CARSON AREA METROPOLITAN PLANNING ORGANIZATION

LOCAL ROAD SAFETY PLAN

Carson Area Metropolitan Planning Organization
CAMPO

NEVADA DOT
SAFE AND CONNECTED

Kimley»Horn

CARSON AREA METROPOLITAN PLANNING ORGANIZATION
LOCAL ROAD SAFETY PLAN

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Carson Area
Metropolitan Planning Organization
C A M P O

CAMPO AGENCY PLEDGE

In this pledge, we formalize Carson Area Metropolitan Planning Organization's (CAMPO) support for the goals in Nevada's *2021-2025 Strategic Highway Safety Plan* (SHSP) and the overall vision of Zero Fatalities on Nevada's public roadways. In following the Safe System Approach principles, the safety of all road users relies on shared responsibility from everyone, including all levels of government, non-profit and advocacy groups, engineers, researchers, and the public. Dedication to proven safety programs and projects can reduce traffic fatalities and serious injuries. CAMPO which consists for members from Carson City, western Lyon County, and northern Douglas County, is committed to enhancing existing programs that work and implementing the safety strategies outlined in the Local Road Safety Plan (LRSP) to continue to drive down fatalities and serious injuries within the CAMPO Region. In accordance with the LRSP, CAMPO will continue to take the necessary steps to improve safety on the region's roadways to realize our goal of zero traffic fatalities by 2050.

CAMPO at its publicly noticed meeting of April 29, 2024, approved the acceptance of the CAMPO Agency Pledge and authorized its Chairperson to sign this document and record that signature for the execution of this pledge in accordance with the action taken.

CAMPO

Lori Bagwell

LORI BAGWELL, CHAIRPERSON
DATED this 29th day of April 2024.

ACKNOWLEDGMENTS

The Carson Area Metropolitan Area Planning Organization (CAMPO), Carson City employees, Nevada Department of Transportation (NDOT), and other partners were instrumental in the development, review, and refinement of this Local Road Safety Plan (LRSP). NDOT, CAMPO, Carson City, and Kimley-Horn would like to express their appreciation to the supporting staff and partners for their participation and contributions.

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STATUTORY NOTICE

§407. Discovery and admission as evidence of certain reports and surveys

Notwithstanding any other provision of law, reports, surveys, schedules, lists, or data compiled or collected for the purpose of identifying, evaluating, or planning the safety enhancement of potential accident sites, hazardous roadway conditions, or railway-highway crossings, pursuant to sections 130, 144, and 148 of this title or for the purpose of developing any highway safety construction improvement project which may be implemented utilizing Federal-aid highway funds shall not be subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data.

EXECUTIVE SUMMARY

A Local Road Safety Plan (LRSP) is a method for developing a locally tailored framework for identifying, analyzing, and prioritizing roadway safety improvements. Within CAMPO, this LRSP identifies emphasis areas to guide further safety evaluation of improvements for local roads within the region boundary. A local road, for the purposes of this LRSP, is defined as any publicly owned road in the CAMPO area with the exception of I-580. Local roads, as defined within this plan, differ from the U.S. Department of Transportation Federal Highway Administration (FHWA) road functional classification of local roads described as roads with primary access to residential, businesses, farms, and other local areas. The CAMPO Local Road Safety Plan includes all functionally classified arterial, collector, and local roads owned by NDOT, Carson City, Lyon County, and Douglas County within the CAMPO boundary.

The CAMPO LRSP analyzes aggregated crash data, and where appropriate, analyzes specific locations to identify trends, high crash locations, and high-risk locations, based on unusual crash history, patterns, or severity.

Study Area

The Carson Area Metropolitan Planning Organization (CAMPO) is a federally recognized metropolitan planning organization (MPO) formed in February 2003. As an MPO, CAMPO is responsible for maintaining, planning, and operating a system of facilities, consisting of roadways, traffic signals, crosswalks, and signage in the urbanized area of Carson City as well as surrounding rural areas including northern Douglas County and western Lyon County. As of 2020, the population of the Carson City Metropolitan Area was approximately 85,000 people and is anticipated to grow 24% to 105,000 people by 2050. CAMPO's transportation network includes 867 centerline miles of roadway.

Goals and Objectives

Vision	Support the Nevada SHSP vision of moving towards significantly reducing fatalities and serious injuries for all road users.
Goals	▪ Increase the safety of the transportation system for all users. ▪ Maintain a sustainable regional transportation system. ▪ Increase the mobility and reliability of the transportation system for all users. ▪ Maintain and develop a multi-modal transportation system that supports economic vitality. ▪ Provide an integrated transportation system.
Objectives	Utilize the results of the study to seek more funding and reimbursement through agreements with NDOT or other sources for maintenance activities and safety improvements, such as the Highway Safety Improvement Program (HSIP), and Safe Streets for All (SS4A).

Stakeholder Engagement

Local stakeholders were engaged in the LRSP process to provide a local perspective for this planning effort. Stakeholders participated in two workshops for the project, including site visits to the 10 priority sites, and provided input on the recommendations. The list of stakeholders that participated in the project is included in **Section 2**.

LRSP Process

This LRSP documents the results of data and information obtained, including the vision, goals, and objectives for the LRSP; existing safety efforts; crash analysis; emphasis areas; and project sheets for 10 priority locations. Furthermore, the development of the LRSP recommendations considers the 10 critical emphasis areas (CEAs) and the six "Es" of traffic safety from Nevada's Strategic Highway Safety Plan (SHSP). The LRSP Process is described in detail in **Section 3**.

Nevada SHSP Six "E's" of Safety

Described in the HSM, the Network Screening Process is a tool for an agency to analyze its entire network and identify and rank locations that, based on the implementation of a countermeasure, are most likely or least likely to see a reduction in the frequency of crashes. Intersections and roadways were analyzed using four crash metrics:

- Number of Crashes
- Critical Crash Rate (CCR) Analysis (HSM Ch. 4)
- Equivalent Property Damage Only (EPDO) Method (HSM Ch. 4)
- Probability of Specific Crash Types Exceeding Threshold Proportion (HSM Ch. 4)

Crash Data Analysis

From 2018 to 2022, there were 4,565 crashes in the CAMPO Region. Of the 4,565 crashes, 300 crashes (6.6%) occurred on Interstate 580 (I-580), and 4,265 crashes (93.4%) occurred on roads with other functional classifications (local roads). Of the 4,565 crashes, 35 (0.8%) were fatal and 82 (1.8%) were serious injury crashes.

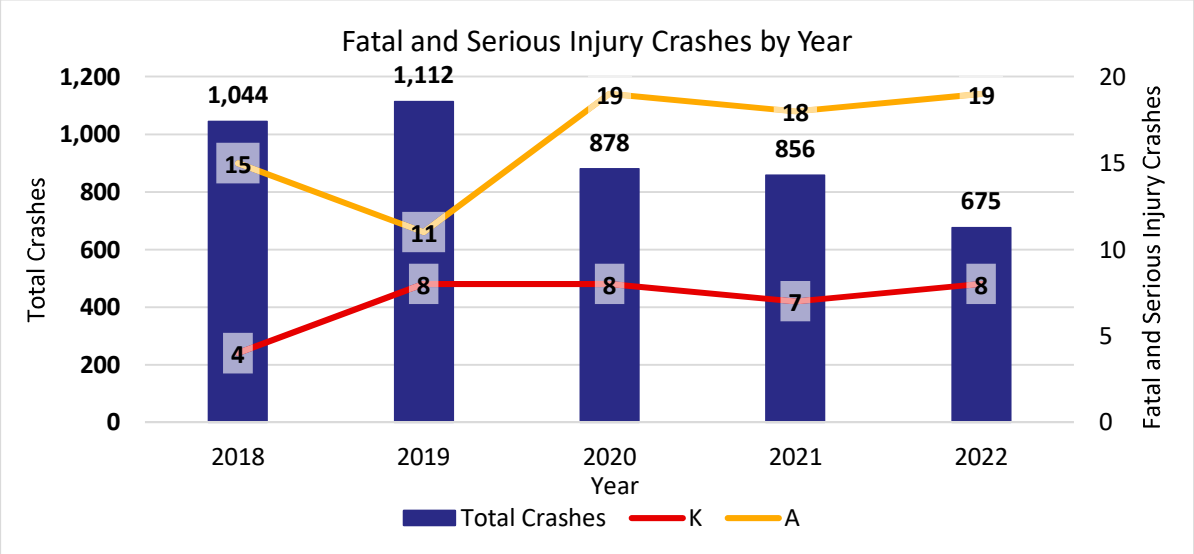

Figure E-1: CAMPO Crashes by Year

Though there has been a decrease in the total number of crashes between 2018 and 2022, there has been an increase in the number of fatal and serious injury crashes over that same period. Crashes that occurred at unsignalized intersections tend to be more severe. Pedestrian and bicycle crashes occurred most often at unsignalized intersections. Of the crashes that occurred within the CAMPO region, 93% of crashes occur on locally owned roads and 73% of crashes occur at intersections.

Engineering Countermeasures

An Engineering Countermeasures Toolbox was developed for consideration by CAMPO throughout the LRSP process. When identifying potential safety improvements, it is important to look at CMFs for the proposed improvements. CMFs are defined as the ratio of the effectiveness of one condition in comparison to another condition and represent the relative change in crash frequency due to a change in one specific condition. In other words, a CMF is a multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure at a specific site. Countermeasures with CMFs less than one are expected to reduce crashes if applied, while those countermeasures with CMFs greater than one are expected to increase crashes.

Priority Location Recommendations

All locally-owned roadway segments and intersections with three or more crashes were cataloged and used for the network analysis conducted. Based on the results, 20 preliminary locations, were identified for further discussion and prioritization. The list of 20 preliminary locations was further refined based on the criteria presented in the network screening analysis and with input from stakeholders to identify 10 priority locations (five segments and five intersections). More details on the 10 priority locations are found in **Section 6.6**.

Segments

1. N Carson Street
2. S Carson Street
3. S Curry Street
4. Saliman Road
5. E College Parkway

Intersections

1. N Carson Street and W Nye Lane
2. US-50 and Airport Road
3. US-50 and Highlands Drive
4. Goni Road and Old Hot Springs Road
5. US-395 and Topsy Lane

For each priority location, safety recommendations were identified to address the factors contributing to crash risks. Project sheets were developed for each of the priority locations containing recommendations and potential safety countermeasures at the location. Common countermeasures applied at the 10 priority locations include:

- Lower Posted Speed
- Improve Street Lighting Illuminance and Uniformity
- Install Intersection Lighting
- Resurface Pavement
- Install Reduced Conflict Intersections
- Install on-Street Bicycle Facility
- Install Rectangular Rapid Flashing Beacons (RRFB)

Recommendations made at these locations represent possible solutions at other locations across CAMPO through the systemic application of countermeasures (**Section 7.3**). CAMPO and NDOT staff will work toward implementation of solutions that best meet the need of particular project or location.

Implementation

CAMPO will plan for implementation of projects in the priority areas. CAMPO staff will continue routine monitoring of safety on local roads to understand changes in crashes and if modifications are needed to address roadway safety. CAMPO will continue to monitor crashes, investigate fatal crashes, identify contributing factors, and continue to communicate with the local Police Departments, safety officials, Nevada Highway Patrol (NHP), transportation engineers, Carson City, Douglas County, and Lyon County.

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A	Serious Injury Crash
AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
ARIDE	Advance Roadside Impaired Enforcement
B	Non-incapacitating Injury Crash
BCR	Benefit/Cost Ratio
C	Possible Injury Crash
CAMPO	Carson Area Metropolitan Planning Organization
CCR	Critical Crash Rate
CEA	Critical Emphasis Area
CMAQ	Congestion Management and Air Quality
CMF	Crash Modification Factor
CPG	Consolidated Public Grant
CRF	Crash Reduction Factor
DRE	Drug Recognition Expert
EPDO	Equivalent Property Damage Only
FARS	Fatality Analysis Reporting System
FHWA	Federal Highway Administration
GIS	Geographic Information System
HFST	High Friction Surface Treatment
HPS	High Pressure Sodium
HSIP	Highway Safety Improvement Program
HSM	Highway Safety Manual
JAC	Jump Around Carson
K	Fatal Crash
LED	Light-Emitting Diode
LPA	Local Public Agencies
LPI	Leading Pedestrian Interval
LRSP	Local Road Safety Plan
MPO	Metropolitan Planning Organization

NCATS	Nevada Citation and Accident Tracking System
NDOT	Nevada Department of Transportation
NHTSA	National Highway Traffic Safety Administration
NVACTS	Nevada Advisory Committee on Traffic Safety
O	No Injury Crash (Property Damage Only)
PDO	Property Damage Only
PSP	Project Safety Process
ROW	Right-of-Way
RRFB	Rectangular Rapid Flashing Beacon
RTP	Regional Transportation Plan
SSA	Safe System Approach
SHSP	Strategic Highway Safety Plan
SRTS	Safe Routes to School
STIP	State Transportation Improvement Program
TIP	Transportation Improvement Program
TRINA	Traffic Records Information Access
UPWP	Unified Planning Work Program
USDOT	United States Department of Transportation
VMT	Vehicle Miles Traveled
VPD	Vehicles Per Day
VRU	Vulnerable Road Users

1. INTRODUCTION

The Carson Area Metropolitan Planning Organization (CAMPO) is a federally recognized metropolitan planning organization (MPO) formed in February 2003. As an MPO, CAMPO is responsible for maintaining, planning, and operating a system of facilities, consisting of roadways, traffic signals, crosswalks, and signage in the urbanized area of Carson City as well as surrounding rural areas including northern Douglas County and western Lyon County, as shown in **Figure 1.** As of 2020, the population of the Carson City Metropolitan Area was approximately 85,000 people and is anticipated to grow 24% to 105,000 people by 2050. CAMPO's transportation network includes 867 centerline miles of roadway.

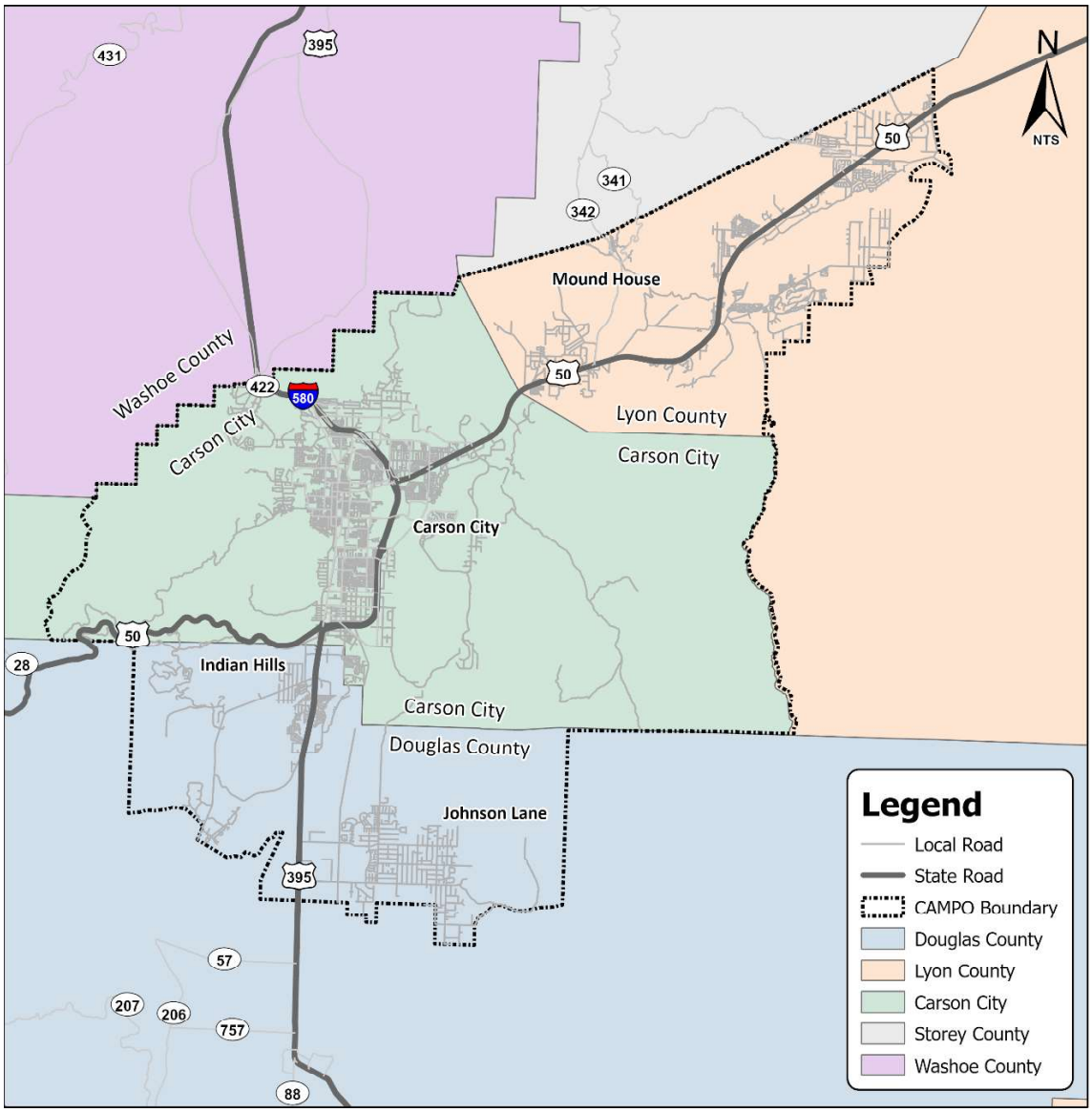


Figure 1 – CAMPO Area Map

1.1. Project Description

A Local Road Safety Plan (LRSP) is a method for developing a locally tailored framework for identifying, analyzing, and prioritizing roadway safety improvements. Within CAMPO, this LRSP identifies emphasis areas to guide further safety evaluation of improvements for local roads within the region boundary. A local road, for the purposes of this LRSP, is defined as any publicly owned road in the CAMPO area with the exception of I-580. Local roads, as defined within this plan, differ from the U.S. Department of Transportation Federal Highway Administration (FHWA) road functional classification of local roads described as roads with primary access to residential, businesses, farms, and other local areas. The CAMPO Local Road Safety Plan includes all functionally classified arterial, collector, and local roads owned by Nevada Department of Transportation (NDOT), Carson City, Lyon County, and Douglas County within the CAMPO boundary. The emphasis areas include crash type and location, and an analysis of notable relationships between current efforts and crash history. This LRSP analyzes aggregated crash data, and where appropriate, analyzes crash data at specific locations to identify trends, high-crash locations, high-risk locations, and locations with unusual crash history, patterns, or severity. Analyzing crash history within the CAMPO Region provides a basis for:

- Identification of safety factors for roadway users.
- Improvement of safety at identified high-crash locations.
- Development of safety measures that align with the Nevada Strategic Highway Safety Plan's (SHSP) six "E's" of safety: Equity, Engineering, Education, Enforcement, Emergency Medical Services/Emergency Response/Incident Management, and Everyone (**Figure 2**).

Figure 2 – Nevada SHSP Six "E's" of Safety

This LRSP summarizes the process of crash history analysis, identification of emphasis areas, and development of engineering and non-engineering countermeasures. The information provided will establish a foundation for decision making and prioritization of safety countermeasures and projects that enhance safety across all modes of travel within the CAMPO Region.

CAMPO has taken steps to enhance multi-modal safety throughout its boundary. It plans to continue making safety a priority in its planning processes. CAMPO will prioritize traffic safety across its road network in this LRSP by identifying emphasis areas, and making site-specific and systemic recommendations that can be implemented to further enhance safety. This LRSP analyzed the most recent five years of crash data (January 1, 2018 – December 31, 2022) and recent roadway improvements to assess historic trends, patterns, and areas of increasing concern.

This LRSP aims to:

- Create a greater awareness of road safety and risks.
- Reduce the number of fatal and serious injury crashes.
- Develop lasting partnerships through collaboration among professionals in various disciplines.
- Support for grant/funding applications.
- Assist in prioritizing investments in traffic safety.

1.2. Vision, Goals, and Objectives

The CAMPO LRSP evaluated the transportation network as well as non-infrastructure programs and policies within the metropolitan area. Mitigation measures were evaluated using criteria to analyze the safety of all road users (drivers and passengers, bicyclists, and pedestrians), the interaction of travel modes, and the potential benefits of safety countermeasures. Historical crash data was used to identify trends and develop a toolbox of countermeasures applicable to conditions within CAMPO that can be used for proactive identification and implementation of opportunities, without relying solely on a reaction and response to crashes as they occur. Together, CAMPO and the NDOT established the Vision, Goals, and Objectives for the CAMPO LRSP, as shown in **Table 1**.

Table 1 – Vision, Goals, and Objectives

Vision	Support the Nevada SHSP vision of moving towards significantly reducing fatalities and serious injuries for all road users.
Goals	▪ Increase the safety of the transportation system for all users. ▪ Maintain a sustainable regional transportation system. ▪ Increase the mobility and reliability of the transportation system for all users. ▪ Maintain and develop a multi-modal transportation system that supports economic vitality. ▪ Provide an integrated transportation system.
Objectives	Utilize the results of the study to seek more funding and reimbursement through agreements with NDOT or other sources for maintenance activities and safety improvements, such as the Highway Safety Improvement Program (HSIP), and Safe Streets for All (SS4A).

1.3. Document Organization

The LRSP is organized into the following sections:

- **Section 1** introduces and presents the vision, goal, and objectives for the LRSP.
- **Section 2** describes stakeholder engagement as part of the LRSP process.
- **Section 3** summarizes the LRSP development process including guidance documents and network screening analysis techniques.
- **Section 4** summarizes the review of relevant CAMPO and NDOT planning documents.
- **Section 5** contains the LRSP network screening and crash analysis data sources.
- **Section 6** provides a summary of the crash data analysis.
- **Section 7** presents engineering countermeasures that can be implemented to enhance traffic safety.
- **Section 8** includes the priority location safety recommendations.

- **Section 9** describes the evaluation and implementation process of how success and progress will be measured for the LRSP.
- **Section 10** identifies the next steps for the LRSP.
- **Appendices**

2. STAKEHOLDER ENGAGEMENT

Local stakeholders were engaged in the LRSP process to provide a local perspective for this planning effort. Stakeholders were comprised of:

- CAMPO Board of Commissioners
- Carson City Public Works
- Carson City Fire Department
- Carson City School District
- Carson City Sheriff's Office
- Court Appointed Special Advocates for Children (CASA) of Carson City
- Douglas County Public Works
- Lyon County Board of Commissioners
- Muscle Powered
- Mound House Citizen's Advisory Committee
- NDOT Rural Counties
- NDOT Traffic Planning
- NDOT Traffic Operations
- NDOT Traffic Safety Engineering
- Nevada Office of Traffic Safety (OTS)
- Washoe Tribes of California and Nevada (Washoe Tribal Roads Department)
- Western Nevada Safe Routes to School

2.1. Technical Workshops

Two technical workshops attended by the stakeholders were conducted for the LRSP. Workshop #1 (**Photograph 1**) was conducted on September 19, 2023. At the meeting, the LRSP stakeholder group was introduced to the project and the network screening methodology, crash analysis, and identification of priority/emphasis areas within the region.

Workshop #2 (**Photograph 2**) was conducted on January 25, 2024, and consisted of a field review of the top 10 priority locations. The top 10 priority locations were identified based on the crash analysis and input from the stakeholders. The field assessment offered an opportunity for the multidisciplinary stakeholder group to identify and provide input for issues at the 10 priority locations. Potential safety countermeasures for each location were recommended and discussed at the field review meeting.

Photograph 1 – Workshop #1

Photograph 2 – Workshop #2 Field Review

3. LRSP PROCESS

CAMPO's primary goal is to increase the safety of its transportation network while promoting sustainability, mobility, and reliability in an integrated, multimodal transportation system. CAMPO has adopted the state targets for safety performance measures to increase safety for the transportation system as follows:

- Number of fatalities (five-year rolling average).
- Rate of fatalities per 100 million Vehicle Miles Traveled (VMT).
- Number of serious injuries (five-year rolling average).
- Rate of serious injuries per 100 million VMT.
- Number of non-motorized fatalities and non-motorized serious injuries (five-year rolling average).

CAMPO's primary goal through this LRSP is to expand on its efforts from the 2020 *Safe Routes to School Master Plan* and identify programmatic solutions through data-driven strategies for the entire region. CAMPO is focused on investments in safety-related improvements moving into the future and this LRSP will allow CAMPO to be eligible for additional safety funding. CAMPO will continue its collaboration with stakeholders to identify and discuss safety issues within the community through the development of the LRSP and its implementation. Guidance on the LRSP process is provided at both the national (FHWA) and state (NDOT) levels. FHWA and NDOT guidance on the LRSP process is described below.

FHWA encourages:

- Establishing a working group (stakeholders) to participate in developing an LRSP.
- Reviewing crash, traffic, and roadway data to identify areas of concern.
- Establishing goals and safety priorities.
- Identifying countermeasures to recommend improvements at spot locations, systemically, and comprehensively.

FHWA employs a systemic approach to help agencies manage risk, especially on rural and local low-volume roadways, as this approach broadens the implementation of improvements by combining crash history and identifying high-risk roadway characteristics to identify low-cost safety improvements.

From NDOT's LRSP website (Local Road Safety Plan | Nevada Department of Transportation (nv.gov)), the process for this LRSP includes the following steps:

- Establish leadership.
- Analyze the safety data.
- Determine emphasis areas.
- Identify strategies.
- Prioritize and incorporate strategies.
- Evaluate and update the LRSP.

The main differences between FHWA and NDOT LRSP guidance lies in the establishment of working groups and the implementation of countermeasures. For example, the establishment of leadership in the NDOT LRSP guidance is more clearly defined than in FHWA guidance.

Additionally, NDOT tailors its recommendations to be evaluated before being incorporated into an updated LRSP.

This LRSP documents the vision, goals, and objectives; current policies, plans, and studies and existing safety efforts; results of the crash data analysis and emphasis areas; and recommendations (including project sheets for 10 priority locations). Furthermore, the development of the LRSP recommendations considers the 10 critical emphasis areas (CEAs) and the six "Es" of traffic safety contained within the Nevada SHSP and the Safe Systems Approach (SSA) throughout its process. The following subsections summarize the Nevada SHSP, SSA, National Highway Traffic Safety Administration (NHTSA) *Countermeasures that Work*, and the American Association of State Highway and Transportation Officials (AASHTO) *Highway Safety Manual* (HSM).

3.1. Nevada SHSP

Nevada's 2021-2025 SHSP groups CEAs into four key areas: Safer Roads, Vulnerable Road Users (VRU), Safer Drivers and Passengers, and Impaired Driving Prevention (**Figure 3**). There are currently 10 CEAs for Nevada, listed below.

Figure 3 – Nevada SHSP Key Areas

- **Safer Roads**
  - Safe Speeds
  - Lane Departures
  - Intersections
  - Work Zones
- **Vulnerable Road Users**
  - Pedestrians
  - Motorcyclists
- **Safer Drivers and Passengers**
  - Occupant Protection
  - Older Drivers
  - Young Drivers
- **Impaired Driving Prevention**
  - Impaired Driving

It is important to note that other vulnerable road users such as bicycles and persons on other personal conveyances are considered as part of the Vulnerable Road Users Key Area, however, they were not identified as "Critical" Emphasis Areas in the SHSP. In addition, Motorcyclists are included in the Vulnerable Road Users Key Area in the 2021-2025 Nevada SHSP, however, they are not included in FHWA's definition of "Vulnerable Road Users." The FHWA definition is as follows:

> *A vulnerable road user is a non-motorist with a fatality analysis reporting system (FARS) person attribute code for pedestrian, bicyclist, other cyclist, and person on personal conveyance or an injured person that is, or is equivalent to, a pedestrian or pedalcyclist as defined in the ANSI D16.1-2007. (See 23 U.S.C. 148(a)(15) and 23 CFR 490.205). A vulnerable road user may include people walking, biking, or rolling. Please note that a*

vulnerable road user: includes a highway worker on foot in a work zone, given they are considered a pedestrian. Does not include a motorcyclist.

3.2. Safe System Approach (SSA)

The SSA principles and elements include safe road users, safe vehicles, safe speeds, safe roads, and post-crash care, as shown in **Figure 4.** The Safe System Approach (SSA), implemented as part of this LRSP, is designed to reduce fatal and serious injury crashes through design that accommodates human mistakes, keeping human vulnerability at the forefront of physical roadway characteristics and design. The SSA is based on six principles: fatalities and serious injuries are unacceptable, humans make mistakes, humans are vulnerable, responsibility is shared, safety is proactive, and redundancy is crucial. SSA will be used to evaluate alternatives that promote safe road users, vehicles, speeds, and roads within CAMPO.

Figure 4 – Safe System Approach

3.3. FHWA Proven Safety Countermeasures

The FHWA Proven Safety Countermeasures includes a collection of 28 countermeasures and strategies that are proven to be effective in reducing fatal and serious injury crashes. LRSPs are one of the Proven Safety Countermeasures that have been shown to reduce fatal and serious injury crashes, with reductions between 17 and 35% across the country[1]. An LRSP provides a framework for identifying, analyzing, and prioritizing roadway safety improvements on local roads. Implementation of LRSPs has improved safety in local jurisdictions across the country by providing a guide for jurisdictions to systemically address the conditions that lead to fatal and serious injury crashes.

LRSPs provide a locally developed and customized roadmap to directly address the most common safety challenges in a given jurisdiction. This LRSP identifies emphasis areas that inform and guide further safety evaluation of CAMPO's transportation network. The emphasis areas include crash type and location, and an analysis of notable relationships between current efforts and crash history. The LRSP analyzes aggregated crash data, and where appropriate, analyzes specific locations to identify trends, high-crash locations, and high-risk locations, based on unusual crash history, patterns, or severity. Analyzing crash history within the CAMPO Region provides a basis for:

- Identification of safety factors for roadway users to maneuver.
- Improvement of safety at identified high-crash locations.
- Development of safety measures that align with the Nevada SHSP's six "E's" of safety.

[1] FWHA Proven Safety Countermeasures, Local Road Safety Plans, https://highways.dot.gov/safety/proven-safety-countermeasures/local-road-safety-plans accessed on September 15, 2023

3.4. NHTSA Countermeasures that Work

The NHTSA Countermeasures that Work, 11th Edition is a guide that State Highway Safety Offices (SHSO) can use as a guide for implementing effective, science-based, behavior-related traffic safety countermeasures. These countermeasures are grouped into the following problem areas:

- Alcohol and Drug Impaired Driving
- Seatbelts and Child Restraints
- Speeding and Speed Management
- Distracted Driving
- Motorcycle Safety
- Young Drivers
- Older Drivers
- Pedestrian Safety
- Bicycle Safety
- Drowsy Driving

Some countermeasures have been researched more extensively than others. The countermeasures identified for each of the areas of focus have a 1- to 5-star effectiveness rating. It is recommended that countermeasures with 3 stars or higher are used as these countermeasures have been researched more extensively and demonstrated to have higher effectiveness. Each countermeasure also has information about cost for implementation on a scale from low to high, the frequency of use of the countermeasure, and the time required to implement. Time to implement is ranked by "short" being three months or less, "medium" more than three months but less than one year, and "long" being more than one year. The effectiveness-to-cost ratio is an important consideration for recommendations that are to come out of the LRSP. The countermeasures outlined in this guide are aimed toward shifting the behaviors of drivers through different types of implementation. Physical changes like those in the FHWA Proven Safety Countermeasures must be considered in conjunction with behavioral countermeasures. While CAMPO can benefit from applying countermeasures for each of the areas of focus, it should pay special attention to the areas of focus that align with the most highly represented CEAs summarized in **Section 6.2.1**, impaired driving, older drivers, speed-related, and pedestrians.

3.5. AASHTO HSM and Network Screening Analysis Methodology

The first edition of the HSM was published by AASHTO in 2010. The HSM presents numerous methods for quantitatively estimating the frequency and severity of crashes at a variety of road and intersection types.[2] This four-part manual is divided into the following parts: A) Introduction, Human Factors, and Fundamentals, B) Roadway Safety Management Process, C) Predictive Method, and D) Crash Modification Factors.

Part B of the HSM (Chapter 4) discusses the Network Screening Process. The Network Screening Process is a tool for an agency to analyze its entire network and identify and rank locations that, based on the implementation of a countermeasure, are most likely or least likely to see a reduction in the frequency of crashes.

[2] AASHTO, *HSM*, 2010, Washington D.C., http://www.highwaysafetymanual.org/Pages/About.aspx

The HSM five-step network screening process[3] consists of:

1. **Establish Focus:** Identify the purpose or intended outcome of the network screening analysis. This decision will influence data needs, the selection of performance measures, and the screening method that can be applied.
2. **Identify Network and Establish Reference Populations:** Specify the types of sites or facilities being screened (i.e., segments, intersections, geometrics) and identify groupings of similar sites or facilities.
3. **Select Performance Measures:** There are a variety of performance measures available to evaluate the potential to reduce crash frequency at a site. In this step, the performance measure is selected as a function of the screening focus and the data and analytical tools available.
4. **Select Screening Method:** There are three principal screening methods described in this chapter (i.e., ranking, sliding window, peak searching). Each method has advantages and disadvantages; the most appropriate method for a given situation should be selected.
5. **Screen and Evaluate Results:** The final step in the process is to conduct the screening and analysis and evaluate the results.

The HSM provides several performance measures derived from statistical methods used to screen roadway networks to identify high crash locations based on overall crash histories. The initial steps of the crash analysis established sub-populations of roadway segments and intersections that have similar characteristics. For this LRSP, intersections were grouped by their control type (signalized and unsignalized) and segments by their functional classification (Principal Arterial, Minor Arterial, Major Collector, Minor Collector, and Local). Individual crash rates were calculated for each sub-population. The population-level crash rates were then used to assess whether a specific location has more or fewer crashes than expected. These sub-populations were also used to determine typical crash patterns to help identify locations where unusual number of specific crash types are occurring. Intersections and roadways were analyzed using four crash metrics:

- Number of Crashes
- Critical Crash Rate (CCR) Analysis (HSM Ch. 4)
- Equivalent Property Damage Only (EPDO) Method (HSM Ch. 4)
- Probability of Specific Crash Types Exceeding Threshold Proportion (HSM Ch. 4)

3.5.1. Critical Crash Rate (CCR) Analysis

The HSM describes the CCR method, which provides a statistical review of locations to determine where risk is higher than that experienced by other similar locations. It is also the first step in analyzing for patterns that may suggest systemic issues that can be addressed at that location, and proactively at others to prevent new safety challenges from emerging. The CCR analysis compares the observed crash rate to the expected crash rate at a particular location based on facility type and traffic volume. CCR uses a locally calculated average crash rate for the specific type of intersection or roadway segment being analyzed. Based on traffic volumes and a weighted crash rate for each facility type, a CCR threshold is established at the 95-percent confidence level to determine locations with higher crash rates that are unlikely to be random. The threshold is calculated for each location individually based on its traffic volume and the crash profile of similar

[3] AASHTO. *HSM.* 2010. Washington, DC. Page 4-2.

facilities. The local CCR differential is the difference in CCR of a particular facility and the average crash rate for a similar facility within the region. A CCR differential value greater than zero reflects a location that has a higher crash rate than facilities with similar volumes, while a negative CCR differential value signifies a below-average crash rate. It should be noted that the CCR does not reflect the severity of the crashes occurring at the location, but rather the number of crashes for the given volume. Detailed CCR formula information is included in **Appendix A**.

3.5.2. Equivalent Property Damage Only Method

The EPDO method, described in the HSM, assigns weighting factors to crashes based on injury level (fatal, serious injury, non-incapacitating injury, possible injury) to develop a PDO score. An EPDO score allows for a fair comparison of crash severity across years or study periods, as this normalized unit considers inflation and cost escalation. Using the EPDO methodology normalizes the data and accounts for the increase in cost from inflation. In this analysis, the injury crash costs were calculated for each location; this value is then divided by the injury cost for a PDO crash. The resulting number is the equivalent number of PDO crashes at each site. This value allows all locations to be compared based on injury crash costs (HSM, Chapter 4). Detailed CCR formula information is included in **Appendix A**.

3.5.3. Probability of Specific Crash Types Exceeding Threshold Proportion

When analyzing crash data systematically, it is important to identify areas where certain types of crashes are occurring with greater frequency. The HSM describes a method of identifying locations where probability of a specific crash type exceeds the threshold population. This method prioritizes locations based on the probability that the true proportion (long-term predicted proportion) of a type of crash or injury level will exceed the threshold proportion. The threshold proportion is based on the proportion of a specific crash type/severity to all crashes within the dataset (HSM, Chapter 4). This analysis identifies locations where certain crash types are over-represented to be isolated for further analysis.

4. REVIEW OF RELEVANT PLANNING DOCUMENTS

This section provides a summary of planning documents reviewed as part of the LRSP evaluation and why they were reviewed, including high-level key points and transportation-related improvements (**Table 2**). The following sections summarize the studies reviewed and are organized by responsible agency. The documents reviewed for this project provide background information that will be beneficial during the development of the CAMPO LRSP. The CAMPO LRSP Policies, Plans, and Studies Memorandum is located in **Appendix B**. The documents reviewed and responsible agencies are listed below:

Table 2 – Relevant Planning Documents

Name of Study (Agency)	Key Takeaways
2024 Unified Planning Work Program (CAMPO)	▪ Identifies objectives for the 2023 and 2024 fiscal years. CAMPO has five work elements with budgets. The total funding amount is divided between the Unified Planning Work Program (UPWP) consolidated planning grant (CPG) with a local match and includes other federal or local funding included. ▪ It will be important for the LRSP to keep in mind that funding is allocated on this two-year cycle so any plans for implementation of recommendations from the LRSP would be budgeted for on the two-year cycle depending on the timing of the project.
Existing Safety-Related Policies and Practices (CAMPO)	▪ The CAMPO governing body is comprised of seven members which includes five members of the Regional Transportation Commission of Carson City including appointees from the surrounding counties (Carson City, Douglas, and Lyon) and each member serves a two-year term. ▪ A key part of safety related practices and policies is to maintain the Regional Transportation Plan, Regional Transportation, Plan, Transportation Improvement Program, and Public Participation Plan. The 2050 Regional Transportation Plan identifies safety performance measures that are based off of the FHWA HSIP and Safety Performance Management measures. They use number of fatalities, rate of fatalities, number of serious injuries, rate of serious injuries, and number of non-motorized fatalities and non-motorized serious injuries to measure performance.
Regional Transportation Plan 2021-2050 and Transportation Improvement Program (CAMPO)	▪ The RTP incorporates plans, such as the Carson City Safe Routes to School (SRTS) Master Plan, to allow for additional funding sources to accomplish safety projects. ▪ There are 13 near-term projects that are unfunded, although some of these cost estimates were not developed at the time of the RTP. Near-term unfunded projects in the RTP include additional pavement rehabilitation projects, congestion mitigation improvements, Jump Around Carson (JAC) expansions, new intersection construction, new roadway construction, congestion mitigations, traffic control devices, and a new bridge. ▪ The TIP prioritizes this list of projects for the future four years. The TIP works in conjunction with the STIP and the RTP. ▪ The TIP also includes various funding sources for transportation projects that are available through the FHWA, United States Department of Housing and Urban Development (HUD), and Federal Transit Administration (FTA).

Table 2 – Relevant Planning Documents (Continued)

Name of Study (Agency)	Key Takeaways
Carson City Public Works Complete Streets Policy (Carson City)	▪ Ensures that streets are safe, accessible, and comfortable for users of all ages and abilities without limitation. ▪ Complete Street elements should be an aspect of all future projects and phases moving forward, so any proposed changes in the LRSP should consider this. CAMPO has created a Complete Streets Performance Monitoring guide that can be used alongside the policy document to guide compliance with Complete Streets. ▪ Public participation is an important part of this process as well, including engagement and visioning. While those aspects are not typically part of an LRSP, it is still important to consider Complete Streets ideas into any LRSP proposals. While the LRSP will be focused on roadway implementations, it still involves bicycle and pedestrian users who can be included in serious injury and fatal crashes.
Western Nevada Safe Routes to School (SRTS) (Carson City, Douglas County, Lyon County, Storey County)	▪ Focuses on encouraging walking and biking to school and improving the safety of students within one to two miles of the schools. ▪ The main considerations for the Carson City SRTS plan include a focus on bus stop connectivity, sidewalk connectivity, and bicycle network connectivity as well as safety in school zones. ▪ The Douglas County SRTS Action Plan (2023) prioritizes the unique needs of each of its 11 school campuses with a goal of identifying infrastructure to allow students to have safe mobility options to and from school. ▪ Any crossover in recommendations between SRTS and the LRSP would be geared toward any fatal or serious injury crashes that involve a pedestrian or a cyclist and a driver.
2020 Carson City Americans with Disabilities Act (ADA) Transition Plan (Carson City)	▪ Provides a framework for Carson City to meet equal access requirements as identified in the ADA. It largely relates to pedestrian facilities in the public right-of-way and ensuring those facilities are provided and always maintained. ▪ To meet the ADA accessibility guidelines, Carson City is relying on the TIP, development permits, and street maintenance for the planned updates and funding. ▪ Any roadway improvements undertaken as part of the LRSP must meet ADA specification for pedestrian facilities as identified within the ADA Transition Plan.
Highway Safety Improvement Program (HSIP), Local Public Agencies (LPA) Process, (NDOT)	▪ The HSIP LPA Process supports efforts to assist agencies with applying for HSIP funding. HSIP is a federal program that uses a data driven approach. The preparation of this LRSP will allow CAMPO to be eligible for HSIP funding. ▪ Each project submitted for funding is required to support at least one emphasis area from the Nevada SHSP. The document provides guidance on important components of an LRSP, including types of data to use other than crash data – roadway characteristics, traffic volumes, maintenance logs, and traffic citations for determining the analysis.
2017 NDOT Access Management System and Standards (NDOT)	▪ Outlines access spacing standards along NDOT-maintained roadways. ▪ This document can be used to determine appropriate access management treatments, median openings, and driveway spacing for NDOT-maintained roadways within CAMPO.

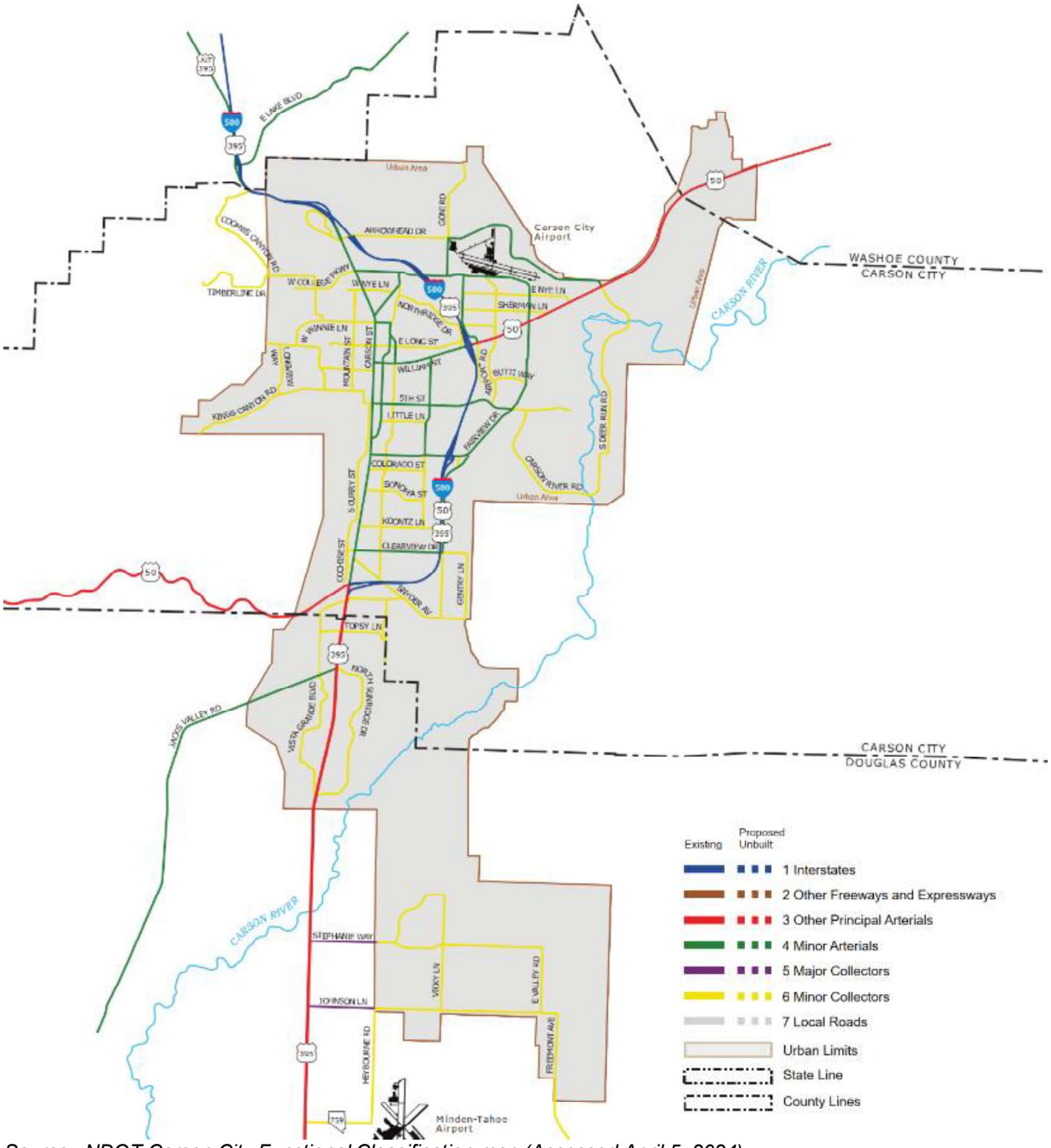
5. DATA SOURCES

Data from various sources including CAMPO, NDOT, and the United States Department of Transportation (USDOT) were used to inform the analysis for this LRSP. Data collected included Geographic Information Systems (GIS) information on the roadway network and intersections. Additional data was obtained including Annual Average Daily Traffic (AADT), crash data, and environmental justice details from the USDOT Justice40 initiative. Further details regarding these data sources are provided in the following sections.

5.1. Roadway Network

The network screening analysis described in **Section 3.5** requires each corridor within the CAMPO Region to be classified by roadway functional classification. NDOT's GIS Functional System data layer was used to identify the functional classification for roadways in the CAMPO Region, refer to **Figure 5** for the NDOT functional classification data layer. NDOT's Road Ownership and Maintenance data layer was used to identify the segments for which CCRs were developed. The two data layers were joined resulting in one layer that includes both the roadway name and its functional classification. The definitions for each classification type are provided below:

- **Principal Arterial:** Principal arterials are intended for the movement of high volumes of traffic at high speeds over long intercity and intracity distances. Roadways in this class may be two-lane or multi-lane facilities. These roadways serve major centers of metropolitan areas, provide a high degree of mobility, and can also provide mobility through rural areas.
- **Minor Arterial:** Minor arterials provide service for trips of moderate length; serve geographic areas that are smaller than those served by the principal arterials and offer connectivity to the principal arterial system. These roadways may be two-lane or multilane roadways and have the capacity to carry medium to high volumes of traffic at medium speeds over short to medium distances.
- **Major Collector:** Collectors serve a critical role in the roadway network by gathering traffic from local roads and funneling them to the arterial network. Collectors serve intercounty (rather than statewide) travel and constitute those routes on which (independent of traffic volume) predominant travel distances are shorter than on arterial routes. Major collector routes are longer in length, have lower connecting driveway densities, have higher speed limits, are spaced at longer intervals, have higher annual average traffic volumes, and may have more travel lanes than their Minor collector counterparts.
- **Minor Collector:** Minor Collector routes are shorter in length, have higher connecting driveway densities, have lower speed limits, are spaced at smaller intervals, have lower annual average traffic volumes, and may have fewer travel lanes than their Major Collector counterparts.
- **Local Road:** Local roads are not intended for use in long-distance travel; they are primarily used at the origin or destination end of the trip due to their provision of direct access to abutting land. The primary purpose of these roads is to provide safe and reasonable land access. They are often designed to discourage through traffic.



Source: NDOT Carson City Functional Classification map (Accessed April 5, 2024)

Figure 5 – NDOT Carson City Functional Classification Map

The functional classifications were used to identify the "Local Roads" for use in the LRSP. The "Local Roads" include roads owned by local agencies and state highways owned by NDOT. The roadway segments were separated by functional classification to develop crash rates specific to their functional design and capacity. Comparative statistics were stratified by functional classification (i.e., only major arterials are compared to major arterials).

5.2. Intersections

Intersections within the CAMPO Region were grouped by control type as either signalized or unsignalized. Unsignalized intersections include stop-controlled intersections and roundabouts. The traffic signal location data layer from CAMPO was used to identify signalized intersections within the roadway network. Intersection crashes were identified as crashes occurring within a 250-foot radius of an intersection; all other crashes were considered to be segment crashes in the safety data analysis.

5.3. Annual Average Daily Traffic

AADT data was collected from NDOT's Traffic Records Information Access (TRINA) application. This data included average annual daily traffic values for roadway segments throughout CAMPO for use in the development of crash rates. Local roads where NDOT TRINA data was not available used an assumed 500 vehicles per day (vpd) to calculate the local CCR differential in the occurrence of a crash on that segment. The assumed 500 vpd was used as an average for AADT on small residential roads as the actual AADT differs between various residential roads depending on number of homes, whether or not it is a through street, and other factors.

5.4. Crash Data

The latest five years of crash data from 2018 to 2022 was provided by NDOT from the Nevada Citation and Accident Tracking System (NCATS) and NHTSA from the Fatality Analysis Reporting System (FARS). NCATS injury and property damage only (PDO) crash data from 2018 to 2021 provided by NDOT was combined with FARS fatal crash data. For 2022, NCATS fatal, injury, and PDO crash data was used because 2022 FARS data had not been finalized at the time of this analysis. A breakdown of the crash data sources used for each crash severity by year is shown in **Table 3**.

The crash counts can vary between the two data sources. NCATS uses information from the responding law enforcement officers. For fatal crashes, FARS uses additional information from the post-crash, including speed studies, crash forensics, officer narratives, and citations issued after the crash. This additional information is compiled and included in the FARS data summary, which is published as final approximately 1.5 years later (2022 FARS data is pending as of March 2024). The additional post-crash information is not always updated in NCATS, resulting in discrepancies between the two data sets. The fatal crash data from 2018 to 2021 was used to compare the CAMPO Region fatal crashes to statewide fatal crashes reported in the Nevada SHSP Fatal Crash Dashboard for the same timeframe.

Table 3 – Summary of Crash Data Sources by Year

Year	Fatal Crash Data	Injury and PDO Crash Data
2018	FARS	NCATS
2019	FARS	NCATS
2020	FARS	NCATS
2021	FARS	NCATS
2022	NCATS	NCATS

5.5. Environmental Justice and Disadvantaged Communities

Since publishing the Title VI Plan for Carson City Regional Transportation Commission (RTC) & CAMPO (2020), the USDOT has established the Justice40 Initiative, which aims to address environmental and economic inequities by ensuring that at least 40% of the benefits of federal infrastructure investments go to disadvantaged communities. Within this initiative, the Transportation Insecurity component specifically targets transportation-related challenges faced by marginalized communities. It focuses on three key indicators to assess transportation insecurity: access to reliable and affordable transportation options, transportation-related safety concerns, and economic burdens associated with transportation costs. By addressing these indicators, the initiative seeks to enhance mobility, reduce environmental health risks, and alleviate financial strain on underserved populations, ultimately promoting equity and sustainability in transportation systems.

Justice40 disadvantaged communities are often concentrated in areas characterized by limited access to resources, economic challenges, and environmental burdens. These communities tend to be disproportionately impacted by various factors, including transportation-related risks. Disadvantaged communities within the CAMPO Region include most of Lyon County south of US–50, as well as the New Empire area and a portion of the south Carson City area, as shown in **Figure 6**.

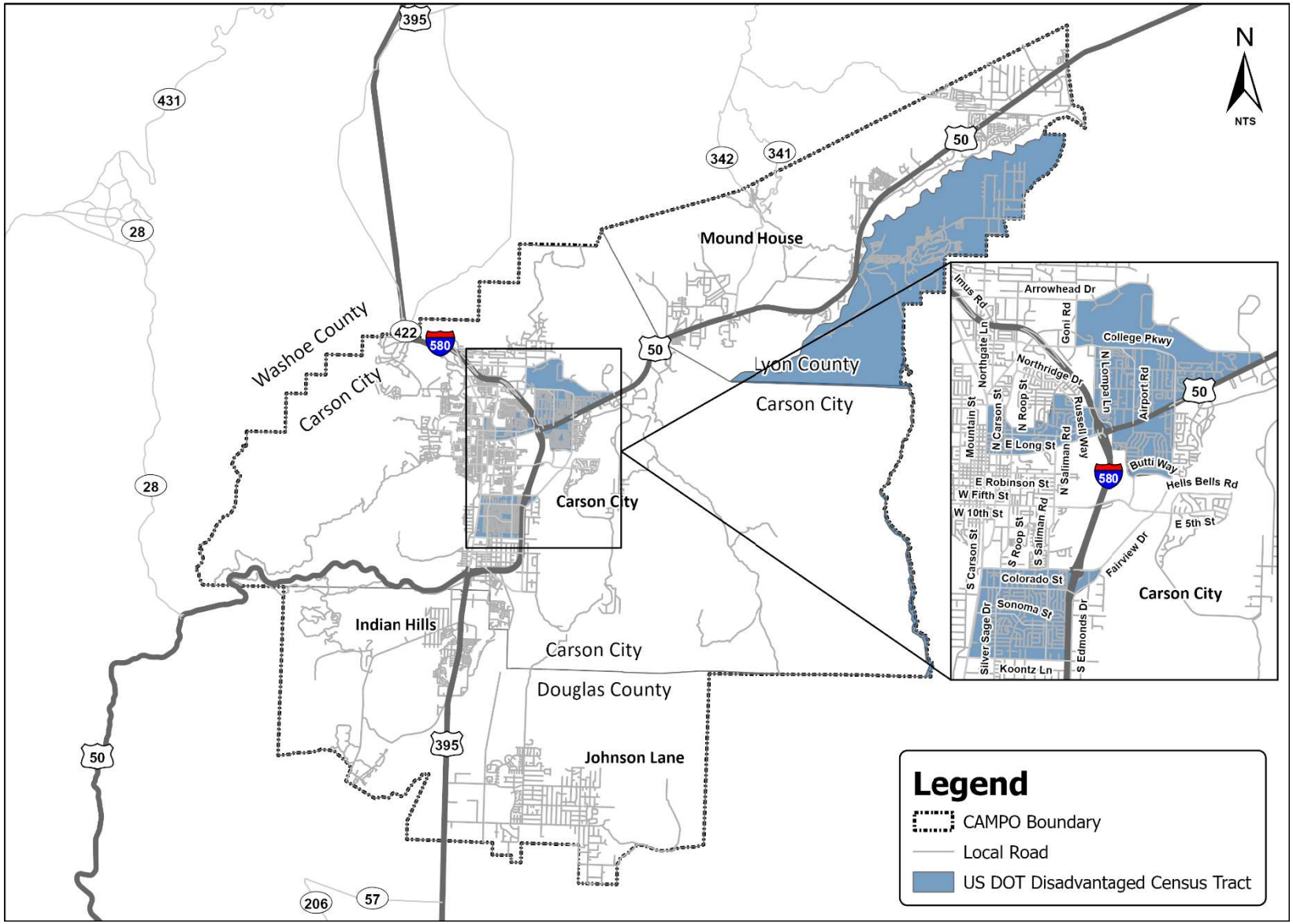


Figure 6 – Justice40 Disadvantaged Communities (Transportation Insecurity)

6. CRASH DATA ANALYSIS

The following sections summarize the results of the safety trends which include the evaluation of crashes by severity, type, driver behavior, VRUs and motorcyclists, and environmental factors. VRUs refer to non-motorized road users, such as pedestrians, and bicyclists. The crash data analysis identified the number of crashes that occurred at each location over the analysis period, and then classified areas that had over-representation on various crash factors. These crash factors were:

- **Crash Severity –** fatal, serious injury, non-incapacitating injury, possible injury, and PDO.
- **Crash Type –** angle, rear-end, sideswipe, head-on, hit object, and overturned.
- **Driver Behavior –** aggressive, impaired, and distracted driving.
- **Vulnerable Road Users –** pedestrian-, and bicyclist-involved crashes.
- **Environmental Factors –** lighting and roadway conditions.

The final Crash Data Analysis Technical Memorandum with detailed crash data tables and figures is included in **Appendix A**.

6.1. Crash Severity Level

Knowing the impacts of the crash, the injuries or type of damage that occurred, is a key part of assessing the environment and safety factors around the site of the crash. The National Safety Council developed the "KABCO" injury scale, which is frequently used by law enforcement for classifying injuries. The KABCO scale is referenced below.

- K – Fatal
- A – Serious injury
- B – Non-incapacitating injury
- C – Possible injury
- O – PDO (no injury)

The crash analysis for the LRSP used the KABCO scale.

6.2. CAMPO Crashes on All Roads

From 2018 to 2022, there were 4,565 crashes in the CAMPO Region. Of the 4,565 crashes, 300 crashes (6.6%) occurred on Interstate 580 (I-580), and 4,265 crashes (93.4%) occurred on roads with other functional classifications (local roads). Of the 4,565 crashes, segment crashes accounted for 929 crashes (20.4%) and intersection crashes accounted for 3,336 crashes (73.1%). Crashes occurring at signalized intersections accounted for 1,394 crashes (30.5%), while crashes that occurred at unsignalized intersections made up 1,942 crashes (42.5%). An intersection crash is defined as a crash that occurs within 250 feet of an intersection.

Of the 4,565 crashes, 35 (0.8%) were fatal and 82 (1.8%) were serious injury crashes. Though there has been a decrease in the number of crashes between 2018 and 2022, there has been an increase in the number of fatal and serious injury crashes over that same period as shown in **Figure 7**.

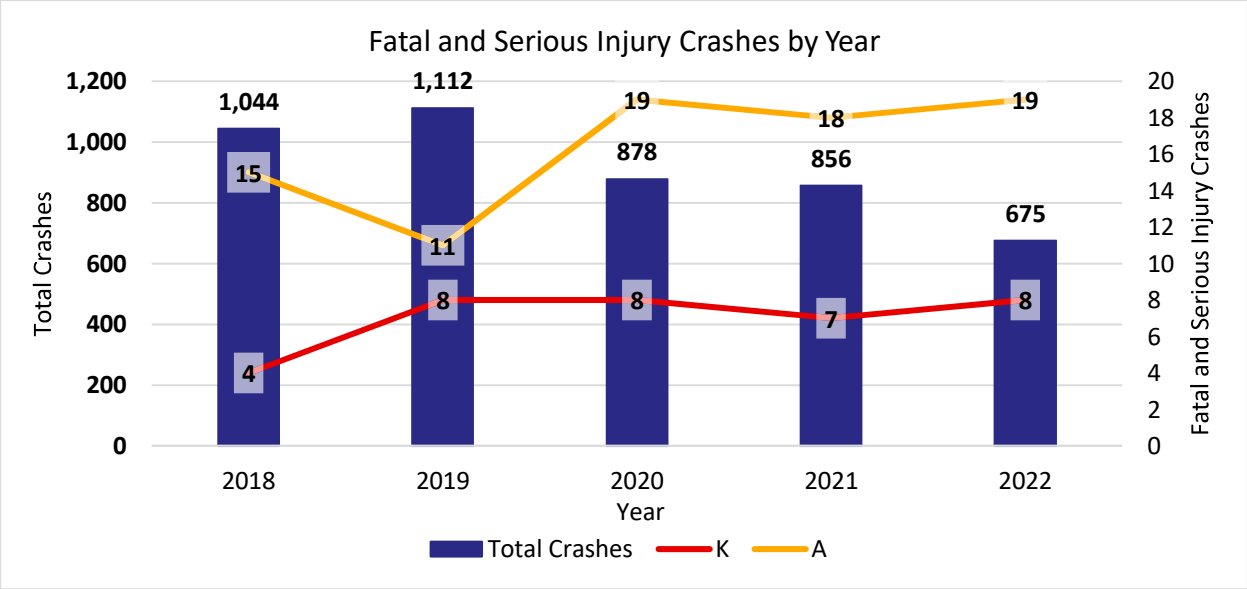
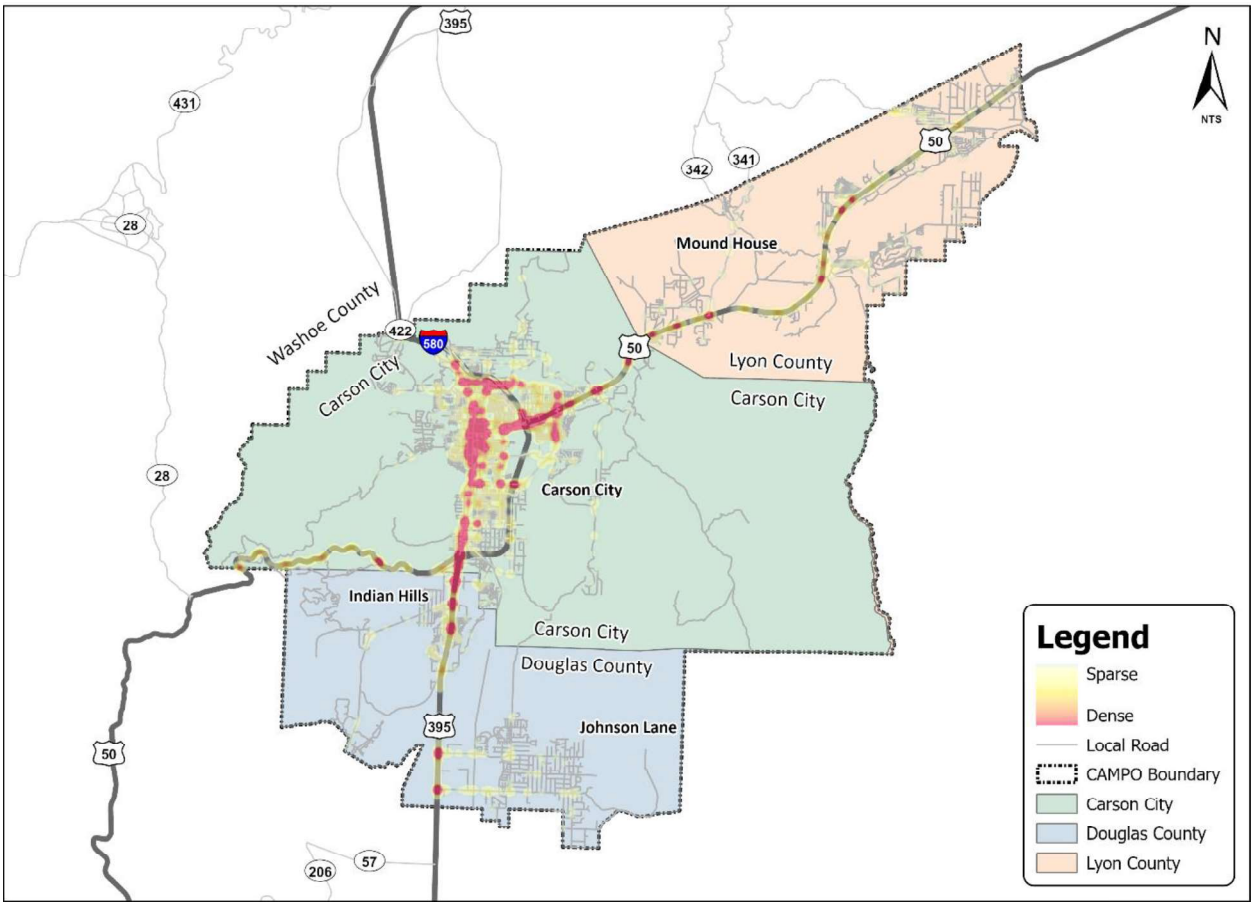


Figure 7 – CAMPO Crashes by Year

CAMPO experienced the highest concentration of crashes within the Carson City limits. Douglas County experienced high crash density where US-395 intersects with Stephanie Way and Johnson Lane. In Lyon County, most crashes occurred along US 50 and are spread out along that stretch of roadway. A heat map illustrating the crash density of all crashes within the CAMPO Region is shown in **Figure 8**.



Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NDOT
FARS Data (January 1, 2018 to December 31, 2021)

Figure 8 – CAMPO Region Crash Density (All Crashes) Map

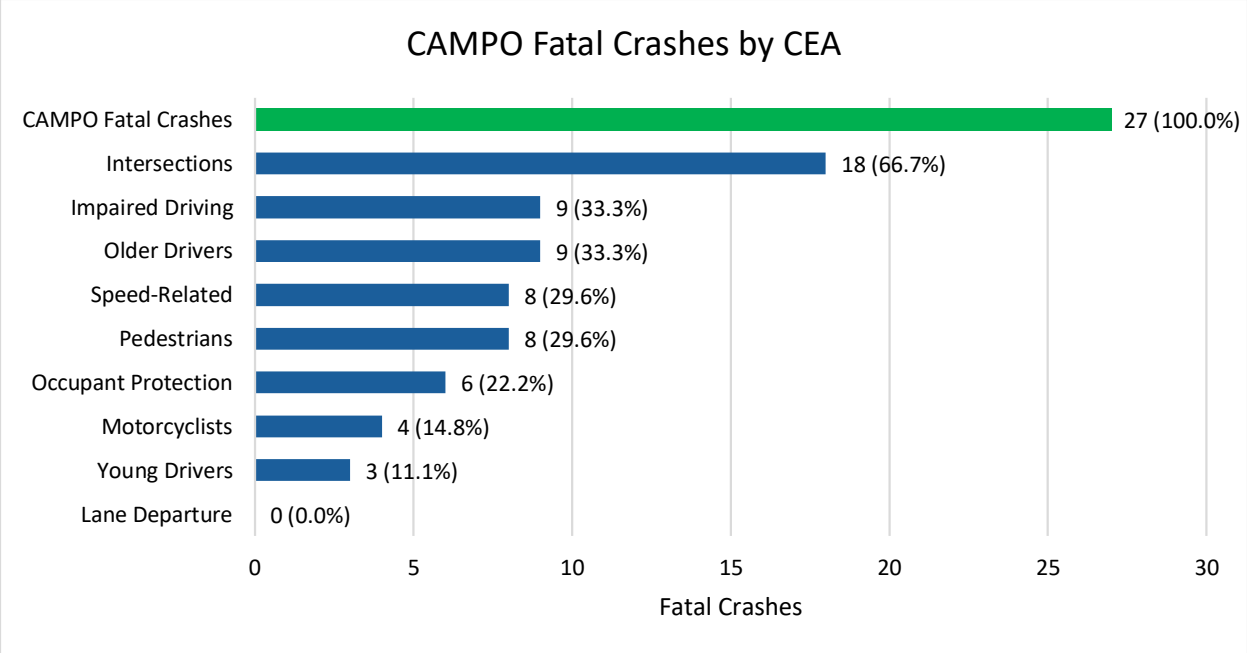
6.2.1. Crashes by Emphasis Area

The fatal crash data was used to compare the CAMPO Region fatal crashes to statewide crashes reported in the Nevada SHSP Fatal Crash Dashboard for the same timeframe. Fatal crashes for all facility types, including interstate, falling under each of the 10 SHSP CEAs were reviewed for CAMPO as shown in **Table 4** and **Figure 9**. The CEAs most highly represented by CAMPO fatal and serious injury crashes are Intersection, Impaired Driving, Older Drivers, Speed-Related, and Pedestrians. Three of the top four CEAs identified for CAMPO (Impaired Driving, Intersections, and Speed-Related) are also top CEAs at the statewide level.

Table 4 – CAMPO and Nevada SHSP CEA Comparison

Nevada SHSP CEA	CAMPO Region Fatal Crashes	Statewide Fatal Crashes
Intersections	**18 (66.7%)**	405 (30.0%)
Impaired Driving	9 (33.3%)	547 (40.5%)
Older Drivers	**9 (33.3%)**	270 (20.0%)
Speed-Related	**8 (29.6%)**	351 (26.0%)
Pedestrians	**8 (29.6%)**	298 (22.1%)
Unrestrained	**6 (22.2%)**	258 (19.1%)
Motorcyclists	4 (14.8%)	261 (19.3%)
Young Drivers	**3 (11.1%)**	128 (9.5%)
Lane Departures	0 (0.0%)	483 (35.8%)
Work Zones	N/A	N/A
Total Crashes	**27 (100.0%)**	**1,350 (100%)**

Source: FARS Data (January 1, 2018 to December 31, 2021)
Note: 1. Intersection crashes are based on a 250-foot influence buffer around each intersection
2. Percentages add up to more than 100%, as a crash may involve multiple CEAs (i.e., a young driver that was impaired and speeding)
3. Work Zones CEA was added to the Nevada SHSP after the analysis was completed, and was not included in the analysis for CAMPO



Source: FARS Data (January 1, 2018 to December 31, 2021)

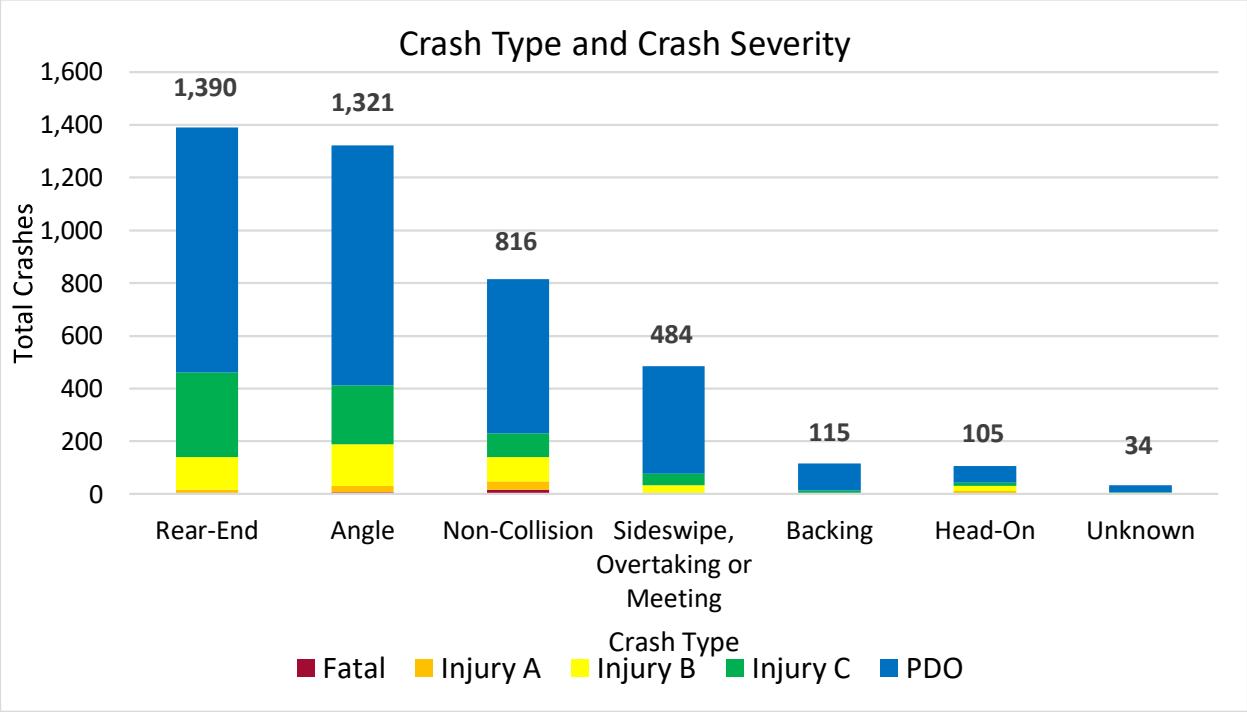
Figure 9 – Crashes by Critical Emphasis Area (2018-2021)

6.3. CAMPO Crashes on Local Roads and State Highways Only

Of the 4,565 crashes, 4,265 crashes occurred on local roads. CAMPO crashes that occurred on local roads made up 93.4% of the crashes that occurred within the region. Fatal crashes on local roads accounted for 34 crashes (0.8%) and serious injury crashes accounted for 81 crashes (1.9%). The following section highlights the crashes that occurred on local roads and omits interstate crashes.

6.3.1. Crash Type

Crash types were reviewed to gain a better understanding of existing crash factors in the CAMPO Region. The most common crash types within the CAMPO Region for all crash severities over the last five years were rear-end (1,390, 32.6%) and angle crashes (1,321, 31.0%), as shown in **Figure 10**. Fatal and serious injury crashes within the CAMPO Region consisted of rear-end (17, 0.4%), angle (32, 0.75%), non-collision (49, 1.1%), and head-on crashes (11, 0.26%). Crash types were a factor in the network screening analysis results further discussed in **Section 8**.

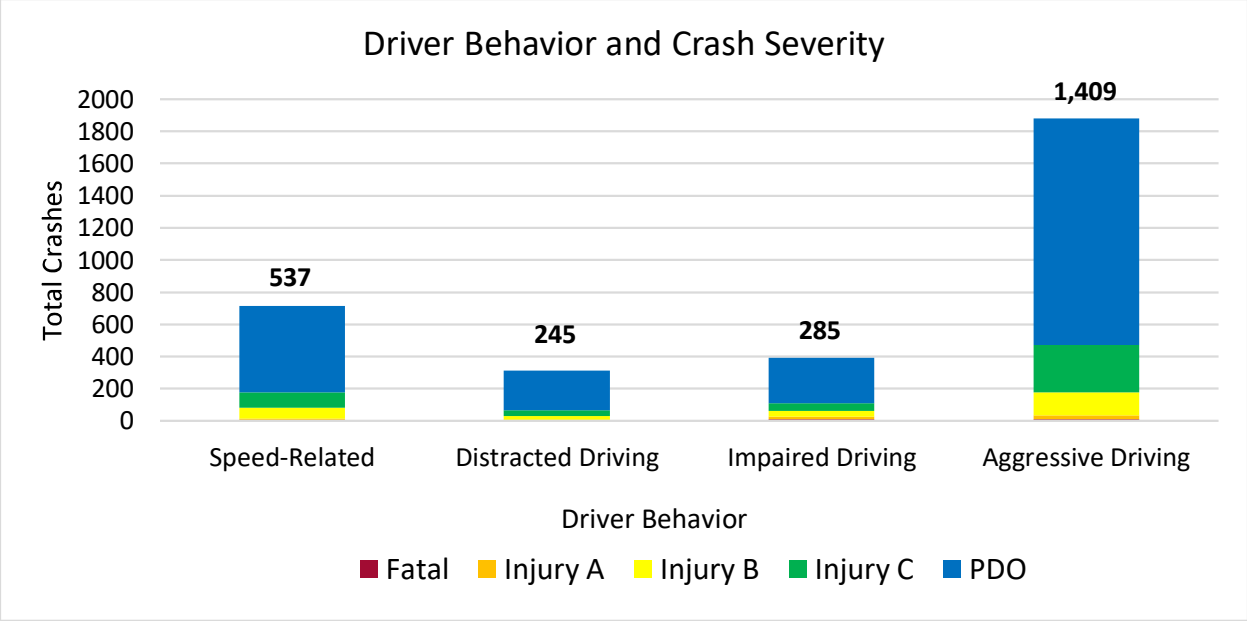


Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NDOT
FARS Data (January 1, 2018 to December 31, 2021)

Figure 10 – Crashes by Crash Type and Injury Severity (2018-2022)

6.3.2. Driver Behaviors

Of the 4,265 crashes, 2,476 (58%) were attributed to a driver's behavior (aggressive driving, speed-related, distracted driving, and impaired driving) as shown in **Figure 11**. Aggressive driving constituted the greatest number of driver behavior crashes with 1,409 crashes (57%), followed by speed-related with 537 crashes (22%), impaired driving with 285 crashes (12%), and distracted driving with 245 crashes (9%). Compared to the total number of fatal and serious injury crashes on local roads, driver behaviors accounted for 29 (85%) of fatal crashes and 52 (64%) of serious injury crashes. No crashes occurred within the CAMPO Region from 2018 to 2022 where a driver was reported to exhibit all three dangerous driver behaviors.

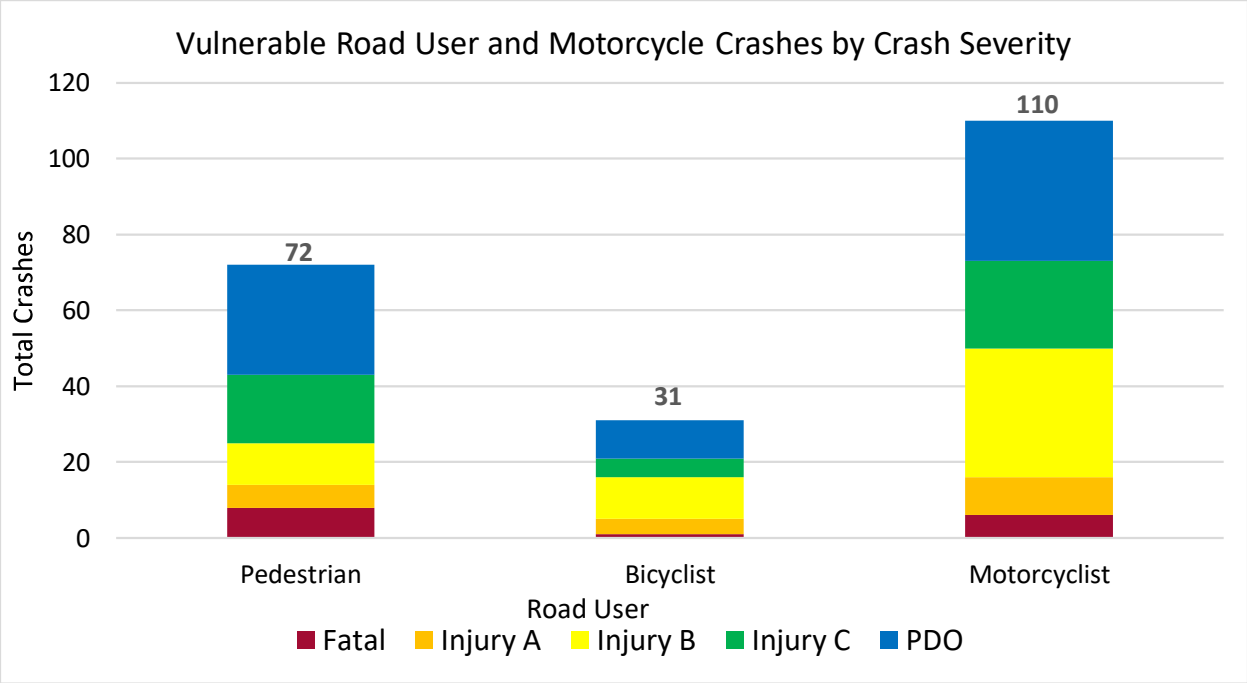


Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NDOT
FARS Data (January 1, 2018 to December 31, 2021)

Figure 11 – Speeding, Distracted Driving, and Impaired Driving Crashes (2018-2022)

6.3.3. Vulnerable Road Users and Motorcyclists

VRUs refer to certain non-motorized road users, such as pedestrians and bicyclists. Motorcyclists were included in the breakdown of other users for this analysis. The breakdown of crashes and crash severity for pedestrians, bicyclists, motorcyclists are shown in **Figure 12**. Of all local road crashes, 72 (1.7%) of crashes on local roads were pedestrian-involved crashes which included eight (11.1% of pedestrian-involved crashes) fatal and six (8.3% of pedestrian-involved crashes) serious injury crashes. Bicycle-involved crashes on local roads made up 31 crashes (0.73%) including one fatal (3.2% of bicycle-involved crashes), and four serious injury crashes (12.9% of bicycle-involved crashes). Motorcyclists accounted for 110 crashes (2.5%) on local roads, including six fatal (5.4% of motorcycle-involved crashes) and 10 serious injury crashes (9.1% of motorcycle-involved crashes). Pedestrian, bicyclist, and motorcyclist crashes occurred more than twice as frequently at unsignalized intersections than on road segments or at signalized intersections.



Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NDOT
FARS Data (January 1, 2018 to December 31, 2021)

Figure 12 – Pedestrian-, Bicyclist-, and Motorcyclist-Involved Crashes (2018-2022)

6.3.4. Environmental and Roadway Factors

An analysis of the lighting conditions shows that crashes occurred most often in daylight conditions (2,961, 69.4%), followed by dark conditions, with or without lighting (994, 23.3%). Fatal crashes occurred with nearly the same frequency in daylight (14 crashes, 0.3%) as dark conditions (13 crashes, 0.03%). The breakdown of crashes by time of day shows the frequency of fatal and serious injury crashes increases during the typical AM and PM peak periods (6 AM to 9 AM, and 5 PM to 8 PM). The two hours with the highest number of fatal crashes during the five-year period were 6 AM to 7 AM (four fatal crashes, 0.09%), and 6 PM to 7 PM (four fatal crashes, 0.09%).

Weather does not appear to be a factor in the majority of crashes in the CAMPO Region as most crashes occurred during clear conditions. Of the 4,265 crashes, 3,002 crashes (70.4%) occurred in clear weather conditions. Rainy and snowy conditions accounted for less than 1% of the crashes combined.

6.3.5. Fatal and Serious Injury Crashes on Local Roads

Of the 4,265 crashes on local roads, 31 crashes (0.7%) were fatal and 81 (1.9%) resulted in serious injury. Of the fatal crashes on local roads, 10 (32.3%) occurred on local road segments, seven (22.6%) at signalized intersections, and 14 (45.2%) at unsignalized intersections. Of the 81 serious injury crashes, 21 (25.9%) occurred on local road segments, 22 (27.2%) at signalized intersections, and 38 (46.9%) at unsignalized intersections. Crashes occurring at signalized intersections accounted for 30.5% (1,394) of all crashes, while crashes that occurred at unsignalized intersections made up 42.5% (1,942) of crashes on local roads. An intersection crash is defined as a crash that occurs within 250 feet of an intersection.

A total of 929 crashes (20.4%) occurred on local road segments in the CAMPO Region. The breakdown of crashes by functional classification shows crashes on principal arterials occurred more than three times as often as crashes on any other functional classification as shown in **Figure 13**.

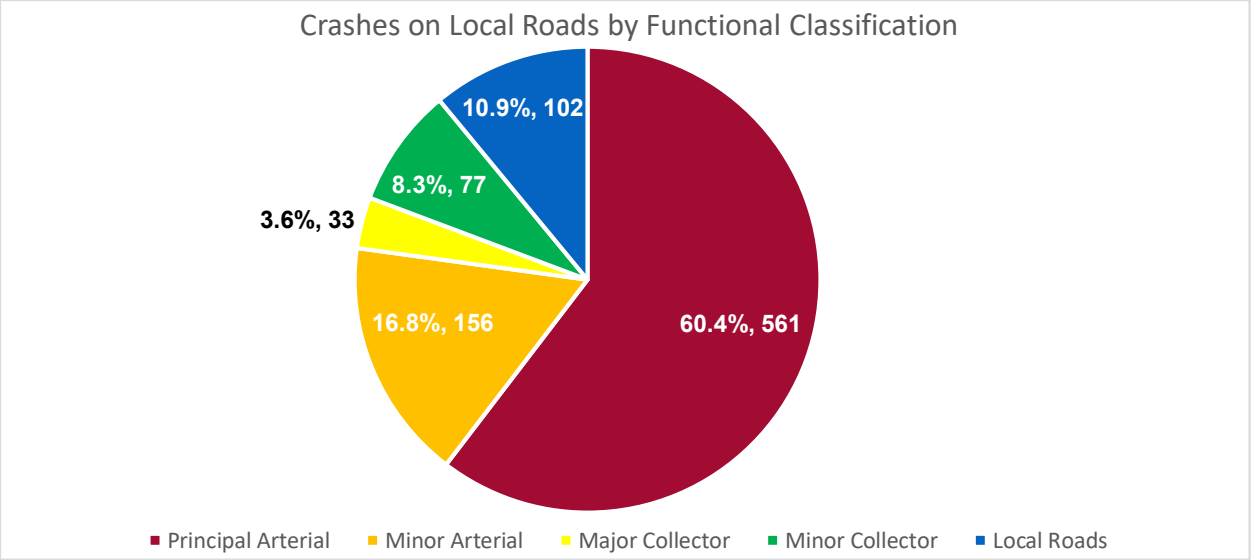


Figure 13 – Crashes by Functional Roadway Classification (2018-2022)

6.3.6. Fatal and Serious Injury Crashes within Disadvantaged Communities

An analysis of fatal and serious injury crashes occurring within the disadvantaged communities identified in **Section 5.5** was conducted. Analyzing census tracts within these areas reveals a concerning pattern of fatal and serious injury crashes. Of the fatal and serious injury crashes occurring on local roads, five fatal (15% of all fatal crashes) and 17 (21%) serious injury crashes occurred within disadvantaged census tracks as shown in **Figure 14**. The data highlights a stark disparity, with disadvantaged communities experiencing a higher frequency of such incidents compared to more affluent neighborhoods. This underscores the urgent need for targeted interventions and investments in transportation infrastructure and safety measures to mitigate risks and improve the well-being of residents in these vulnerable communities. The crash analysis provides details of crashes occurring in these disadvantaged communities, but it does not provide details of where the drivers and passengers live. It is possible that those involved in these crashes do not live in these areas.

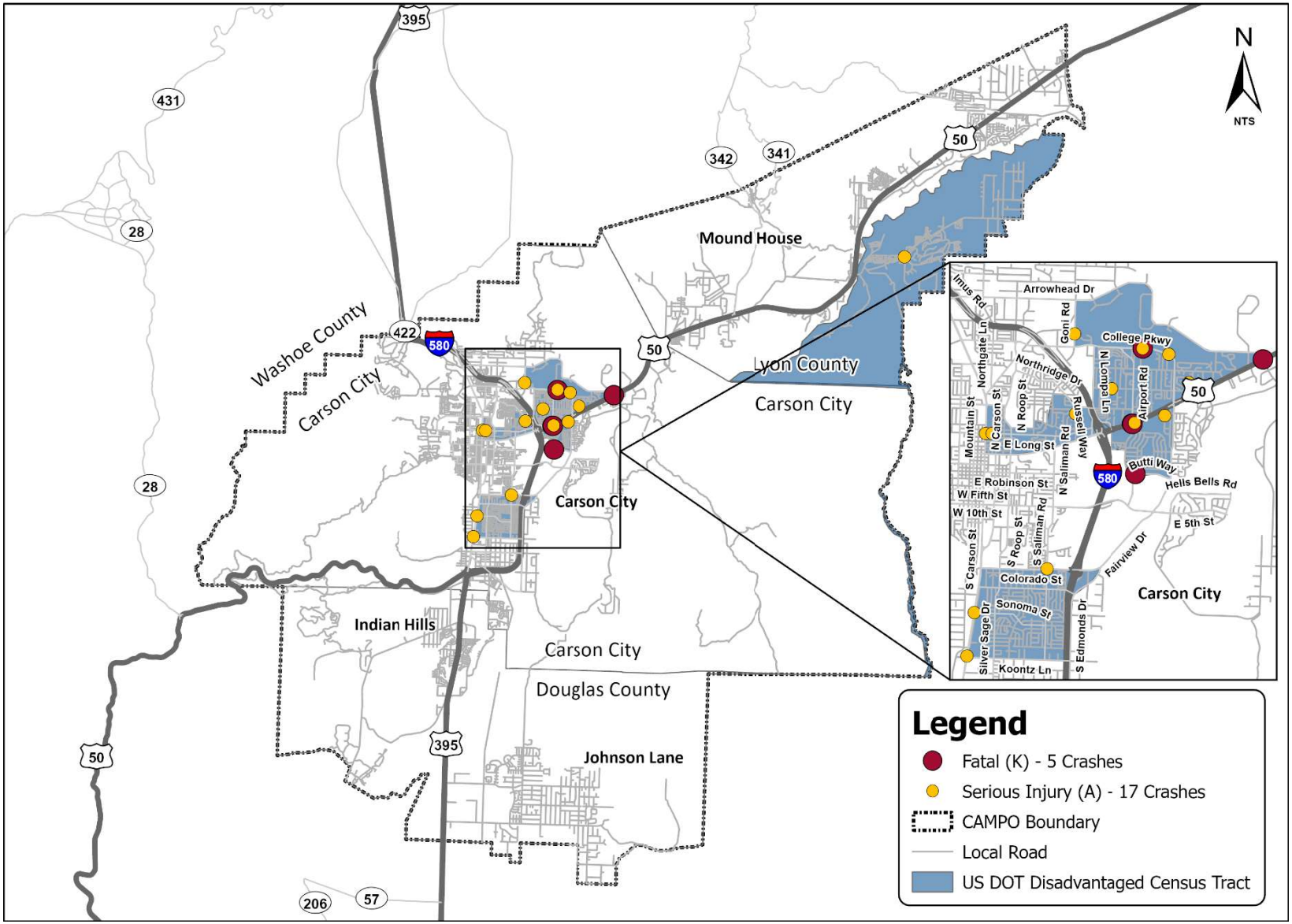


Figure 14 - Justice40 Transportation Insecurity Disadvantaged Census Tract Crashes

6.4. Crash Data Analysis Summary

- Though there has been a decrease in the number of crashes between 2018 and 2022, there has been an increase in the number of fatal and serious injury crashes over that same time period.
- Four of the top five CEAs identified for CAMPO (Impaired Driving, Intersections, Speed-Related, and Pedestrians) are also top CEAs at the statewide level.
- Crashes on local roads made up 4,265 (93.4%) crashes within the region. Three hundred (6.6%) crashes occurred on the interstate.
- Segment crashes from 2018 to 2022 accounted for 929 crashes (20.4%).
- Intersection crashes accounted for 3,336 crashes (73.0%). Crashes occurring at signalized intersections accounted for 30.5% of all crashes, while crashes that occurred at unsignalized intersections made up 42.5% of all crashes.
- The most common crash types within the CAMPO Region for all crash severities over the last five years were rear-end (1,390, 30.4%) and angle crashes (1,321, 28.9%).
- Crashes on principal arterials occurred more than three times as often as crashes on any other functional classification.
- Crashes that occurred at unsignalized intersections tend to be more severe.
  - Of the crashes that occurred at unsignalized intersections, 14 (45.2%) were fatal crashes and 38 (46.9%) were serious injury crashes.
  - Of crashes that occurred at signalized intersections, 7 (22.6%) were fatal crashes and 22 (27.2%) were serious injury crashes.
  - Of the crashes that occurred on segments, 10 (32.2%) were fatal crashes and 21 (25.9%) were serious injury crashes.
- Pedestrians were involved in 72 (1.7%) crashes. Of the pedestrian-involved injury crashes, eight (0.19%) were fatal, and six (0.14%) were reported to have caused serious injury.
- Bicycle-involved crashes made up 31 (0.7%) crashes that occurred including one fatal (0.23%), and four serious injury crashes (0.94%).
- Motorcyclists accounted for 110 crashes (2.6%) over the five-year period, including six fatal (0.14%) and 10 serious injury crashes (0.23%).
- Pedestrian and bicycle crashes occurred most often at unsignalized intersections.
- Crashes occurred most often in daylight conditions (2,961, 69.4%), followed by dark conditions, with or without lighting (994, 23.3%).
- The two hours with the highest number of fatal crashes during the five-year period were 6 AM to 7 AM (four fatal crashes, 0.09%), and 6 PM to 7 PM (four fatal crashes, 0.09%).
- Weather does not appear to be a contributing factor in crashes as the majority of crashes occurred during clear and cloudy weather conditions. Rainy and snowy conditions accounted for less than 1% of the crashes combined.

Detailed crash data analysis information is located in **Appendix A**.

6.5. Network Screening Results

All locally-owned roadway segments and intersections with three or more crashes were cataloged and used for the network analysis conducted. Based on the results, 20 preliminary locations, were identified for further discussion and prioritization. The 20 preliminary locations consisted of 10 segments, five signalized, and five unsignalized intersections. The identification of the 20 locations utilized the network screening results for local CCR differential, EPDO score, and crash patterns or clusters of crashes to determine each location. The local CCR is the maximum crash rate expected to occur at that location within the study area. EPDO weighs factors related to the societal costs of fatal, injury, and property damage-only crashes and is assigned to crashes by severity to develop an EPDO score that considers the frequency and severity of crashes.

To identify high-risk locations, segments and intersections that did not rank highly based on crash history (through the use of the local CCR differential and EPDO score) can benefit from applications of countermeasures systemically. Incorporating this approach allows agencies to manage risk, especially on rural and local low-volume roadways where crashes can be spread out with minimal repeat crashes at a given location, or where crash history does not exist. For example, portions of E College Parkway from I-580 to US-50 had a high local CCR differential while others did not. In this case, the entire segment of E. College Parkway from I-580 to US-50 was selected because the segment had similar roadway characteristics that could improve safety.

6.6. 10 Priority Locations

The list of 20 preliminary locations was further refined based on the criteria presented in the network screening analysis and with input from stakeholders to identify 10 priority locations (five segments and five intersections) that would be further reviewed during Workshop 2. Eight of the 10 priority locations are in Carson City. The intersections in Lyon and Douglas counties were selected based on stakeholder input and the desire to include locations from each of the three counties within the CAMPO Region as part of the LRSP process. A field review of the 10 priority locations was conducted to identify issues and concerns and apply recommendations that are both location-specific and systemic. The final list of priority intersections and segments with network screening analysis results is shown in **Table 5** and **Table 6**, respectively**.** A map presenting the 10 priority locations is provided in **Figure 15**. Field review sheets (located in **Appendix C**) were created to document issues, concerns, and potential recommendations at each of the priority locations during the field review conducted on January 25th, 2024.

Project sheets were then created from the input of the field sheets to include location maps with an aerial photo, crash data summary, and a list of recommended safety countermeasures with corresponding CMFs, the number, type, and severity of crashes associated with the countermeasure, the annual benefit and cost, and planning level implementation cost estimates in 2023 dollars. The potential safety countermeasures identified reflect safety improvements that can be applied to reduce the likelihood of future crashes. Countermeasures were subjected to a benefit cost analysis, described in **Section 8.3**, to determine their potential return on investment.

Table 5 – List of Priority Intersections

Intersection	Crashes
US-395 & Topsy Lane (Signalized)	78
Airport Road & US-50 (Signalized)	54
N Carson Street & W Nye Lane (Unsignalized)	25
Goni Road & Old Hot Springs Road (Unsignalized)	11
Highlands Drive & US-50 (Unsignalized)	6

Table 6 – List of Priority Segments

Segment	Crashes
S Carson Street from US-50 to Stewart Street (2.27 mi)	208
E College Parkway from I-580 to US-50 (2.21 mi)	163
N Carson Street from Long Street to I-580 (2.07 mi)	139
S Curry Street from Lake Glen Drive to Curry Circle (1.02 mi)	124
Saliman Road from Long Street to Fairview Drive	7

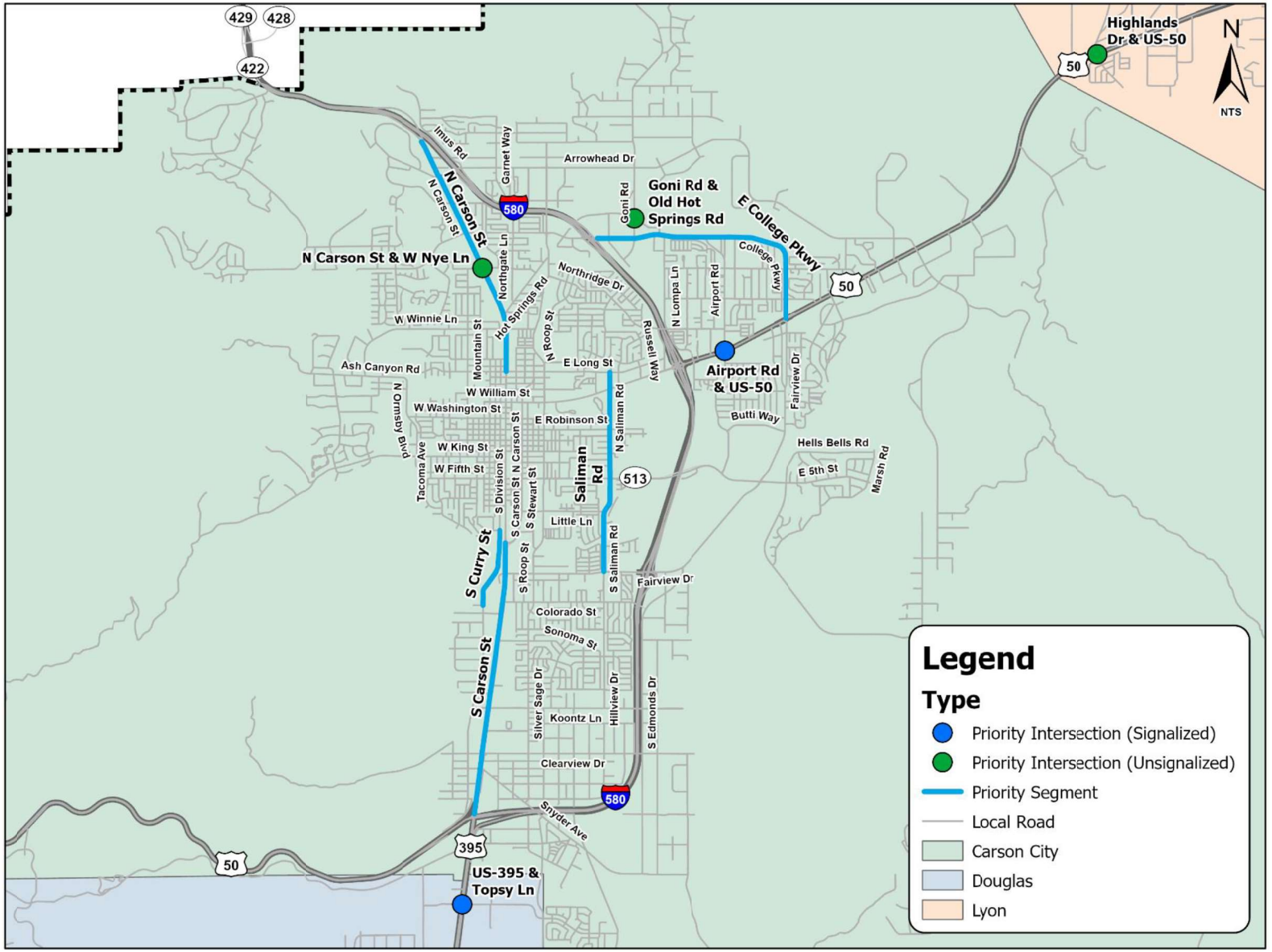


Figure 15 – CAMPO Priority Locations

7. ENGINEERING COUNTERMEASURES

While many safety countermeasures could be used to improve roadway safety, the following sections provide countermeasures for consideration by CAMPO based on the issues and recommendations for the priority locations. The effectiveness of safety countermeasures are designated by a Crash Modification Factors (CMF) and related Crash Reduction Factor (CRF), which are used to determine a Benefit-Cost Ratio (BCR) (**Section 7.5**) associated with the engineering countermeasures. CMFs and CRFs are defined below, with detailed CMF data included in **Appendix D.**

7.1. Crash Modification Factors

When identifying potential systemic safety improvements, it is important to look at CMFs for the proposed improvements. The CMF Method is found in Part D of the HSM. CMFs are defined as the ratio of the effectiveness of one condition in comparison to another condition and represent the relative change in crash frequency due to a change in one specific condition. In other words, a CMF is a multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure at a specific site. Countermeasures with CMFs less than one are expected to reduce crashes if applied, while those countermeasures with CMFs greater than one are expected to increase crashes, as illustrated in **Figure 16**.

$$CMF = \frac{\text{EXPECTED CRASHES WITH TREATMENT}}{\text{EXPECTED CRASHES WITHOUT TREATMENT}}$$

CMF = 1.0	Expected to have no impact on safety
CMF < 1.0	Expected to reduce crashes
CMF > 1.0	Expected to increase crashes

Figure 16 – CMF Calculation

The CMF Method is used to calculate the expected number of crashes by taking the observed number of crashes and multiplying those crashes by the applicable CMF for the proposed countermeasure. It is recommended that CMFs be applied to a minimum of three years of crash data for urban and suburban sites and five years of crash data for rural sites. This LRSP used five years of data for both rural and urban settings for consistency across the CAMPO network. A sample calculation of the CMF Method with one CMF applied to a particular site for a single year is shown in **Figure 17**.

10.1 crashes / year x 0.91 (CMF) =	9.2 crashes / year: a reduction of 0.9 total crashes per year and a CRF of 9%

Figure 17 – CMF Method Sample Calculation

A CRF is similar to a CMF but stated in different terms. A CRF is defined as a percentage of crash reduction that might be expected after the implementation of a given countermeasure at a specific site, and is the inverse of the CMF, as shown in **Figure 18**.

$$CRF = (1 - CMF) \times 100$$

Figure 18 – CRF Calculation

Caution should be used in the selection of appropriate CMFs. The following guidance should be considered when selecting CMFs for predictive crash analysis:

- CMFs should be selected from the HSM Part D, the NDOT Planning Level CMF list, or from FHWA's CMF Clearinghouse website (http://www.cmfclearinghouse.org).
- Read the countermeasure abstract to determine if the CMF is applicable to the proposed improvement.
- CMFs with a four-star rating or higher should be considered for use in analysis. Three-star rated CMFs may be used in instances where that is the only CMF available. CMFs highlighted in FHWA's Proven Safety Countermeasures are used regardless of their star rating since they are recommended for use by FHWA.
- Be sure the selected CMF is applicable to the set of crash data being used for analysis. Some CMFs may only be applicable to a subset of the crash data.
- The application of multiple CMFs can overestimate the expected crash reduction. Unless each CMF addresses independent crash types, multiple CMFs should not be used. It is suggested that no more than three independent CMFs be applied to a particular site.

The countermeasures proposed in this document were chosen because of their effectiveness in reducing crashes.

7.2. Engineering Countermeasures Toolbox

Countermeasures that may be considered in the reduction of crashes are listed in **Table 7**. CMF values for the proposed improvements were found on the HSM Part D, the NDOT Planning Level CMF list, and the FHWA's CMF Clearinghouse website. The CMFs were applied according to guidance provided in the NDOT Project Safety Process (PSP) Benefit-Cost Ratio (BCR) spreadsheet. CMFs and CRFs have been provided for reference to help CAMPO understand potential reductions from crashes by different countermeasures. Detailed summary pages for the CMFs, including the NDOT Planning Level CMF list, CMF information from the FHWA Clearinghouse website, and FHWA Proven Safety Countermeasures summaries are included in **Appendix D**.

Table 7 – CAMPO Engineering Countermeasures Toolbox

Countermeasure	Also Addresses		CMF/CRF	Intersection/ Segment	Site Specific/ Systemic	CMF Applies to	
	Pedestrian	Bicycle				All Crash Types	Nighttime
Improve signal timing (coordination) (CMF ID 3072)			Varies/Varies	SI	Systemic	X	
Install Intersection Lighting (NDOT Planning Level CMF US-10)	X		0.90/10%	US	Systemic	X	X
Install Left Turn Lane When Warranted (NDOT Planning Level CMF SI-03)			0.76/24%	SI	Systemic	X	
Change from Permitted-Protected to Protected on Major Approach (NDOT Planning Level CMF SI-07)			0.58/42%	SI	Site Specific	X	
Convert signal from pedestal-mounted to mast arm (NDOT Planning Level CMF SI-09)			0.66/34%	SI	Site Specific	X	
Replace standard stop sign with flashing LED stop sign (CMF ID 6602)			0.58/42%	US	Site Specific	X	

**Denotes FHWA Proven Safety Countermeasure*
Note: SI = Signalized Intersection and UI = Unsignalized Intersection

Table 7 – CAMPO Engineering Countermeasures Toolbox (Continued)

Countermeasure	Also Addresses		CMF/CRF	Intersection/ Segment	Site Specific/ Systemic	CMF Applies to	
	Pedestrian	Bicycle				All Crash Types	Nighttime
Install raised median (CMF ID 10984)			0.72/28%	Segment	Site Specific	X	
Install pedestrian median fencing (CMF ID: 5258)	X		0.88/12%	Segment	Site Specific		
Install pedestrian countdown timer (NDOT Planning Level CMF BP-04)	X		0.30/70%	SI	Systemic		
Install advanced yield or stop markings and signs (CMF ID 9018)	X	X	0.89/11%	US	Site Specific		
Add 3-Inch Yellow Retroreflective Sheeting to Signal Backplates (NDOT Planning Level CMF SI-10)			0.85/15%	SI	Systemic	X	
Install Dynamic Speed Feedback Sign (CMF ID: 6885)			0.95/5%	Segment	Site Specific	X	

**Denotes FHWA Proven Safety Countermeasure*
Note: SI = Signalized Intersection and US = Unsignalized Intersection

Table 7 – CAMPO Engineering Countermeasures Toolbox (Continued)

Countermeasure	Also Addresses		CMF/CRF	Intersection/ Segment	Site Specific/ Systemic	CMF Applies to	
	Pedestrian	Bicycle				All Crash Types	Nighttime
Install right-turn lane When Warranted (NDOT Planning Level CMF US-07)			0.78/22%	US	Site Specific	X	
Install Raised Median with or without marked Crosswalk (Uncontrolled) (CMF ID 8799)	X		0.68/32%	US	Site Specific		
Install flashing beacons at stop-controlled intersections (NDOT Planning Level CMF US-24)			0.95/5%	US	Site Specific	X	
Clear sight triangles (NDOT Planning Level CMF US-16)			0.53/47%	US	Systemic	X	
Add flashing yellow arrow turn phase (NDOT Planning Level CMF SI-08)			0.85/15%	SI	Site Specific	X	
Install Chevron Signs, Curve Warning Signs, and Subsequent Flashing Beacons (CMF: 1914)			0.52/48%	Segment (Curves)	Site Specific	X	
Rectangular Rapid Flashing Beacon (RRFB) (NDOT Planning level CMF BP-03)	X		0.53/47%	SI/US/Segment	Site Specific	X	

**Denotes FHWA Proven Safety Countermeasure*
Note: SI = Signalized Intersection and US = Unsignalized Intersection

Table 7 – CAMPO Engineering Countermeasures Toolbox (Continued)

Countermeasure	Also Addresses		CMF/CRF	Intersection/ Segment	Site Specific/ Systemic	CMF Applies to	
	Pedestrian	Bicycle				All Crash Types	Nighttime
Install all-way STOP control (NDOT Planning Level CMF US-22)			0.41/59%	US	Site Specific	X	
Upgrade existing markings to wet-reflective pavement markings (CMF ID 8102)			0.89/11%	Segment	Systemic	X	
Retroreflective strips on signposts (Part of Implement Systemic Signing and Marking Improvements at Stop-Controlled Intersections (NDOT Planning Level CMF US-17)			0.75/25%	US	Systemic	X	
Replace TWLTL with Raised Median (CMF ID: 2514)			0.77/23%	Segment	Site Specific	X	
Install Raised Median with Marked Crosswalk (Uncontrolled) (CMF:175)			0.54/46%	UI/Segment	Site Specific	X	
Install On-Street Bike Facility (NDOT Planning Level CMF BP-05)		X	0.40/60%	Segment	Site Specific	X	
Crosswalk Visibility Enhancements (FHWA Proven Safety Countermeasures)	X		0.58/42%	SI/US	Systemic	X	

**Denotes FHWA Proven Safety Countermeasure; Note: SI = Signalized Intersection and US = Unsignalized Intersection*

Table 7 – CAMPO Engineering Countermeasures Toolbox (Continued)

Countermeasure	Also Addresses		CMF/CRF	Intersection/ Segment	Site Specific/ Systemic	CMF Applies to	
	Pedestrian	Bicycle				All Crash Types	Nighttime
Implement Systemic Signing and Marking Improvements at Stop-Controlled Intersections (NDOT Planning Level CMF US-17)			0.81/19%	US	Systemic	X	
Change Right-Turn Lane Geometry to Increase Line of Sight (Intersection Level) (CMF ID: 8496)			0.56/44%	SI/US	Site Specific	X	
Increase Length of Signal Phases to Allow Pedestrians More Crossing Time (CMF ID: 5252)			0.49/51%	SI	Site Specific	X	
Resurface Pavement (CMF ID: 10280)	X		0.79/21%	SI	Site Specific	X	
Lower Posted Speed Limit (CMF ID: 11288)			0.86/14%	Segment	Systemic	X	
Improve Street Lighting Illuminance and Uniformity (CMF ID: 11026)			0.70/30%	Segment	Site Specific	X	
Provide Highway Lighting (FHWA Proven Safety Countermeasures; CMF ID: 192)			0.67/33%	Segment	Site Specific	X	

**Denotes FHWA Proven Safety Countermeasure*
Note: SI = Signalized Intersection and US = Unsignalized Intersection

Table 7 – CAMPO Engineering Countermeasures Toolbox (Continued)

Countermeasure	Also Addresses		CMF/CRF	Intersection/ Segment	Site Specific/ Systemic	CMF Applies to	
	Pedestrian	Bicycle				All Crash Types	Nighttime
Install Advanced Street Name Signs (NDOT Planning Level CMF SI-13)			0.98/2%	SI	Systemic	X	
Install Reduced Conflict Intersection (S-Island, J-Turn, or RCUT) (NDOT Planning Level CMF US-02)			Varies/Varies	US	Site Specific	X	
Convert Non-Signalized Urban Intersection to Roundabout (NDOT Planning Level CMF US-14)			0.29/71%	US	Site Specific	X	
Install a Pedestrian Hybrid Beacon (PHB or HAWK) (NDOT Planning Level CMF BP-02)			0.40/60%	Segment	Site Specific	X	
Implement Leading Pedestrian Interval (NDOT Planning Level CMF BP-05)	X		0.64/36%	SI	Site Specific	X	
Improve Pavement Friction - High Friction Surface Treatment (HFST) (NDOT Planning Level CMF CS-02)	X		0.65/35%	SI/US/Segment	Systemic	X	
Prohibit On-Street Parking (CMF ID: 153)			0.80/20%	Segment	Site Specific	X	

**Denotes FHWA Proven Safety Countermeasure*
Note: SI = Signalized Intersection and US = Unsignalized Intersection

7.3. Non-Infrastructure/Behavioral Countermeasures

There are a number of strategies and actions underway on the statewide level to address non-infrastructure or behavioral causes of roadway crashes. As described in **Section 3.1**, the Nevada SHSP includes four Key Areas: Safer Roads, Vulnerable Road Users, Safer Drivers and Passengers, and Impaired Driving. There are active task forces for each key area that meet quarterly to discuss the implementation of strategies and actions included in the SHSP, many of which could be applied in the CAMPO area.

In addition to the CEAs identified for CAMPO through the LRSP process, there are actions underway for motorcycle safety, work zone safety, and impaired driving that CAMPO may participate in.

CAMPO may also consider partnerships with businesses to extend outreach and education to road users, such as motorcycle dealerships to encourage attending motorcycle ridership courses or insurance companies or AARP to provide information on training/refresher courses for older drivers.

Non-infrastructure/behavioral traffic safety countermeasures are described in NHTSA's *Countermeasures that Work,* 11th Edition, which are proven non-infrastructure countermeasures that have demonstrated effectiveness and could be applied locally through CAMPO's participation in statewide organizations and committees such as the Nevada Advisory Committee on Traffic Safety (NVACTS). The countermeasures summarized in **Table 8** are those identified by NHTSA and may be effective countermeasures within the CAMPO Region. CAMPO may consider continued support of statewide efforts related to these and future countermeasures.

Table 8 –NHTSA Non-Infrastructure/Behavioral Countermeasures Toolbox

Countermeasure	Effectiveness	Cost to Implement	Use	Time to Implement
Older Drivers				
License Screening and Testing	**** †	$$	High	Medium
Formal Courses for Older Drivers (Classroom + On-road feedback) ††	****	$$	Low	Medium
Speeding				
Lower Speed Limits	*****	$	High	Varies
High-Visibility Enforcement	****	$$$	Medium	Medium
Pedestrians				
Pedestrian Safety Zones	****	$$$	Low	Long
Elementary-Age Child Pedestrian Training	***	$	Unknown	Medium
Unrestrained Occupant				
Primary Enforcement Seat Belt Use Laws	*****	$	Medium	Short
Nighttime, High-Visibility Seat Belt Law Enforcement	****	$$$	Unknown	Medium
Young Drivers				
Graduated Driver Licensing (GDL)	*****	$	High	Medium
GDL Intermediate License Passenger Restrictions	*****	$	High	Medium

Source: NHTSA Countermeasures that Work, 11th edition
Note: Non-infrastructure countermeasures for Intersection crashes are not available.
Effectiveness:
*****Demonstrated to be effective by several high-quality evaluations with consistent results*
******Demonstrated to be effective in certain situations*
Cost to Implement:
$$$ Requires extensive new facilities, staff, equipment, or publicity, or makes heavy demands on current resources
$$ Requires some additional staff time, equipment, facilities, and/or publicity
$ Can be implemented with current staff, perhaps with training, limited costs for equipment, facilities, and publicity
†Proven for identifying drivers whose driving should be limited
††Proven for improving on-road driving when classroom-based training is paired with individualized feedback.
Use:
High: More than two-thirds of states, or a substantial majority of communities
Medium: Between one-third and two-thirds of states or communities
Low: Less than one-third of states or communities
Unknown: Data not available
Time to Implement:
Long: More than 1 year
Medium: More than 3 months but less than 1 year
Short: 3 months or less

7.4. Safety Benefit-Cost Analysis Methodology

Safety benefits based on the CMFs and associated crash reductions were applied to the NDOT PSP BCR spreadsheet. The PSP BCR spreadsheet uses the evaluation of safety benefits following the comprehensive societal cost analysis documented in the HSM which uses the Consumer Price Index (CPI) and Employment Price Index (ECI) to obtain comprehensive societal costs based on the KABCO crash severity scale. Societal costs encompass the comprehensive economic, social, and health-related burdens borne by society due to roadway crashes. **Table 9** provides the comprehensive societal cost values used for the LRSP analysis. The HSM cost estimate methodology used by NDOT is described in the NDOT *2023 Performance Management Report* (page 159).

Table 9 – Crash Severity Societal Cost

Crash Severity	2023 Comprehensive Societal Costs
K – Fatal Injury Crash	$7,286,652
A – Incapacitating Injury Crash	$387,209
B – Non-Incapacitating Injury Crash	$141,477
C – Possible Injury Crash	$79,850
O – Property Damage Only Crash	$12,951

The societal costs shown above are then used to determine the societal benefit with the implementation of applicable countermeasures. The calculated societal benefits are then applied to the countermeasure implementation and maintenance costs to calculate the BCR. A BCR greater than 1.0 indicates that the societal benefits of a countermeasure outweigh the planning level costs incurred by implementing the recommendation. While a BCR less than 1.0 indicates the countermeasure's costs outweigh its benefits. By analyzing the BCR for each recommendation, decision-makers can prioritize interventions with the highest potential for reducing crashes while optimizing resource allocation.

8. RECOMMENDATIONS

The following sections provide more information on potential engineering and non-infrastructure safety countermeasures that are likely to address conditions that were observed to contribute to crash activity in CAMPO.

8.1. Priority Locations Safety Recommendations

For each priority location, safety recommendations were identified to address the factors contributing to crash risks.

A summary of the potential safety countermeasures identified for each of the priority locations listed below and corresponding benefit/cost is presented in **Table 10** through **Table 19**. Project sheets were developed for each of the priority locations containing recommendations and potential safety countermeasures on each issue at the location. To review the issues recorded by the field review team for the 10 priority locations, refer to **Appendix C**. The project sheets, cost estimates, NDOT PSP CMF Method BCR calculations are included in **Appendix E**.

Table 10 – Potential Safety Countermeasures for N Carson Street

Location		Recommendation	Countermeasure	BCR
N Carson Street	Segment	Provide PROWAG compliant pedestrian facilities.	N/A	-
	Segment	Install speed feedback signs, oversized speed limit signs, reduced speed limit.	Install Dynamic Speed Feedback Sign CMF ID: 6885	19.22
	Segment	Reconfigure the roadway cross section to install bike lanes. Consider green paint at bicycle conflict zones.	Install On-Street Bike Facility (BP-01)	0.63
	Segment	Install vegetation with irrigation on existing medians.	N/A	-
	Segment	Install lighting with LED bulbs along the segment.	Lighting (FHWA Proven Safety Countermeasures CMF ID: 192)	15.10
	Segment	Consider replacing unsignalized intersection with roundabout.	Convert Non-Signalized Urban Intersection to Roundabout (NDOT Planning Level CMF US-14)	3.31
	Segment	Improve pavement friction in front of crosswalks.	Improve Pavement Friction - High Friction Surface Treatment (HFST) (NDOT Planning Level CMF CS-02)	45.68
	Medical Parkway/Arrowhead Road, College Parkway, Hot Springs Road Intersections	Replace all pushbuttons with Accessible Pedestrian Signals (APS).	N/A	-
	Medical Parkway/Arrowhead Road, College Parkway, Hot Springs Road Intersections	Install pedestrian refuge area and evaluate appropriate enhanced pedestrian treatment (PHB, RRFB, etc.) at these locations. Install bulb-outs where feasible and improve lighting at pedestrian crossings.	Rectangular Rapid Flashing Beacon (RRFB) (NDOT Planning level CMF BP-03)	10.77
	Medical Parkway/Arrowhead Road, College Parkway, Hot Springs Road Intersections	Install new pedestrian ramps compliant with PROWAG standards.	N/A	-
	Medical Parkway Intersection	Install dual mast-arm (LED) lighting.	Install Intersection Lighting (NDOT Planning Level CMF US-10)	17.69
	Medical Parkway Intersection	Obtain right-of-way (ROW) and install bus turnouts.	N/A	-

Table 11 – Potential Safety Countermeasures for S Carson Street

Location		Recommendation	Countermeasure	BCR
S Carson Street	Segment	Install speed feedback signs and oversized speed limit signs.	Lower Posted Speed Limit (CMF ID: 11288)	62.67
	Segment	Limit left turns from side streets with raised median islands and access management. Recommend replacing gore lines with median island to manage speeds north of Clearview Drive.	Replace TWLTL with Raised Median (CMF ID: 2514)	2.35
	Segment	Trim and maintain landscaping.	N/A	-
	Segment	Widen pedestrian walkways.	N/A	-
	Segment	Install lighting along the segment.	Improve Street Lighting Illuminance and Uniformity (CMF ID: 11026)	2.35
	Intersections	Replace all pushbuttons with Accessible Pedestrian Signals (APS).	N/A	-
	Intersections	Analyze crossing time of pedestrian phase and adjust signal timing. Communicate that travel times and safety will improve if following the speed.	N/A	-
	Intersections	Install advanced street name signs.	Install Advanced Street Name Signs (NDOT Planning Level CMF SI-13)	38.16
	Clearview Drive Intersection	Install new pedestrian ramps to allow for crosswalk to be perpendicular to travel lanes.	N/A	-
	Clearview Drive Intersection	Install new pedestrian ramp that complies with PROWAG and allows for proper drainage.	N/A	-
	Clearview Drive Intersection (Northeast Corner)	Reinforce with signage and install bollards to prohibit vehicles from entering the multi-use path.	N/A	-
	Clearview Drive Intersection	Change from FYA to protected phasing.	Change from Permitted or Permitted-Protected to Protected (CMF ID: 333)	1300.21

Table 12 – Potential Safety Countermeasures for S Carson Street (Continued)

Location		Recommendation	Countermeasure	BCR
S Carson Street	Clearview Drive Intersection	Restripe crosswalk markings at intersection.	Implement Systemic Signing and Visibility Improvements at Signalized Intersection (NDOT Planning Level CMF SI-14)	0.00
	Rhodes Street Intersection	Install streetlighting at the RRFB crossing with breakaway poles.	Install Intersection Lighting (NDOT Planning Level CMF US-10)	54.16
	Rhodes Street Intersection	Install S-island to prevent eastbound lefts or evaluate for future traffic signal.	Install Reduced Conflict Intersection (S-Island, J-Turn, or RCUT) (NDOT Planning Level CMF US-03)	2.10
	Colorado Street Intersection	Evaluate the need for a signal based on traffic impact study for the new development. Install traffic signal if warranted.	N/A	-
	Appion Way Intersection	Evaluate the need for a signal based on traffic impact study for the new development. Install traffic signal if warranted.	N/A	-
	Appion Way Intersection (West leg)	Install advanced signage to alert drivers of bike crossing.	Install Advanced Street Name Signs (NDOT Planning Level CMF SI-13)	0.32

Table 12 – Potential Safety Countermeasures for S Curry Street

Location	Location	Recommendation	Countermeasure	BCR
S Curry Street	Segment	Assess environmental concerns with future improvement project within the corridor.	N/A	-
	Segment	Change posted speed to 25 mph.	Lower Posted Speed Limit (CMF ID: 11288)	9.75
	Segment	Improve driveways and curb ramps to comply with PROWAG.	N/A	-
	Segment	Install "No Parking" signage.	Prohibit On-Street Parking (CMF ID: 153)	20.40
	Segment	Improvement project to widen roadway. Right-of-way and extensive grading needed.	Change Lane Width From 10 to 12 (in feet) (CMF ID: 10223)	0.05
	Segment	Conduct lighting study and install appropriate streetlight along the segment. Right-of-way and extensive grading required.	Lighting (FHWA Proven Safety Countermeasures CMF ID: 192)	0.05
	Segment	Consider using sharrows, bike lanes, striping, or enhanced "Share the Road" signage for vehicles to be aware and look out for bikes.	N/A	-
	Segment	Install advanced signage to direct bicyclists and pedestrians to multi-use path on S Carson Street (not use Curry St).	N/A	-
	North end of Segment	Consider raising chevron signage so it is above the foliage.	N/A	-
	Midpoint on Segment	Relocate or underground utility poles or widen sidewalk.	N/A	-
	Midpoint on Segment	Grade an area off the roadway for trail users. Right-of-way and extensive grading needed.	N/A	-
	Segment	Extend guardrail. Extensive grading and potential environmental impacts.	N/A	-

Table 13 – Potential Safety Countermeasures for Saliman Road

Location		Recommendation	Countermeasure	BCR
Saliman Road	Segment	Reduce the speed limit to 25 mph based on the Roadway Environment of "RE5 - Urban /Small Town Center" per the NDOT Speed Management Action Plan. Consider painting the speed limit on the road. Install dynamic speed feedback signs.	Lower Posted Speed Limit (CMF ID: 11288)	19.24
	Segment	Install "No Parking" and "No U-Turn" signage in front of the schools.	Prohibit On-Street Parking (CMF ID: 153)	60.73
	Segment	Remove the TWLTL and install raised medians as part of access management.	Replace TWLTL with Raised Median (CMF ID: 2514)	1.21
	Segment	Replace HPS bulbs with light emitting diode (LED) bulbs.	Improve Street Lighting Illuminance and Uniformity (CMF: 11026)	40.46
	Segment	Install lighting with LED bulbs along the segment.	Lighting (FHWA Proven Safety Countermeasures CMF ID: 192)	2.68
	Segment	Restripe roadway to provide wider bike lane or buffered bike lane. Consider green paint at bicycle conflict zones.	Install On-Street Bike Facility (BP-01)	0.31
	Segment	Evaluate the need for a signal. Install signal if warranted.	N/A	-
	Saliman Rd and Robinson Street	Install signage or flashers to reduce the speed through the curve.	Install Chevron Signs, Curve Warning Signs, and Subsequent Flashing Beacons (CMF: 1914)	577.48
	Saliman Rd and Little Lane	Evaluate the need for a signal based on the traffic impact study for the new residential development. Install signal if warranted.	N/A	-
	Saliman Rd and Little Lane	Replace all push buttons with accessible pedestrian signals (APS).	N/A	-
	Intersections/ Crosswalks	Install RRFBs and repair damaged pedestrian fencing in the median.	Rectangular Rapid Flashing Beacon (RRFB) (NDOT Planning Level CMF BP-03)	0.57

Table 14 – Potential Safety Countermeasures for E College Parkway

Location		Recommendation	Countermeasure	BCR
E College Parkway	Segment	Install additional oversized chevrons at curve.	Install Chevron Signs, Curve Warning Signs, and Subsequent Flashing Beacons (CMF: 1914)	727.71
	Segment	Restripe roadway and shift lanes by narrowing median to add bicycle facilities. Consider green paint at bicycle conflict zones.	Install On-Street Bike Facility (BP-01)	0.07
	Segment	Rehabilitate pavement along segment and repaint striping.	Resurface Pavement (CMF: 10280)	0.46
	Segment	Replace HPS bulbs with light emitting diode (LED) bulbs.	Improve Street Lighting Illuminance and Uniformity (CMF: 11026)	402.33
	Segment	Conduct a lighting study to verify illuminance and streetlight pole spacing.	N/A	-
	Segment	Provide PROWAG compliant pedestrian facilities.	N/A	-
	Segment	Obtain right-of-way and construct bus turnout.	N/A	-
	College Pkwy, east of Airport Road	Evaluate the option to acquire right-of-way (ROW) to widen sidewalk.	N/A	-
	College Parkway, east of Goni Road	Stripe the curb to be red within the vicinity of the fire hydrant to be compliant with local standards.	N/A	-
	Retail Drive Intersection	Reduce curb radii at the intersection.	N/A	-
	Retail Drive Intersection	Evaluate signal phasing to consider protected N/S left turns, lead pedestrian intervals (LPI), or exclusive pedestrian phase.	Implement Leading Pedestrian Interval (NDOT Planning Level CMF BP-05)	19.82
	Retail Drive Intersection	Replace all pushbuttons with Accessible Pedestrian Signals (APS).	N/A	-

Table 15 – Potential Safety Countermeasures for N Carson Street and W Nye Lane

Location		Recommendation	Countermeasure	BCR
N Carson St & W Nye Ln	Intersection	Realign the intersection, realign the curb ramps and restripe crosswalk, and provide pedestrian refuge islands.	Install Raised Median with Marked Crosswalk (Uncontrolled) (CMF ID: 175)	0.00
	Intersection	Install truncated domes on all curb ramps.	N/A	-
	Intersection	Rehabilitate pavement and restripe crosswalks and lane lines.	Resurface Pavement (CMF: 10280)	10.01
	Intersection	Install pedestrian refuge area and enhanced pedestrian crossing (PHB, RRFB, etc.) with bulb-outs. Improve lighting at pedestrian crossing. Education and enforcement are critical components about enhanced pedestrian crossings.	Rectangular Rapid Flashing Beacon (RRFB) (NDOT Planning level CMF BP-03)	-
	Intersection	Limit left turns from side streets with raised median islands and access management.	Install Reduced Conflict Intersection (S-Island, J-Turn, or RCUT) (NDOT Planning Level CMF US-03)	99.01
	Intersection	Replace HPS bulbs with light emitting diode (LED) bulbs.	Improve Street Lighting Illuminance and Uniformity (CMF: 11026)	16.39
	Intersection	Install lighting within the center median (dual mast arms) to light the crosswalk.	Install Intersection Lighting (NDOT Planning Level CMF US-10)	0.26
	Intersection	Clear debris and maintain walkways. Work with utility companies to determine need. Relocate or underground utility or widen sidewalks.	N/A	-

Table 16 – Potential Safety Countermeasures for US-50 and Highlands Drive

Location		Recommendation	Countermeasure	BCR
US-50 & Highlands Dr	Intersection	Evaluate enhanced pedestrian facility (PHB) with advance warning signs.	Install a Pedestrian Hybrid Beacon (PHB or HAWK) (NDOT Planning Level CMF BP-02)	5.91
	Intersection	Install intersection lighting with LED bulbs.	Install Intersection Lighting (NDOT Planning Level CMF US-10)	102.16
	Intersection	Rehabilitate pavement and shoulder area.	Resurface Pavement (CMF: 10280)	5.42
	Intersection	Conduct speed study and enhance speed reduction zones signs. Install advanced street signs and oversized speed limit signs.	Install Advanced Street Name Signs (SI-13)	37.96
	Intersection	Consider acceleration lane in the median for northbound to westbound left turns.	Install Reduced Conflict Intersection (S-Island, J-Turn, or RCUT) (NDOT Planning Level CMF US-02)	70.30
	300 ft SW of Highlands Dr	Consider roundabout in this location or realign Red Rock Rd and Highlands Dr for a full (signalized) intersection.	Convert Non-Signalized Urban Intersection to Roundabout (NDOT Planning Level CMF US-13)	10.99
	300 ft SW of Highlands Dr	Add acceleration lane for left turns out of Red Rock Road.	N/A	-
	300 ft SW of Highlands Dr	Study segment of US 50 from Linehan Road to Highlands Drive to limit lefts out of the side streets with median islands and reroute truck and bus traffic.	Install Reduced Conflict Intersection (S-Island, J-Turn, or RCUT) (NDOT Planning Level CMF US-02)	135.07

Table 17 – Potential Safety Countermeasures for US-50 and Airport Road

Location		Recommendation	Countermeasure	BCR
US-50 & Airport Rd	Intersection	Consider improving bike lane connectivity at intersection: green paint, white dashed lines to mark extension, blend in (westbound), and/or exclusive (eastbound).	Install On-Street Bike Facility (NDOT Planning Level CMF BP-01)	0.23
	Intersection	Adjust all-red clearance time for signal phasing.	N/A	-
	Intersection	Rehabilitate pavement and restripe crosswalks and lane lines.	Resurface Pavement (CMF: 10280)	7.60
	Intersection	Pedestrian improvements with PROWAG compliant crossings and pedestrian curb ramps.	N/A	-
	Intersection	Install dual mast-arm light poles (LED) on each corner.	Improve Street Lighting Illuminance and Uniformity (CMF ID: 11026)	83.72
	Northeast and Southeast Corners	Replace all pushbuttons with Accessible Pedestrian Signals (APS).	N/A	-
	Southwest Corner	Install 1A/1B signal pole for pedestrian signal head for improved visibility.	N/A	-
	North Leg	Adjust angle of Airport Rd on north leg realignment. Realign intersection so that NWC and SEC turning radii are 15 to 25 feet each.	Install Reduced Conflict Intersection (S-Island, J-Turn, or RCUT) (NDOT Planning Level CMF US-02)	45.84
	North of US-50	Develop maintenance agreement between owners of multi-use path.	N/A	-
	NB Through Lane	Evaluate need for extra signal head. Center signal heads with each travel lane.	N/A	-

Table 18 – Potential Safety Countermeasures for Goni Road and Old Hot Springs Road

Location		Recommendation	Countermeasure	BCR
Goni Road & Old Hot Springs Road	Intersection	Realign the intersection to improve sight distance.	Change Right-Turn Lane Geometry to Increase Line of Sight (Intersection Level) (CMF ID: 8496)	4.25
	Intersection	Incorporate recommendations for intersection improvements for the new medical facility in development including pedestrian facilities and on-street parking facilities.	N/A	-
	Intersection	Assess need for pedestrian crossings at east and north legs with pedestrian facilities. Rehabilitate pavement and restripe crosswalks and other pavement markings.	Resurface Pavement (CMF: 10280)	3.21
	Intersection	Install streetlights at the intersection with LED bulbs in coordination with adjacent development and intersection improvements.	Install Intersection Lighting (NDOT Planning Level CMF US-10)	0.70
	Intersection	Install PROWAG complaint curb ramps and crosswalk markings.	N/A	-
	West Leg	Add signage for limited sight distance, install advanced warning signs, and relocate stop bars on Old Hot Springs Road to improve sight distance.	Implement Systemic Signing and Marking Improvements at Stop-Controlled Intersections (NDOT Planning Level CMF US-17)	86.72
	Goni Road Segment	Review existing speed limit sign locations and add new locations using oversized speed limit signs.	Implement Systemic Signing and Marking Improvements at Stop-Controlled Intersections (NDOT Planning Level CMF US-17)	41.30
	Goni Road Segment	Install signage for heavy vehicles.	N/A	-
	Goni Road Segment	Reconfigure the roadway cross section to install bike lanes. Consider green paint at bicycle conflict zones.	Install On-Street Bike Facility (NDOT Planning Level CMF BP-05)	0.00

Table 19 – Potential Safety Countermeasures for US-395 and Topsy Lane

Location		Recommendation	Countermeasure	BCR
US-395 & Topsy Lane	Intersection	Install retroreflective backplates on each signal head.	Add 3-Inch Yellow Retroreflective Sheeting to Signal Backplates (NDOT Planning Level CMF SI-10)	33.77
	Intersection	Coordinate signal timing with Jacks Valley/Clear Creek intersection.	N/A	-
	Intersection	Clear debris from curb ramps. Evaluate curb ramps per PROWAG guidelines.	N/A	-
	Intersection	Redesign right turn lanes to improve sight visibility, reduce speeds for right turning vehicles, and shorten the pedestrian crossing distance.	N/A	-
	Intersection	Install oversized speed limit signage.	N/A	-
	Intersection	Install advance street name signs.	Install Advance Street Name Signs (SI-13)	78.79
	Intersection	Rehabilitate pavement and restripe crosswalks and lane lines.	Improve Pavement Friction – High Friction Surface Treatment (CS-02)	122.56
	1350 feet south of Topsy Lane	Evaluate intersection design and modify medians to prevent vehicles from making a left out of the driveway.	Install Reduced Conflict Intersection (S-Island, J-Turn, or RCUT) (NDOT Planning Level CMF US-03)	9
	Northeast Corner	Design compliant taper on northbound US 395 to allow for vehicles to merge.	N/A	-
	East Leg	Install bike lane signage on Topsy Lane.	N/A	-
	East Leg	Align signal heads with one centered over each lane.	N/A	-
	East Leg	Design compliant taper on Topsy Lane to allow for vehicles to merge.	N/A	-
	West Leg	Reconfigure bike lane to avoid drop inlet or relocate drop inlet. Consider a more bike traversable inlet cover.	N/A	-

8.2. Systemic Countermeasure Recommendations

In order to enhance road safety and mitigate the risk of crashes, several systemic safety countermeasures have been identified for potential implementation within the region. These countermeasures have been selected based on their proven effectiveness in addressing common safety concerns. However, it is essential to conduct further evaluation/assessment of existing infrastructure before implementing these measures systemically. Evaluations should include inventories of intersection lighting, pedestrian crossing locations, and stop-controlled intersections to ensure appropriate application. Potential systemic countermeasures for use in CAMPO are included in **Table 20**.

These systemic safety countermeasures offer promising opportunities to enhance road safety within CAMPO. However, thorough evaluation of the region's infrastructure, traffic patterns, and crash data is imperative to identify suitable locations for implementation and ensure optimal effectiveness. Further assessment will enable informed decision-making and targeted deployment of these countermeasures to maximize their impact on reducing crashes and improving overall safety for road users.

Table 20 – Systemic Countermeasure Recommendations

Systemic Countermeasure Recommendation from CAMPO Project Sheets	CMF	Associated Crash Type/Severity	Pros/Cons	Location	Typical Characteristics for Application	Example Location
Green pavement at bicycle conflict zones (MUTCD 3H.06)	N/A	N/A	+ Identifies conflict zones between bikes and vehicles - High maintenance to keep clean/repaint	Segments Intersections	Bicycle lanes, extensions of bicycle lanes through intersections, extensions across entrance to exclusive turn lanes, bicycle boxes. Can be used at entrances to separated bike lanes or any conflict, weaving, or crossing location. Can be used to enhance bike lane pavement markings.	US 50 and Airport Road
High Friction Surface Treatment (HFST) (NDOT Planning Level CMF: CS-02) Intersection CMP (NCHRP)	0.65 0.80 (Intersections)	All/All	+ Low-cost compared to infrastructure improvements, higher quality pavement - Higher cost than regular pavement	Segments (Curves) Intersections	Urban or Rural Segments/curves: Horizontal curves, steep downward grades, interchange ramps Intersections: higher-speed signalized and stop-controlled intersections, intersection approaches, crosswalk approaches, locations with a history of rear-end, failure to yield, wet-weather, or red-light-running crashes.	N Carson Street

Table 20 – Systemic Countermeasure Recommendations (Continued)

Systemic Countermeasure Recommendation from CAMPO Project Sheets	CMF	Associated Crash Type/Severity	Pros/Cons	Location	Typical Characteristics for Application	Example Location
Crosswalk Visibility Enhancements (FHWA Proven Safety Countermeasures) (CMF ID: 4123)	0.60	Pedestrian/All	+ Increases visibility of pedestrians, bicyclists, wheelchair users. Assist users with where to cross. - Consider enhanced pedestrian crossings for multilane midblock locations	Mid-block crossings Stop-controlled intersections	All midblock pedestrian crossings and unsignalized intersections Could include in-street signing for two- or three-lane roads with speed limits less than 30 mph ADT > 10,000	N Carson Street, S Carson Street, Saliman Road
Install Intersection Lighting (NDOT Planning Level CMF: US-10)	0.67	Nighttime/All	+ Increases visibility at intersections for pedestrians and other users at nighttime. - Requires space for foundation for poles. Requires additional power. Additional items in the right-of-way. Could cause light pollution.	Intersections	Intersections with presence of crosswalks, vulnerable road users (non-motorized users) Signalized and unsignalized intersections	Goni Road and Old Hot Springs Road US 50 and Highlands Drive

Table 20 – Systemic Countermeasure Recommendations (Continued)

Systemic Countermeasure Recommendation from CAMPO Project Sheets	CMF	Associated Crash Type/Severity	Pros/Cons	Location	Typical Characteristics for Application	Example Location
Lower Posted Speed Limit (CMF ID: 11288) (NDOT Speed Management Action Plan)	0.86	All/K,A,B,C	+ Increases survivability in a crash (reduces risk), reduces crashes. - May require an engineering study, increased enforcement, and geometric changes to achieve desired speeds.	Segments	Urban or Rural Urban areas with vulnerable road users Areas with high number of speed-related crashes or speed issues Consideration for driveway density, intersection spacing, land use context, roadway geometry, roadside conditions	S Carson Street US 50 and Highlands Drive
Install Advanced Street Name Signs(CMF ID: 2449)	0.98	All/All	+ Alerts drivers in advance of an intersection to reduce crashes due to way-finding.- May result in sign clutter in urban areas.	Intersections	Urban or Rural(Urban) Signalized intersections(Rural) Install street name signs with advance intersection warning signs	US 50 and Highlands Drive

Table 20 – Systemic Countermeasure Recommendations (Continued)

Systemic Countermeasure Recommendation from CAMPO Project Sheets	CMF	Associated Crash Type/Severity	Pros/Cons	Location	Typical Characteristics for Application	Example Location
Implement Systemic Signing and Marking Improvements at Stop-Controlled Intersections (NDOT Planning Level CMF: US-17) Includes doubled-up, oversized advance intersection warning signs (Rural) Retroreflective sheeting on signposts Enhanced pavement markings	0.81	All/All	+ Alerts drivers in advance of a stop-controlled intersection. - May be a high number of improvements based on number of stop-controlled intersections included.	Stop-controlled intersections	Urban and Rural Stop-controlled intersections	Goni Road and Old Hot Springs Road
Implement Systemic Signing and Marking Improvements at Signalized Intersections (NDOT Planning Level CMF: SI-14) Includes replace signal heads, replace push buttons and signs, restripe stop bars, restripe crosswalks	0.96	All/All	+ Improves visibility at signalized intersections. - May be a high number of improvements based on number of signalized intersections included.	Signalized intersections	Signalized intersections without systemic signing and marking improvements	S Carson Street and Clearview Drive

Table 20 – Systemic Countermeasure Recommendations (Continued)

Systemic Countermeasure Recommendation from CAMPO Project Sheets	CMF	Associated Crash Type/Severity	Pros/Cons	Location	Typical Characteristics for Application	Example Location
Add 3-Inch Yellow Retroreflective Sheeting to Signal Backplates (NDOT Planning Level CMF: SI-10)	0.85	All/All	+ Increases visibility of signal heads. - Minimizing installation time, accessing existing signal heads, structural limitations.	Signalized intersections	Signalized intersections that do not currently have backplates with retroreflective borders.	US 395 and Topsy Lane
Install Chevron Signs, Curve Warning Signs, Subsequent Flashing Beacons, and Edge Lines (CMF ID: 1914)	0.52	All/All	+ Increases driver awareness of upcoming curve. - Assessment of each curve required to address specific geometric features.	Segments (Curves)	Curves with no curve delineation treatment or those with improperly placed or missing devices.	E College Pkwy, Saliman Road
Replace HPS bulbs with LED bulbs (Improve Street lighting and uniformity) (FHWA Proven Safety Countermeasure, CMF ID: 11026)	0.68	Nighttime/All	+ Increases visibility on roadway segments, intersections, and midblock crossings. Increases visibility for vulnerable road users. - Potential cost and time to replace based on number of streetlights.	Segments and Intersections	Systematic (all locations) Replace HPS bulbs in streetlights with LED bulbs.	Saliman Road

Table 20 – Systemic Countermeasure Recommendations (Continued)

Systemic Countermeasure Recommendation from CAMPO Project Sheets	CMF	Associated Crash Type/Severity	Pros/Cons	Location	Typical Characteristics for Application	Example Location
Install Edge Line Striping (CMF ID: 1945)	0.89	Lane Departure Crashes/All	+ Impacts driver behavior and reaction to navigate curves. Helps with speed selection. - Installation and maintenance.	Segments (Curves)	Urban and Rural segments, horizontal curves	E College Pkwy (curve)

9. EVALUATION AND IMPLEMENTATION

9.1. Evaluation

The success of the LRSP will be evaluated using the preliminary process outlined below. This process will be useful to ensure proper implementation of goals and to determine when updates are needed.

- Establish a committee that is charged with setting comprehensive goals for CAMPO and overseeing the execution of the LRSP initiatives.
- Annual progress meetings are recommended to be conducted to track the implementation of the plan. In addition, the success of the plan will be evaluated on an annual basis.
- An update to the plan should be considered after no more than five years.
- Continued monitoring and recording of traffic incidents on local roadways by law enforcement.
- Maintain a list of focus areas where there are transportation safety concerns, based on historical crash data.

9.2. Implementation

One of the goals of the LRSP is to provide a document that is usable and can be frequently consulted by CAMPO to aid in requesting funding and in the completion of traffic safety improvement projects. Implementation of the LRSP should be coordinated with current or upcoming projects (i.e., US 50 and North Carson Complete Streets Project), development of new projects, establishing new policies and programs, and developing and strengthening relationships with stakeholders.

With regard to projects, the following identifies potential focus areas for CAMPO in the near-to-mid-term.

9.2.1. Near- and Mid-Term Focus Areas

The opportunities identified in this LRSP provide countermeasures that can be applied within CAMPO. Over the next three to five years, it is recommended that CAMPO concentrate its efforts on the following emphasis areas:

- Intersections
- Older Drivers
- Speed-Related
- Pedestrians
- Unrestrained Occupants
- Young Drivers

Analysis conducted at the regionwide level indicated that these factors were some of the most frequent influences contributing to fatal crashes within CAMPO. The countermeasure opportunities previously discussed in this LRSP for both project-specific and systemic improvements can be used as a basis for developing projects at locations where addressing these focus areas would be of the most benefit. Projects that address these focus areas can be developed with a high BCR (by applying citywide crash rates), allowing competitive projects to be

developed even at sites with little to no direct crash history, but with conditions that might contribute to future crashes.

9.2.2. Policies, Plans, and Processes

CAMPO has taken meaningful steps to prioritize road safety and has successfully integrated these approaches into numerous regionwide programs, policies, and practices. This LRSP included an assessment of CAMPO's existing policies, plans, and processes and identified opportunities to enhance programs, policies, and practices to address road safety more comprehensively (**Section 4**). Current efforts by CAMPO to prioritize safety include the Carson City Public Works Complete Streets Policy and the Carson City SRTS Plan.

Other policies, plans, and processes that could be amended or developed to prioritize safety include:

- Incorporate safety as a priority in the RTP and TIP.
- Recommend safety improvements for new developments through the design review process that are context-sensitive safety solutions.
- Develop/adopt other safety policies such as:
  - Access Management Guidelines
  - Unsignalized Crosswalk Guidance (for RRFBs and PHBs)
  - Roundabout Policy
  - Speed Limit Setting
  - Low-Cost (Systematic) Safety Improvements at Signalized and Unsignalized Intersections.

CAMPO and LRSP stakeholders should collaborate to discuss how to incorporate and prioritize safety through existing and new policies, plans, and processes.

9.2.3. Partnerships

CAMPO should continue to partner with NDOT to collaborate on projects, plans and studies for improving safety on the roadways within the Carson City area. In addition to the partnership with NDOT, CAMPO can partner with other safety professionals through the Nevada SHSP Task Forces, Nevada Department of Public Safety-Office of Traffic Safety, local businesses, major employers, and the school districts to strengthen the opportunities to implement the recommendations in the LRSP, both infrastructure and non-infrastructure/behavioral.

9.3. Routine Monitoring of Safety on Local Roads

Routine monitoring of safety on local roads is important to understand if there are changes in crashes and if modifications are needed to address roadway safety. The following process is recommended to monitor the safety of local roads.

- CAMPO should meet twice a year with the Police Department, Signal Maintenance, Street Maintenance, NDOT, Douglas County, and Lyon County to review high crash locations and safety concerns.
  1) Meeting No. 1 – Identify top 10 crash locations and discuss safety concerns at each location.
  2) Meeting No. 2 – Review recommended safety countermeasures from engineering and non-engineering countermeasures toolbox (**Table 7** and **Table 8**) and identify applicable countermeasures for implementation.
- Read all the crash reports (forwarded by the Police Department). If there is a potential crash pattern or a potential engineering solution is identified, a traffic study is opened for further review and implementation.
- Establish a multi-disciplinary crash investigation team that focuses on fatal and serious injury crashes similar to the Denver Zero Fatalities Rapid Response Program. It is recommended that staff reviews crash history and all existing signage and striping at the crash locations.
- CAMPO, the Police Department, and the Safe Routes to School (SRTS) Coordinators should meet with all new and existing schools on a regular basis to develop/update their SRTS map and review traffic control around school sites.
- Establish a safety data review checklist that should be completed annually.

9.4. Updates to the LRSP

The following steps outline the process for updating CAMPO's LRSP every five years.

1. Access necessary data
   - Roadway and intersection classification/configurations
   - Average Daily Traffic Volumes (Collected from counts where available)
   - Collision history
2. Network screening
   - Calculate the CCR for each roadway functional classification and intersection control type
   - Rank for each facility type
     i. Roadway Segment
        1. Primary
        2. Secondary
        3. Local
     ii. Intersection
        1. Signalized
        2. Unsignalized
3. Select locations
   - Identify the location with a higher CCR than what is typical of comparable facility types within CAMPO
   - Analyze the collision history and work with local officials to understand any significant exterior influences on the location
4. Countermeasures
   - Using the Countermeasures Toolboxes (**Table 7** and **Table 8**), identify potential countermeasures that can be applied to locally to enhance safety features
5. Develop a Project Sheet that can serve as a template for analyzing future locations
6. Calculate the benefit and the cost of each applicable countermeasure using the NDOT Planning Level CMF List and the NDOT PSP CMF Method BCR spreadsheet. If those are not available, refer to other resources such as the CMF Clearinghouse and follow a similar calculation (using 20-year cost and benefit numbers).

The LRSP has completed steps 1 through 6. In subsequent years, CAMPO can begin at step 1 to continue the LRSP process. Additional items CAMPO can do to keep the LRSP current are:

1. When new or reconstruction projects arise, use the data processed to identify locations with similar characteristics and apply countermeasures which proved effective
2. Proactively update its roadway and traffic standards to address systemic safety issues identified in the LRSP

9.5. Funding

The development and implementation of safety projects are typically funded through a combination of federal and state sources. Federal funding plays a significant role, with programs such as the HSIP providing resources specifically designed for improving roadway safety. These federal funds are often supplemented by state transportation funds, allocated through instruments such as the STIP. The following is a high-level introduction into some of the main funding programs and grants for which CAMPO can apply.

9.5.1. Highway Safety Improvement Program (HSIP) and Eligibility

The HSIP is a federal program housed under Infrastructure Investment and Jobs Act Bipartisan Infrastructure Law. This program apportions funding as a lump sum for each state, which is then divided among apportioned programs. HSIP requires a data-driven, strategic approach to improving highway safety on all public roads that focuses on performance. HSIP funds can be used for highway safety improvement projects on any public road or publicly owned bicycle or pedestrian pathway or trail, as well as other types of projects, activities, and strategies that support progress toward reducing the number of traffic-related fatalities and serious injuries. In addition, projects utilizing HSIP funds must support the emphasis areas and strategies identified in the state's SHSP.

The Normally HSIP call-for-projects is made at an interval of one to two years. The applicant must be a city, a county, an MPO, or a tribal government federally recognized within the State of Nevada. To qualify for HSIP funding, projects must address documented safety concerns on public roadways, aiming to reduce the frequency and severity of crashes. Eligible projects typically focus on high-crash locations, hazardous roadway features, and crash-prone intersections identified through comprehensive safety analyses. Additionally, projects must align with the goals and priorities outlined in the Nevada SHSP, emphasizing data-driven approaches to improving roadway safety. NDOT prioritizes projects with demonstrated potential for significant safety benefits, ensuring that HSIP funds are strategically allocated to maximize their impact on reducing traffic fatalities and injuries across Nevada's transportation network.

9.5.2. Safe Streets and Roads for All (SS4A)

The SS4A program supports efforts to address roadway safety issues identified to have the most significant roadway as part of safety action plans. The SS4A program provides two levels of grant funding: Planning and Demonstration grants and Implementation Grants. CAMPO should complete the SS4A Certification Eligibility Worksheet for the given fiscal year to determine SS4A eligibility. This LRSP has been prepared to satisfy the requirements of the fiscal year (FY) 2024 SS4A Certification Eligibility Worksheet (**Appendix F**).

9.5.3. Other Funding Sources

The HSIP is the funding mechanism most commonly used to fund LRSP projects, however, there are other funding sources available, including the following:

- NHTSA Highway Safety Grants (Behavioral)
- Active Transportation Program (bicycle and pedestrian improvements)
- Transportation Alternatives Program (TAP)
- Safe Routes to School
- Congestion Management and Air Quality (CMAQ) funds

- Sign replacement programs
- Funding through the MPO
- Inclusion in Carson City budget
- Tribal transportation safety funding (if applicable)
- Specialty bond programs
- Private sector partnerships

10. NEXT STEPS

CAMPO has completed this LRSP to guide the process of future transportation safety improvements for years to come. The data-driven analysis process identified crash types, related primary crash factors, and locations of recent crashes. Based on this process, emphasis areas were identified. These emphasis areas will guide traffic safety improvements, education programs, and capital improvements for the region.

Using the analyzed data and outputs from this LRSP, CAMPO will:

1. Apply for HSIP and Safe Streets for All (SS4A) grant funding for safety improvement implementation throughout the region that addresses the various emphasis areas identified.
2. Actively seek other funding opportunities to improve safety for all road users.
3. Collaborate with identified stakeholders and partnering agencies as improvements are made to create a cohesive transportation network.
4. Iteratively evaluate existing and proposed transportation safety programs and capital improvements to design and operate a safer transportation network in the CAMPO Region.
5. Complete an annual review of safety data to evaluate the progress of countermeasure implementation.

CAMPO also plans to have the CAMPO Board formally approve and adopt this LRSP to include in regional transportation planning and master planning documents. CAMPO should update the LRSP every five years to ensure the plan continues to meet the region's safety needs.