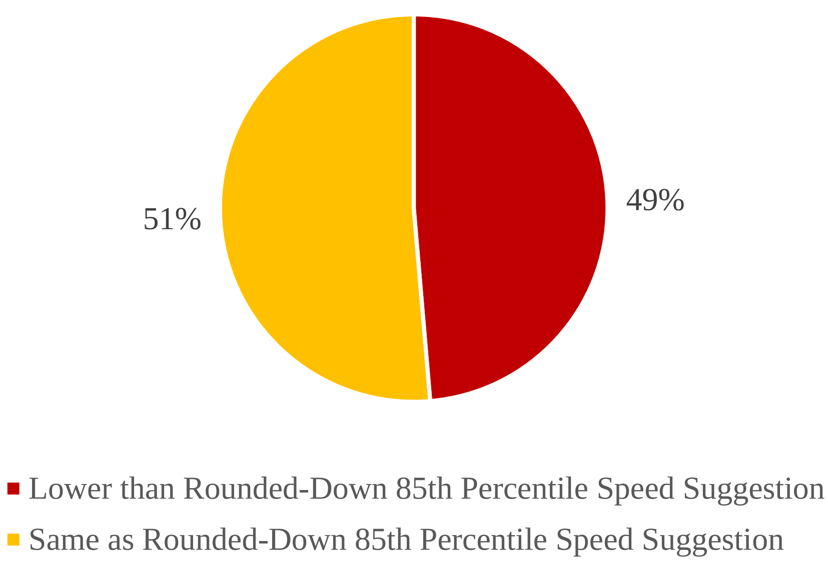

Figure 7.2 Rounding results of the closest 50th percentile speed suggestion compared to the rounded-down 85th percentile speed.

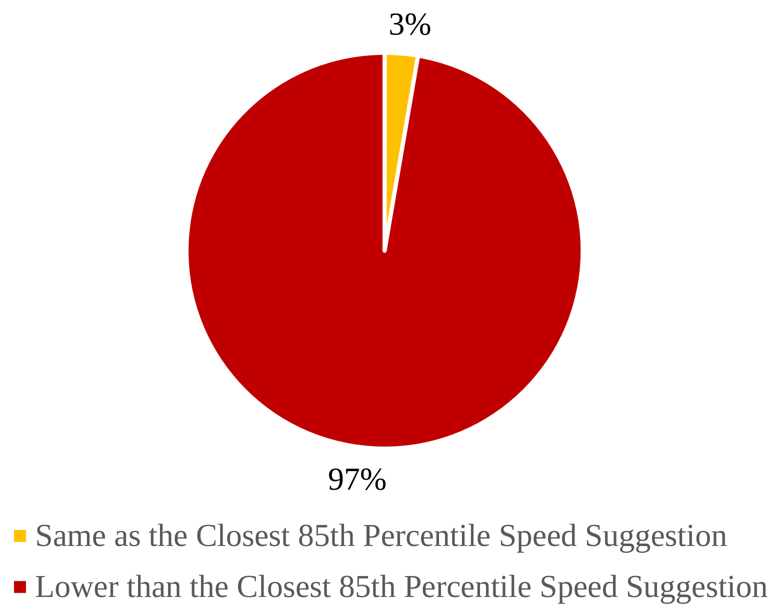

Figure 7.3 Rounding results of the closest 50th percentile speed suggestion compared to the closest 85th percentile speed.

7.3 Limitations and Challenges

The SLS-Procedure and SLS-Tool is designed to provide analysis for a uniform segment of roadway. In practicality, there are few roads that can be considered uniform for all portions of the road. In order to compensate for this requirement, it was necessary to estimate an average, such as in the case of shoulder width measurements. Another approach was to judge whether a characteristic is uniform for most of the segment or not. For example, a wide sidewalk on a portion of the segment did not change the fact that most of the segment lacked a sidewalk.

Many UDOT speed studies are commissioned in locations where the speed limit transitions from a high-speed rural area into a low-speed rural town area. A frequent problem in these areas is vehicles that maintain high speeds while traveling into town. The most common result when analyzing using the SLS-Tool is that the high speeds in these transition zones force both the 85th percentile and the 50th percentile to an unnaturally high value and pushing up the value that is suggested using the SLS-Tool. Because the SLS-Procedure and SLS-Tool can only analyze a uniform segment, it is impossible to make a non-arbitrary decision on how and where to step down and step up the speed limit. The location of the suggested speed limit transition areas is a topic mentioned in the UDOT speed study, however, the SLS-Tool is not able to provide any guidance for setting these boundaries in the study area.

Although both UDOT and the authors of the NCHRP Project 17-76 report have the same names for the functional classes of each SLSG, the exact definitions may vary in characteristics from the UDOT classification. There may be instances where the functional class that has already been assigned by UDOT may differ from the definition used in the SLS-Tool. For example, UDOT divides collectors into major collectors and minor collectors while the SLS-Tool does not.

Other limitations include gaps or other limitations in the data. Because of the reduction in AADT for the year 2020 compared to 2019, an average AADT over the previous three years was used in place of the most recent year's AADT. This replacement smoothed out the abrupt change in AADT trends for the year 2020, a year that was heavily disrupted by the COVID-19 pandemic. Other data required additional judgment to extract items like the width of sidewalks or the level of bicycles on a roadway. Additional data collection may be needed to quantify the level of investment that these types of facilities have included. Because the 66 segments analyzed by the research team were selected by the TAC members and came from one 11-month time period, the results presented in this report may not be statistically representative to make firm conclusions on the effect of the SLS-Procedure and SLS-Tool being applied on Utah roads.

7.4 Recommendations

The research team recommends that the SLS-Procedure and SLS-Tool be used as a reference when performing speed studies. The SLS-Procedure and SLS-Tool have the capability to assist in the speed study process. Utah State Code and UDOT policy permit that a posted speed can be less than the 85th percentile speed if an engineering study provides consideration to certain roadway characteristics as listed in section 2.4.2 of this report. Specifically, the SLS-Tool can help provide a quantitative and rule-based analysis for the following characteristics: shoulder condition, roadside development, roadside culture, pedestrian activity, parking practices, and reported crash experience. Because the guidance does not specify any quantitative threshold values, the decision is left up to the judgment of the analyst to decide if a posted speed limit should depart from the 85th percentile rule and be set closer to the 50th percentile speed. The SLS-Tool can aid the analyst by following the decision-rule-based procedures established in the SLS-Procedure.

One of the most helpful features that the SLS-Tool can assist UDOT with is the threshold values from crash data. The Tool provides a measuring stick as to the number of crashes that justify imposing a lower posted speed with consideration to the length and context of each segment. The SLS-Tool asks for the number of crashes on the KABCO scale. First, the Tool asks for the total number of KABCO crashes during the time period. Second, the Tool asks for the fatal and injury crashes (KABC). Currently, UDOT speed studies report the total number of crashes (KABCO). In addition, some studies list the number of “severe” crashes or the number of “speed related” crashes. To help the SLS-Tool requirements line up with those in the speed study, future speed studies should also report KABC crashes and list them by segment or mile point. Showing where crashes occur along a road segment would also aid in knowing what areas should receive special attention and may depart from the 85th percentile rule.

It should be noted that the SLS-Tool is inadequate at analyzing roadway segments that have a speed limit that is meant to serve as a transition speed limit between two contexts. These types of segments can differ in length across the state. The adoption of standards to specify the length of transition segments and the allowable mph increment change during a transition period could help drivers know what to expect each time that they begin to move through a speed limit transition. When performing a speed study and selecting the boundaries for the segments, the boundaries should align with the entire length of a uniform speed limit segment. Many speed studies bookend the boundaries with a small segment that matches the characteristics of an adjacent segment not part of the analysis area. The analysis for these segments is dependent on the road characteristics of the segment that are not included in the scope of the UDOT speed study. Going forward, UDOT should include larger segments that can be analyzed in context of the SLSG descriptions.

Even with no change to the MUTCD and the Utah Code, the SLS-Procedure and SLS-Tool can assist professionals in helping determine and define the threshold for the factors that are listed in UDOT policy but not given specific values for when to make a different decision. For example, the SLS-Tool can set different thresholds in values of 100 million vehicle miles traveled (MVMT) and override the default values. This can help the analysts make less subjective judgments. The other characteristics may work similarly. The tool provides an easy way to calculate access point density and traffic signal density. The Tool also emphasizes the importance of sidewalks and bike lanes in urban areas and can remind the analyst of accommodation that is needed for these users. The Tool may also assist in determining when speed management studies are applicable and how to decide whether using the 50th percentile speed is justified.

Furthermore, the tool can indicate when speed management techniques may be needed in a particular context. Because the SLS-Tool is ultimately tied to existing speeds of traffic, the suggested speed limit may not be appropriate for the local context. A speed management study may be warranted when both the 85th percentile and 50th percentile speed limit suggestions are above the current posted speed limit. The speed management study will recommend the traffic calming measures that are most likely to cause a decline in the 85th and 50th percentile speeds.

7.5 Future Research

Additional research could be performed by UDOT to better understand how changes in the speed limit affect the behavior of drivers. Whenever a change of a posted speed limit is made on a section of UDOT road, a follow-up study is required. Being able to analyze the outcome of a speed limit change would be valuable data that can give insight as to how drivers react. Gathering a review of recent changes could also evaluate whether the UDOT speed studies are leading to recommendations that end up getting implemented. The research could also compare the suggested speed limit using the SLS-Tool with the UDOT speed study and the implemented changes. If any roadway segments are changed because of recommendations coming out of a speed management study, the research can evaluate what speed management techniques make an impact on lowering the operating speed.

In 2022, Salt Lake City approved lowering the speed limit on local streets from 25 mph to 20 mph. Although these roads do not fall within the jurisdiction of UDOT, the outcome of this change could provide valuable insights to UDOT. The city is taking an injury minimization approach, which hopes that a lower speed limit will reduce the speed of vehicles and thus reduce the severity of injuries with pedestrians and other vehicles.

As noted in the limitations and challenges section, the expanded functional classification system used in the SLS-Procedure and SLS-Tool may not align perfectly with UDOT's functional classification system. Further research could investigate the nuances of these classification systems and investigate how UDOT's system has been applied to Utah roads. The study of UDOT's functional classification system could also evaluate the feasibility of implementing a road risk engineering speed-limit-setting approach. The approach consists of setting a consistent speed limit on all roads of a given functional classification and making improvements that create an environment that incentivizes drivers to maintain the operating speed closer to the speed limit.

Posted speed limits in rural towns remain a challenge for UDOT. Additional research could synthesize the length of transition zone segments and the speed increment difference of such changes. This research could aid UDOT in working with small towns to find solutions to lower the speed of vehicles traveling through their town center and assist in improving the roadside culture beside adjacent businesses and attractions. The feasibility of implementing speed management techniques could also be evaluated.

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