



# LAKE TAHOE REGION SAFETY STRATEGY

TAHOE REGIONAL PLANNING AGENCY



FINAL  
February 2019

## ACKNOWLEDGEMENTS

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CALTRANS DIVISION OF  
LOCAL ASSISTANCE



Highway Safety Improvement Program  
Traffic Safety Engineering Division



We thank the diligent and hard-working consultant team who conducted the analysis and developed recommendations to push the Tahoe Region towards reducing traffic related fatalities and injuries and worked extensively with the Tahoe Regional Planning Agency as well as its many partner agencies to find agreement on proposed recommendations. We greatly appreciate your dedication, investment of time, and expertise you provided.

 **KITTELSON**  
& ASSOCIATES



## ENGINEER'S SEAL

By signing and stamping this Systemic Safety Analysis Report, Erin M. Ferguson, P.E. is attesting to this report's technical information and engineering data upon which the recommendations, conclusions, and decisions included in this report are made.



## STATEMENT OF PROTECTION OF DATA FROM DISCOVERY AND ADMISSIONS

Per Section 148 of Title 23, United States Code [23 U.S.C. §148(h) (4)] REPORTS DISCOVERY AND ADMISSION INTO EVIDENCE OF CERTAIN REPORTS, SURVEYS, AND INFORMATION—Notwithstanding any other provision of law, reports, surveys, schedules, lists, or data compiled or collected for any purpose relating to this section, 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 identified or addressed in the reports, surveys, schedules, lists, or other data.

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## 1.0 INTRODUCTION

The Lake Tahoe Region Safety Strategy (Safety Strategy) was developed in collaboration with the Tahoe Region's transportation partner agencies and stakeholder organizations. The process used to develop the Safety Strategy brought these stakeholder agencies together to consider data analysis findings, recommendations, projects, and changes in how transportation projects are developed. The overall intent is to collectively reduce crashes on Tahoe roadways. This analysis will be used by TRPA and its partner agencies to inform transportation project and policy decision-making. The desired outcome is to support local jurisdictions in identifying and implementing projects that reduce crash frequency and severity.

As part of the Safety Strategy development process, partners also drafted two memorandums of understanding that establish agreements between TRPA and its partners agencies to, when implementing and operating within the TRPA boundary:

- (1) Develop transportation projects in a multimodal, context-sensitive manner, focusing on projects that meet the needs of people biking, walking, taking transit and driving by minimizing the risk of crash-related fatalities and injuries; and
- (2) Collaborate to improve the quality of and access to crash data for the Tahoe Region.



These memorandums bring together agencies from across the Tahoe Region and, like the Tahoe Watershed, establish the understanding and agreement that the Tahoe Region is uniquely different from other geographic areas for which partner agencies may be responsible. In recognition of that unique difference and need to improve road safety in the Tahoe Region, partner agencies will sign the two memorandums of understanding as part of their commitment to reduce the number of people killed and injured in crashes on public roads with the Tahoe Region. This commitment does not supersede any participating agency's process or authorities for developing improvements on its facilities, but rather provides a commitment to collaborate when considering and developing safety improvements.

This section describes the process used to develop the content and recommendations documented in this Safety Strategy, discusses who and how partner agency and organizations were engaged throughout the Safety Strategy's development and describes how the local jurisdictions in the Tahoe Region can use the Safety Strategy to drive transportation-related decision-making.

## 1.1 SAFETY STRATEGY DEVELOPMENT PROCESS

TRPA received funds from Nevada DOT and Caltrans to conduct systemic safety analyses for the public roadways within the Tahoe Region. TRPA used the funds to conduct the analysis as part of an effort to develop a regionwide safety strategy in collaboration with its partner agencies. TRPA used the following process to develop the Safety Strategy:

- 1 Created a Project Development Team (PDT) comprised of representatives from 15 regional partner agencies within the Tahoe Region.
- 2 Hired a consulting team to lead the technical work for the Safety Strategy's content and facilitate meetings with the PDT. The consulting team's technical scope of work included the following core activities:
  - Obtained, in collaboration with TRPA: (1) crash data from Caltrans, Nevada DOT, and hospitals within the Tahoe Region; (2) roadway characteristics data; and (3) traffic volume data.
  - Evaluated the quality of the crash data, identified opportunities to improve the quality of that data (e.g., reduce underreporting of certain crash types), and identified opportunities to make the data consistent across the Tahoe Region. These recommendations are documented in the Data Improvement Memorandum of Understanding<sup>1</sup>.
  - Assessed the Tahoe Region's approach to design vehicle volumes and its potential impact on road user safety as an outcome of transportation projects that are designed, constructed and operated. Developed recommendations and an alternative approach for evaluating and developing transportation projects in the Tahoe Region.
  - Conducted systemic safety analyses for the Tahoe Region using the crash data, roadway characteristic data, and traffic volume data available.
  - Identified high priority locations as candidates for safety projects based on the outcome of the systemic safety analysis.
  - Developed a countermeasures toolbox to be used across the Tahoe Region to quickly and proactively act to reduce the risk of crashes on the roadway network. Attachment A - Rapid Assessment and Response to Safety Issues Toolbox.
  - Developed safety projects for the locations where projects appeared both viable and eligible for Highway Safety Improvement Program (HSIP) funds.
  - Documented the approach and findings in the Lake Tahoe Region Safety Strategy.
- 3 Held eight PDT meetings over the course of the Safety Strategy's development, approximately a 12-month total schedule, to engage the PDT in meaningful discussions and provide feedback on the technical work and core activities listed above.
- 4 In addition to the eight PDT meetings, the team engaged individual agency stakeholders in one-on-one conference calls and in-person meetings. These meetings provided an opportunity to discuss the Safety Strategy's contents and specific concerns about the technical work and findings. Through this process, memorandums of understanding were developed to help implement recommendations from the technical work. These discussions included the following:



<sup>1</sup> Formerly named Safety Improvement Commitment MOU

- April 23, 2018 – Discussion with Caltrans regarding alternative design volume approach<sup>2</sup>
- April 26, 2018 – Discussion with NDOT regarding alternative design volume approach
- May 29, 2018 – Discussion with Caltrans regarding candidate HSIP locations on Caltrans' facilities
- May 30, 2018 – Discussion with Caltrans regarding Performance Evaluation MOU
- July 11, 2018 – Field Visits to highest priority locations on Caltrans' facilities with Caltrans District 3 staff to discuss potential improvements
- July 12, 2018 – Field Visits to highest priority locations on City of South Lake Tahoe and El Dorado County facilities with City and County staff
- August 3, 2018 – Discussion with Caltrans, Placer County, El Dorado County regarding priority projects on Caltrans' facilities for HSIP grant applications
- August 3, 2018 – Discussion with El Dorado County regarding priority projects for HSIP grant applications
- August 7, 2018 – Discussion with Caltrans regarding Performance Evaluation MOU
- August 9, 2018 – Discussion with City of South Lake Tahoe regarding priority projects for HSIP grant applications
- August 21, 2018 – Discussions with NDOT regarding Data Improvement and Performance Evaluation MOUs
- September 20, 2018 – Discussion with NDOT regarding Data Improvement and Performance Evaluation MOUs
- September 25, 2018 – Discussion with Placer County regarding Data Improvement and Performance Evaluation MOUs
- October 19, 2018 – Discussion with Placer County regarding Performance Evaluation MOU

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<sup>2</sup> Eventually renamed Performance Evaluation MOU

## 1.2 PROJECT DEVELOPMENT TEAM PARTICIPATING AGENCIES AND ENGAGEMENT



There were 15 agencies or organizations who participated on the PDT. Attachment B contains the meeting agendas, meeting summaries and participant list from each PDT meeting; that information captures the specific individuals from agencies where a different individual or additional individuals joined a meeting based on the topics to be discussed.



Table 1 summarizes the topics discussed at each PDT meeting.

**Table 1: Summary of PDT Meeting Topics**

PDT Meeting	Date	Topics Discussed
PDT Meeting #1	November 30, 2017	<ul style="list-style-type: none"> <li>Crash Reporting</li> <li>Design Volumes Initial Discussion</li> <li>Overview of Initial Locations of Concern</li> </ul>
PDT Meeting #2	February 14, 2018	<ul style="list-style-type: none"> <li>Design Volumes Recommendations</li> <li>Crash &amp; Roadway Data Analysis Findings</li> </ul>
PDT Meeting #3	March 22, 2018	<ul style="list-style-type: none"> <li>Design Volumes Recommendations</li> <li>Crash &amp; Roadway Data Analysis Findings</li> <li>Crash Data Recommendations</li> </ul>
PDT Meeting #4	May 3, 2018	<ul style="list-style-type: none"> <li>Design Volume Recommendations</li> <li>Countermeasure Toolbox</li> <li>Priority Locations for HSIP Grant Applications</li> </ul>
PDT Meeting #5	June 20, 2018	<ul style="list-style-type: none"> <li>Priority Locations for HSIP Grant Applications</li> <li>Countermeasure Toolbox</li> <li>Design Volumes Memorandum of Understanding (MOU) Update</li> </ul>
PDT Meeting #6	June 28, 2018	<ul style="list-style-type: none"> <li>Performance Evaluation MOU (Previously called Design Volume MOU)</li> <li>Data Collection MOU</li> </ul>
PDT Meeting #7	August 15, 2018	<ul style="list-style-type: none"> <li>Safety Projects and HSIP Applications</li> <li>Data Collection MOU</li> <li>Performance Evaluation MOU</li> <li>Overview of Lake Tahoe Region Safety Strategy</li> </ul>
PDT Meeting #8	November 1, 2018	<ul style="list-style-type: none"> <li>Final Deliverables: <ul style="list-style-type: none"> <li>Lake Tahoe Region Safety Strategy</li> <li>Data Collection MOU</li> <li>Performance Evaluation MOU</li> <li>Performance Evaluation Tool</li> </ul> </li> </ul>

### 1.3 DRIVING DECISIONS: CONNECTION TO REGIONAL TRANSPORTATION PLAN, POLICY, PROJECTS, AND FEDERAL PERFORMANCE MEASURES

The Safety Strategy supports the goals of and is aligned with direction of the Tahoe Region established in the 2017 Linking Tahoe: Regional Transportation Plan (RTP) and newly established federal performance measures. In the course of decision-making for the Region, the Safety Strategy<sup>3</sup>:

- Acts as a guide to implement the 2017 RTP goals and policies, especially those policies under Goal 3: Safety and Goal 4: Operations and Congestion Management.
- Provides recommendations for data-derived roadway safety investment projects to be included in future amendments and updates to the RTP, Active Transportation Plan (ATP), local jurisdiction Area Plans, and state led projects.
- Establishes a consistent, multimodal, safety-conscious, and context sensitive evaluation procedure for considering and developing transportation projects in the Tahoe Region prior to project design and permitting by TRPA current planning department (see Section 1.5).
- Provides an understanding of the overarching crash patterns and trends by road user that should be considered when developing, constructing, and operating transportation infrastructure projects.
- Provides a toolbox of recommended Tahoe-appropriate proven safety infrastructure countermeasures.
- Establishes a commitment from TRPA and its partner agencies and organizations to improve the quality of crash data collected within the Tahoe Region and to create a regional clearinghouse of such data, via TRPA, to facilitate continuous updates to trend analysis and priority location identification as well as comply with federal performance measurements that require regional reporting of traffic fatalities and severe injuries.



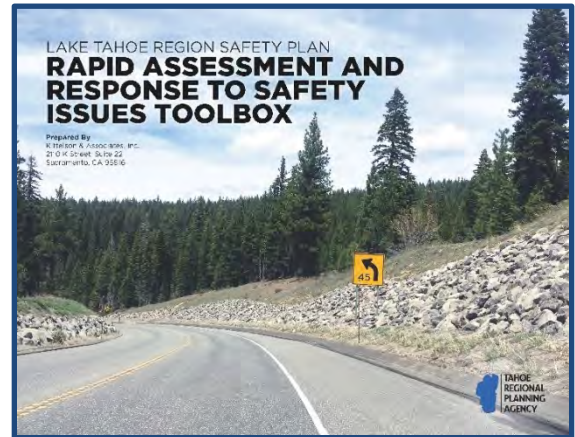
### 1.4 SUPPORTING LOCAL JURISDICTIONS

Local jurisdictions are encouraged to consider the safety analysis results and priority locations as they look for opportunities to improve roadway safety in their communities. Specific information in the Safety Strategy that may be useful resources for local jurisdictions include:

- Section 3.1 Regionwide Crash Trend Analysis Findings – Presents the crash patterns and trends occurring consistently throughout the Tahoe Region. Considering these trends and how they could be prevented as transportation projects are being developed can help reduce future crashes. This information may also be helpful contextual or supporting information for grant applications.
- Section 3.2 Network Screening and Systemic Findings – Presents risk factors for pedestrian and bicycle crashes and risk factors for motor vehicle crashes. Those risk factors are roadway characteristics that are contributing to crashes in the Tahoe Region. Constructing projects that remove those roadway characteristics or better address a need indicated by those characteristics (e.g., the need to slow vehicle speeds) can help improve road safety. This information may also be helpful contextual or supporting information for grant applications.

<sup>3</sup> Including associated attachments.

- ❖ Section 5.0 High-Risk Corridors and Intersections – Identifies specific locations where, because of a combination of crash history and roadway risk factors, there is a potential to improve roadway safety (i.e., the risk of crashes reduced) through engineering improvements. These locations may be competitive for safety funding such as HSIP grants or other funding sources such as Active Transportation Program (ATP) grant funds.
- ❖ Section 6.0 Countermeasures Identified to Address Safety Issues – Identifies potential, Tahoe appropriate countermeasures for consideration at specific locations within the Tahoe Region. The information in this section can be used to consider further enhancements to be incorporated into already-planned improvements or as stand-alone improvement projects.
- ❖ Section 7.0 Viable Project Scopes and Prioritized List of Safety Projects – Presents the list of projects identified through the Safety Strategy development. These projects are the highest priority for implementation based on crash history, crash risk, and feasibility. Many of the highest priority locations are on state facilities. This would require local jurisdictions to coordinate with the appropriate state agency if they desire to lead the improvement or to urge the state to take the lead.
- ❖ Attachment A Rapid Assessment and Response to Safety Issues Toolbox – Presents Tahoe-appropriate proven safety countermeasures to be considered as part of transportation projects to help reduce the likelihood of crashes. Information in the toolbox per countermeasure includes considerations for implementation, expected crash reduction benefit, planning level cost estimate, and HSIP eligibility.



## 1.5 ESTABLISHING A CONSISTENT, MULTIMODAL, SAFETY-CONSCIOUS, AND CONTEXT SENSITIVE EVALUATION PROCEDURE

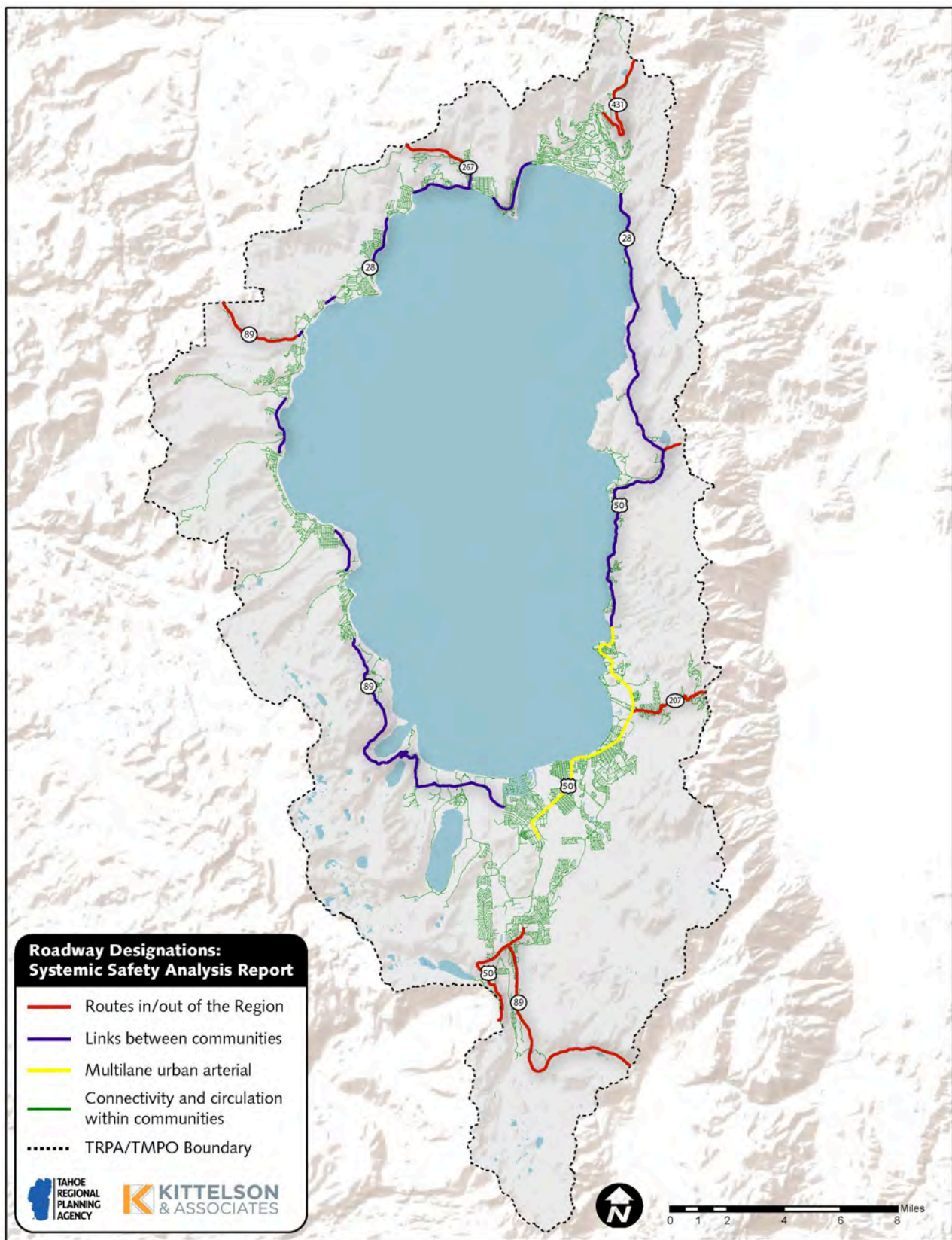
To proactively help reduce the risk of crashes on roadways in the Tahoe Region, Safety Strategy PDT partners created a transportation performance evaluation procedure. This procedure establishes a consistent process for considering multiple modes, safety, and context as transportation projects are planned and designed. The purpose of the performance evaluation procedure is to proactively reduce the risk of crashes from occurring by intentionally designing projects to be more modally balanced and oriented towards reducing crash risk.

### The performance evaluation procedure:

- ❖ Establishes road types to characterize the basic roles of different roadways within the Tahoe Region. The road types are: (1) Routes In and Out of the Region; (2) Links between Communities; (3) Multilane Urban Arterial; and (4) Connectivity and Circulation within Communities.
- ❖ Establishes different levels of modal priority across the road types.
- ❖ Defines two evaluation time periods for which each projects under development would be evaluated:
  1. Peak hour - Average Sunday midday during a non-holiday weekend within the busier months of the year. The intent is to capture a reasonable amount of visitor activity without focusing on the extreme peaks of the tourist season.
  2. Off-Peak Hour - Average mid-week day during the evening commuter period during a non-holiday week and months that are typically outside the tourist seasons. The intent is to focus on evaluating the performance of a project that residents of the Tahoe Region would experience outside of the typical tourist peaks.
- ❖ Presents evaluation criteria for safety, pedestrians, bicyclists, transit, and autos. Each project under development would be evaluated for each criterion.

- Establishes targets for each evaluation criteria based on the Tahoe Region travelshed road type and relative modal priority.
- Encourages decisions related to project alternatives and design be influenced and informed by how well the multimodal evaluation criteria align with the modal priority of the road type and corresponding evaluation criteria target.
- Provides guidance related to freight and emergency vehicles to be considered as part of each transportation infrastructure projects' development and design.

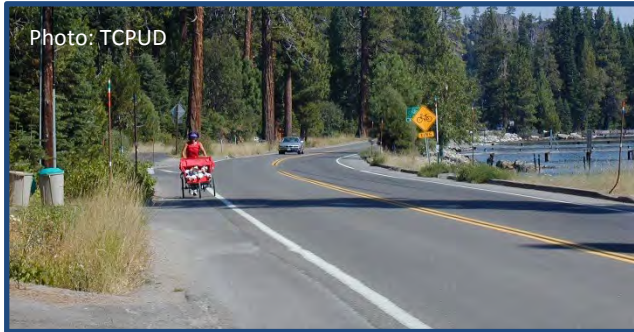
TRPA and its partner agencies have agreed to use the performance evaluation procedure as part of developing and designing transportation infrastructure projects in the Tahoe Region. The details of the performance evaluation procedure can be found in the Performance Evaluation Memorandum of Understanding.



## 2.0 SAFETY DATA UTILIZED (CRASH, VOLUME, ROADWAY)

The team used crash data, roadway data and traffic volume data to evaluate roadway safety performance in the Tahoe Region. The purpose of combining those data sources as part of the safety analysis was to identify the characteristics that are correlated to and most frequently contribute to crashes. That information was then used to identify priority locations, countermeasures, and safety projects that would address crash history as well as document roadway characteristics associated with crash risk.

### 2.1 CRASH DATA



The team obtained the most recent five (5) years of complete crash data (2012 – 2016) available from the California and Nevada portion of the TRPA boundary area. There were two sources for the California data. Injury and fatal crashes were obtained from the University of California, Berkeley, Transportation Injury Mapping System (TIMS) database, which provides crashes with location information for spatial analysis in GIS software. The remaining Property Damage Only crashes were obtained from the California Statewide Integrated Traffic Records System (SWITRS); the team geolocated these

crashes for spatial analysis. The Nevada crash data was provided directly from Nevada DOT to TRPA. These data include the full range of severities (Property Damage Only through fatal).

The states' databases maintain different crash attributes and report similar attributes differently, making comparison for analysis challenging. Kittelson recoded data from each state to analyze the complete crash database along the following attributes:

- 📌 Crash severity
- 📌 Crash type
- 📌 Lighting conditions
- 📌 Weather
- 📌 Primary Collision Factor / Violation category
- 📌 Road surface (e.g., dry, wet, snowy)
- 📌 Roadway condition (e.g., obstruction, work zone)
- 📌 Time-of-day, day-of-week, and month



Photo: Drone Promotions

## 2.2 ROADWAY DATA

For this analysis effort TRPA assembled a spatial database including several roadway characteristics and several additional characteristics inventoried as part of the project. Roadway characteristics included in the spatial database are listed below. A data dictionary including a complete list of attributes is included in Attachment C.

### Roadway Characteristics included in the spatial analysis are:

- 📌 Median presence
- 📌 Traffic volume
- 📌 Functional classification
- 📌 Number of lanes
- 📌 Posted speed

### Intersection characteristics included in the spatial database are:

- 📌 Intersection control type
- 📌 Lane configurations
- 📌 Number, approach leg, and striping type of marked crosswalks at intersection (including distance offset from intersection, if applicable)
- 📌 Presence of pedestrian signal heads and countdowns
- 📌 Additional signage present at intersection
- 📌 Posted approach speed
- 📌 Presence of a school at or near the intersection
- 📌 Enhanced crossing elements (e.g., flashing beacons)

## 2.3 TRAFFIC VOLUME DATA

The team used the TRPA travel model to obtain traffic volume estimates for inclusion in the spatial database. The travel model includes an estimate of the number of vehicles per day on roadway segments. To include the estimates in the analysis database, the team transferred modeled link volume estimates to the analysis roadway network and categorized traffic volume estimates in increments of 1,000 vehicles per day (e.g., 14,000-14,999, 15,000-15,999, ...). The model traffic volumes were used to identify pedestrian and bicycle risk factors. Given these were travel model estimates, the team did not feel comfortable using them to assess motor vehicle crashes. The estimates were used for the pedestrian and bicycle analysis to try to expand the information available to consider risk for those crash types. This was necessary, because there are a smaller total reported number of crashes relative to motor vehicle crashes, though they result in proportionally more severe injury and fatality outcomes. Further detail on risk factors is provided in Section 3.0.

## 3.0 DATA ANALYSIS TECHNIQUES AND RESULTS

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There are important opportunities to reduce the risk of injuries and fatalities on roads across the Tahoe Region. From 2012 through 2016, approximately 2,672 reported crashes involving some combination of motor vehicles, pedestrians and bicyclists were reported. Of those approximately 32 percent or 856 of the reported crashes resulted in at least one injury of some sort and approximately 1 percent or 32 of the reported crashes resulted in at least one person killed. Eight of the 32 fatalities were people walking or biking.<sup>4</sup>

The team evaluated regional crash patterns and trends, considering pedestrian and bicycle modes separately from crashes only involving motor vehicles. This approach gives attention and weight to understanding how changes

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<sup>4</sup> Six were walking and two were biking.

can be made to reduce people’s risk of being in a crash when they are most vulnerable, such as when they are walking or biking. In addition to regional crash trends, the team identified priority locations for safety investments and risk factors associated with the roadway crashes that have occurred in the Tahoe Region from 2012-2016.

### 3.1 REGIONWIDE TRENDS ANALYSIS FINDINGS

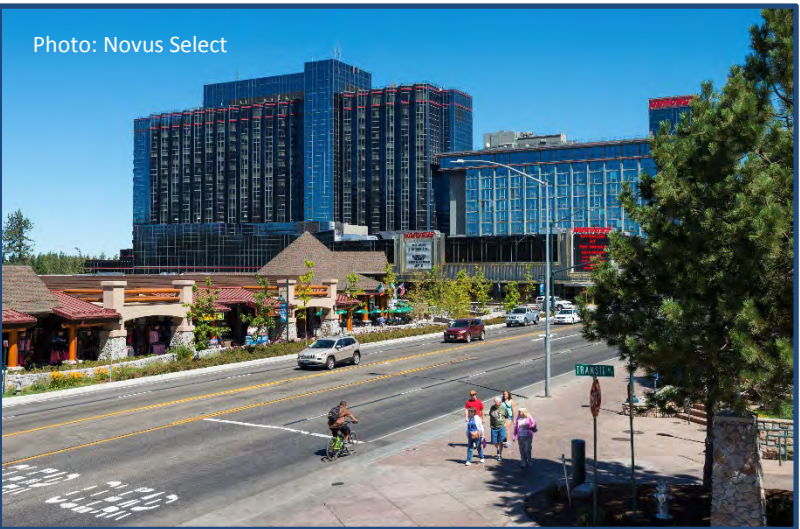


Photo: Novus Select

The following two sections discuss trends in: (1) pedestrian and bicycle crashes across the Lake Tahoe Region including severity, temporal trends, lighting and weather; and (2) motor vehicle crashes across the Lake Tahoe Region including severity, type, temporal trends and weather.

#### Pedestrian and Bicycle Crashes

The team analyzed the pedestrian and bicycle crash data. Throughout this analysis, crashes involving bicyclists are divided between two categories: “motor vehicle,” meaning the crash involved a bicyclist and a motorist, and “no motor vehicle”, meaning it was what is typically called a “solo”

bicyclist crash, involving just the bicyclist. There were a few crashes involving a pedestrian and a bicyclist; these are uniformly coded as pedestrian crashes, because of the generally greater vulnerability of the pedestrian in these cases. Property Damage Only (PDO) crashes were omitted, as the rate of underreporting for PDO crashes involving non-motorized parties is expected to be so great as to cast doubt on any apparent trends. For reference, there were 17 pedestrian or bicyclist involved PDO crashes reported over the 2012-2016 time period.

During this five-year period, there were 51 reported pedestrian crashes and 99 reported bicycle crashes in the Tahoe Region. These are further broken down by motor vehicle involvement and shown in Table 2. As also shown in Table 2, the Nevada data did not include any “no motor vehicle” bicycle or pedestrian crashes. The lack of any such recorded crashes in Nevada suggests that NDOT does not collect and report this data.

**Table 2: Bicycle and Pedestrian Crash Totals, 2012-2016**

	Bicycle Crashes		Pedestrian Crashes	
	Motor Vehicle	No Motor Vehicle	Motor Vehicle	No Motor Vehicle <sup>5</sup>
California	57	23	32	3
Nevada	19	0	16	0
<b>Total</b>	<b>76</b>	<b>23</b>	<b>48</b>	<b>3</b>

Source: SWITRS, NDOT, TDG 2018

<sup>5</sup> No motor vehicle crashes for pedestrians are typically crashes with bicycles.

These crashes are depicted in Exhibit 1 through Exhibit 10. Fatal and severe injury crash symbols are depicted slightly larger for emphasis; because of this, a few moderate or minor injury crashes may be obscured on the maps. However, clear clusters of crashes are still evident; these will be further discussed, in the priority locations section.



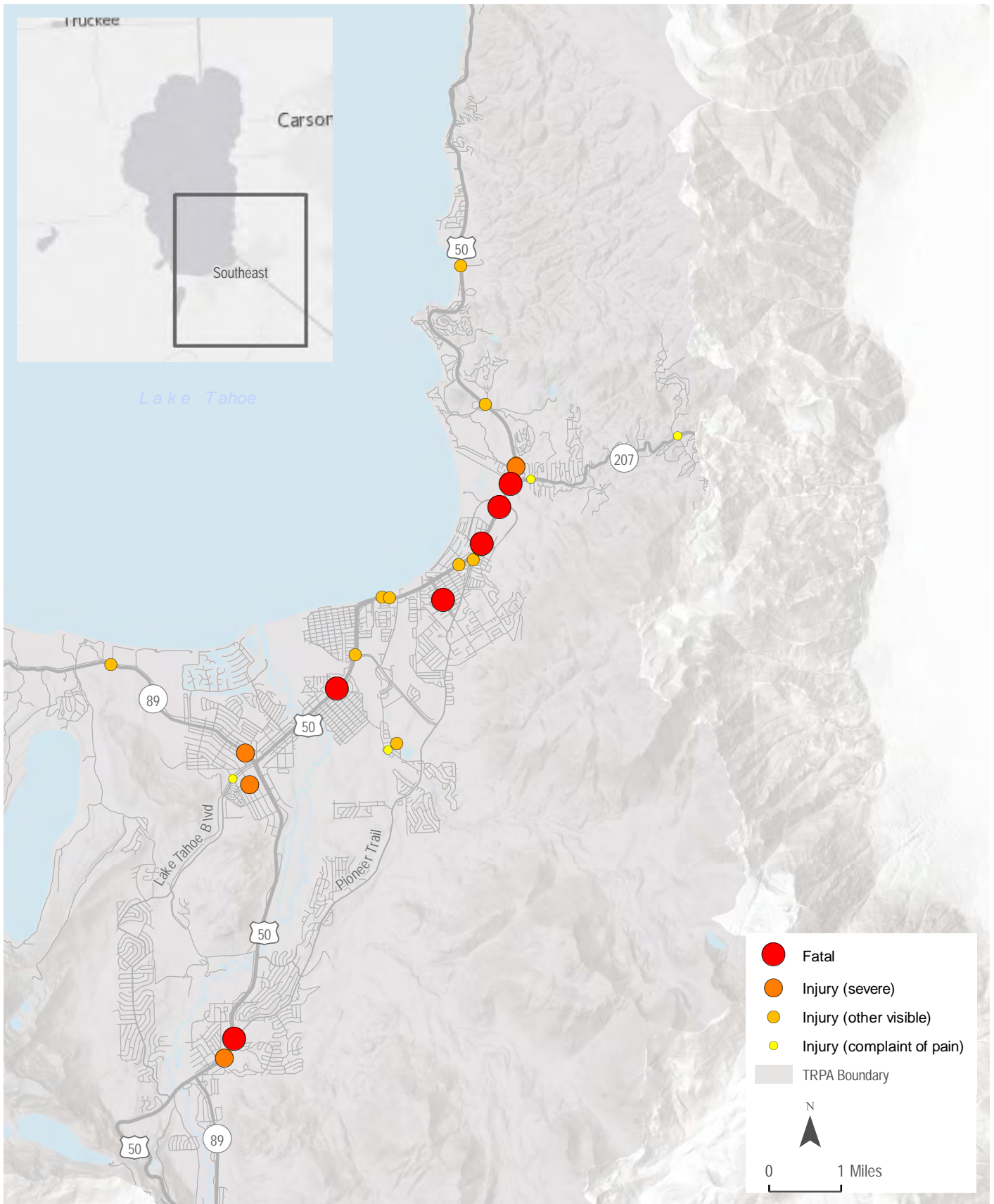


Exhibit 1

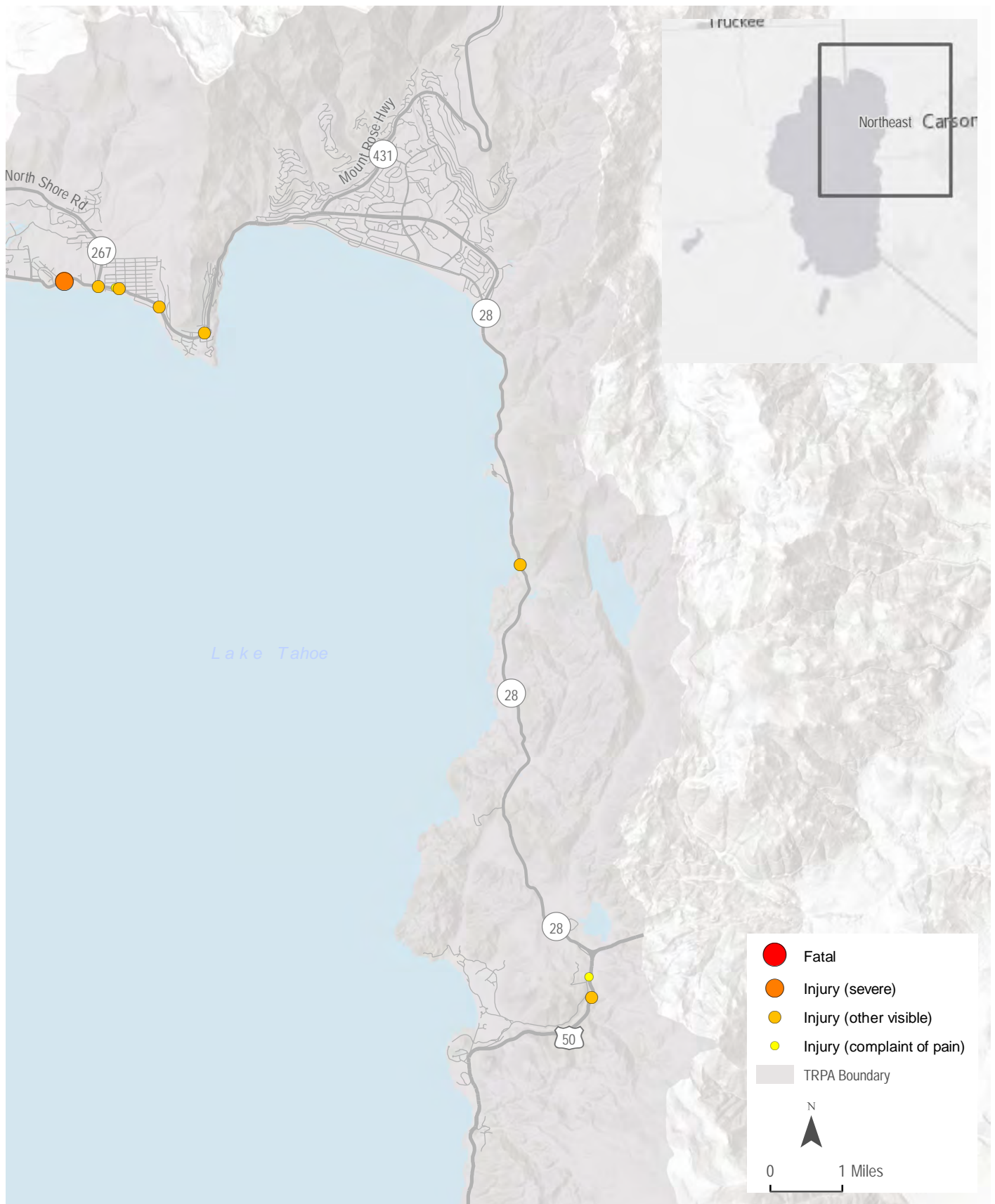


Exhibit 2

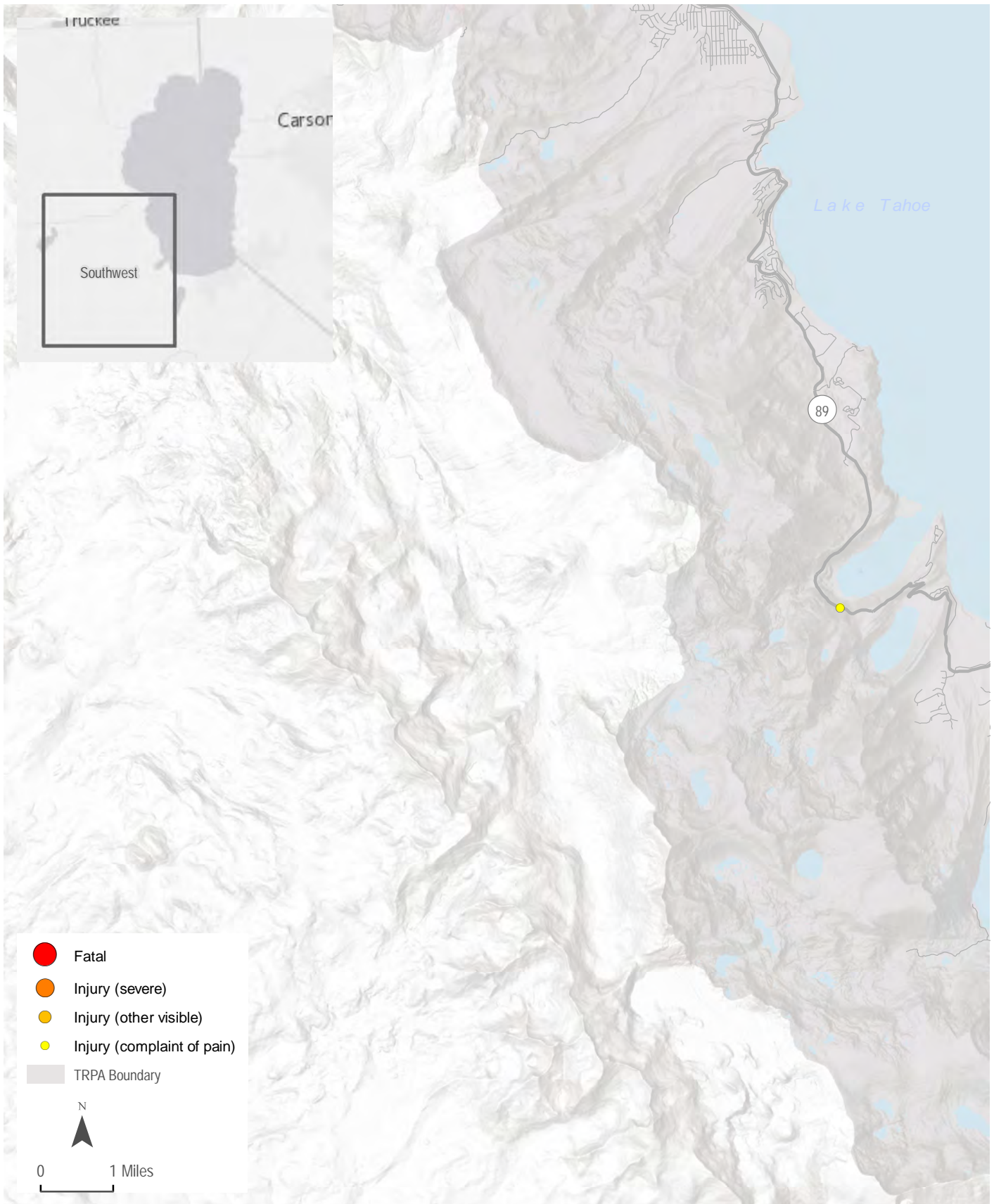


Exhibit 3

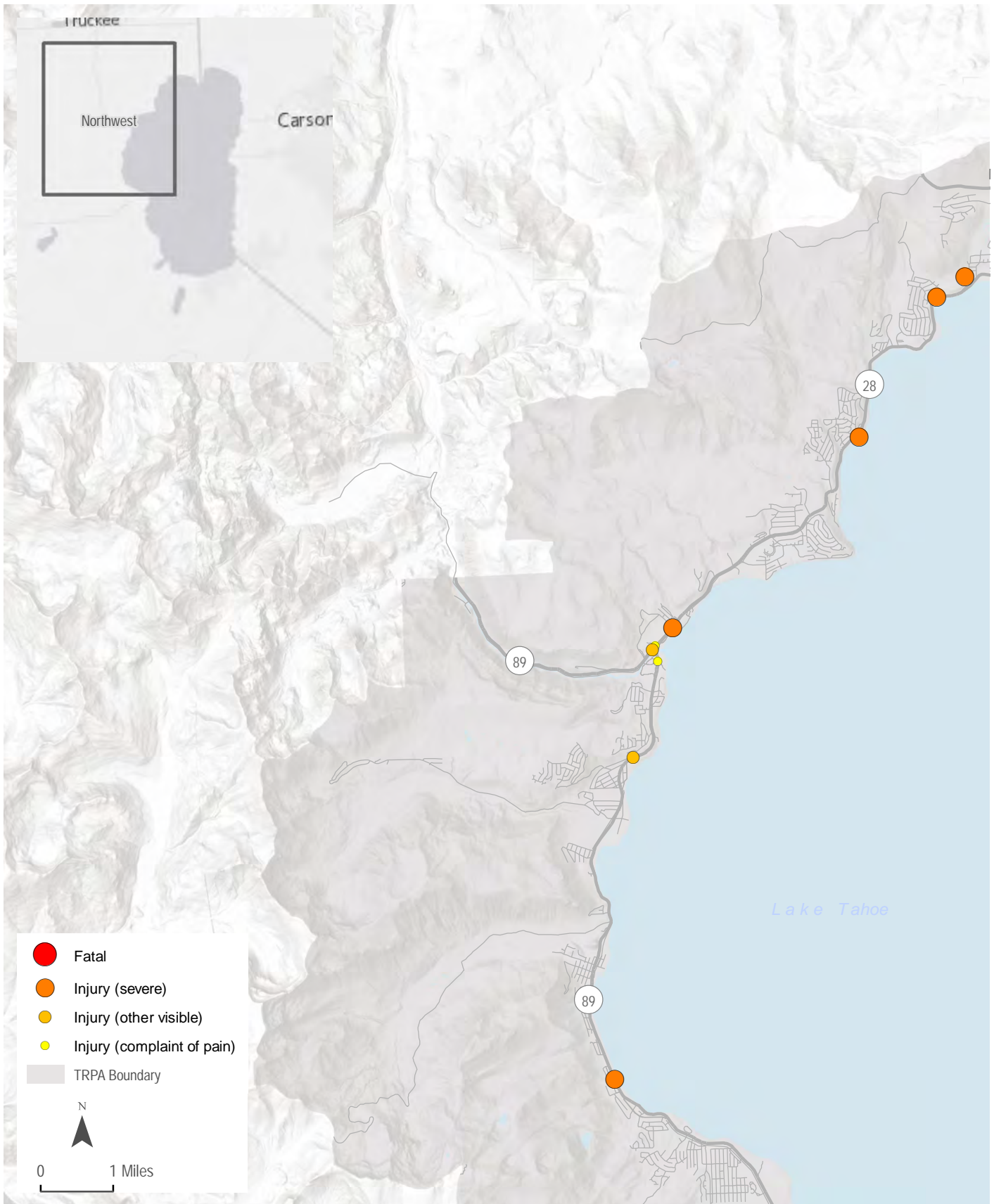


Exhibit 4

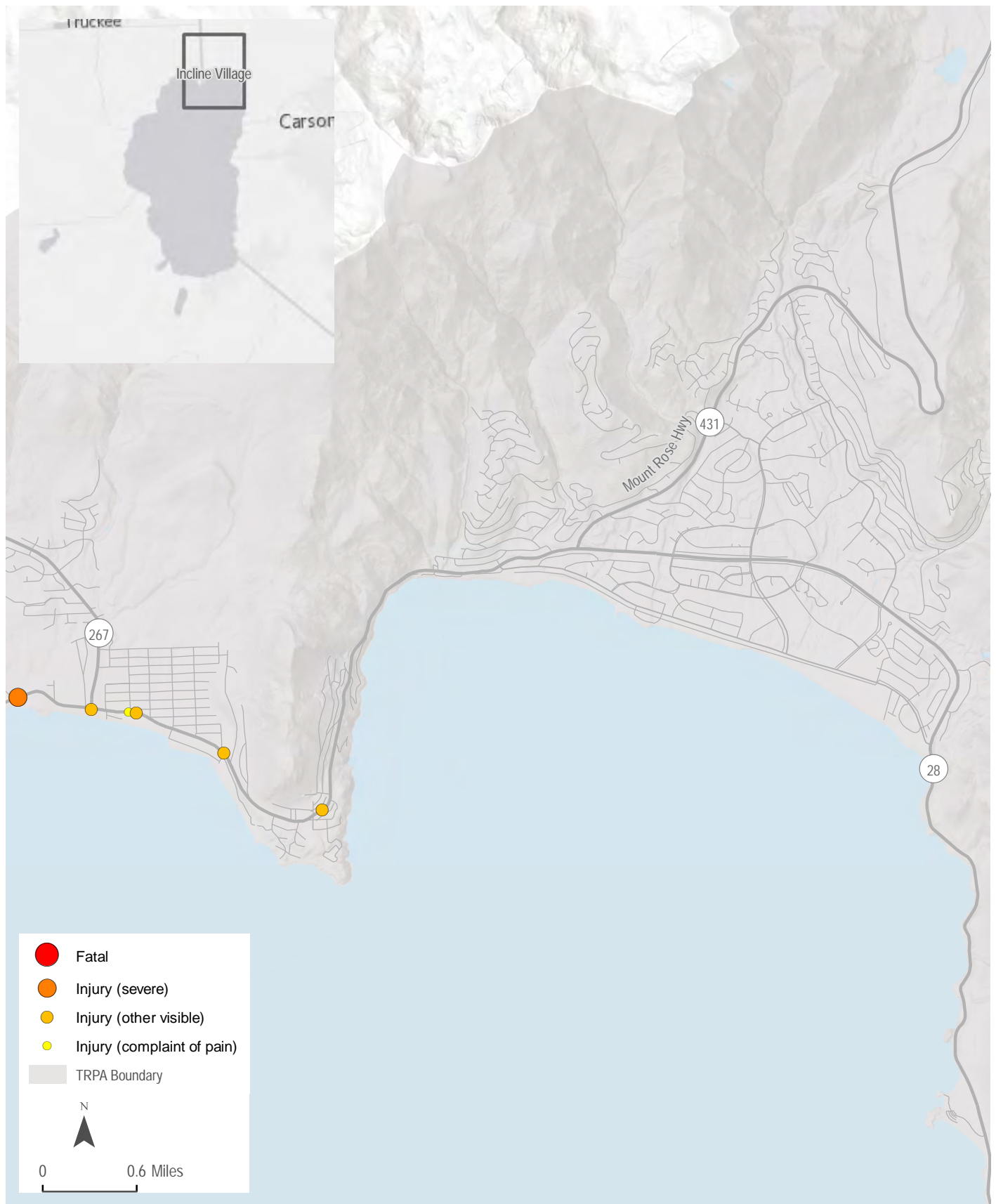
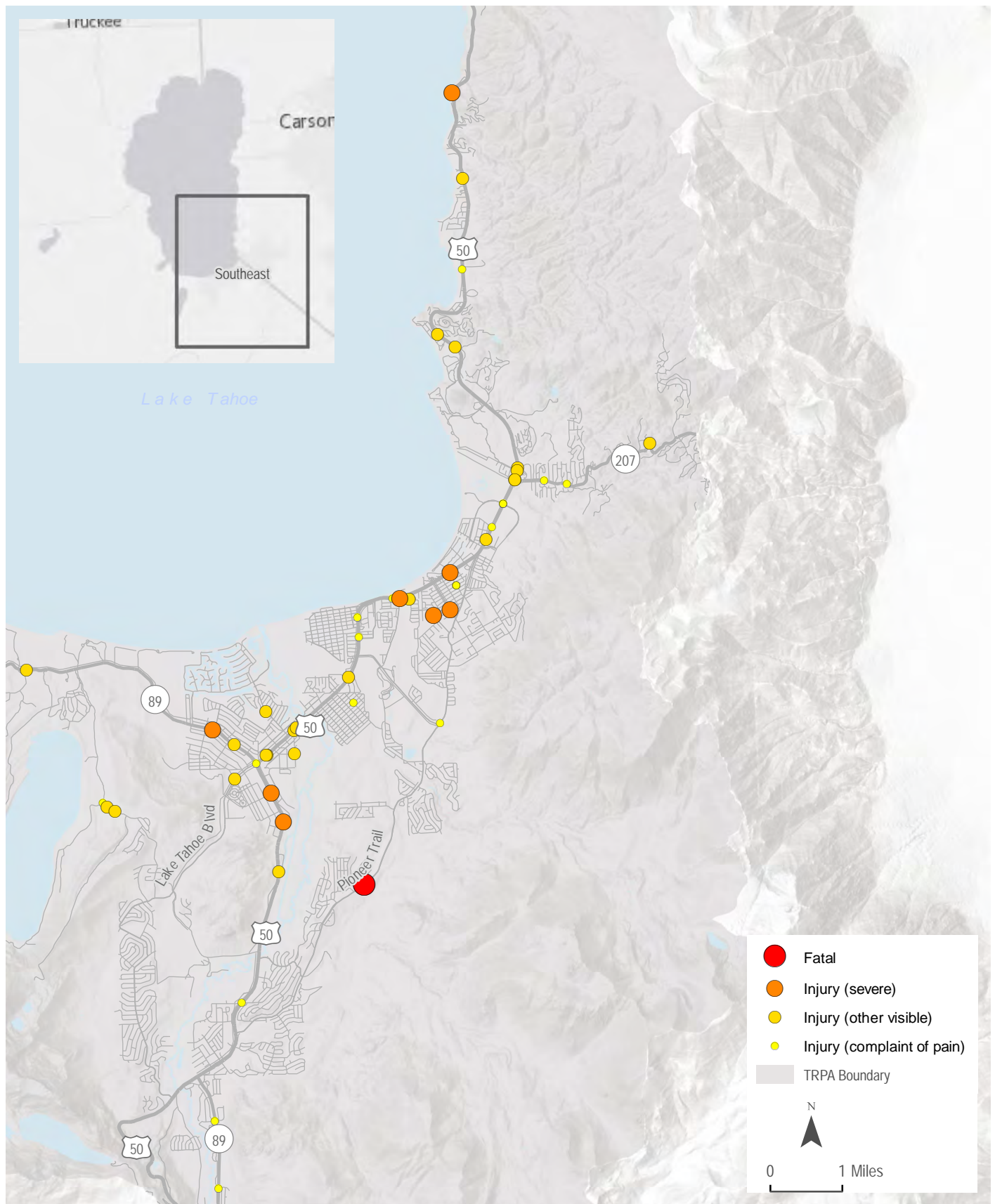
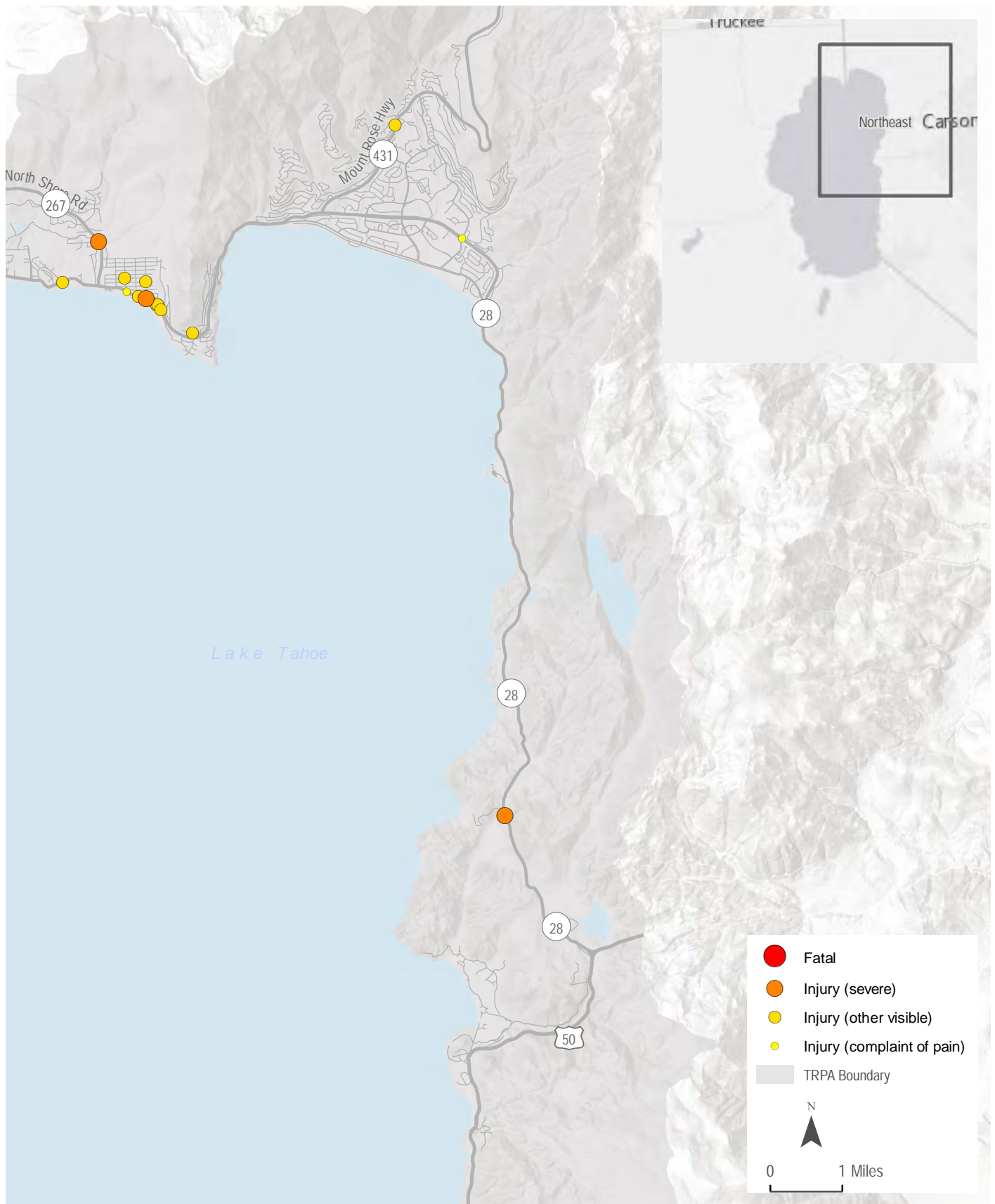
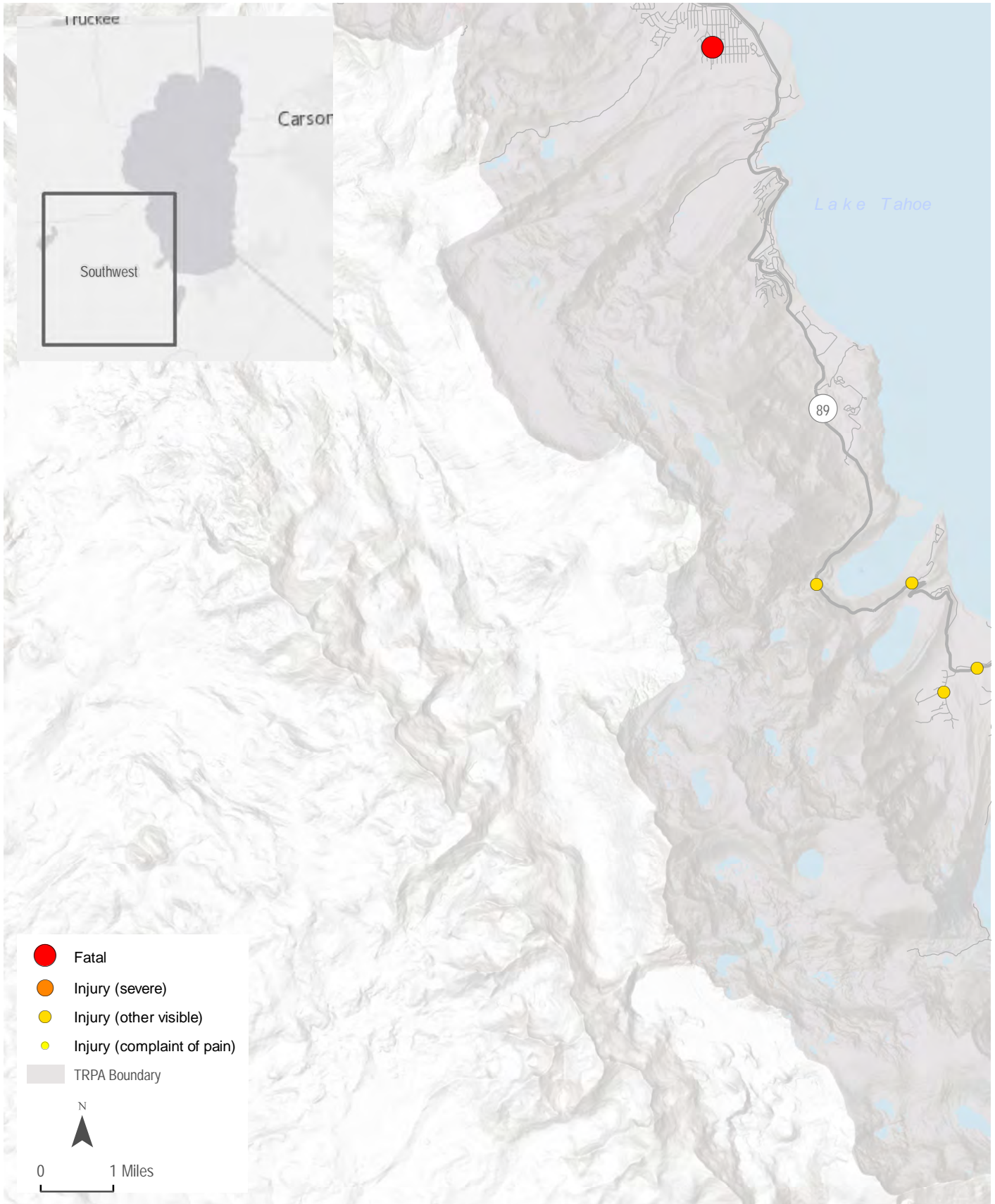


Exhibit 5







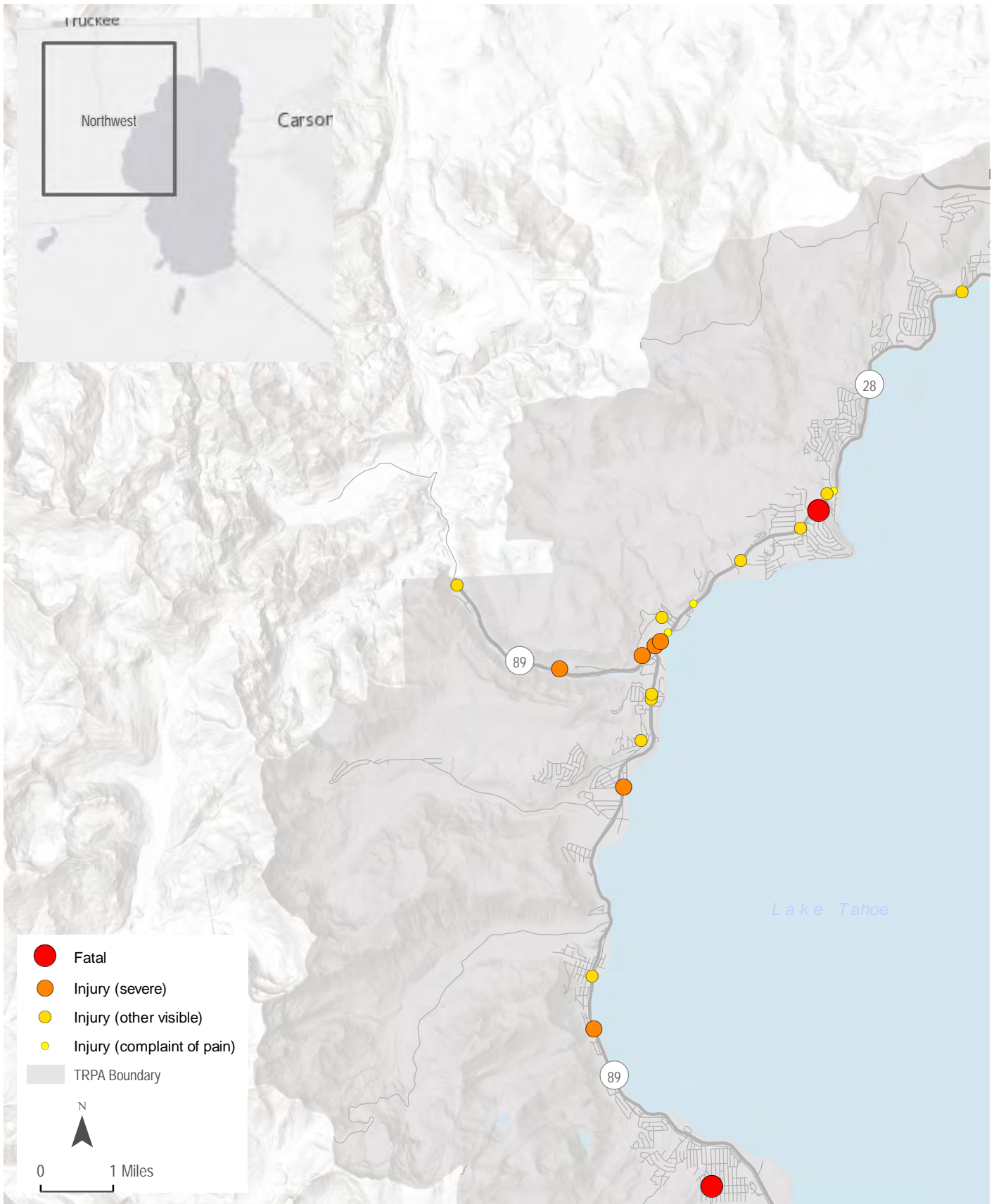


Exhibit 9

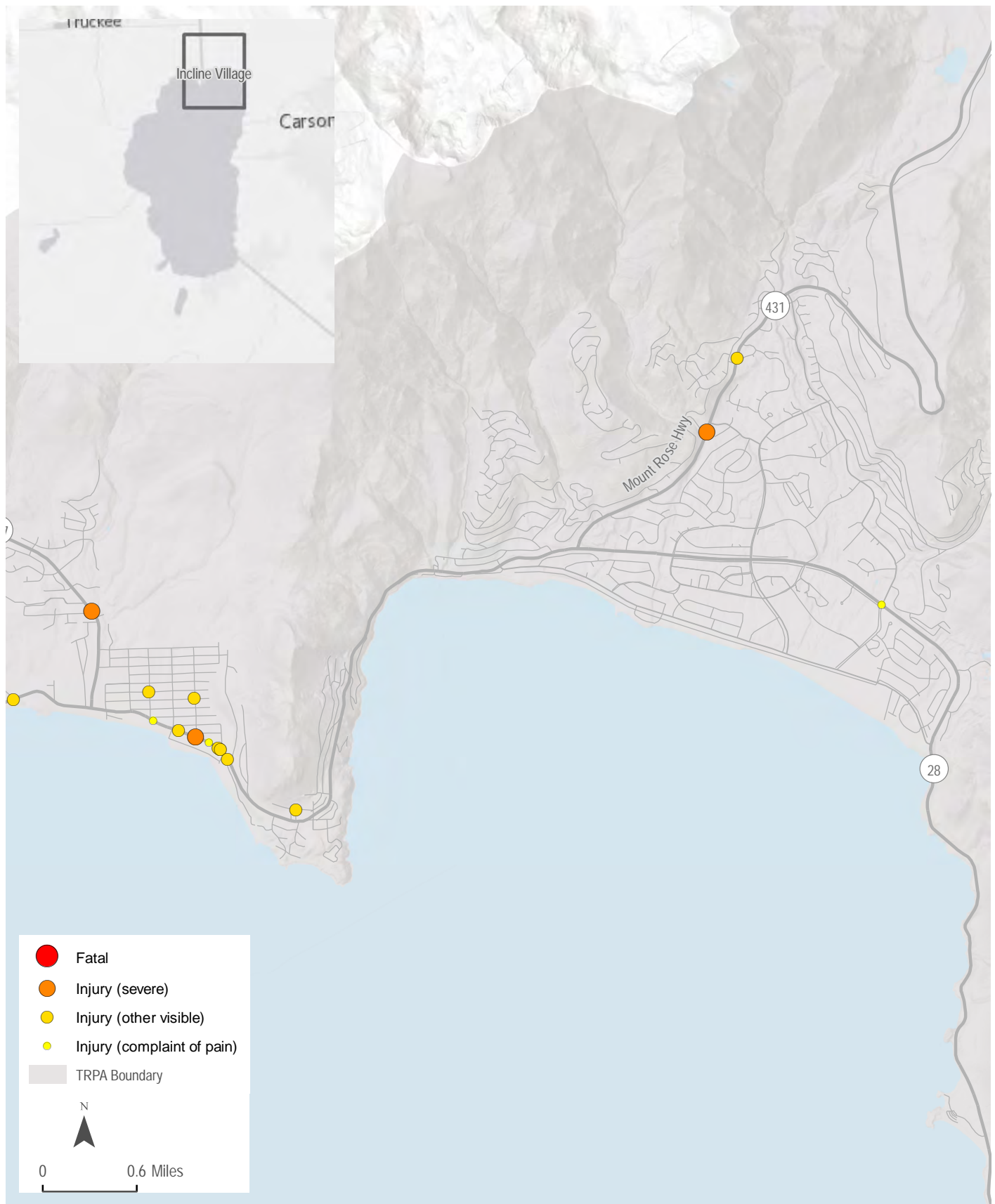


Exhibit 10

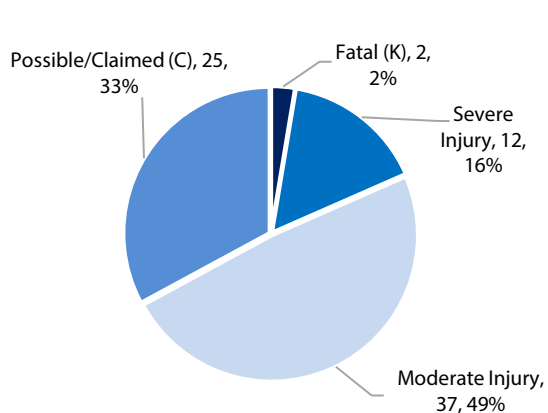
### Crash Severity

Exhibit 11 and Exhibit 12 present observed crash severities for collisions involving pedestrians and bicyclists. For pedestrians, severe crash (fatal or incapacitating) make up approximately one-third of observed crashes, which speaks to their relative vulnerability; when pedestrians are struck the outcome tends to involve injury or fatality. Crashes involving bicyclists had a lower reported percentage of severe and fatal outcome compared to pedestrians. Both are considered vulnerable road users relative to motorists.

### Time Series Patterns

**Exhibit 12: Crash Severity of Police-Reported Bicycle/Motor Vehicle Crashes.**

Source: SWITRS, NDOT, TDG 2018



**Exhibit 12: Crash Severity of Police-Reported Pedestrian/Motor Vehicle Crashes.**

Source: SWITRS, NDOT, TDG 2018

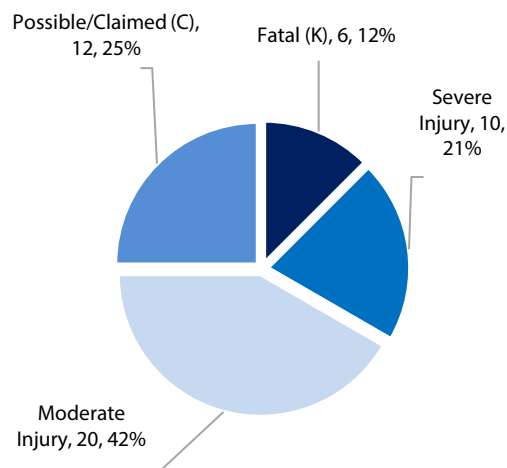
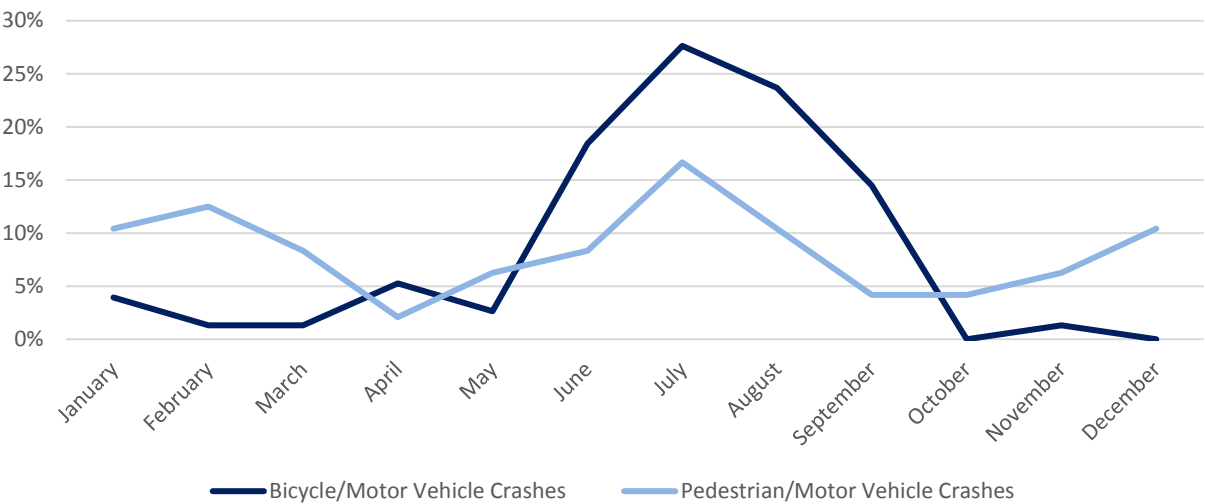


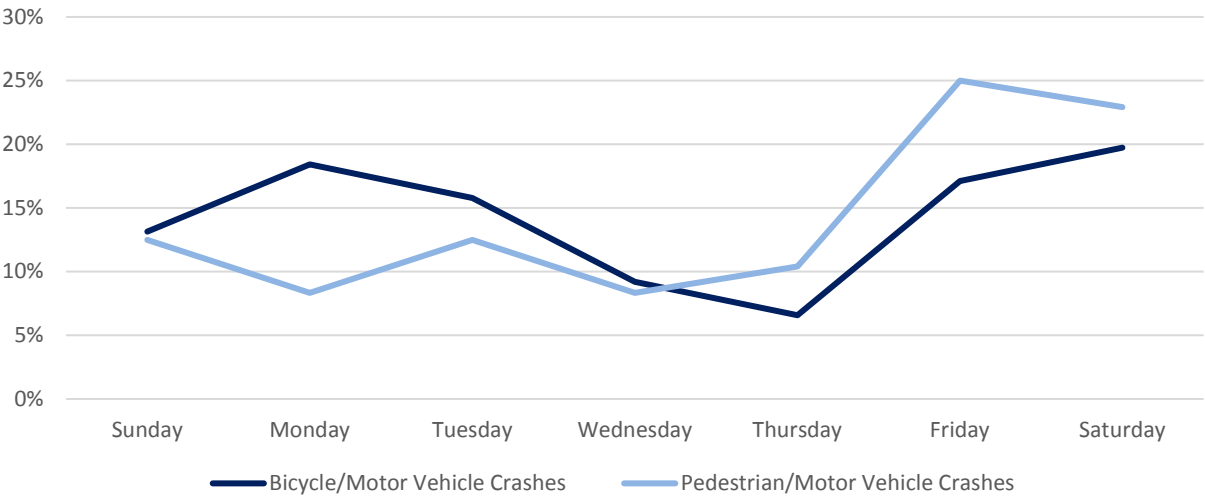
Exhibit 13 and Exhibit 14 show the time series patterns of motor vehicle-involved non-motorized traffic crashes in the Tahoe Region. For pedestrian and bicycle crashes, there is no clear annual trend. However, 2014 had the highest number of severe crashes for both modes in the analysis period.

Crashes peak during the summer months; this is particularly pronounced for bicycle crashes, which appear infrequently in the data during the winter. While July is also the highest month for pedestrian crashes, pedestrian crashes are generally more dispersed throughout the year. These patterns likely indicate a combination of activity patterns associated with these modes and risk. Bicycling exhibits strong seasonality in Tahoe, whereas people tend to walk year-round given Tahoe's strong winter economy. At the same time, increased darkness in the winter months is associated with increased pedestrian crashes which is shown further below. This combination of darkness and winter pedestrian exposure likely contributes to the winter increase in pedestrian crashes seen in Exhibit 14.

**Exhibit 13: Pedestrian and Bicycle Crashes per Month.** Source: SWITRS, NDOT, TDG 2018



**Exhibit 14: Crashes by Day of Week.** Source: SWITRS, NDOT, TDG 2018





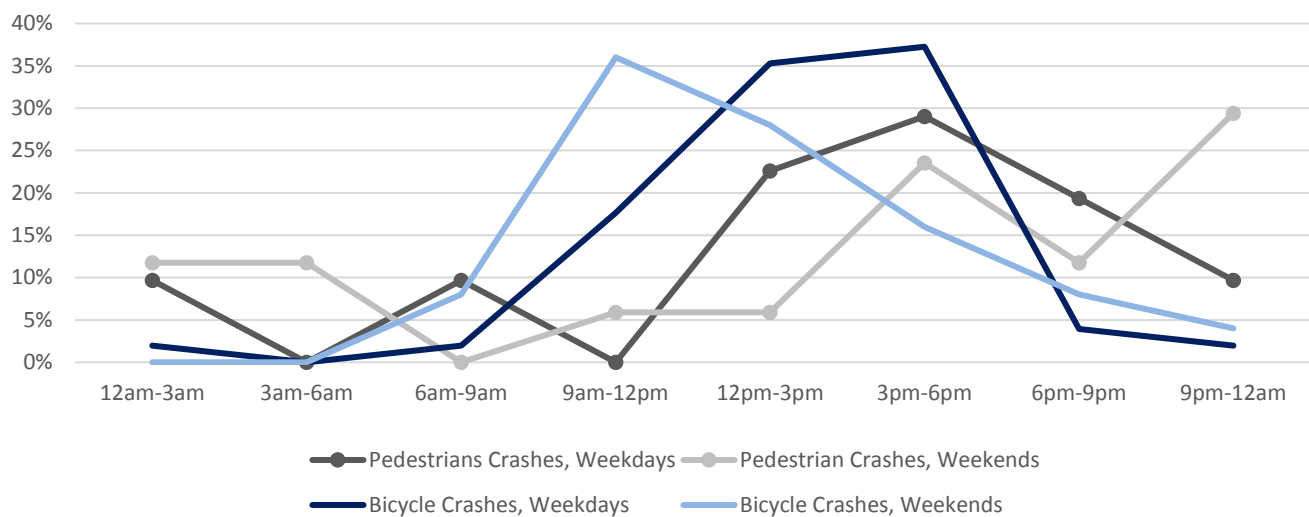
U.S. 50, west of South Tahoe Y. Photo: Kittelson

As Exhibit 14 shows, bicycle crashes occur roughly uniformly throughout the week (with a dip on Thursdays that has no evident explanation other than randomness), while pedestrian crashes are notably elevated on Fridays and Saturdays. Similar to the monthly patterns, this could point to elevated activity rates on these days, which fits with patterns of weekend activity in a tourist economy.

day separately for weekdays and weekends.

Finally, Exhibit 15 examines the distribution of pedestrian and bicycle crashes throughout the

**Exhibit 15: Crashes by Hour-of-Day.** Source: SWITRS, NDOT, TDG 2018



As would be expected given when exposure likely peaks, bicycle crashes tend towards the morning/midday on weekends, but towards the afternoon/evening on weekdays. This afternoon bias on weekdays is most likely associated with a combination of higher levels of bicycle and motor vehicle traffic during commute times. Pedestrian crashes on weekdays are similarly concentrated around the afternoon/evening. However, weekend pedestrian crashes tend more towards the evening and nighttime. While the number of people driving at these times are likely not as high as some other times of the day, the combination of darkness and moderate levels of people driving could be leading to more pedestrian crashes.

### **Lighting**

Lighting influences pedestrian safety in the Tahoe Region. While 8 percent of bicycle crashes occurred outside of daylight hours, 46 percent of pedestrian crashes occurred in the dark. Out of these, 45 percent were in places without streetlights. Furthermore, 75 percent of fatal or incapacitating injury pedestrian crashes happened in the dark. These statistics are notable when considering that fewer people are generally walking or driving at night, so there are fewer opportunities for crashes to occur than during the day. Potential contributing factors to reported night crashes could be related to drivers not seeing pedestrians early enough to slow down in time to avoid a crash, particularly on higher-speed roadways. Adding pedestrian lighting, such as spot-lighting in crosswalks, combined with other visibility-improving countermeasures, like curb extensions and flashing beacons, could help reduce this crash risk. All lighting would need to meet TRPA required night sky guidelines. Where appropriate, reducing vehicle speeds would also improve pedestrian and driver safety.

### **Weather**

Weather did not seem to play a major factor in reported pedestrian and bicyclist crash patterns. Nearly 90 percent of bicycle/motor vehicle crashes and just over 83 percent of pedestrian/motor vehicle crashes occurred when the weather was clear, with just a few occurring when the weather was cloudy. Three crashes total occurred when the roadway was wet, with one of those being a fatal or severe injury for a pedestrian.

### **Motor Vehicle Crashes**

The team analyzed motor vehicle crash data (excluding motor vehicle crashes involving pedestrians or bicyclists, which were analyzed separately) from January 1, 2012 through December 31, 2016. Motor vehicle crashes summary information is depicted in Exhibit 16 through Exhibit 20. Fatal and severe injury crashes are depicted slightly larger for emphasis, which may obscure crashes with less severe outcomes. In analyzing crash patterns and trends, Kittelson considered the following attributes available in the crash data:

- ❖ Crash severity
- ❖ Crash types
- ❖ Temporal trends
- ❖ Driver and vehicle factors
- ❖ Weather and road conditions



Photo: North Tahoe Business Association

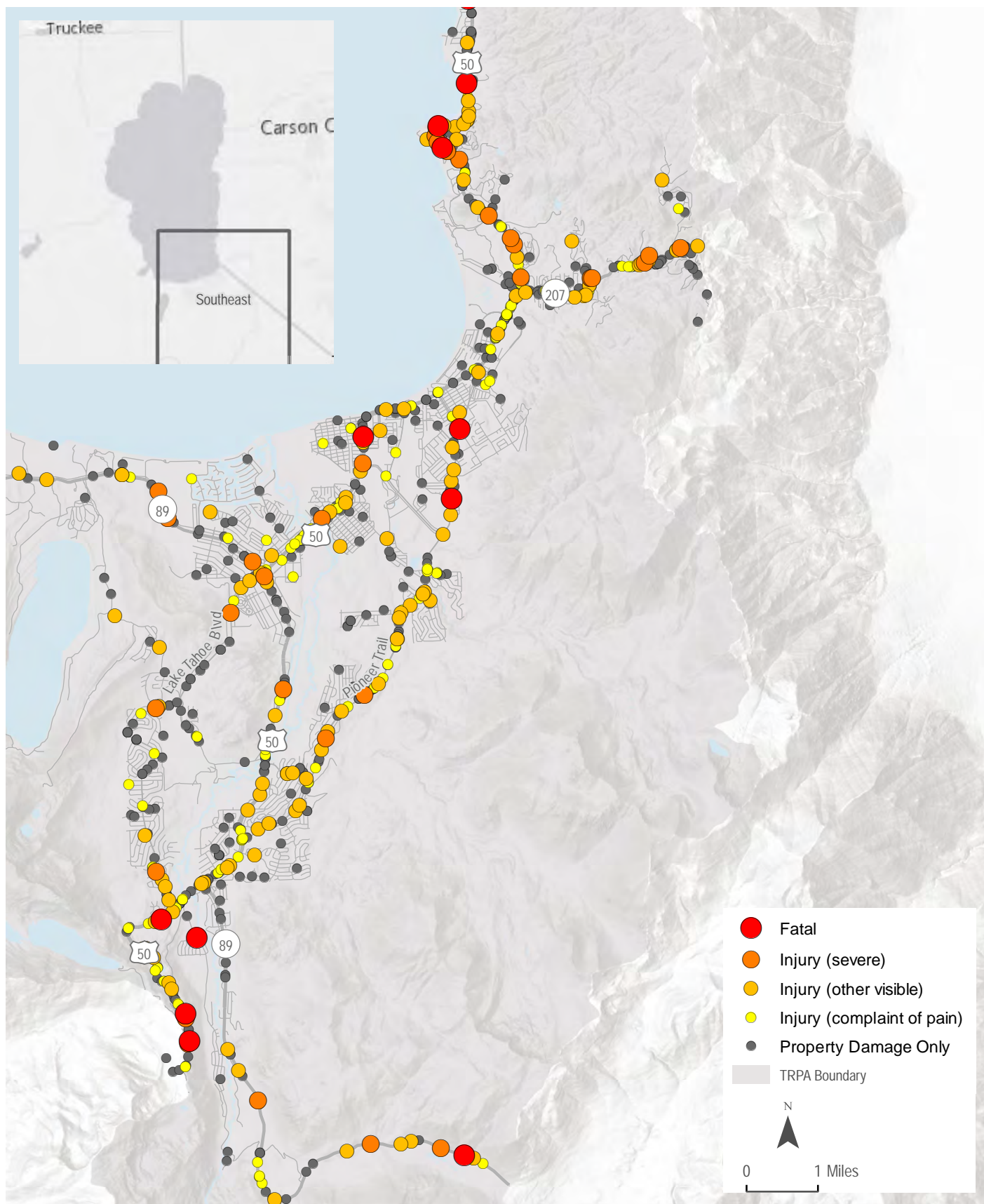


Exhibit 16

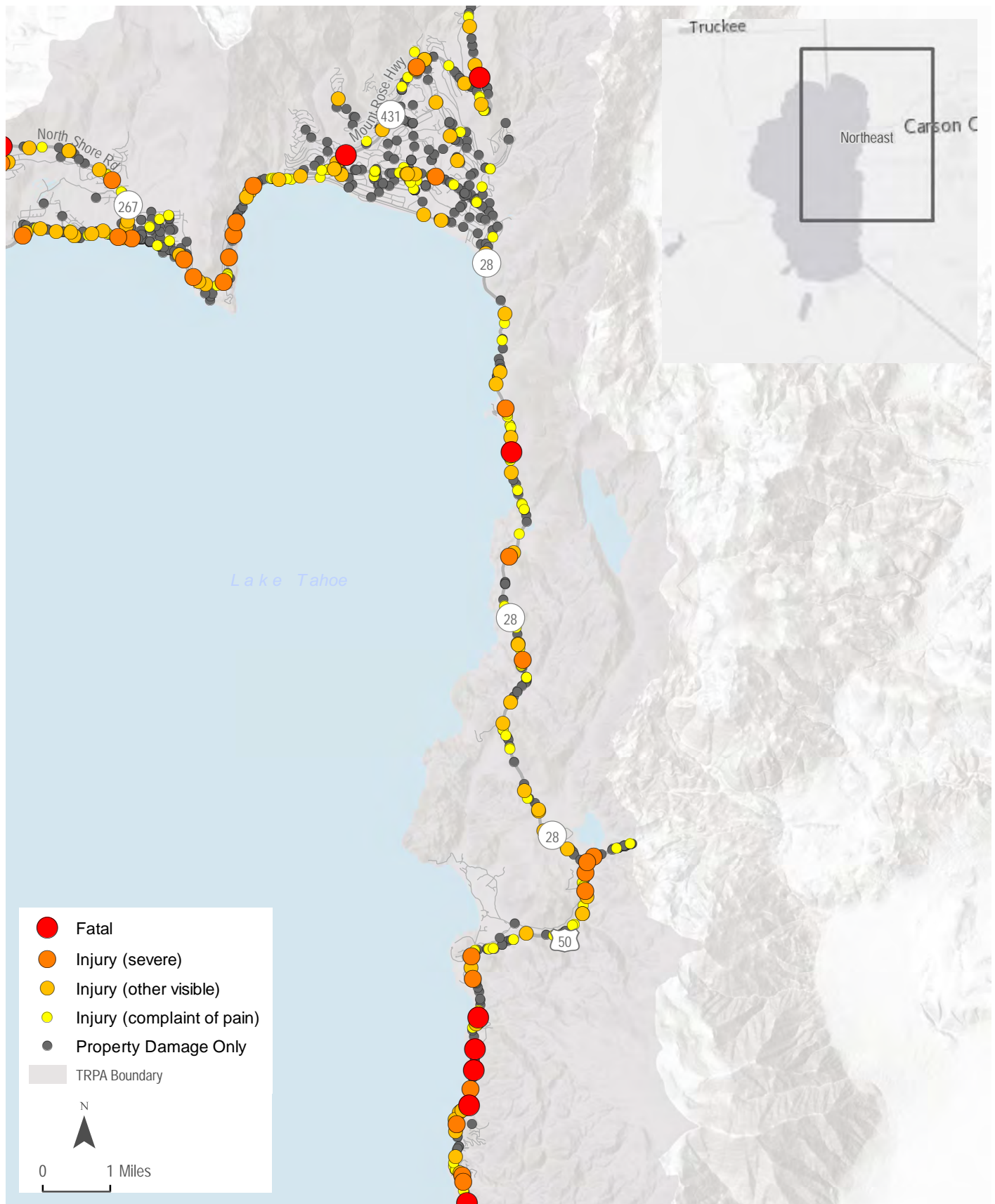


Exhibit 17

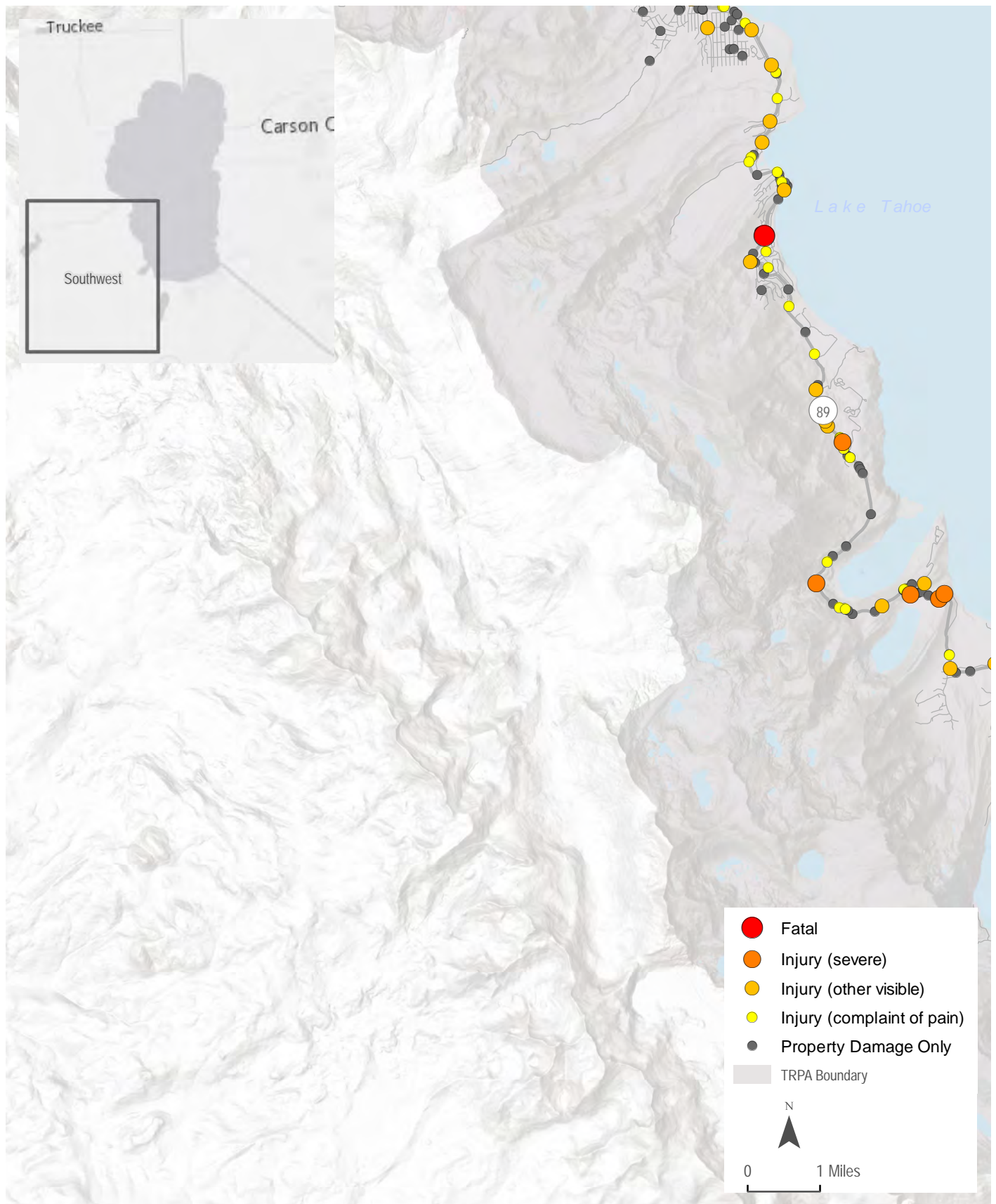


Exhibit 18

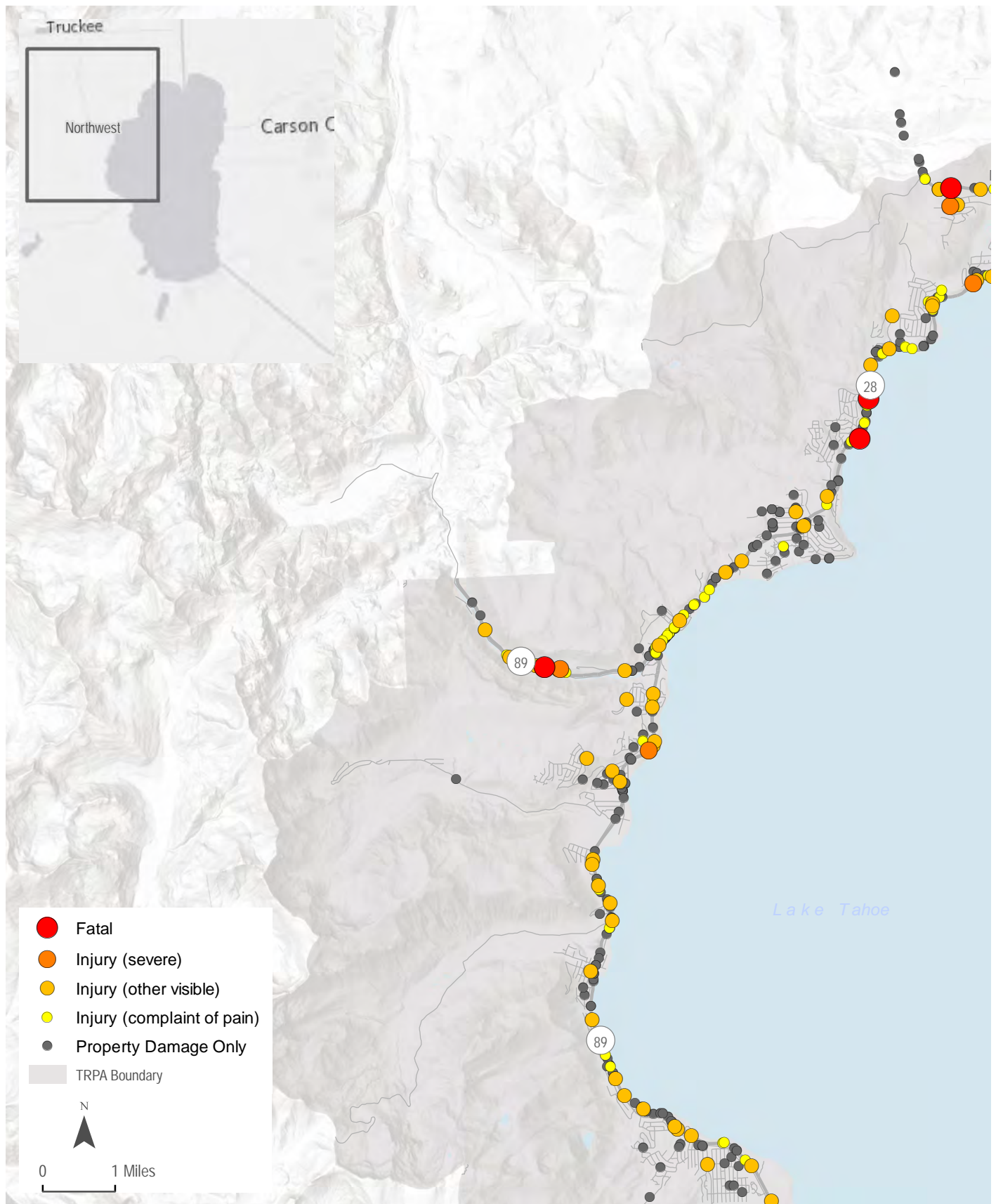


Exhibit 19

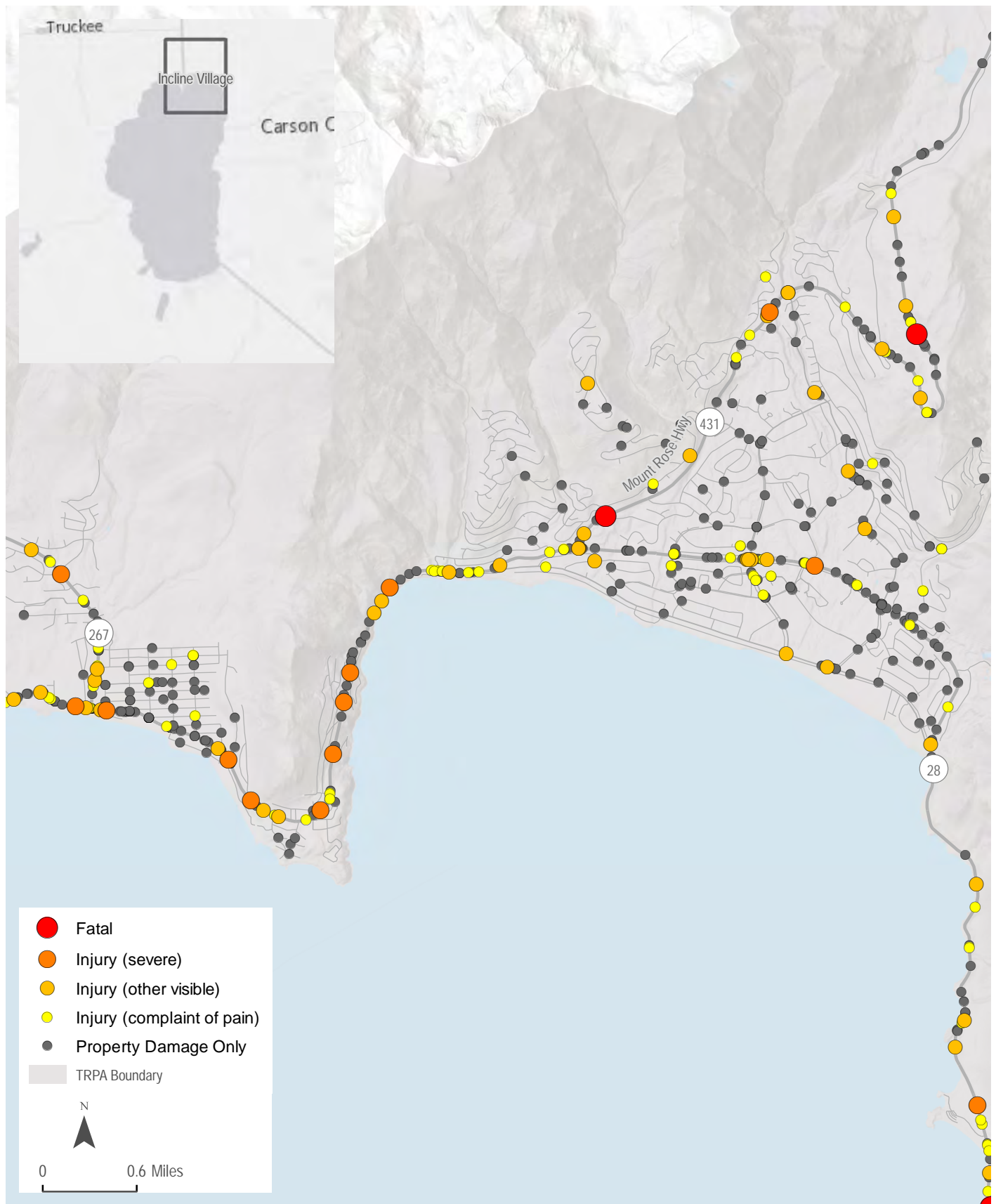


Exhibit 20

### Crash Severity

Exhibit 21 summarizes the reported crashes by severity. There were 2,548 total reported motor vehicle crashes, of which 29 percent resulted in an injury and 1 percent, totaling 24 people, resulted in a fatality.

**Exhibit 21: Lake Tahoe Region Crash Severity.** Source: SWITRS, NDOT, Kittelson 2018

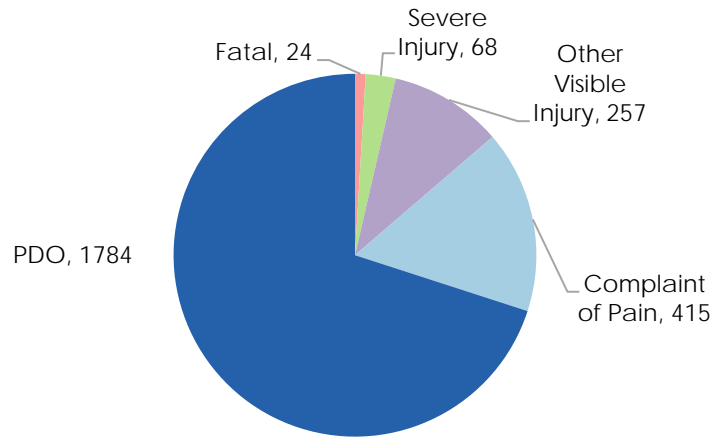


Table 3 presents the severity of crashes based on location. There were more intersection crashes than segment crashes; however, the segment crashes resulted in a higher percentage of severe outcomes.

**Table 3: Lake Tahoe Region Crash Severity by Location**

Severity	Intersection	Segment	Overall
All Injury and Fatal	380 (26%)	384 (35%)	764 (30%)
Fatal/Severe Injury only	32 (2%)	60 (5%)	92 (4%)
<b>Total</b>	<b>1,450</b>	<b>1,098</b>	<b>2,548</b>

Source: SWITRS, NDOT, Kittelson 2018

### Crash Type

Although Nevada and California crash data use different language to describe crash types, Kittelson was able to combine fields for comparison and analysis. Of particular note is Nevada's non-collision crash type, which indicates a single-vehicle crash or a non-motorist involved. The most commonly cited vehicle factors in non-collisions are unsafe speed, unsafe lane change, other improper driving, run off road, or wrong side of the road. Exhibit 22 presents crash types by severity.

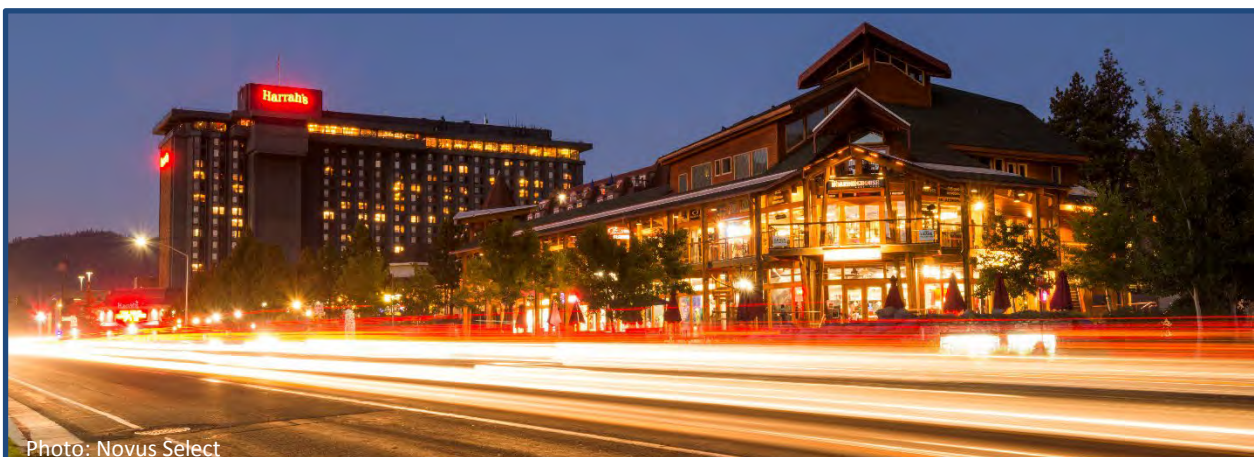
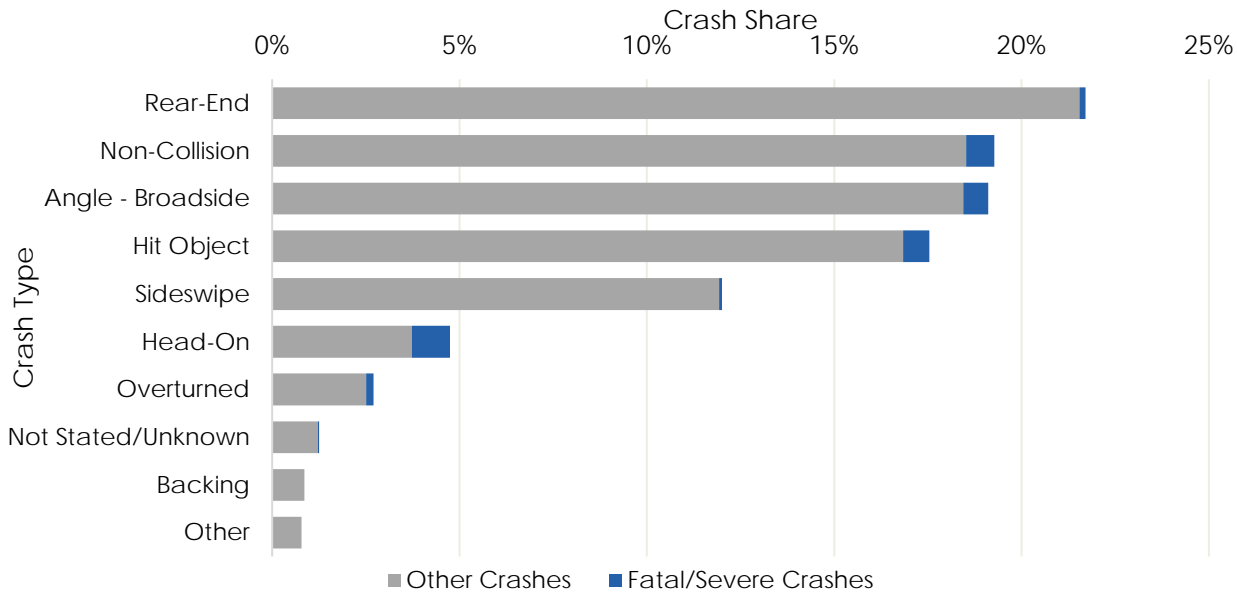


Photo: Novus Select

**Exhibit 22: Lake Tahoe Region Vehicle Crash Types.** Source: SWITRS, NDOT, Kittelson 2018



**Trends illustrated in Exhibit 23 include:**

- Rear-end (22 percent of total crashes), non-collision (19 percent of total crashes), and angle-broadside crashes (19 percent of total crashes) were the most frequently cited crash types.
- The highest fatal/severe injury percentage among crash types observed was for overturned (7 percent) and head-on crashes (21 percent).
- Head-on crashes had a higher fatal/severe injury percentage (22 percent) than the overall percentage of 4.<sup>6</sup>

**Temporal Trends**

Exhibit 23 and Exhibit 24 present monthly and time of day crash trends. The month of year and time of day analyses indicate:

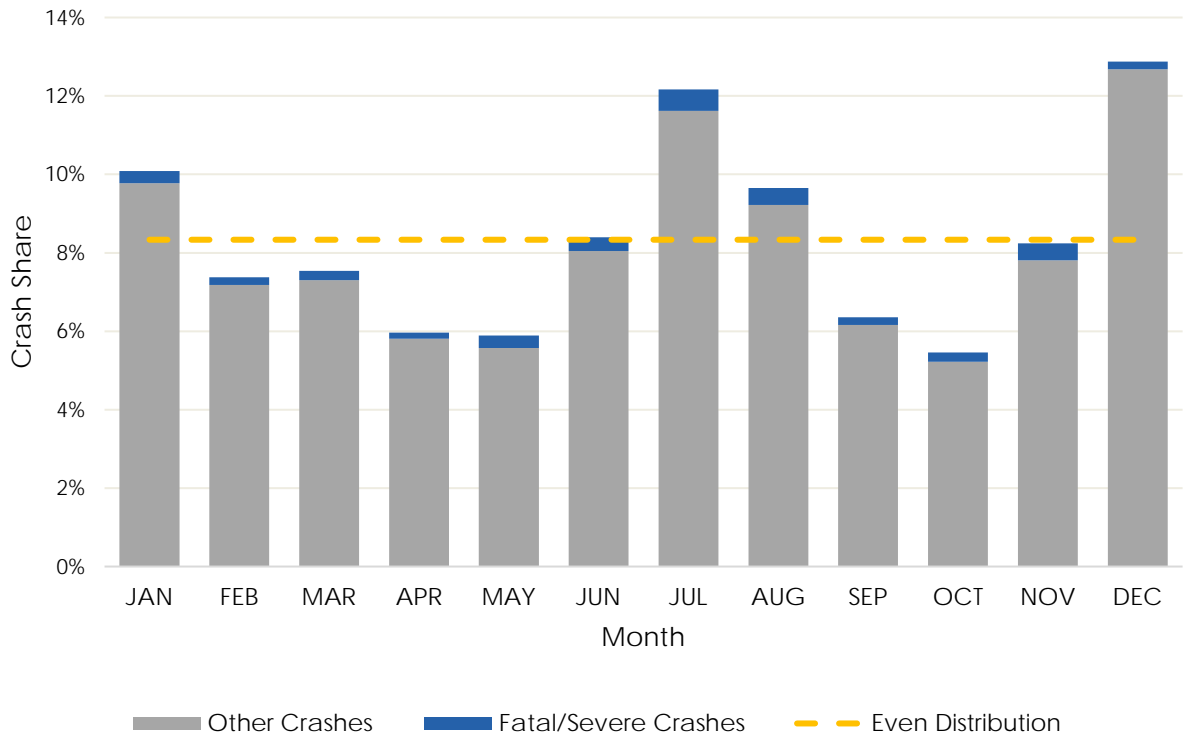
- July, August, December and January exhibited the highest frequency of crashes. The crash share in these four months is higher than if the same number of crashes occurred each month (i.e. an even distribution across all months in the year). July, August, and December are months with more people using the roadways, which is in line with tourism and may contribute to an increase in crashes. Anecdotally, law enforcement noted December and January are believed to have high crashes due to drivers not yet having become accustomed to the onset of winter conditions.
- The time-of-day trends show the highest share of crashes occur between 7:00 AM and 5:00 PM, with a peak in the mid-afternoon (2:00 to 4:00 PM).



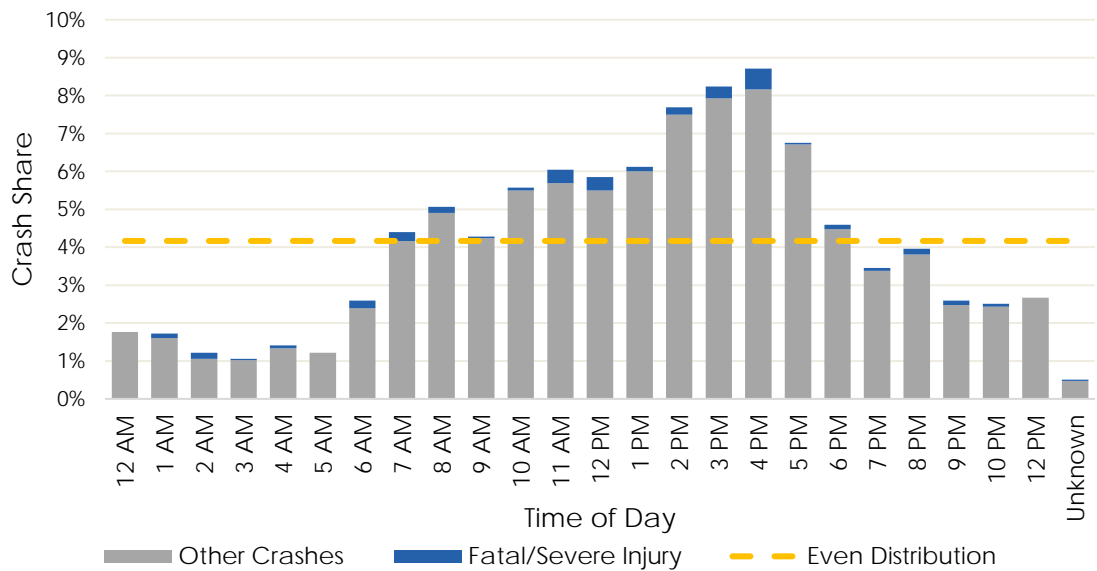
Photo: Novus Select

<sup>6</sup>The difference between the overall fatal/severe injury percentage and among head-on crashes were statistically significant at a 99.9 percent confidence level (p-value < 0.001).

**Exhibit 23: Lake Tahoe Region Severity of Crashes by Month.** Source: SWITRS, NDOT, Kittelson 2018



**Exhibit 24: Lake Tahoe Region Severity of Crashes by Time of Day.** Source: SWITRS, NDOT, Kittelson 2018

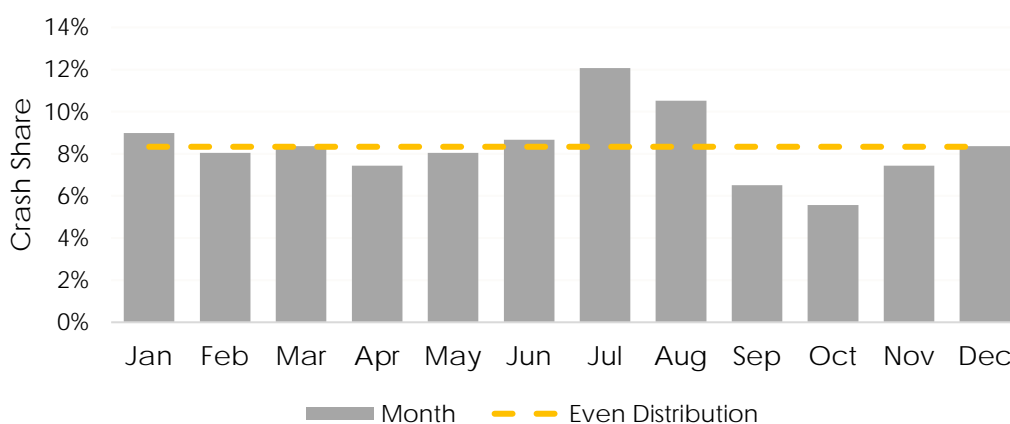


### Driving Under the Influence

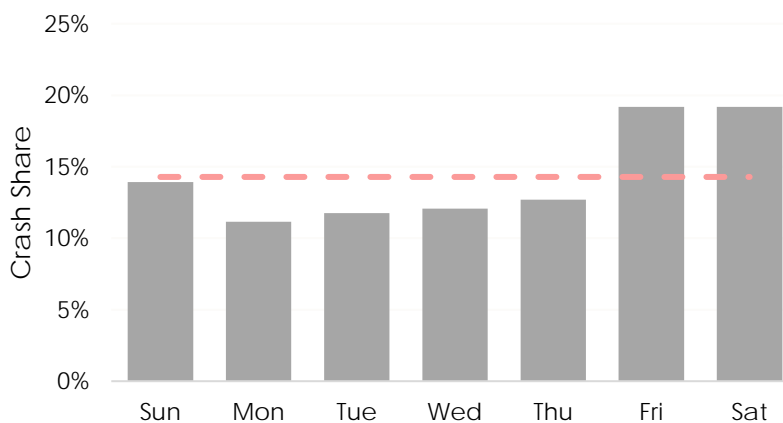
Alcohol and drug involvement influences road safety in the Region. Behavioral influences can vary seasonally and by day of the week. California SWITRS data does not report alcohol and drug use separately, instead reporting their influence in one category together.

- Some level of alcohol or drug influence was cited in 323 crashes, 13 percent of crashes overall.
- The fatal/severe injury percentage among these crashes was 6 percent, higher than the 4 percent percentage among total reported crashes.
- Exhibit 25 and Exhibit 26 indicate the highest occurrence of drug/alcohol related crashes is in the summer months and on the weekends.

**Exhibit 25: Driving under the Influence Crashes by Month.** Source: SWITRS, NDOT, Kittelson 2018



**Exhibit 26: Driving Under the Influence Crashes by Day of Week.** Source: SWITRS, NDOT, Kittelson 2018

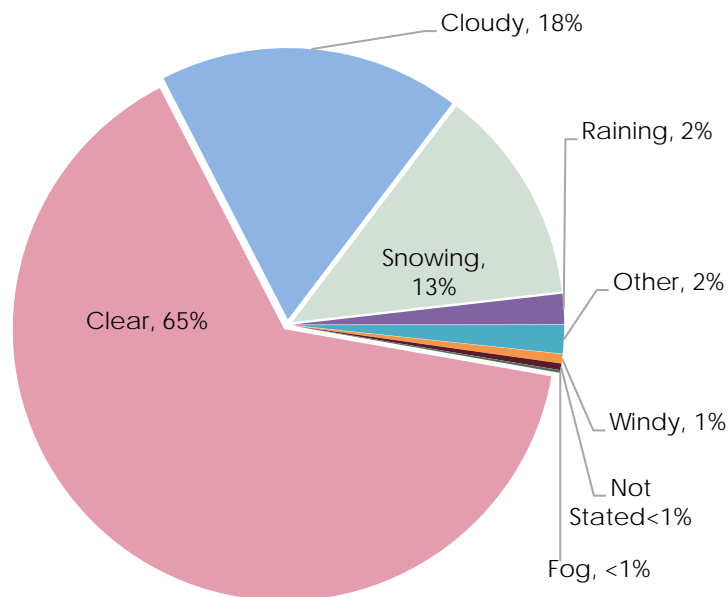


## Weather and Road Conditions

Exhibit 27 presents the weather conditions of the reported crashes.

- 1 The majority of crashes (83 percent) occurred during clear or cloudy conditions.
- 1 In adverse rain or snow conditions, non-collision and angle-broadside crashes were the most common crash types.
- 1 Unsafe speed was the highest contributing factor during rain and snow conditions, cited in 58 percent of these crashes.

**Exhibit 27: Weather Conditions of Crashes.** Source: SWITRS, NDOT, Kittelson 2018



## 3.2 NETWORK SCREENING ANALYSIS TECHNIQUE AND FINDINGS

Network screening analysis results identified priority locations across the Tahoe Region based on crash history. Those priority locations helped inform the risk factor analysis leading to the countermeasures and projects discussed further in later sections.

### Approach for Identifying Pedestrian and Bicycle Priority Locations

The team used two main approaches to identify priority locations for pedestrian and bicycle safety. First, the team applied a half-mile moving window aggregation to the streets in the Tahoe Region. Then the team summarized crashes by severity separately for each mode, and an overall Equivalent Property Damage Only (EPDO) score was calculated for each section of road. This was based on the crash values specified in the Caltrans Local Roadway Safety Manual (LRSM), Appendix D. Based on this moving window evaluation, the team identified locations with an EPDO value exceeding \$2 million. This value was chosen as the cutoff for priority locations because \$2 million is the highest value assigned to a single fatal or serious injury crash based on Caltrans costs by crash severity used in the HSIP funding program. Including sections with EPDO scores below this value could lead to the identifying locations where a single severe crash occurred that may not be a true “hotspot” because of the random variation associated with crash locations.

To supplement the identified priority locations, the team identified corridors (combinations of intersections and segments) where the crash prediction models developed (and described in the sections below) suggest high expected rates of pedestrian and bicycle crashes, in line with systemic safety principles<sup>7</sup>. The team developed

<sup>7</sup> Systemic safety planning seeks to resolve traffic safety problems by targeting known risk factors to treat locations where crashes are most likely to occur in the future, rather than focusing on where they have occurred in recent years.

these models using the same data that was used to identify the priority locations, there is substantial overlap between the locations identified by the two methods. However, the systemic considerations also point to additional corridor locations that share some of the risk factors but may have otherwise been missed for prioritization.

**Approach for Identifying Motor Vehicle Priority Locations**

For the spatial analysis necessary to identify priority locations, the team geocoded and mapped the crashes as previously described. The team identified the high-priority safety intersections and roadway segments using the Equivalent Property Damage Only (EPDO) network screening performance measure from the Highway Safety Manual (HSM). Kittelson performed the EPDO screening calculation for each location including intersections and roadway segments within the planning area. The EPDO performance measure is described below.



**Equivalent Property Damage Only**

The EPDO performance measure assigns weighting factors to crashes by severity relative to PDO crashes. The weighting factors used for the network screening are based on the crash costs by severity used for Caltrans’ Highway Safety Improvement Program Benefit Calculator Tool. The crash costs vary based on the location type: signalized intersection, unsignalized intersection, or roadway. The weights for each crash severity by location type are shown in Table 4.

**Table 4: Crash Weights by Severity and Location Type**

Location Type	Crash Weights by Severity					
	Fatal	Severe Injury	Other Injury	Visible	Complaint Pain	of Injury Property Damage Only
Signalized Intersection	126	126	10.86		6.13	1
Unsignalized Intersection	200	200	10.86		6.13	1
Roadway	173	173	10.86		6.13	1

Source: Caltrans, Highway Safety Improvement Program Benefit Calculator Tool, 2016.

The weights generally reflect an order of magnitude difference between the societal costs of fatal and severe injury collisions versus non-severe injury collisions. The weighting factors intentionally weigh fatal and severe injuries equally to recognize the difference between a severe injury crash versus a fatal crash are often more of a function of the individuals involved. Therefore, both represent locations where Tahoe Region implementation partners may want to prioritize improvements. The crash weights vary by location type because of the relative costs associated with the crash severity at those location types. Hence, fatal or severe crashes at an unsignalized intersection location result in more persons injured or more severely injured in a crash and as a result have a higher average cost than at a signalized intersection or roadway location. As a result, unsignalized intersections have higher weights for those severities than the other two location types.

### *Intersection Analysis Methodology*

The team first coded reported crashes by severity. Crashes within 250 feet of an intersection were then spatially joined and summarized in ArcGIS to develop the total number of crashes by severity at each intersection. Where intersections were less than 500 feet from each other, crashes were assigned to the nearest intersection. Crashes occurring more than 250 feet from an intersection were included in the segment analysis discussed in the following section. The EPDO score for intersections was calculated by multiplying each crash severity total by its associated weight (by intersection type) and summing the results, using the following formula:

*EPDO Score = Fatal weight \* # of fatal crashes + severe injury weight \* # of severe injury crashes + other visible injury weight \* # of other visible injury crashes + complaint of pain injury weight \* # of complaint of pain injury weight crashes + PDO crashes*

The EPDO score was then annualized by dividing the score by the number of years (five) of crash data used in the analysis.

### *Segment Analysis Methodology*

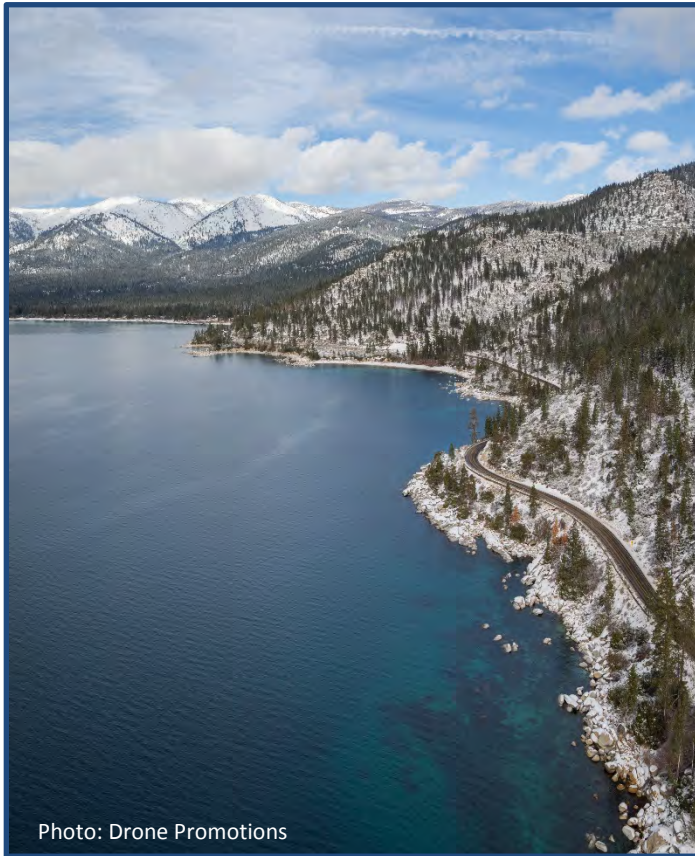


Photo: Drone Promotions

Following the approach used for intersection analysis, the team first coded reported crashes by severity using a Python script in ArcGIS. This segmented the Tahoe street network into one-fourth (1/4) of a mile segments, incrementing the segments by one-eighth (1/8) of a mile. This methodology helps to identify portions of roadways with the greatest potential for safety improvements. Once the roadway segments were created, the script spatially joined crashes to the corridor segment, excluding those identified with intersections as described above. Similar to the intersection methodology above, the team summarized the crashes by severity, and multiplied the totals by the EPDO weights for roadway segments. The weighted crashes were then summed and annualized by dividing the score by the number of years of crash data (6) to generate an annualized EPDO score.

### *Identifying Priority Locations*

From these results, the team chose high-scoring intersection and segments throughout the Region with identified risk factors present as priority locations. In some cases, they combined top-scoring segments that were adjacent or nearby one another to develop a consolidated list of priority segments.

Results are presented in the next section.

### **Network Screening Results**

The network screening results informed identification of risk factors, which is described in Section 6.3. The network screening results also led to the priority locations for safety improvements. Those priority locations are presented in Section 8.0 as the high-risk corridors and intersections.

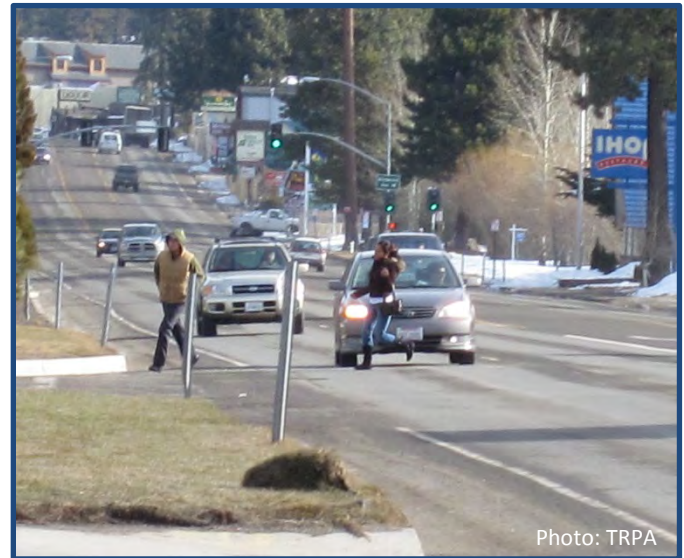
### 3.3 ANALYSIS TECHNIQUES AND RESULTS TO IDENTIFY RISK FACTORS

This section presents the approach used to identify risk factors for pedestrian and bicycle crashes and for motor vehicle crashes. Risk is defined in this instance as common traffic or physical characteristics shared by the top roadway segments and intersections identified from the network screening analysis results described above. Presence of these characteristics indicates a potentially higher risk for crashes within the Tahoe Region.<sup>8</sup>

#### Approach to Identify Pedestrian and Bicycle Related Risk Factors

The team identified risk factors for pedestrians and bicyclists by identifying those roadway conditions under which crashes appear to be overrepresented. To consider the effects of multiple variables in combination with one another, the team developed Negative Binomial statistical models that predict the number of expected crashes within a given length of road based on the characteristics of the road. These multivariate models account for the fact that multiple apparent risk factors tend to be present on the same road sections, and they are helpful for understanding their relative influence. For instance, traffic volumes tend to be higher on higher speed roads, but both factors are important separately as well as in combination.

For this analysis, reported pedestrian and bicycle crashes involving motor vehicles were assigned to adjacent road segments. If a crash was near multiple roads (e.g. at intersections), the crash was assigned to the highest functional class or highest speed road. A separate analysis of intersection-related crashes was not conducted due to the relatively small sample of crashes; rather, these results point to the general traffic environments most associated with pedestrian and bicycle crashes. Similarly, crashes that do not involve a motor vehicle were omitted due to the presumed low reporting rates associated with these crashes.



#### Risk Factors for Pedestrian and Bicycle Crashes

The team developed separate crash models for crashes between motor vehicles and pedestrians, motor vehicles and bicyclists, and motor vehicles and all non-motorized parties. The best fitting models for each are summarized in Table 5.

<sup>8</sup> Note: This commonality does not prove causality; it suggests a potential connection or contributing factor.

**Table 5: Risk Factor Models for Non-Motorized Traffic**

	Pedestrian (N=48)	Bicycle (N=76)	Bicycle and Pedestrian (N=124)
Intercept	0.010*** (-0.373)	0.022*** (0.270)	0.032 *** ( -0.221)
Overdispersion	0.965 (0.816)	1.770** (0.834)	1.155*** (-0.439)
Mixed-Use	4.317*** (0.381)	2.785*** (0.319)	3.400*** (-0.250)
Tourist Land Use	3.440*** (0.484)	2.349** (0.434)	2.820*** (-0.334)
Speed Limit 30-35 mph	2.602 (0.606)	2.566* (0.484)	2.751*** (-0.379)
Speed Limit 40+ mph	1.903 (0.625)	2.056 (0.486)	2.173** (-0.384)
More Than 3 Lanes	1.227 (0.403)	1.831* (0.071)	1.570* (0.267)
6,000-11,999 ADT	7.848*** (0.639)	5.489*** (0.526)	6.056*** (-0.405)
12,000-19,999 ADT	5.179*** (0.690)	6.673*** (0.509)	5.751*** (-0.408)
20,000+ ADT	18.771** (0.607)	13.451*** (0.482)	14.654*** (-0.375)

Statistical significance indicated by the following: \*  $p < 0.10$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ . Numbers indicate parameter point estimates; numbers in parentheses indicate standard errors.

Source: SWITRS, NDOT, TDG 2018

Note that the first number represents the risk ratio, while the number in parentheses represents the standard error. For example, pedestrian crashes are 4.3 times as likely to occur in “mixed-use” areas as in areas that are not designated mixed-use, holding all other variables in the model constant. Similarly, “tourist” land uses are associated with an elevated risk (2.35 times) for bicyclist crashes as compared to non-tourist, non-mixed-use areas, again with all other variables held constant.

“Overdispersion” is a metric used to gauge the validity of the model results. In general, the more dispersed the results are, the less the model explains about the crashes, hence they are “overdispersed”. In this case, the overdispersion is significantly different from 0, which means there are likely additional important variables that could help to explain the crash outcomes. For example, it is possible elements related to roadway geometries or the physical environment factors not captured in the databases, and therefore not able to be analyzed, could impact the propensity for crashes to occur. However, even widely-accepted crash prediction models demonstrate overdispersion, so this does not invalidate the models.

The asterisks indicate a level of significance of the result, which is essentially a way to apply some measure of confidence in the association between crash outcomes and a given variable. The higher the level of significance, the greater our confidence that the result was not achieved by chance.

This table shows many of the identified risk factors are common across the non-motorized modes. The following section elaborates on factors that appear to affect the expected number of crashes at a given location in the Tahoe Region.

#### ***Mixed-Use and Tourist Zones***

Areas with land uses designated as “mixed-use” and “tourist” have disproportionately higher rates of pedestrian and bicycle crashes relative to roadway mileage in these areas. This is suspected to be a factor of higher levels of pedestrian and bicyclist activity in these areas, as land uses in these areas tend to have more trip attractors than other parts of the Region. The higher numbers of people walking and bicycling in these areas results in more opportunities for crashes to occur. In addition, these environments tend to be relatively complex, with high frequencies of driveways to access surface parking lots along the major streets in the Region. The resulting conflicting movements between turning motor vehicle traffic and vulnerable road users on the shoulder, in the bicycle lane, or on the sidewalk are known to result in higher collision rates.

### *Traffic speeds*

High traffic speeds, and particularly those in the 30-35 mph range, are associated with elevated crash rates for pedestrians and bicyclists. The 30-35 mph range for pedestrians is only marginally significant ( $p$ -value = 0.115), meaning there is less confidence in this direct association for just pedestrian crashes than for the combination of pedestrian and bicyclist crashes, for example. However, this term is included, because the value is close and it fits with what is known about the oppositional relationship between traffic speeds and pedestrian safety. The moderately high traffic speeds are associated with higher crash rates than speeds over 40 mph, which could point to lower rates of walking and bicycle use on the high-speed roads because of a lack of perceived comfort and safety (rather than, for example, the 40+ mph roads actually have fewer crashes). However, these 30-35 mph zones also appear to result in elevated risk, even while still attracting pedestrian and bicyclist traffic.



### *Number of Lanes*

The total number of lanes on a segment is not significant in the pedestrian model and is only marginally significant in the bicycle model. However, the total number of vehicle lanes on a segment exceeding 3 appears to be a factor in the overall combined bicycle and pedestrian model. The lack of statistical significance for this term could be an effect of limited sample sizes; that is, there may not be enough data in the pedestrian dataset to identify the effect of the number of lanes above and beyond the effects of traffic volumes, despite there still being an effect.



**Exhibit 28: Multiple traffic lanes and no bike lane at Kahle and US 50.**

Source: Google, 2018

### *Traffic Volumes*

Motor vehicle traffic volumes are known to be a primary risk factor for people walking and bicycling, and this proves to be the case in the Tahoe Region. Generally, as volumes increase, so too does the effect on non-motorized traffic crash risk. The expected number of non-motorized crashes increases on high volume roads (> 20k ADT). This could reflect the fact that many of the state highways in the Tahoe Region simultaneously function as the main streets through town and house many of the attractor land uses. However, it may also reflect that more cars, particularly when they are traveling at fairly high speeds, result in more opportunities for conflicts. Additionally, because state highways serve as main streets in the Tahoe Region, many of these roads generally have complex traffic dynamics that combine for a higher risk

environment for pedestrians and bicyclists. These dynamics include higher pedestrian and bicycle volumes and a demand for people to walk or bike across the street. Exhibit 28 and Exhibit 29 show examples of these combinations of risk factors in the Tahoe Region.

### Approach to Identify Motor Vehicle Related Risk Factors

The team applied a risk-based analysis of the top 10 percent of locations identified through the intersection and roadway segment network screening. Risk is assessed based on common characteristics (i.e. “risk factors”) shared by the corridors and intersections with the highest collision rates. Presence of these factors indicates potentially higher risk for crashes within the Tahoe Region. The risk factors were used during field visits and project development to identify treatments to reduce the frequency and severity of crashes. These risk factors were and can be used in the future to identify additional locations where crashes have not yet been reported to make proactive low-cost improvements to those locations to reduce the potential for future crashes.

The team reviewed the following roadway characteristics previously described in the spatial database to help determine potential risk factors for intersections and roadway corridors. The team identified trends that were consistently present across the top locations and could be tied to a roadway characteristic. That characteristic was identified and documented as a risk factor. Examples of risk factors present at priority locations are illustrated in Exhibit 30 and Exhibit 31.

### Risk Factors for Motor Vehicle Crashes

#### Roadway Segment Risk Factors

Roadway segment risk factors include:

- ❑ Two-lane cross sections;
- ❑ Undivided roadways; and,
- ❑ Posted speeds 45 mph or higher.

#### Intersection Risk Factors

Intersection risk factors include:

- ❑ Three-leg stop controlled intersections of a highway and a minor street;
- ❑ Intersections with no turn lane storage on approach; and,
- ❑ Undivided major approached to intersection.



**Exhibit 29: Multiple lanes, no bike lanes and no permitted crossings or crosswalks at U.S. Highway 50.** Source: Google, 2018



**Exhibit 30: Two-lane, undivided roadway State Route 89 near Cascade Lake Road (Segment 2).** Source: Google, 2018



**Exhibit 31: Two-lane, undivided roadway at State Route 207/Kingsbury Grade (Segment 13).** Source: Google, 2018

Examples of risk factors present at priority locations are illustrated in Exhibit 32 and Exhibit 33.



**Exhibit 32: Three-leg stop-control intersection, highway and minor street, with undivided major approach and no turn storage at State Route 89 and Mountain Drive.**  
Source: Google, 2018



**Exhibit 33: Three-leg stop-control intersection, highway and minor street, with undivided major approach and no turn storage at U.S. Highway 50 and Martin Drive.** Source: Google, 2018

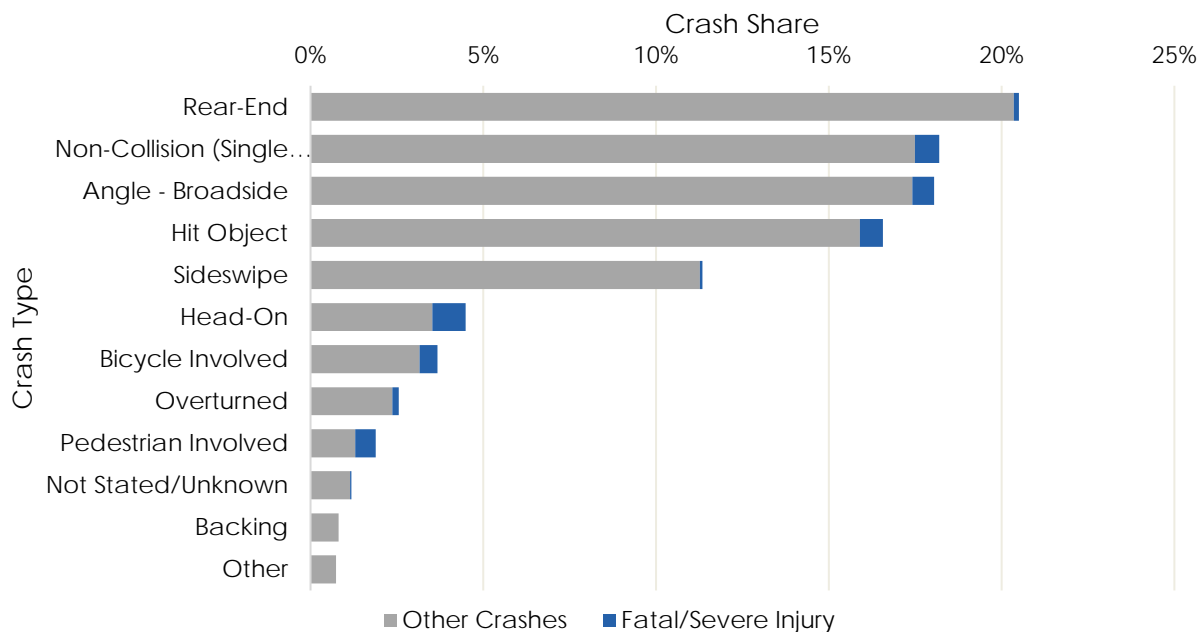
## 4.0 HIGHEST OCCURRING CRASH TYPES

The top crash types from across the Tahoe Region responsible for fatalities and severe injuries are presented below.

### 4.1 TOP CRASH TYPES

There were 32 fatal crashes in the 5 years of data analyzed (24 motor vehicle collisions, 6 motor vehicle/pedestrian collisions, and 2 motor vehicle/bicycle collisions). As discussed in previous chapters, collisions involving pedestrians and bicyclists were analyzed separately from motor vehicle-exclusive crashes. The two have been combined for discussion in this section, with results presented in Exhibit 34.

**Exhibit 34: Top Crash Types.** Source: SWITRS, NDOT, Kittelson 2018, TDG 2018



**The three most common crash types in frequency were the following:**

- 1 Rear end collisions (20 percent of total);
- 1 Non-collisions<sup>9</sup> (18 percent of total); and,
- 1 Angle-broadside collisions.

**By total number of fatal or severe injury crashes, the top five crash types were the following:**

- 1 Non-collisions / hit object collisions (45 severe injury or fatal); and,
- 1 Head-on collisions (26 severe injury or fatal);
- 1 Pedestrian involved collisions (22 severe injury or fatal);
- 1 Angle-broadside collisions (17 severe injury or fatal); and,
- 1 Bicycle involved collisions (14 severe injury or fatal).

<sup>9</sup> As presented here, non-collisions are motor vehicle crashes, exclusive of bicyclists or pedestrians. In this case, they represent single-vehicle crashes.

## 4.2 TOP PRIMARY COLLISION FACTORS

The top collision factors are presented in this section, separated between pedestrian and bicycle collisions and motor vehicle collisions.

### Pedestrian and Bicycle Collisions

The reported primary contributing factors for pedestrian/motor vehicle crashes are not particularly informative for identifying countermeasures. Two-thirds of these crashes were either not coded or coded as “unknown”, “pedestrian violation”, “pedestrian right-of-way,” or “other.”

For bicycle/motor vehicle crashes, the reported primary contributing factors categories are shown in Table 6. Because of crash reporting limitations in the Nevada dataset, it was not possible to determine which party was at fault in collisions, nor which party was associated with the stated violation. Despite that constraint in the Nevada data, there are some helpful insights. For example, “improper turning” is relevant in a notable number of crashes. Of these, six were along segments, likely associated with traffic turning into driveways, and the other seven were at unsignalized intersections. While knowing who made the improper turn would facilitate countermeasure selection at these locations, best practices can point to countermeasures that should help regardless of which party is at fault. Among bicycle/motor vehicle crashes, the most common collision factors were the following: “automobile right-of-way,” “improper turning,” and “traffic signals and signs.”<sup>10</sup>

**Table 6: Primary Contributing Factors Cited in Bicycle/Motor Vehicle Crashes.** Source: SWITRS, NDOT, TDG 2018

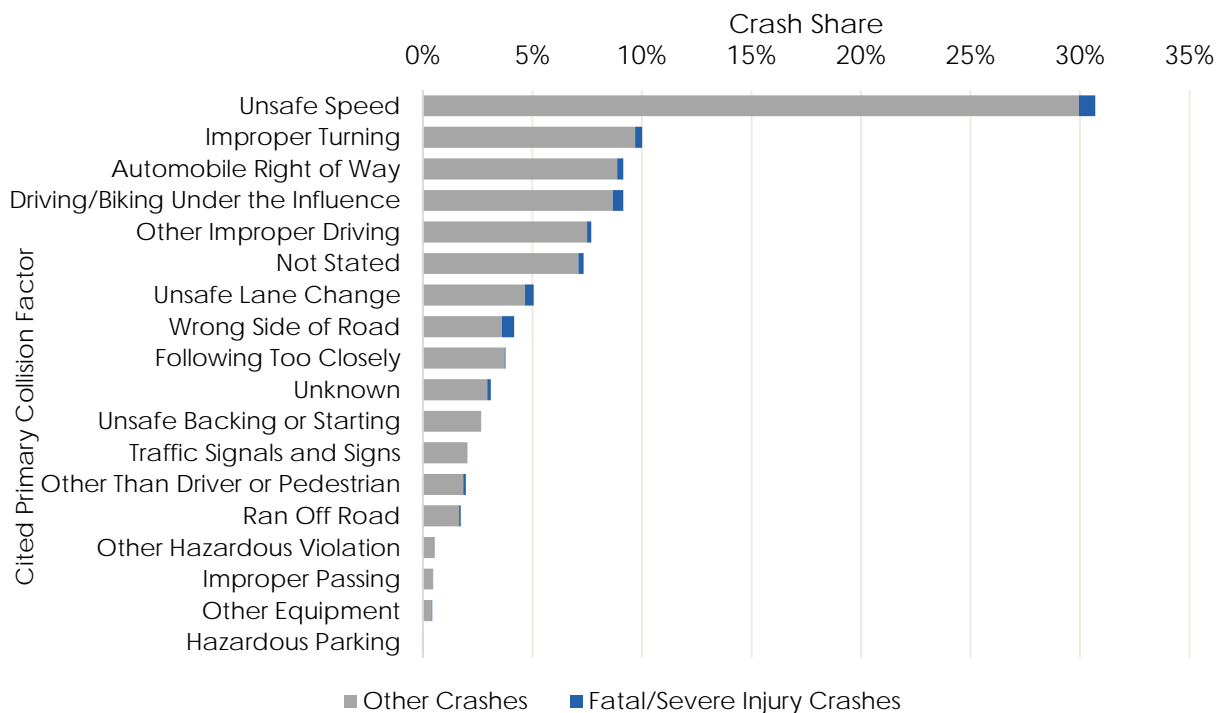
Violation	Fatal/Severe Injury	Other Injury	Total
Automobile Right of Way	4	15	19
Improper Turning	3	10	13
Unknown or Not Stated	1	12	13
Traffic Signals and Signs	0	8	8
Unsafe Speed	1	5	6
Unsafe Lane Change	0	5	5
Wrong Side of Road	1	4	5
Other	2	2	4
Driving/Biking Under the Influence	2	1	3
<b>Total</b>	<b>14</b>	<b>62</b>	<b>76</b>

<sup>10</sup> This collision factor refers to a failure on the part of one road user to obey a traffic signal or sign.

## Motor Vehicle Collisions

Exhibit 35 presents motor vehicle collisions by cited primary collision factor. The highest contributing factors to crashes within the study period were unsafe speed (31 percent of total), improper turning (10 percent), automobile right of way (9 percent), driving under the influence of drugs or alcohol (9 percent), and driving under the influence of drugs or alcohol (9 percent).

**Exhibit 35: Tahoe Region Primary Collision Factor and Severity.** Source: SWITRS, NDOT, Kittelson 2018



<sup>11</sup> Automobile right of way refers to a crash in which one driver failed to yield the right of way to another driver.

## 5.0 HIGH-RISK CORRIDORS AND INTERSECTIONS (CRASH HISTORY AND ROADWAY CHARACTERISTICS)

The high-risk corridors and intersections were identified using the network screening analysis described in Section 3.2. Those locations are presented below as the priority locations for safety investments within the Tahoe Region. The pedestrian and bicycle priority locations are discussed first followed by motor vehicle priority locations. Section 6.0 presents initial countermeasures identified for these locations, and Section 7.0 presents a subset of viable project scopes that were identified from this initial set of locations.

### 5.1 PEDESTRIAN AND BICYCLE PRIORITY LOCATION

Many areas with higher traffic speeds and wide streets lack appropriate bicycle infrastructure. Most contain bike lanes; however, these may insufficiently address bike safety. Areas with higher speeds tend to serve a wider range of bicyclists when they have separated infrastructure and better crossing opportunities. The risk factors of speeds, traffic volumes, and pedestrian and bicycle exposure informed the priority locations shown in Exhibit 36 through Exhibit 39. In some cases, projects are underway that are improving high priority locations, such as the improvement in Kings Beach, Tahoe City, US 50 at Pioneer trail and SR 89 in Meyers, and potentially US 50 at Stateline through the US 50 Community Revitalization Project.

Table 7 summarizes the Pedestrian and Bicycle high priority locations. The identified priority locations for pedestrians and bicyclists are on state highways. State Route 28 at Kings Beach and U.S. Highway 50 through Stateline/Heavenly Village have notable overall crash rates. However, the Kings Beach location has recently had pedestrian and bicycle infrastructure improvements through the Kings Beach Commercial Core Improvement Project, which evaluation results do not reflect.

The highways circling Lake Tahoe also serve as the main streets for many community and commercial centers. The high priority locations are the commercial centers of Tahoe City, Kings Beach, Stateline/South Lake Tahoe, Meyers, and Homewood, as shown in Exhibits 36 through 40. These areas have destinations on both sides of the street. The high pedestrian crash rates in these areas are most likely attributed to people walking in places without sidewalks or crossing at uncontrolled locations; however, detailed information about pedestrian crash types was not available. All the high priority locations also are located on roadways in California, which does not mean that there are not locations in Nevada where bicycle and pedestrian safety improvements should be explored. The concentration in California may be more indicative of more people walking and biking in the community centers within California relative to those in Nevada.

**Table 7: Crash Summary for High Priority Locations.** Source: SWITRS, NDOT, TDG 2018

Locations	Bicycle/MV Crashes	Bicycle/No MV Crashes	Pedestrian/MV Crashes	Pedestrian/No MV Crashes	Total Ped/Bike Crashes
US 50 at Stateline/ Heavenly Village	8	0	9	1	18
SR 28/Kings Beach	6	3	2	0	11
SR 28/Tahoe City	2	2	3	0	7
US 50/South Lake Tahoe	2	0	1	1	4
US 50 @ South Lake Tahoe, South of the Y	3	0	0	0	3
SR 89/ Homewood	0	0	1	1	2
US 50/Meyers	0	0	2	0	2
SR 89/South Lake Tahoe, North of the Y	2	0	0	0	2

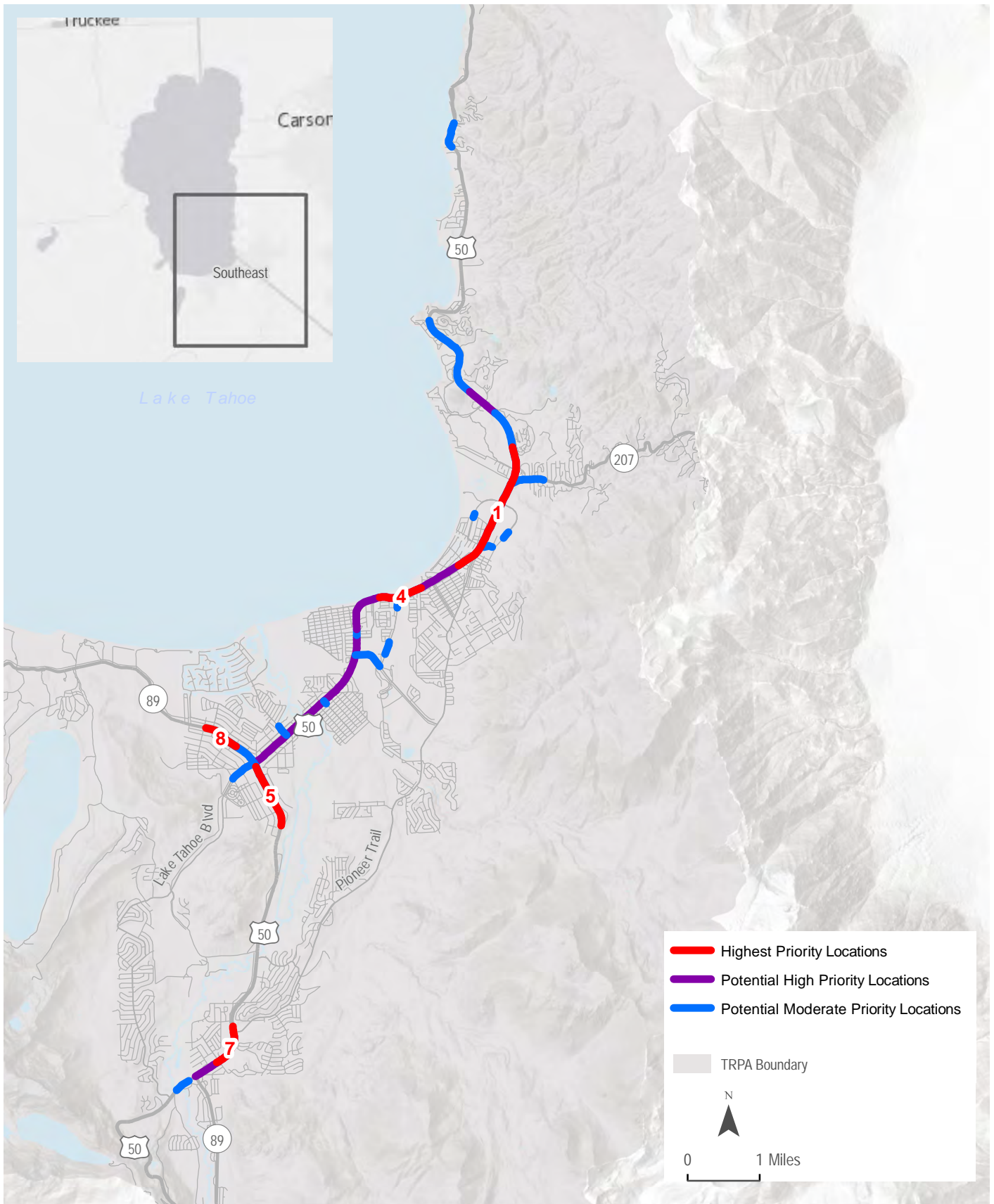


Exhibit 36

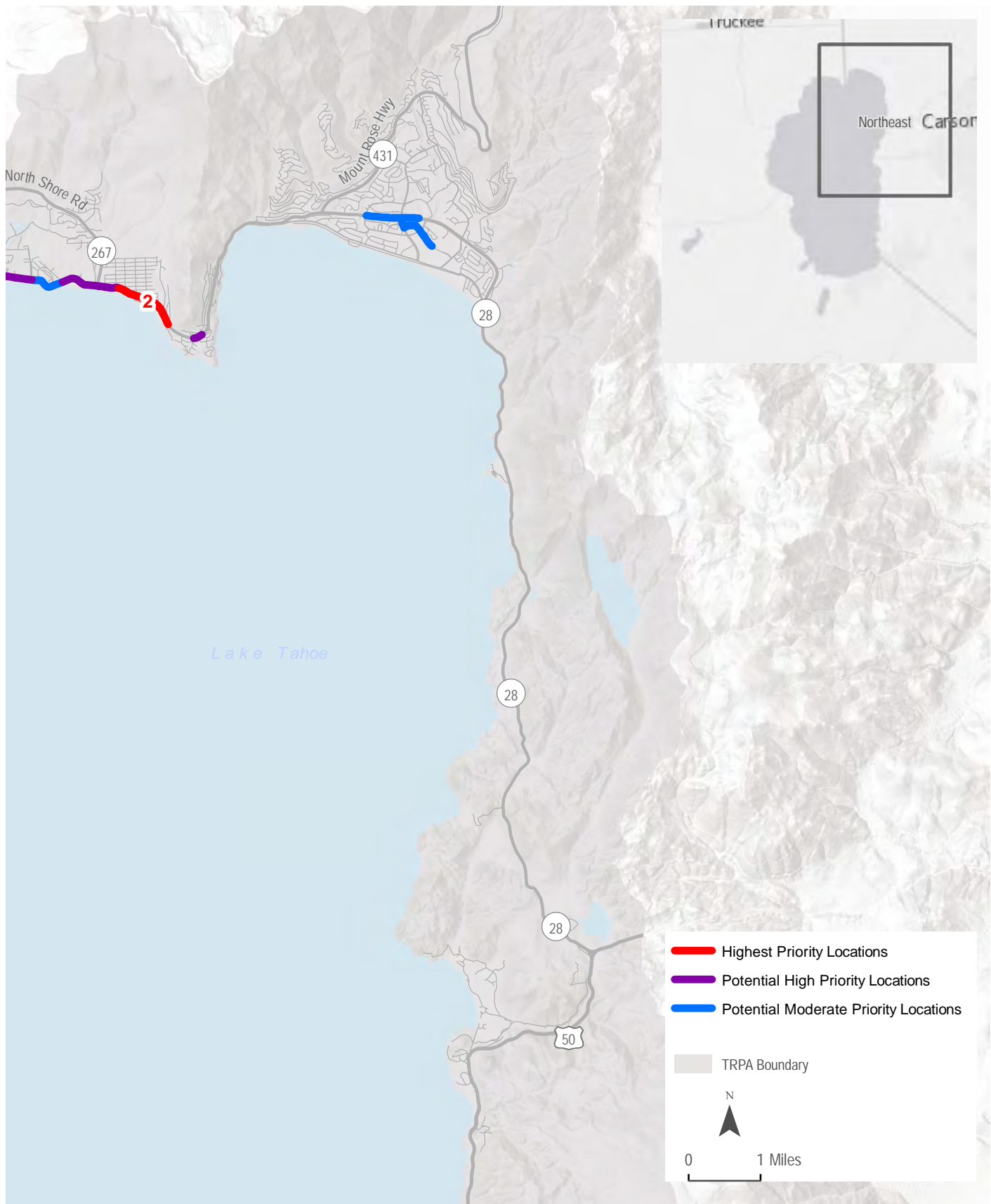


Exhibit 37

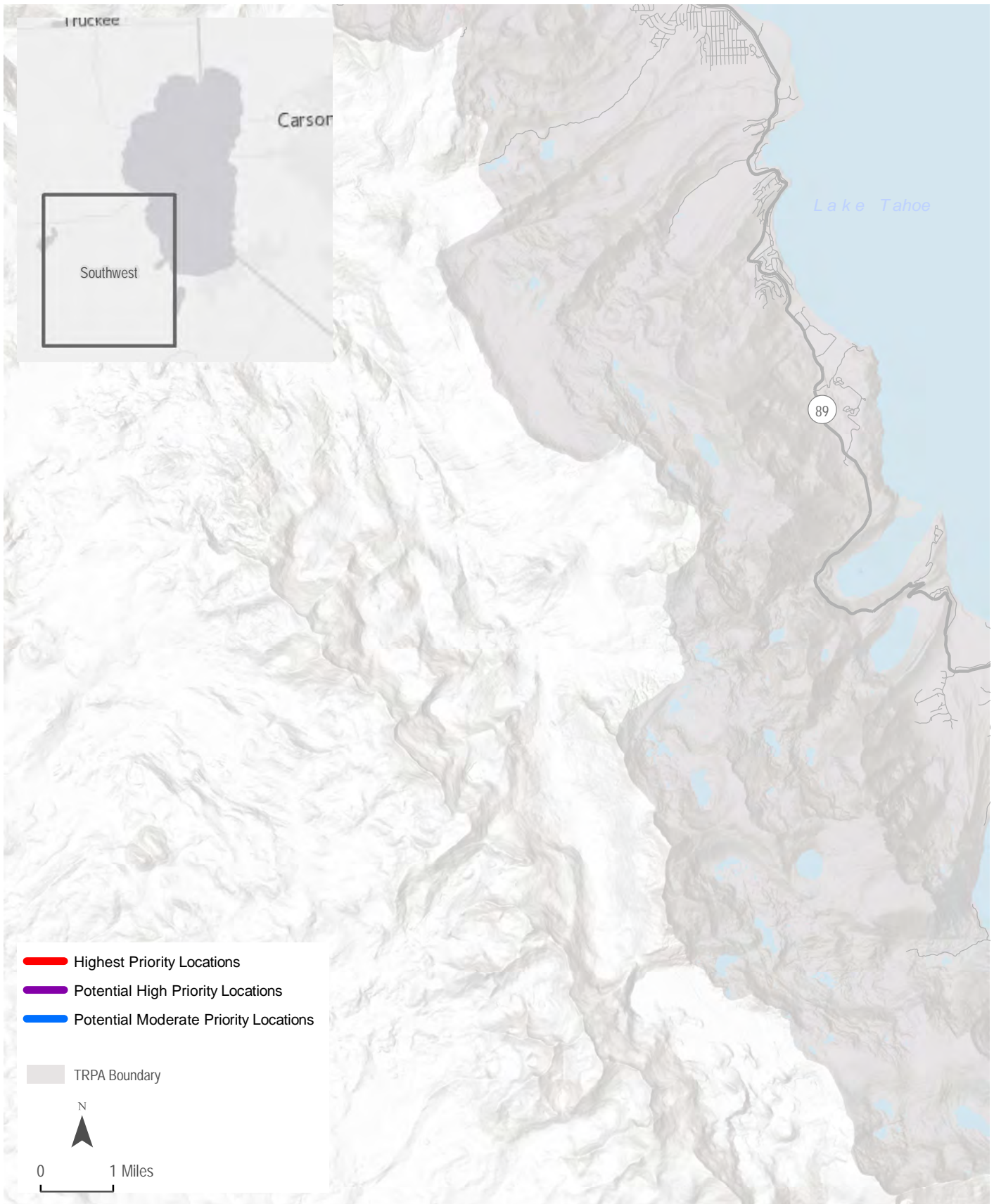


Exhibit 38

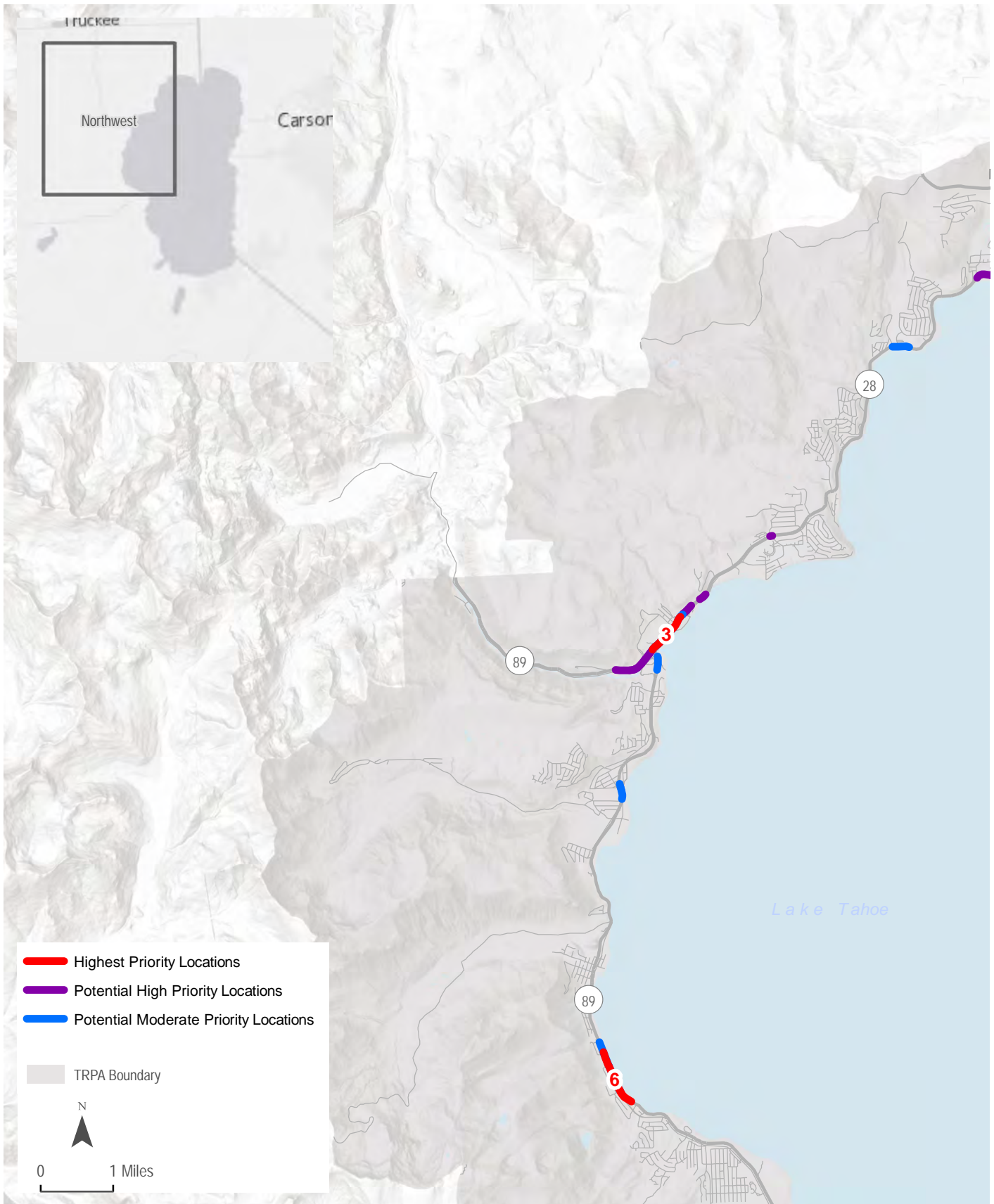


Exhibit 39

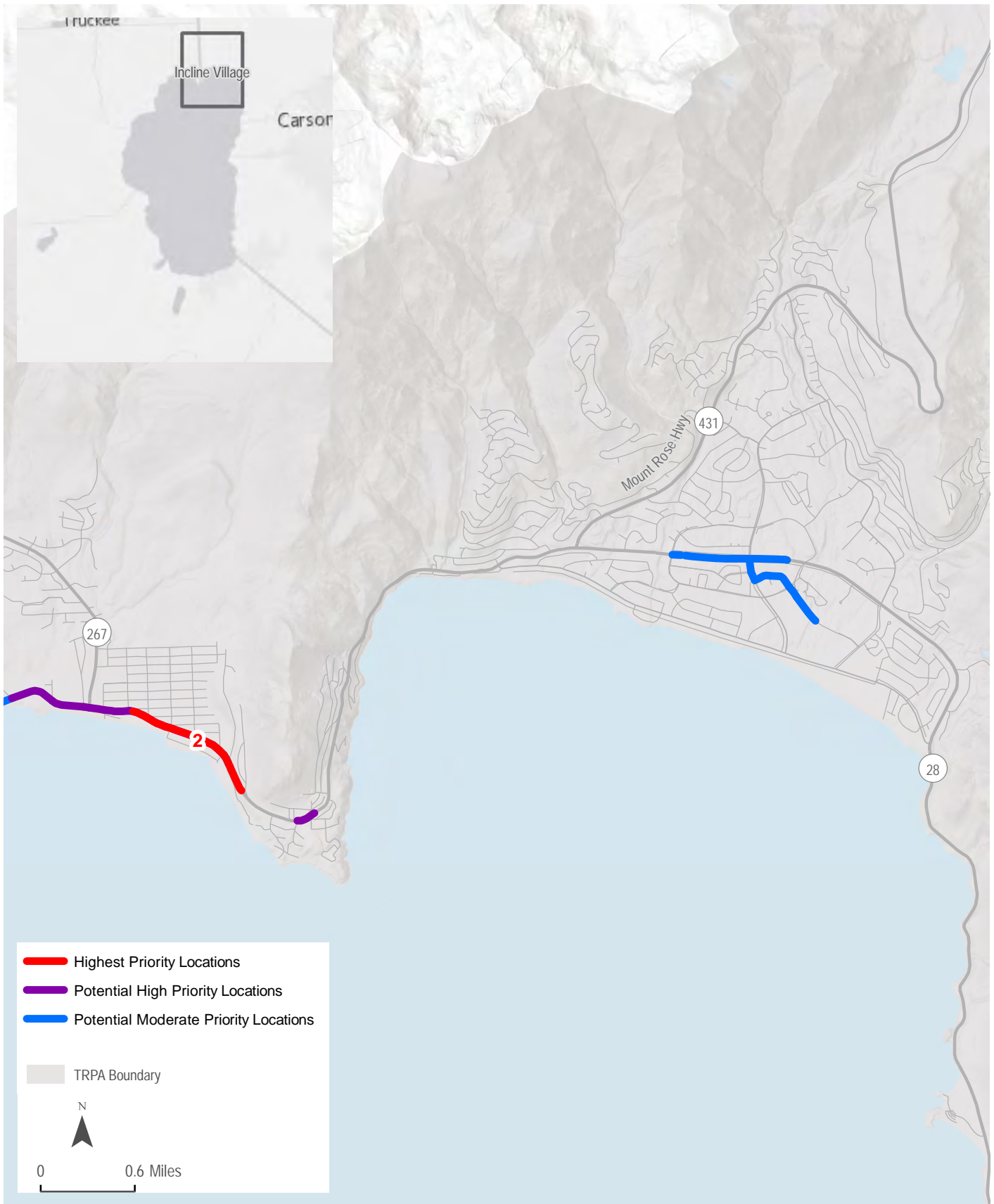


Exhibit 40

Exhibit 41 depicts the pedestrian and bicyclist crash severity frequencies by mode within each of the identified priority locations. Crashes with a severity of “K” (fatal) and “A” (incapacitating or severe injury) are given the most attention and are associated with a higher benefit valuation in the allocation of HSIP grant funds. Crash severity of “B” indicates Moderate Injury, a severity of “C” indicates Complaint of Pain or Minor/Possible Injury, and a severity of “O” indicates PDO (i.e., no injuries because of the crash).



Accordingly, locations with high crash rates at these severity levels have been prioritized. Given this criterion, State Route 28 through Tahoe City, U.S. Highway 50 through Stateline/Heavenly Village, and State Route 89 through Meyers are the top priorities for the Region in terms of pedestrian and bicycle safety. As noted above, there are several on-going projects and/or planning studies working to address transportation related issues in these areas.

**Exhibit 41: Collision Severity by Priority Location.** Source: SWITRS, NDOT, TDG 2018

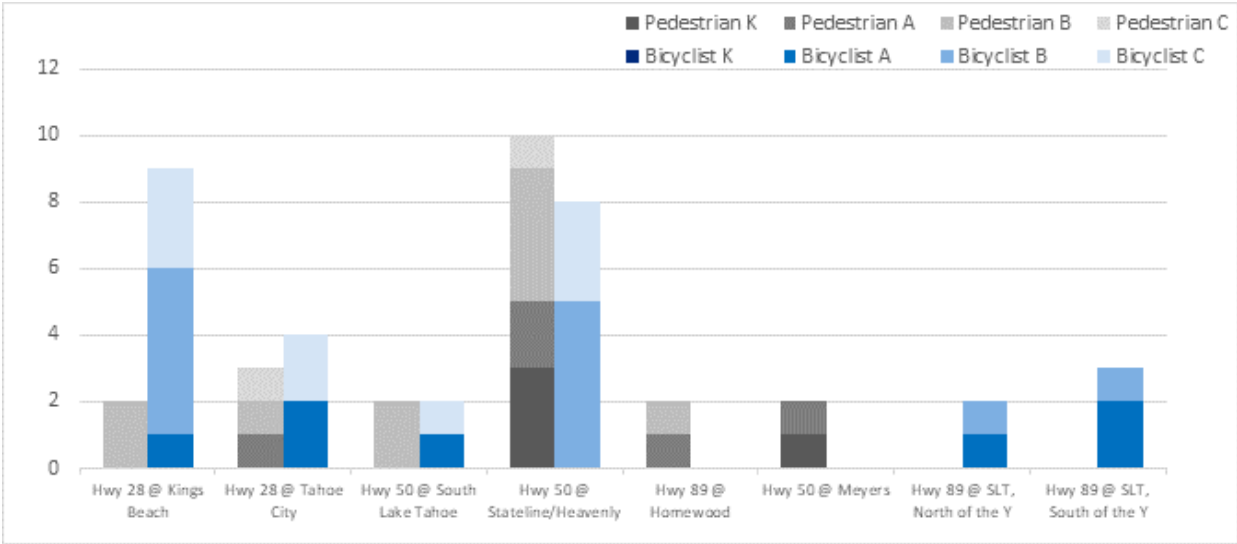
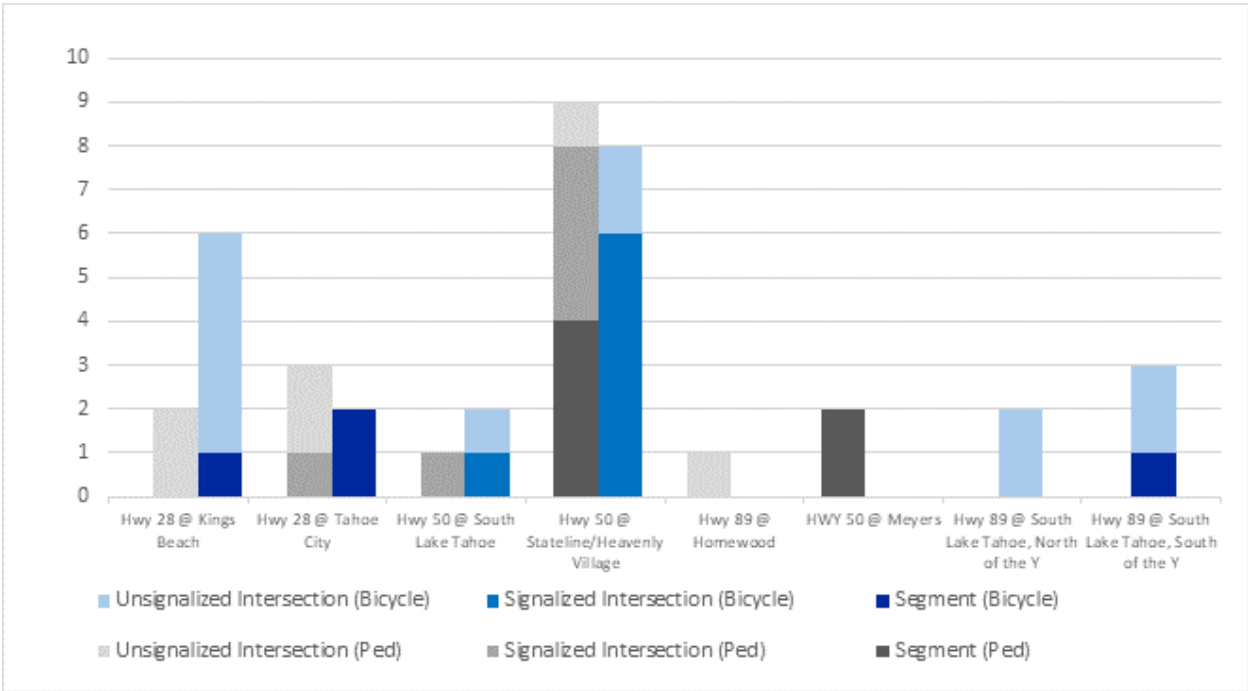


Exhibit 42 presents the type of location where the crashes occurred. “Intersection” crashes here are defined as those within 250 feet of an intersection. The U.S. Highway 50/Stateline area has a notable proportion of crashes occurring at signalized intersections.

**Exhibit 42: Pedestrian and Bicycle Collisions by Location Type**



Source: SWITRS, NDOT, TDG 2018

## 5.2 MOTOR VEHICLE PRIORITY LOCATION AND ASSOCIATED TRENDS

Table 8 and Table 9 as well as Exhibit 43 through Exhibit 47 present the segment and intersection priority locations for motor vehicles. They are listed from highest severity score to lowest based on the number and severity of crashes at the location.



**Table 8: Priority Roadway Segments**

Segment Number	Street Name	Location/Extents	Length (miles)	Annualized Severity Score	State Highway
1	SR-267/North Shore Boulevard	South of Brockway Summit	0.375	74.8	Yes
2	US-50	Old Meyers Grade Road to Echo Summit Road	0.875	74.4	Yes
3	US-50	West of North Upper Truckee Road	0.25	74.4	Yes
4	SR-89	East of Cascade Lake/Cascade Lake Road	0.5	71.8	Yes
5	SR-89	Near D.L. Bliss State Park/Lester Beach Road	0.375	71.8	Yes
6	SR-89/West Lake Boulevard	Btw. Sequoia Avenue Intersections	0.375	71.8	Yes
7	SR-89/West River Road	West of Twin Crags	0.625	71.8	Yes
8	SR-207/Kingsbury Grade	Btw. Palisades Drive and Summer Place	0.375	71.8	Yes
9	SR-207/Kingsbury Grade	Btw. Logging Road Lane and Buchanan Road	0.375	71.8	Yes
10	US-50	Southbound tunnel	0.160	40.8	No
11	SR-28	North of Spooner Lake	0.375	39.3	Yes
12	SR-28	South of Sand Harbor Beach	0.375	39.3	Yes
13	SR-28	Sand Harbor Beach	0.25	39.3	Yes
14	SR-28	South of Carnelian Bay	0.375	39.3	Yes
15	SR-28/North Lake Boulevard	Btw. Beach Street and Secline Street	0.375	39.3	Yes
16	SR-28/Lakeshore Boulevard	West of Lakeshore Terrace	0.25	39.3	Yes
17	US-50	South of the Tunnel	0.25	39.0	No
18	US-50	South of Logan Shoals	0.376	39.0	No
19	US-50	Logan Shoals	0.375	39.0	No
20	US-50	Segment approaching SR-28	0.875	39.0	No
21	SR-89	Lake Tahoe Boulevard to B Street	0.25	38.0	Yes

**Table 9: Priority Intersections**

Intersection Number	Intersection	North-South Street	East-West Street	Annualized Severity Score	State Highway
1	SR 28/US Hwy 50	US Hwy 50	SR 28	60.4	Yes
2	US Hwy 50/Martin Drive	US Hwy 50	Martin Drive	47.9	No
3	US Hwy 50/Lakeview Drive	Lakeview Drive/Lake Shore Blvd	US Hwy 50	46.2	No
4	US Hwy 50/Warrior Way	US Hwy 50	Warrior Way	45.6	No
5	US Hwy 50/Cedarbrook	US Hwy 50	Cedarbrook	44.5	No
6	US Hwy 50/Hidden Woods Drive	US Hwy 50	Hidden Woods Drive	43.6	No
7	SR 28/Secline Street	Secline Street	SR 28	42.8	Yes
8	SR 207/S Benjamin Drive	S Benjamin Drive	SR 207	42.6	Yes
9	US Hwy 50/Modesto Avenue	US Hwy 50	Modesto Avenue	42.5	Yes
10	SR 431/Marlette Way	SR 431	Marlette Way	42.4	Yes
11	SR 28/Amagosa Road and Gonawabie Road	SR 28	Amagosa Road/Gonawabie Road	41.8	Yes
12	US Hwy 50/Kelly Circle	US Hwy 50	Kelly Circle	41.8	No
13	SR 28/Park Lane	SR 28	Park Ln	41.6	Yes
14	SR 28/Robert Avenue	SR 28	Robert Avenue	41.4	Yes
15	Lake Tahoe Boulevard/Boulder Mountain Court	Boulder Mountain Court	Lake Tahoe Boulevard	41.4	No
16	US Hwy 50/Lodi Avenue	Lodi Avenue	US Hwy 50	41.2	Yes
17	Friedhoff Road/Pittman Terrace	Friedhoff Road	Pittman Terrace	41.2	No
18	SR 28/Beaver Street	SR 28	Beaver Street	40.6	Yes
19	US Hwy 50/Bigler Avenue	US Hwy 50	Bigler Avenue	40.4	Yes
20	US Hwy 50/Zephyr Point Entrance	US Hwy 50	Zephyr Point Entrance	40.4	No
21	SR 431/2nd Creek Drive	2nd Creek Drive	SR 431	40.2	Yes
22	SR 207/Ansaldo Acres Road	Ansaldo Acres Road	SR 207	40.2	Yes
23	N Upper Truckee Road/E San Bernardino Avenue	E San Bernardino Avenue	N Upper Truckee Road	40.2	No
24	SR 267/Commonwealth Drive and Kingswood Drive	SR 267	Commonwealth Drive/Kingswood Drive	40.2	Yes
25	SR 28/Laurel Drive	Laurel Drive	SR 28	40.0	Yes
26	SR 89/Mountain Drive	SR 89	Mountain Drive	40.0	Yes
27	Pioneer Trail/Edna Street	Pioneer Trail	Edna Street	40.0	No

Intersection Number	Intersection	North-South Street	East-West Street	Annualized Severity Score	State Highway
28	SR 89/5th Street	SR 89	5th Street	40.0	Yes
29	US Hwy 50/Jewell Road North	US Hwy 50	Jewell Road	40.0	Yes
30	Pioneer Trail/Glen Eagles Road	Pioneer Trail	Glen Eagles Road	40.0	No

Source: Kittelson 2018

Exhibit 43 through Exhibit 47 on the following pages are maps of the priority locations listed in Tables 8 and 9 above.

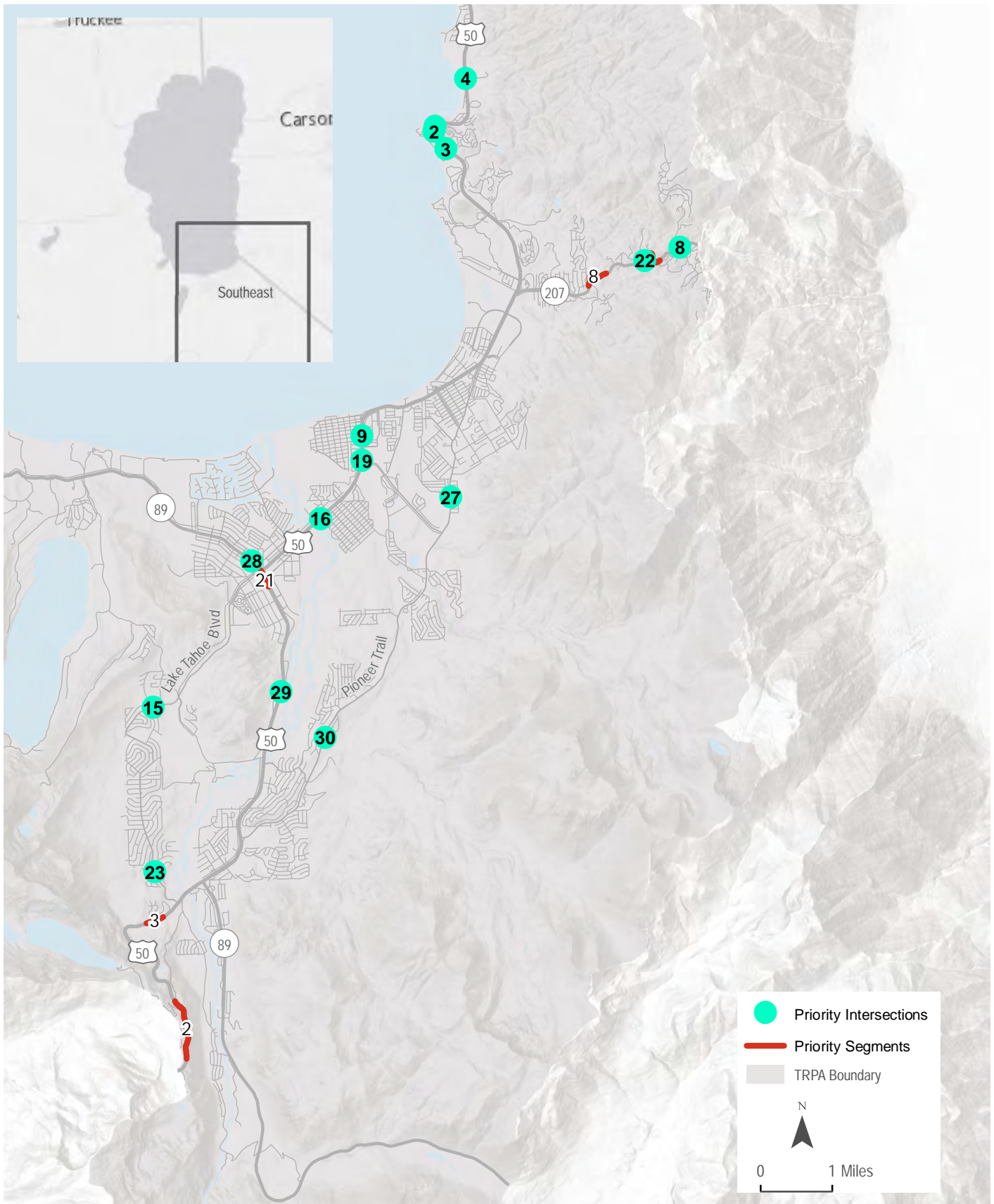


Exhibit 43

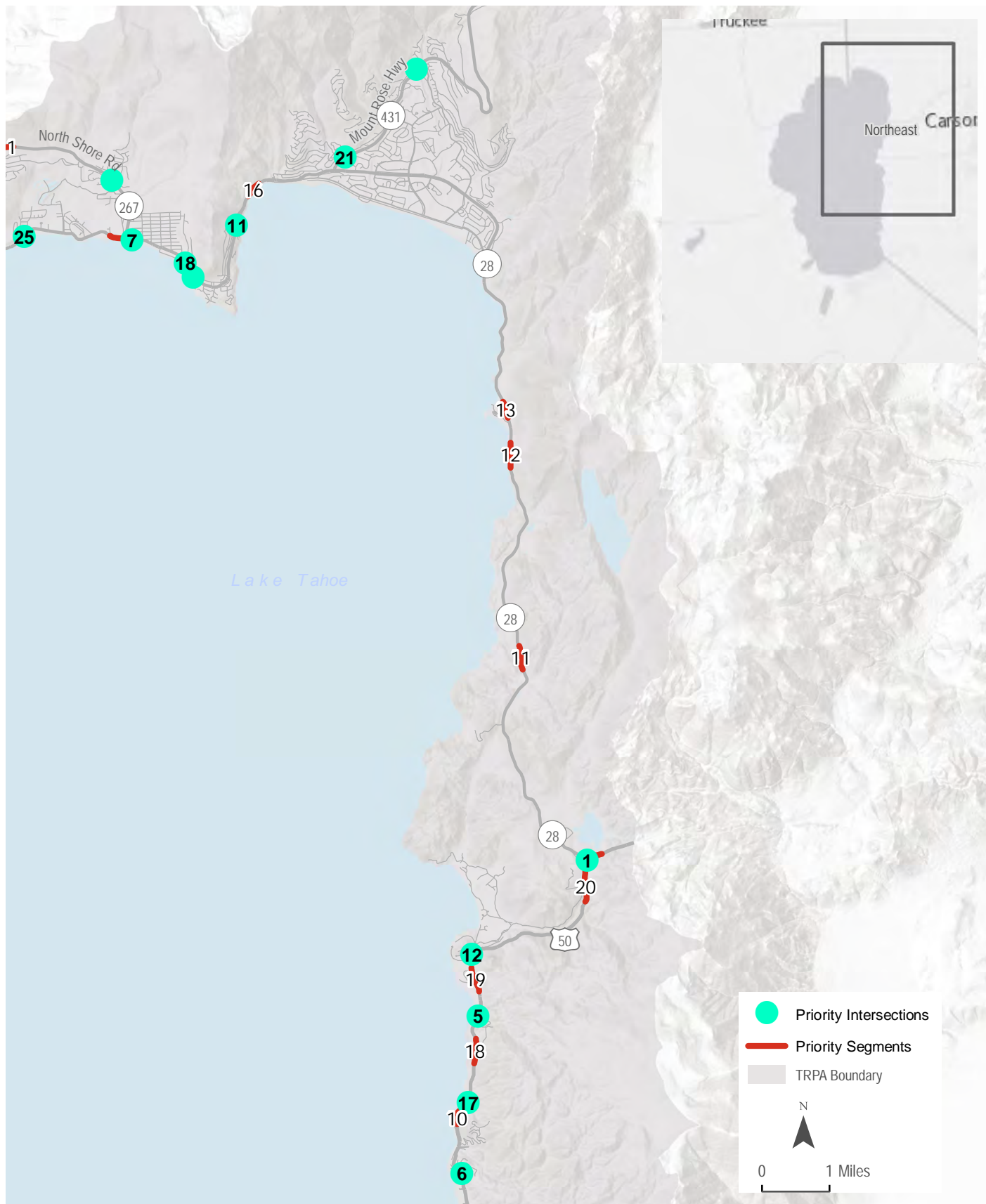


Exhibit 44

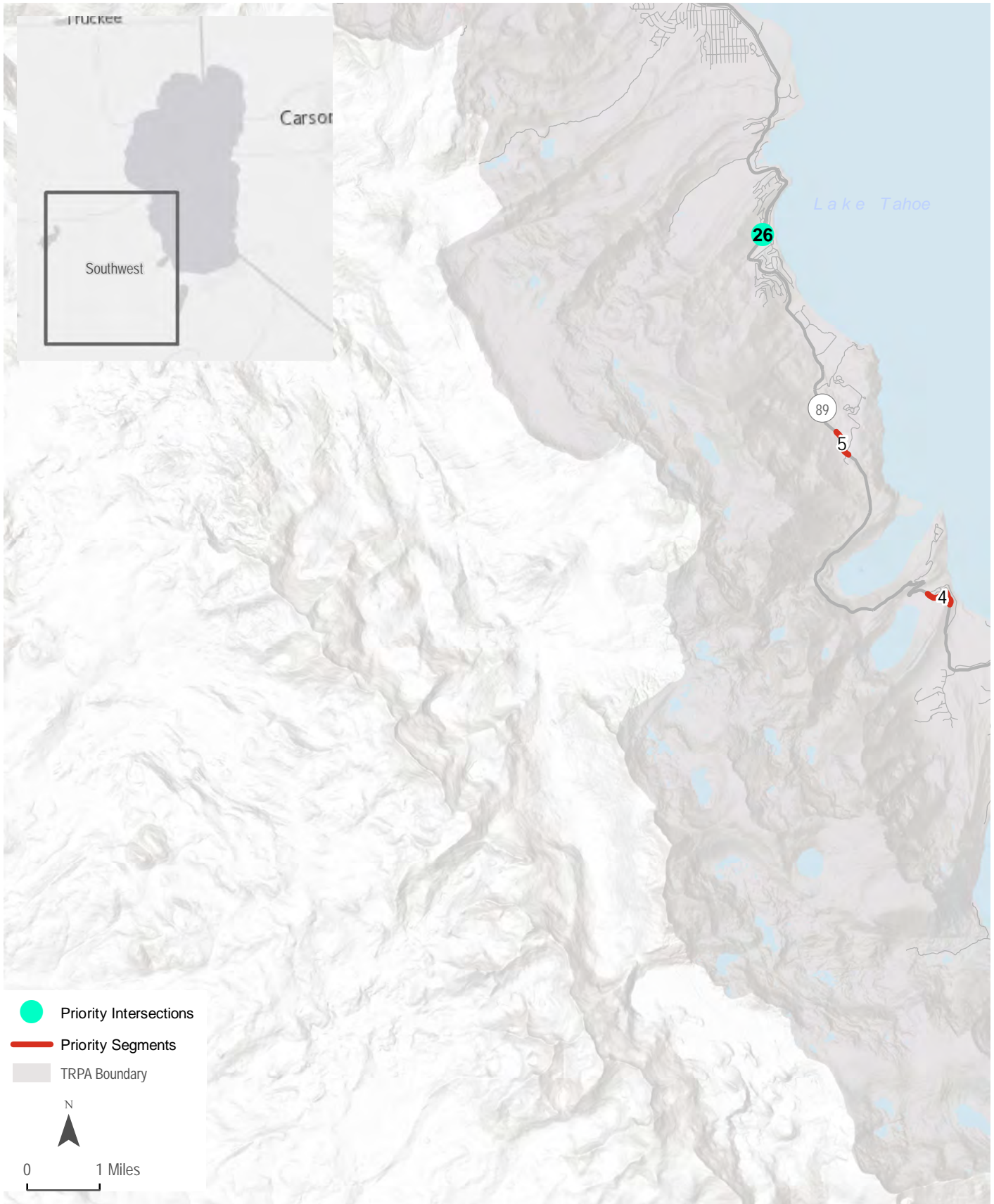


Exhibit 45

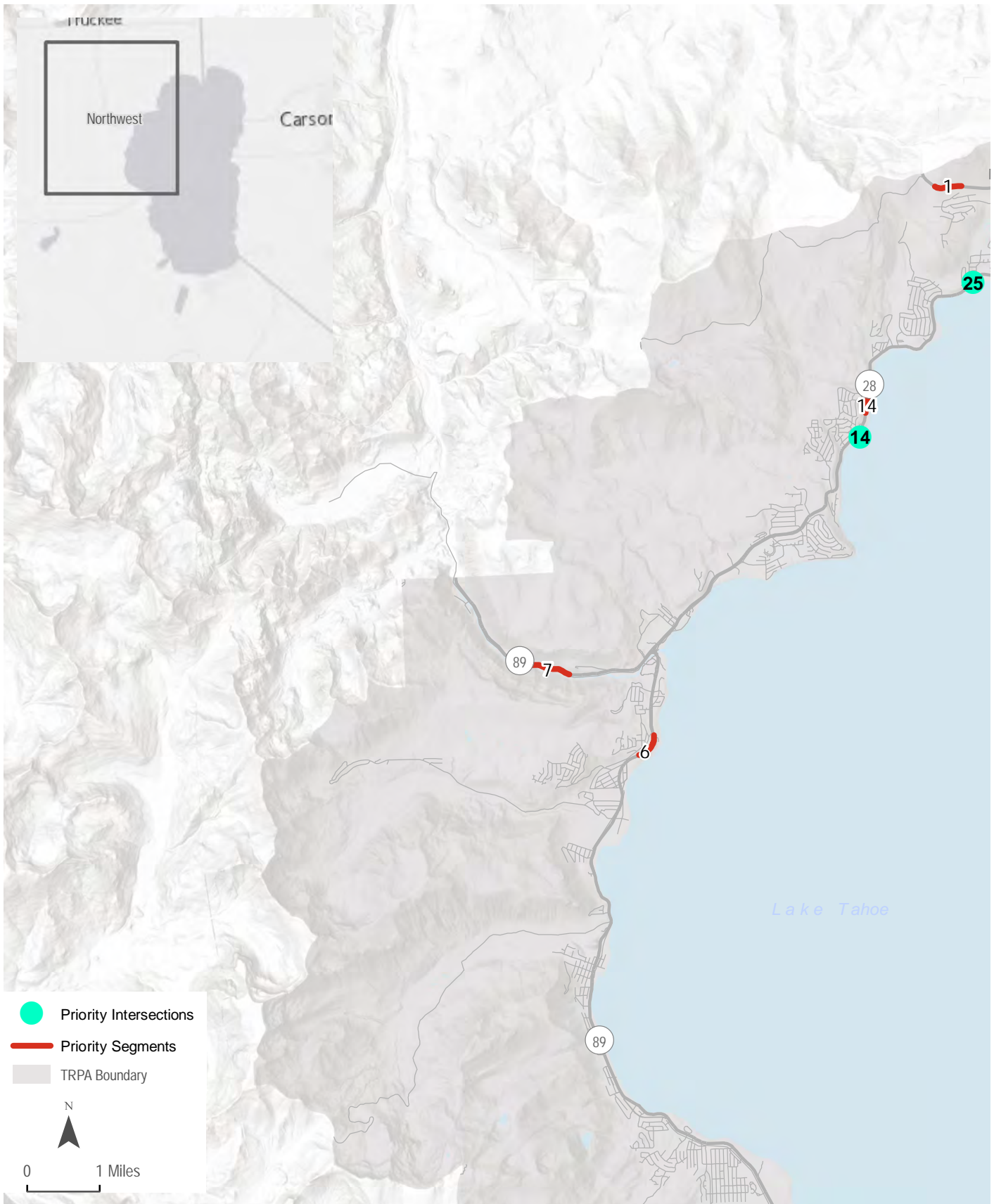


Exhibit 46

Motor Vehicle Priority Locations Tahoe  
Regional Planning Agency  
Lake Tahoe Region Safety **Strategy**

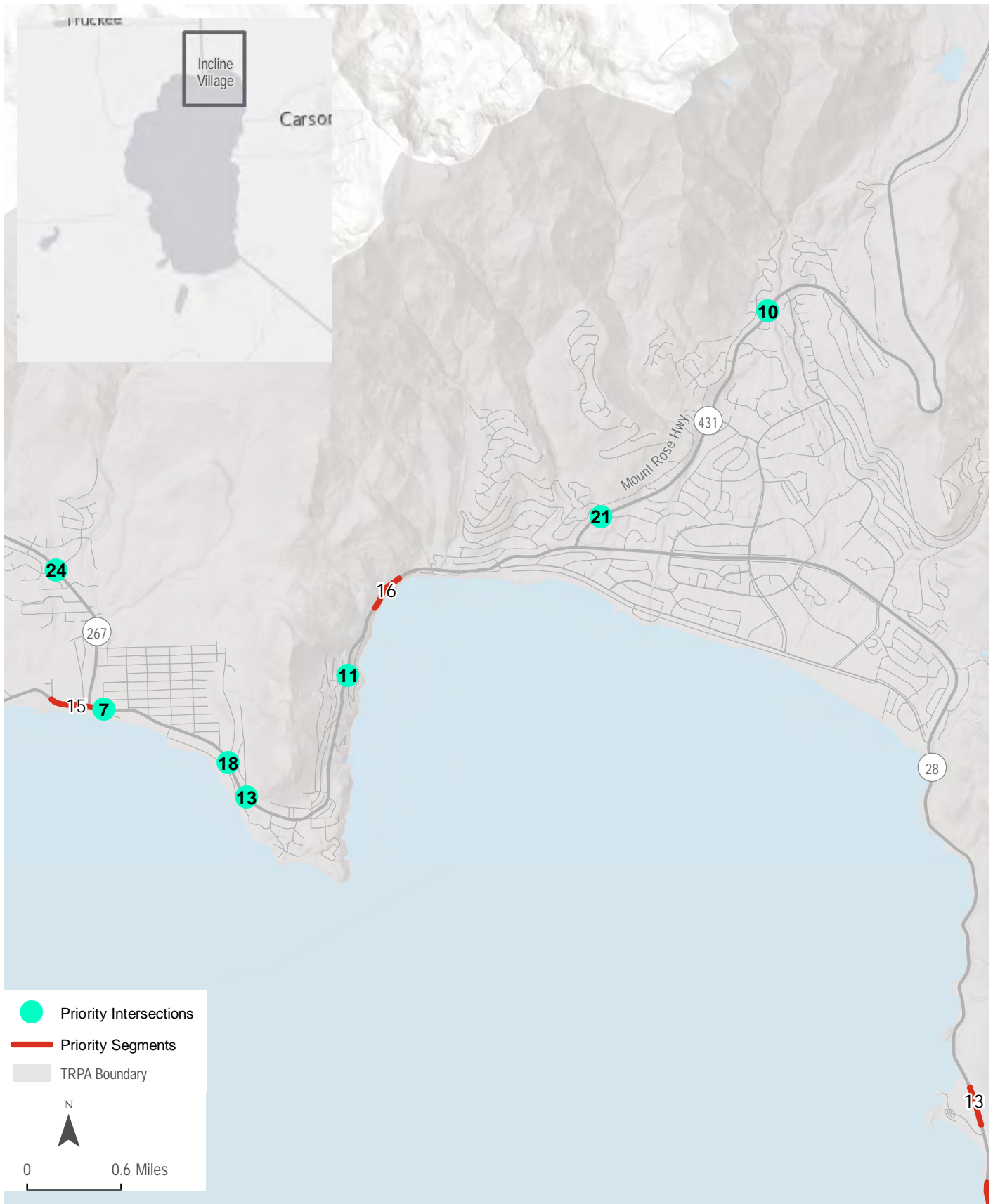


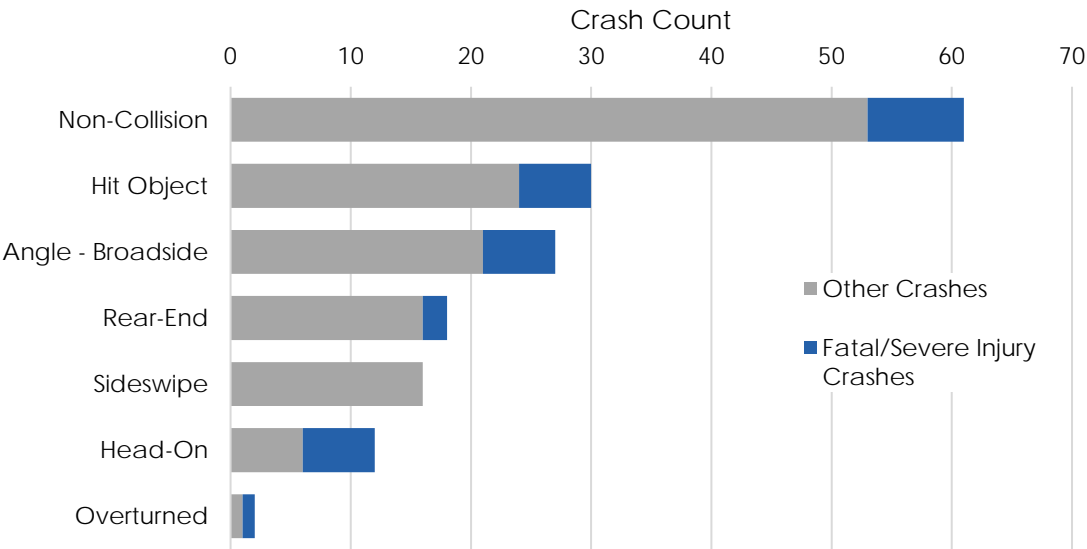
Exhibit 47

*Motor Vehicle Crash Patterns and Trends per Priority Location*

The team analyzed crash patterns and trends at priority locations to inform possible countermeasure selection that could improve safety performance.

**Priority Roadway Segment Crashes:** There were 166 reported crashes including 29 fatal or severe injury crashes on the priority roadway segments, accounting for 7 percent of total crashes and 32 percent of fatal/severe injury crashes in the five years of crash data analyzed. Exhibit 48 presents the crash type breakdown, including the fatal and severe injury share among those crash types.

**Exhibit 48: Crash Types and Severities on Priority Roadway Segments**



Source: SWITRS, NDOT, Kittelson 2018

Trends with respect to crash types and severities for priority roadway segments include:

- 1 Non-collisions (37 percent) and hit object crashes (18 percent) were the most prevalent among crash types on priority roadway segments.
- 1 The highest fatal/severe injury percentage among crash types was observed for angle-broadside (22 percent), hit object (20 percent), and non-collision (13 percent) crash types.

Table 10 presents reported primary collision factors among fatal and severe injury crashes for the three most frequent and high severity crash types on priority roadway segments.

**Table 10: Fatal/Severe Injury Priority Segment Crashes by Primary Collision Factor and Crash Type**

Reported Primary Collision Factor	Fatal/Severe Injury Crash Count by Crash Type		
	Non-Collision	Angle-Broadside	Hit Object
Unsafe Speed	1	3	2
Improper Turning	-	-	3
Unsafe Lane Change	3	-	-
Unknown	1	-	1
Ran Off Road	1	-	-
Not Stated	-	1	-
Wrong Side of Road	-	1	-
Other Improper Driving	1	-	-
Automobile Right of Way	-	1	-
Other than Driver or Pedestrian	1	-	-
<b>Total among Fatal/Severe Injury Crashes</b>	<b>8</b>	<b>6</b>	<b>6</b>

Source: SWITRS, NDOT, Kittelson 2018

Observations from the primary collision factors for fatal and injury crashes on the priority corridors include:

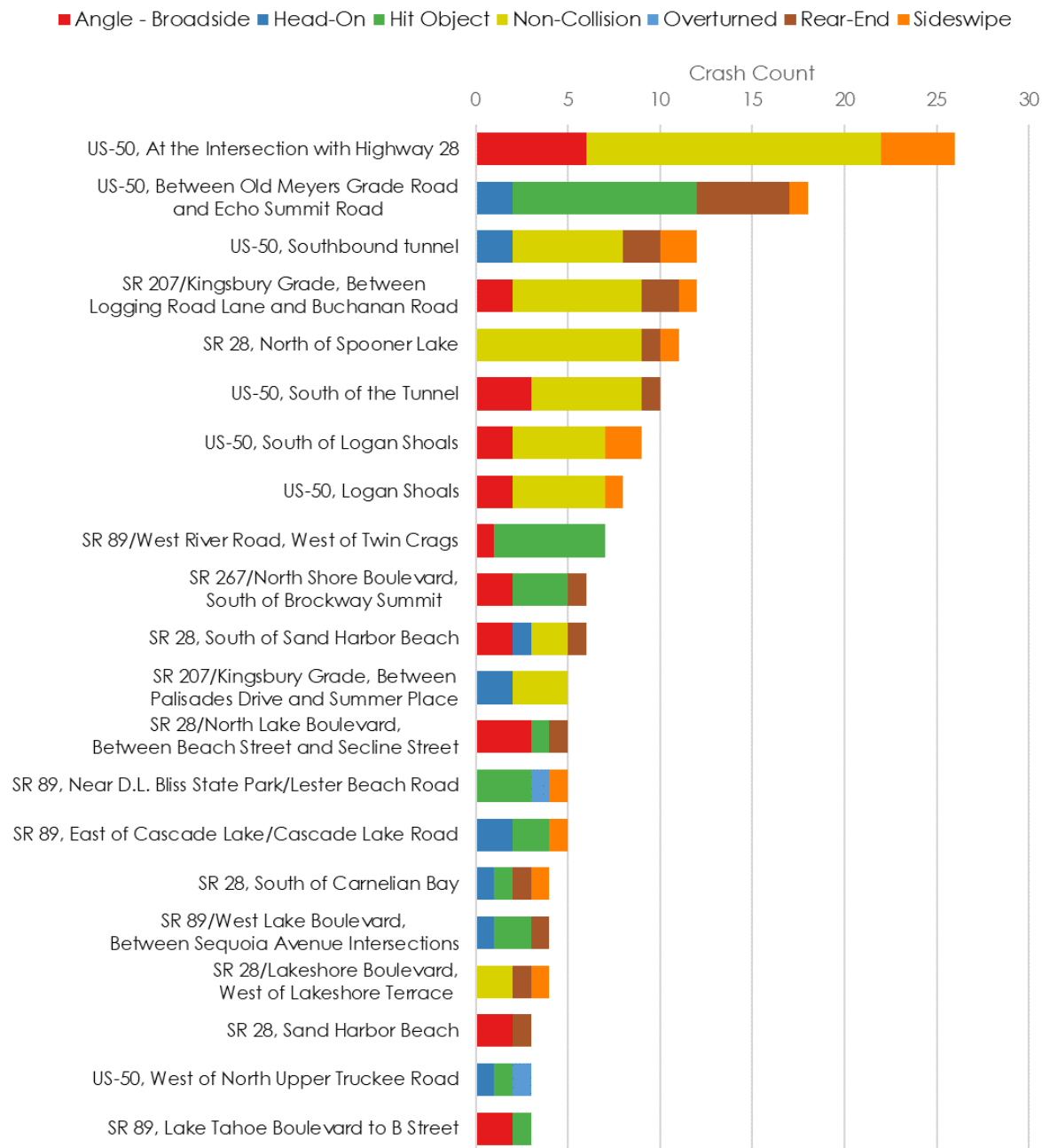
- ❖ Unsafe speed was associated with all crash types, including multiple angle-broadside and hit object crashes. Many of the segments are state highway segments with posted speeds of 45 mph or greater (a risk factor). Speed management is a key factor in improving roadway safety performance.
- ❖ Improper turning was associated with three fatal or severe injury hit object crashes. Access management by consolidating the number of driveways on a segment and managing where drivers can turn through the use of medians can help facilitate safe turn movements and reduce the risk for crashes.
- ❖ Unsafe lane changes, crashes in which one motor vehicle was involved, yielded three fatal or severe injury non-collision events.

**Segment Specific Trends:** Exhibit 49 presents crash types along each priority roadway segment. Of note are the following locations:

- ❖ Six of seven crashes (86 percent) on SR-89/West River Road, West of Twin Crags were hit object crashes, the highest percentage among priority roadway segments.
- ❖ Nine of eleven crashes (82 percent) on SR-28, north of Spooner Lake were non-collision events, the highest percentage among priority roadway segments.
- ❖ The highest count of fatal or severe injury crashes among priority segments included:
  - US 50, between Old Meyers Grade Road and Echo Summit Road (4 such crashes), and
  - US 50, at the intersection with SR-28 (3 such crashes).

## Exhibit 49: Priority Roadway Segment Crashes by Location and Type

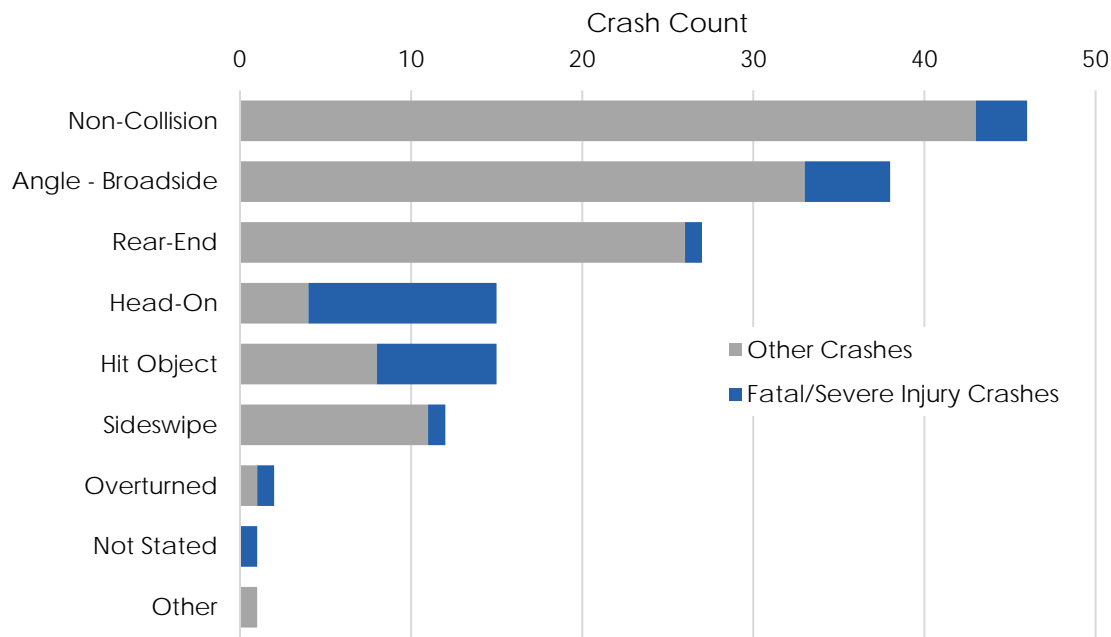
Source: SWITRS, NDOT, Kittelson 2018



**Priority Intersection Crashes:** There were 157 reported crashes, including 30 fatal or severe injury crashes, at priority intersections accounting for 6 percent of total crashes and 33 percent of fatal or severe injury crashes. Exhibit 50 presents the crash type breakdown, including the fatal and severe injury percentage among those crash types.

- Non-collisions (29 percent) and angle-broadside crashes (24 percent) were the most prevalent among crash types at priority intersections.
- Among crash types with more than 10 occurrences, the highest fatal/severe injury percentages occurred among head-on crashes (73 percent), hit object crashes (47 percent), and angle-broadside crashes (13 percent).

**Exhibit 50: Crash Types and Severities at Priority Intersections, Tahoe Region**



Source: SWITRS, NDOT, Kittelson 2018

Table 11 presents reported primary collision factor among fatal and severe injury crashes for four of the most frequent and high severity crash types at priority intersections.

- Four of seven fatal or severe injury object crashes were cited with driving under the influence as the primary collision factor.
- Head-on crashes were the most common among fatal or severe injury crashes at priority intersections, totaling 11 of the 30 crashes. These head-on crashes were most often associated with driving on the wrong side of the road (3 crashes) and unsafe speed (4). Accordingly, two identified intersection risk factors include intersection approaches with no turn lane storage and undivided major street approaches.

**Table 11: Fatal/Severe Injury Priority Intersection Crashes by Primary Collision Factor and Crash Type**

Reported Collision Factor	Primary	Fatal/Severe Injury Crash Count by Crash Type			
		Head-On	Hit Object	Angle-Broadside	Non-Collision
Driving/Biking Under the Influence		1	4	-	-
Wrong Side of Road		3	-	-	1
Unsafe Speed		4	-	-	-
Unsafe Lane Change		1	1	1	-
Automobile Right of Way		1	-	2	-
Not Stated		1	-	1	-
Unknown		-	-	1	-
Improper Turning		-	1	-	-
Other Than Driver or Pedestrian		-	1	-	-
Other Equipment		-	-	-	1
Other Improper Driving		-	-	-	1
<b>Total among Fatal/Severe Injury Crashes</b>		<b>11</b>	<b>7</b>	<b>5</b>	<b>3</b>

Source: SWITRS, NDOT, Kittelson 2018

### Intersection Specific Trends

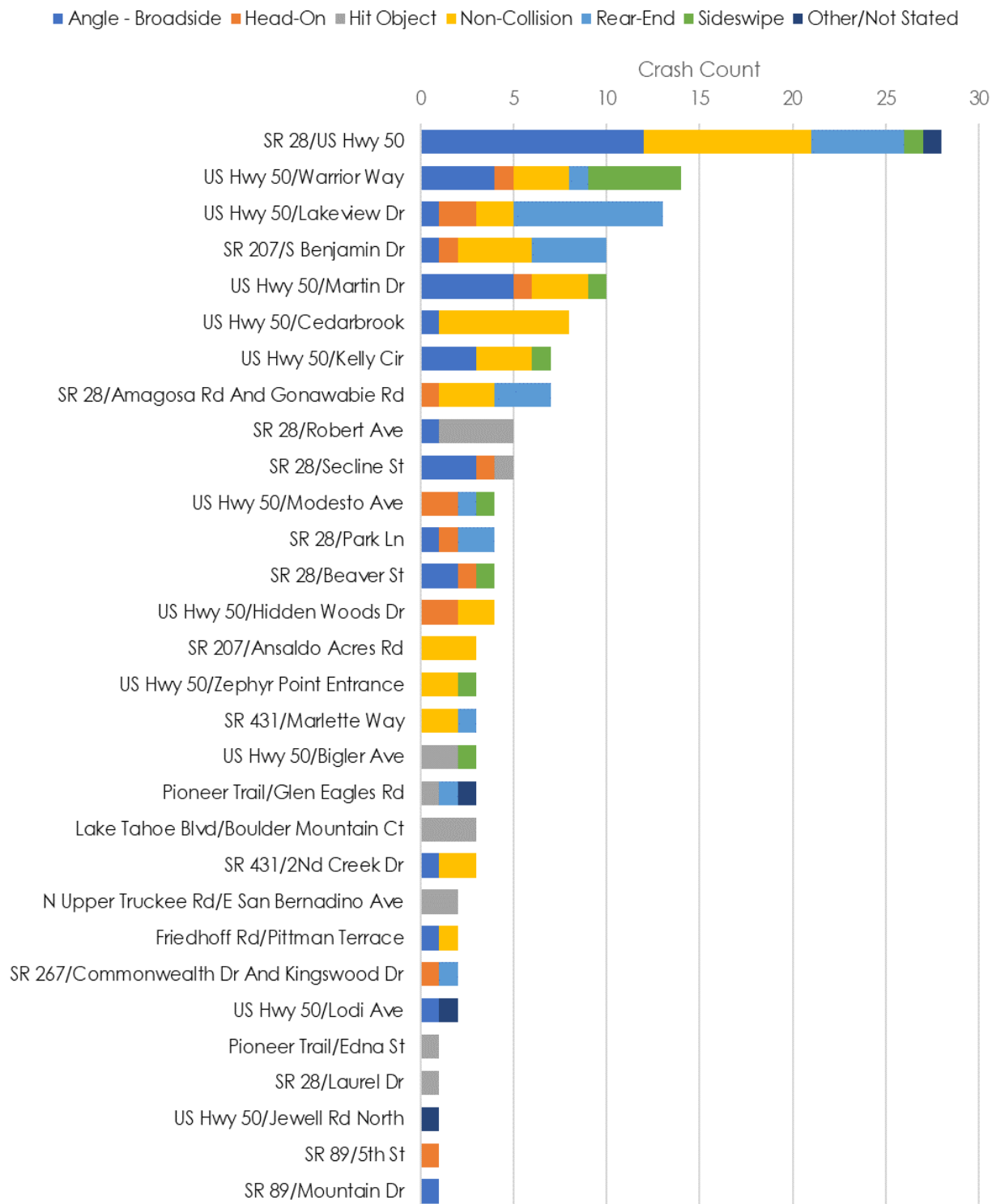
Exhibit 51 presents crash types at each priority intersection. Of note are the following locations:

- Five of ten crashes (50 percent) at U.S. Highway 50/Martin Drive were angle-broadside crashes.
- Seven of eight crashes (88 percent) at U.S. Highway 50/Cedarbrook were non-collisions (i.e., single-vehicle crashes).
- Eight of 13 crashes (62 percent) at U.S. Highway 50/Lakeview Drive were rear-end crashes.



Photo: M. Beryl

**Exhibit 51: Priority Intersection Crashes by Location and Type**



Source: SWITRS, NDOT, Kittelson 2018

# 6.0 COUNTERMEASURES IDENTIFIED TO ADDRESS THE SAFETY ISSUES

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The following presents the potential systemic treatments identified for the Tahoe Region. These treatments were selected based on the crash patterns and trends from the systemic safety analysis, observations from field reviews, and professional resources such as the Caltrans Local Road Safety Manual and the Federal Highway Administration’s resources regarding systemic safety. These proposed countermeasures were further refined, with some locations eventually developed into project scopes (as described in Section 7.0). Furthermore, Attachment A - Rapid Assessment and Response to Safety Issues Toolbox was developed as a countermeasure resource for Tahoe’s regional partner agencies to use in the future to identify effective and proactive countermeasures. The content of the Rapid Assessment and Response to Safety Issues Toolbox draws from the Caltrans Local Road Safety Manual.

The countermeasures identified within this section are intended to be a starting point for consideration when transportation projects are being developed for those locations. The lists contained below can be used as input into project development for capital projects or could be used for future HSIP funding cycles. In both cases, it would be appropriate to further vet the recommendations based on the site-specific context and constraints. Maintenance operations during winter seasons should be considered with implementation and best practices used to meet maintenance needs while also implementing proven safety countermeasures. During project initiation, if projects are led by local jurisdictions on state highways, ongoing maintenance and operations and the need for encroachment permits should be negotiated.

## 6.1 POTENTIAL TREATMENTS FOR PEDESTRIAN AND BICYCLE SAFETY ISSUES

Many of the identified countermeasures in this section are intended to help mitigate high traffic speeds (in the 30-35 mph range). Consistently providing bicycle facilities throughout the Tahoe Region and particularly along or parallel to priority corridors would help reduce the risk of bicycle crashes. Additionally, more frequent and higher visibility crossing opportunities and connected sidewalks could reduce pedestrian-related crashes within the priority locations.

Table 12 lists the priority areas and specific treatment recommendations to reduce crashes and improve conditions for walking and bicycling and indicates whether the suggested treatment qualifies for HSIP funding. The degree to which funding is available from HSIP is dependent on the specific state with jurisdiction. Design considerations for implementing the treatments listed at the priority locations, or if applied to other locations, would need to be addressed in subsequent work to advance these projects.

**Table 12: Countermeasure Recommendations for Bicycle and Pedestrian Priority Locations**

Countermeasures	Applicable Priority Locations	Eligible for HSIP
<p>Crossing enhancements for uncontrolled locations including: High visibility markings, pedestrian refuge islands, rectangular rapid flashing beacons, and/or curb extensions</p> <p>Crossing enhancements for signalized locations: pedestrian refuge islands, leading pedestrian intervals, protected pedestrian crossing phase, and/or curb extensions</p>	<ul style="list-style-type: none"> <li>▶ SR 28/Commons Beach Rd</li> <li>▶ SR 28/Cobblestone Shopping Center/ Commons Beach Stairs</li> <li>▶ SR 28/Watson Cabin/Commons Beach Stairs</li> <li>▶ SR 28/Grove St</li> <li>▶ SR 28/Jackpine Street</li> <li>▶ SR 28 at midblock crossing/Bus Stop east of Safeway center</li> </ul>	Yes
<p>Installing new enhanced crosswalks</p> <p>Installing new enhanced crosswalks (continued)</p>	<ul style="list-style-type: none"> <li>▶ SR 89/Homewood Mountain Resort/West Shore Café</li> <li>▶ SR 89/Fawn Street</li> <li>▶ SR 89/South Street<sup>12</sup></li> <li>▶ SR 89/Tahoe Ski Bowl Way</li> <li>▶ US 50/SR 89 at Santa Fe Rd/Apache Ave</li> <li>▶ US 50/SR 89 between 3008 US-50 and 2977 US-50 (Holiday Market</li> <li>▶ US 50/SR 89 at Hopi Ave 180 feet southwest of intersection</li> <li>▶ US 50/Rufus Allen Blvd (suitable for people biking)</li> <li>▶ US 50/Pioneer Trail</li> <li>▶ US 50/Heavenly Village Way - Park Avenue</li> <li>▶ US 50/Friday Avenue</li> <li>▶ US 50/Transit Way</li> <li>▶ US 50/Lake Parkway</li> <li>▶ US 50/Kingsbury Grade</li> <li>▶ US 50/Kahle Drive</li> </ul>	Yes
Pedestrian scale lighting for crosswalks and intersections	<ul style="list-style-type: none"> <li>▶ SR 28/Commons Beach Rd</li> <li>▶ SR 28/Cobblestone Shopping Center/ Commons Beach Stairs</li> </ul>	Yes

<sup>12</sup> Study for crosswalk in progress led by Caltrans.

Countermeasures	Applicable Priority Locations	Eligible for HSIP
	<ul style="list-style-type: none"> <li>▶ SR 28/Watson Cabin/Commons Beach Stairs</li> <li>▶ SR 28/Grove St</li> <li>▶ SR 28/Jackpine Street</li> <li>▶ SR 28 at midblock crossing/Bus Stop east of Safeway center</li> <li>▶ SR 89/Homewood Mountain Resort/West Shore Café</li> <li>▶ SR 89/South Street<sup>13</sup></li> <li>▶ SR 89/Fawn Street</li> <li>▶ SR 89/ Tahoe Ski Bowl Way</li> <li>▶ US 50/SR 89 at Santa Fe Rd/Apache Ave</li> <li>▶ US 50/SR 89 between 3008 US-50 and 2977 US-50 (Holiday Market)</li> </ul>	
Advanced stop bar on approach to intersections	<ul style="list-style-type: none"> <li>▶ SR 28/SR 89 to Bus Stop east of Safeway center</li> </ul>	Yes
Designated Class II or other specific space for bicyclists to close gaps in the bicycle network	<ul style="list-style-type: none"> <li>▶ SR 28/SR 89 to Bus Stop east of Safeway center</li> <li>▶ SR 28 from SR 89 to Macinaw Road</li> <li>▶ SR 28/Jackpine St to the eastern edge of Tahoe City</li> <li>▶ SR 89 at the two- to one-lane merge North of West Way until F Street</li> <li>▶ US 50/SR 89 (the Y) to Pioneer Trail</li> <li>▶ (Old) US 50 from Pioneer Trail to Lake Parkway</li> <li>▶ US 50 from Lake Parkway to Kahle Drive</li> </ul>	Yes
Two-stage left-turn box for people biking	<ul style="list-style-type: none"> <li>▶ US 50/Takela Drive</li> <li>▶ US 50/Fairway Avenue</li> <li>▶ US 50/Ski Run Boulevard</li> </ul>	No

<sup>13</sup> Study for crosswalk in progress led by Caltrans.

Countermeasures	Applicable Priority Locations	Eligible for HSIP
Dynamic speed feedback signs to manage motor vehicle speeds	<ul style="list-style-type: none"> <li>▶ SR 28/West of Commons Beach Road</li> <li>▶ SR 28 at midblock crossing/Bus Stop east of Safeway center</li> <li>▶ SR 89/North of Silver Street</li> <li>▶ SR 89/South of Tahoe Ski Bowl Way</li> </ul>	Yes
Identify and implement speed management strategies to be able to reduce the posted speed limit and actual vehicle speeds <sup>14</sup>	<ul style="list-style-type: none"> <li>▶ SR 89/North of Silver St to McKinney Drive</li> <li>▶ SR 89 at the two- to one-lane merge North of West Way until F Street</li> <li>▶ US 50/SR 89 (the Y) to Pioneer Trail</li> <li>▶ (Old) US 50 from Pioneer Trail to Lake Parkway</li> </ul>	Varies
Install sidewalk to address gap	<ul style="list-style-type: none"> <li>▶ SR 89/Silver Street to Tahoe Ski Bowl Way</li> <li>▶ SR 89/McKinney Drive - East side of street from north of Fawn Street to McKinney Drive</li> <li>▶ (Old) US 50 from Pioneer Trail to Lake Parkway (sidewalk widening)</li> <li>▶ US 50/Lake Parkway to Kingsbury Grade</li> <li>▶ US 50/Kahle Drive to Visitor Center/Bus Stop</li> </ul>	Yes
Install gateway treatment	<ul style="list-style-type: none"> <li>▶ SR 89/North of Silver Street</li> <li>▶ SR 89/South of Tahoe Ski Bowl Way</li> </ul>	No
Roadway reconfiguration	<ul style="list-style-type: none"> <li>▶ (Old) US 50 from Pioneer Trail to Lake Parkway (5 to 3 vehicle lanes)</li> </ul>	Yes
Remove channelized right-turn lanes	<ul style="list-style-type: none"> <li>▶ US 50/Lake Parkway</li> </ul>	No

Source: TDG 201

<sup>14</sup> Some examples of speed management strategies include vehicle speed feedback signs, marking or painting narrow lane widths, fewer vehicle lanes (i.e., roadway reconfigurations), raised medians, curb extensions, roundabouts, signal timing adjustments, landscaping (trees, plants) along a road at back of curb.

The countermeasures identified in Table 12 were checked for consistency with various existing plans and ongoing projects so as not to be contradictory or preclude those projects, including the Kings Beach Commercial Core Improvement Project (2017), Lake Tahoe Complete Streets Resource Guide (2016), SR 89/Fanny Bridge Community Revitalization Project (under construction), Meyers Area Plan (2018), Linking Tahoe: Active Transportation Plan (2016), Linking Tahoe: Regional Transportation Plan (2017), US 50/South Shore Community Revitalization Project (under development ), Kahle Drive Vision (2014), Placer County Tahoe Basin Area Plan (2017), Tahoe Valley Area Plan (2015) as well as the road safety audits (RSAs) completed for Tahoe City, Meyers, US 50 in City of South Lake Tahoe and US 50 in Nevada.

## 6.2 POTENTIAL TREATMENTS FOR MOTOR VEHICLE SAFETY ISSUES

Based on the risk factors identified for priority locations, Table 13 and Table 14 present promising options for potential treatments at priority locations to improve systemic safety performance. The specific design considerations for implementing the countermeasures listed at the priority locations previously discussed (or other locations) would need to be addressed in subsequent work to advance these projects. The intent of each of the treatments below is that their implementation would be done in a manner consistent with requirements in the Manual of Uniform Traffic Control Devices (MUTCD) or other regulatory documents and facility owned authorities. This list of treatments and priority locations are intended to help further or in some instances initiate ideas for safety improvements at locations ranked highest in the Tahoe Region.



**Table 13: Potential Treatments for Motor Vehicles at Priority Roadway Segments**

Countermeasure	Applicable Road Type	Applicable Crash Type	Associated Risk Factors	Eligible HSIP Funding
Increasing Clear Zone. Remove or Relocate Objects outside of Clear Recovery Zone	Curves	Head on, run off road, hit object, opposite direction	Two lane cross sections	Yes
TRPA and MASH <sup>1</sup> approved barrier/guardrail	Curves	Run off road, hit object, opposite direction	Two lane cross sections	Yes
Median barrier	Curves	Run off road, hit object, opposite direction	Undivided roadways	Yes
Enhanced delineation – reflectors or object markers	Curves	Head on, run off the road, hit object, opposite direction		Yes
Center line or edge line and TRPA approved Shoulder Rumble strips with considerations for bicyclist entry and exit	Curves, high speed roads	Head on, opposite direction, sideswipe, run off road	Undivided roadways	Yes
Install acceleration/deceleration lanes	Entering high speed roadways	Rear end, sideswipe	Two-lane cross sections	Yes
Reconfigure roadway to reduce the number of through vehicle lanes	Roadway Segments	Rear end while making a left turn across oncoming traffic	Undivided roadways posted speeds 45 mph or higher	Yes
Install climbing lane where there is a large difference between car and truck speed	Roadway segments		Two-lane cross sections Posted speeds 45 mph or higher	No
Adding/widening shoulders	Curves/roadway segments	Head on, run off road, hit object, opposite direction	Two-lane cross sections	Yes
Install chevron signs on horizontal curves	Curves	Run off road, sideswipe, head on	Two-lane cross sections, undivided roadways	Yes
Install curve advance warning signs with or without flashing beacon	Curves	Run off road, sideswipe, head on	Two-lane cross sections, undivided roadways	Yes

Sources: FHWA, Caltrans, Kittelson 2018.

Notes: <sup>1</sup>Manual for Assessing Safety Hardware

**Table 14: Potential Treatments for Motor Vehicle Priority Intersections**

Countermeasure	Applicable Road Type	Applicable Crash Type	Associated Risk Factors	Eligible for HSIP Funding
Center line and TRPA approved Shoulder Rumble strips with considerations for bicyclist entry and exit	Curves, high speed roads	Head on, opposite direction, sideswipe, run off road	Undivided major approaches to intersections	Yes
Install acceleration/deceleration lanes	Entering high speed roadways	Rear end, sideswipe	Intersections with no turn lane storage on approach	Yes
Reconfigure roadway to reduce the number of through vehicle lanes	Roadway Segments	Rear end while making a left turn across oncoming traffic	Intersections with no turn lane storage on approach	Yes
Adding/widening shoulders	Curves/roadway segments	Head on, run off road, hit object, opposite direction	Intersections with no turn lane storage on approach	Yes
Improve sight distance to intersection by removal of obstruction that limits sight distance	Stop controlled intersections		Three-leg stop controlled intersections of a highway and a minor street	Yes
Double arrow warning sign at stem of T-intersections	Stop controlled intersections		Three-leg stop controlled intersections of a highway and a minor street	No
Install/upgrade larger or additional stop signs or other intersection warnings/regulatory signs	Stop controlled Intersections		Three-leg stop controlled intersections of a highway and a minor street	Yes
Install flashing beacons as advance warning	Stop-controlled intersections		Three-leg stop controlled intersections of a highway and a minor street	Yes
Roundabout	Intersections, transition from high speed to low speed		Three-leg stop controlled intersections of a highway and a minor street	Yes
Convert to all-way stop control from 2-way or yield control	Unsignalized intersections	Left turn, angle	Three-leg stop controlled intersections of a highway and a minor street	Yes
Create directional median openings to allow and restrict left-turns and U-turns	Unsignalized intersections with median		Intersections with no turn lane storage on approach, Undivided major approaches to intersection	Yes

Countermeasure	Applicable Road Type	Applicable Crash Type	Associated Risk Factors	Eligible for HSIP Funding
Doubled up, oversized advanced intersection warning signs with lighted street name sign plaques	Unsignalized intersections		Three-leg stop controlled intersections of a highway and a minor street	No
Upgrade intersection pavement markings	Unsignalized intersections			Yes
Turn lanes at two-way stop-controlled intersections	Two-way stop-controlled intersections	Rear end, left-turning/broadside	Intersections with no turn lane storage on approach	No

Sources: FHWA, Caltrans, Kittelson 2018.

## 7.0 VIABLE PROJECT SCOPES AND PRIORITIZED LIST OF SAFETY PROJECTS

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The following describes the process for identifying the viable projects within the Tahoe Region, what those projects include, the planning level cost estimates, and associated benefit-cost ratios.

### 7.1 IDENTIFYING VIABLE PROJECTS

The team identified viable projects from the lists of the high-risk corridors and intersections (i.e., priority locations) in Section 8.0. The priority locations for pedestrian and bicycle safety was combined with the list of priority locations for motor vehicle safety. The combined list included 42 intersections and 29 segments for which Section 9.0 documented high-level countermeasure recommendations.

The list of locations was reduced to a list of 30 locations using the following steps:

1. Determining where the extent of the priority pedestrian and bicycle locations overlapped with the priority motor vehicle locations. For these locations, the locations were merged and redefined the extents of the locations as necessary.
2. For each location, the EPDO score (i.e., severity score) was recalculated based on all crash types for all modes.
3. The locations were then reordered based on the recalculated crash severity score and the locations with the 25 highest crash severity scores were selected as the strongest potential locations on which to focus. This was based on the ultimate intent of developing competitive HSIP grant applications for California and supporting possible HSIP-funded projects in Nevada and recognizing that grant funding source places an emphasis on benefit/cost ratio calculations. Therefore, the severity scores were used to identify locations with the greatest potential benefit. Due to this, the initial list only included locations on state highway systems – 12 locations in California, 12 locations in Nevada, and 1 location that crossed between the states. Those happened to be the locations across the Tahoe Region with the highest severity score.
4. Because the initial list included no locations that were off state highways, five locations with the highest crash severity scores that were not on the state-highway facilities were added to the list to arrive a total of 30 for discussion with the PDT.
5. The list of 30 locations was presented at the 4th PDT meeting on May 3rd to determine if any of the priority locations had recently or were already planned to receive improvements of some kind. They were also discussed at the June 20th (PDT Meeting #5). The outcome of the two meetings was a focused list of up to eight locations for concept designs and cost estimates (six locations in California and two in Nevada).

These 30 locations are presented in Exhibit 52 through Exhibit 56.

**Table 15: List of 30 Candidate Project Locations**

ID	Location Name	Crash (EPDO)	Severity	Score	California Nevada	/	Off-State Highway
S1	Road Segment: US-50 at F STREET to SR-89 at 13TH STREET	186			CA		No
S2	Road Segment: US-50 around the intersection with SR-28	168			NV		No
S4	Road Segment: US-50, OLD MEYERS GRADE ROAD to ECHO SUMMIT ROAD	147			CA		No
S3	Road Segment: SR-28, JACKPINE ROAD to East of Safeway	132			CA		No
S5	Road Segment: US-50, PIONEER TRAIL to LAKE PARKWAY	119			CA/NV		No
S6	Road Segment: SR-89, West of TWIN CRAGS	111			CA		No
S7	Road Segment: SR-28/N Lake BLVD, BEACH STREET and SECLINE STREET	83			CA		No
I1	Intersection: SR-28/ROBERT AVENUE	81			CA		No
I2	Intersection: SR-89/5TH STREET	80			CA		No
S11	Road Segment: US-50, Southbound tunnel	75			NV		No
S8	Road Segment: SR-267, South of BROCKWAY SUMMIT	75			CA		No
S9	Road Segment: SR-207, PALISADES DRIVE to SUMMER PLACE	74			NV		No
S10	Road Segment: SR-89, East of intersection with CASCADE LAKE	72			CA		No
I3	Intersection: US-50/PARK AVENUE/HEAVENLY VILLAGE WAY	68			CA		No
I4	Intersection: SR-28/US-50	60			NV		No
I5	Intersection: US-50/SR 207	51			NV		No
I6	Intersection: US-50/WARRIOR WAY	49			NV		No
I7	Intersection: US-50/MARTIN DRIVE	48			NV		No
I8	Intersection: US-50/LAKEVIEW DRIVE	46			NV		No
S12	Road Segment: SR-89, LAKE TAHOE BOULEVARD to B STREET	44			CA		No
I9	Intersection: SR-28/GROVE STREET	44			CA		No
I10	Road Segment: US-50 near CEDARBROOK	44			NV		No
I11	Intersection: US-50/HIDDEN WOODS DRIVE	44			NV		No
I12	Intersection: SR-207/S BENJAMIN DRIVE	44			NV		No
S13	Road Segment: SR-207, LOGGING ROAD LANE and BUCHANAN ROAD	43			NV		No
I13	Intersection: LAKE TAHOE BOULEVARD/BOULDER MOUNTAIN COURT	41			CA		Yes
I14	Intersection: TAMARACK AVENUE and BLACKWOOD ROAD	41			CA		Yes
I15	Intersection: NORTH UPPER TRUCKEE ROAD/EAST SAN BERNARDINO AVENUE	40			CA		Yes
I16	Intersection: PIONEER TRAIL/GLEN EAGLES ROAD	40			CA		Yes
I17	Intersection: PIONEER TRAIL/EDNA STREET	40			CA		Yes

Source: Kittelson 2018

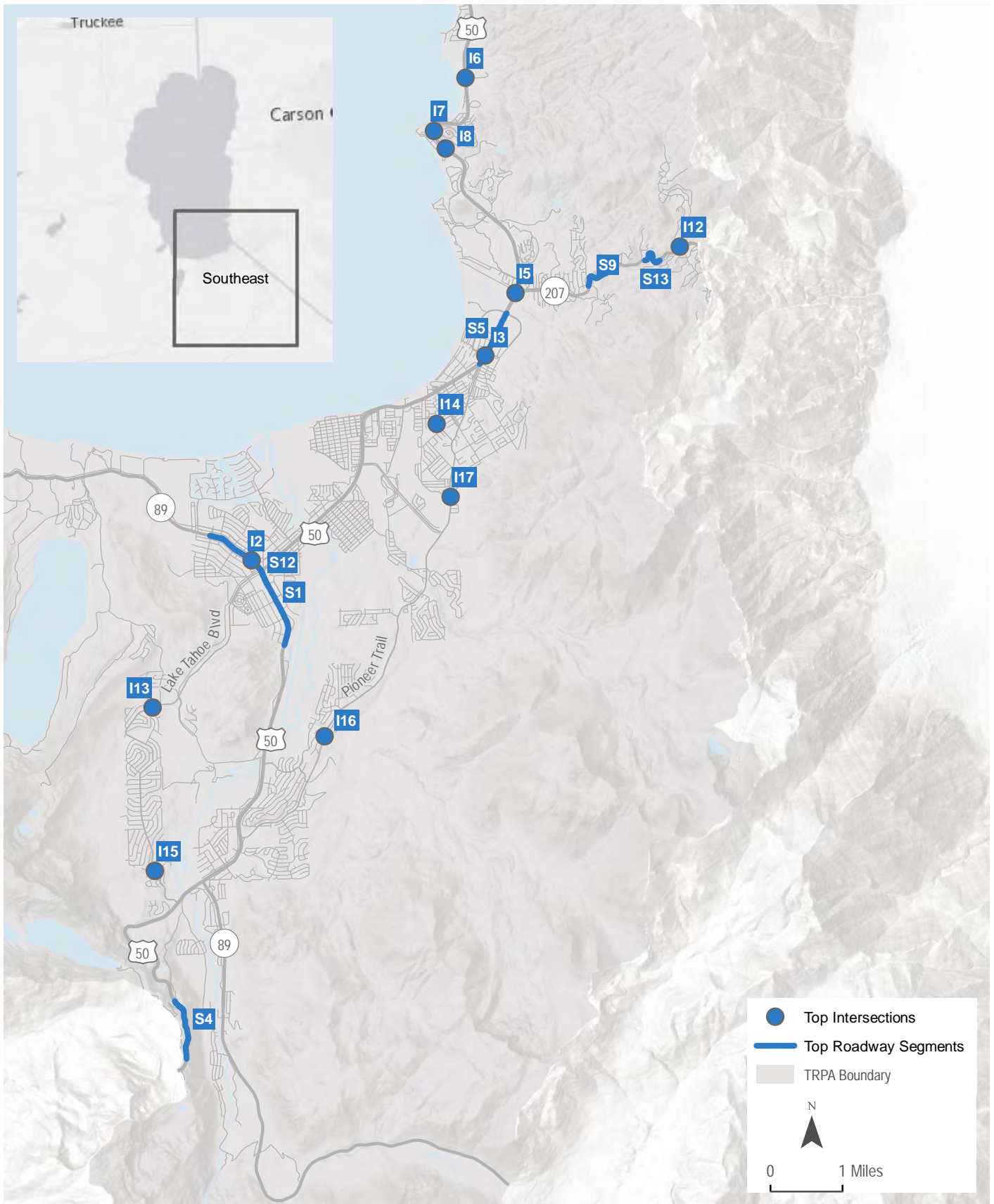


Exhibit 52

**Candidate Project Locations**  
Tahoe Regional Planning Agency  
Lake Tahoe Region Safety Strategy

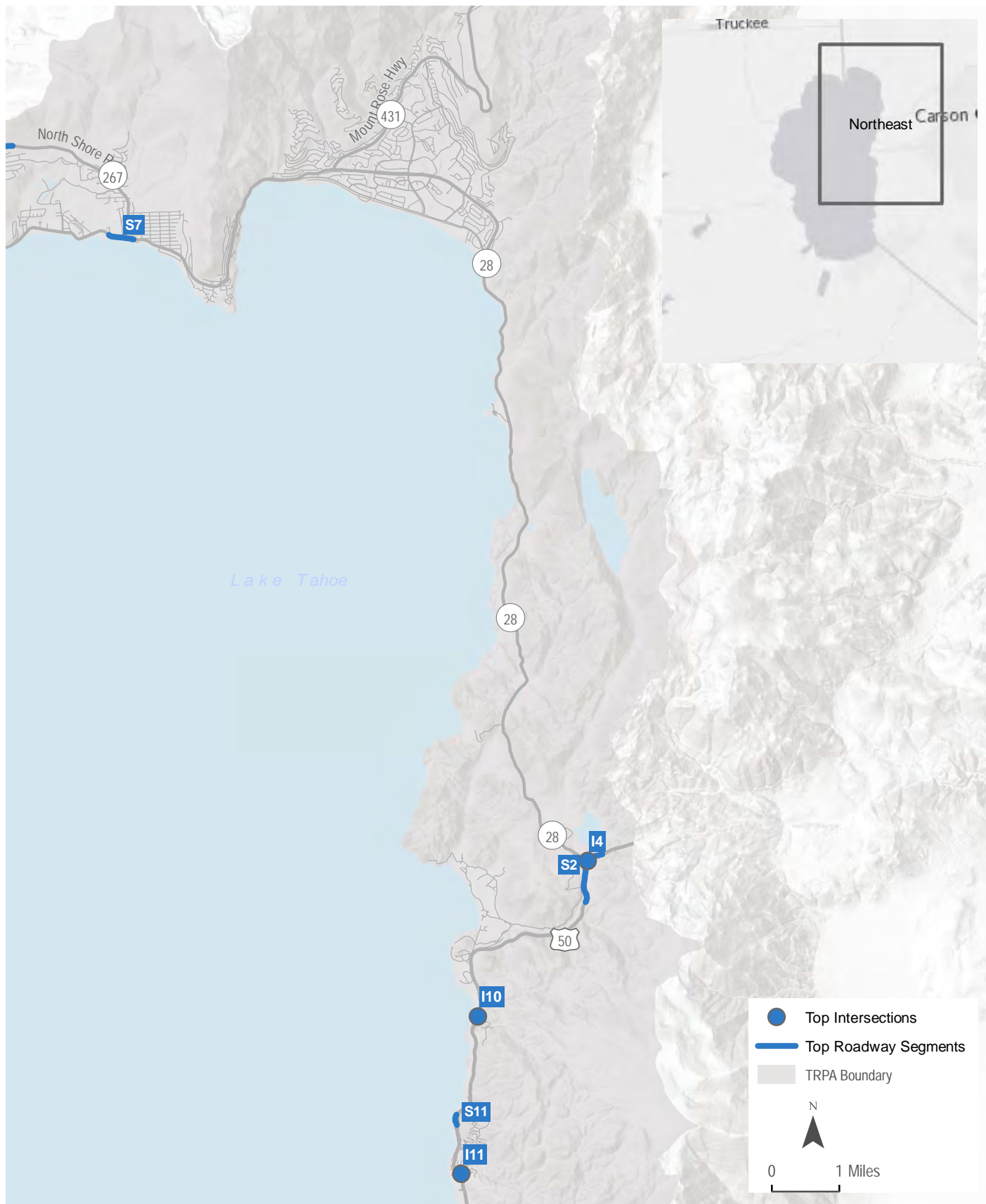


Exhibit 53

**Candidate Project Locations**  
Tahoe Regional Planning Agency  
Lake Tahoe Region Safety Strategy

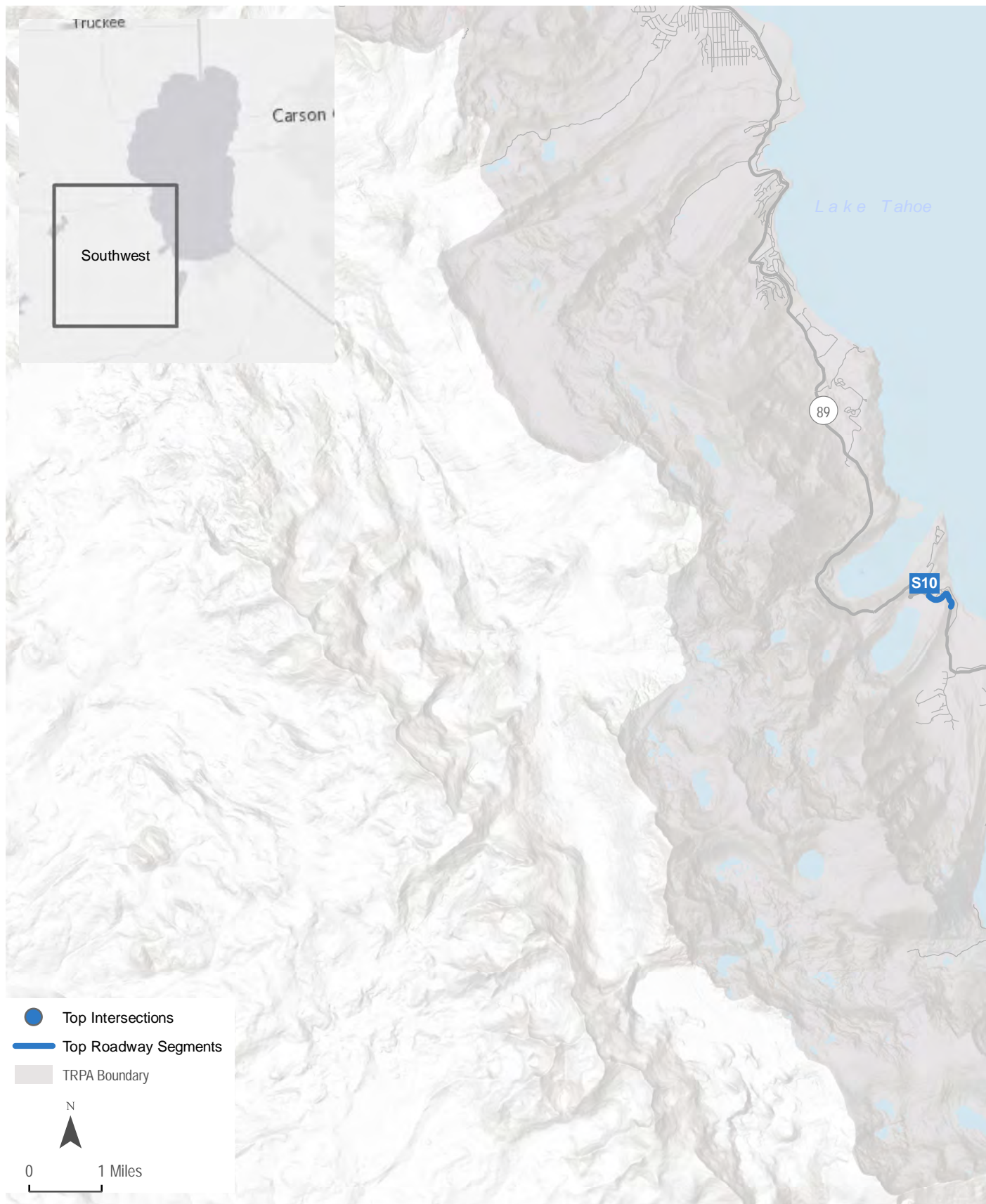


Exhibit 54

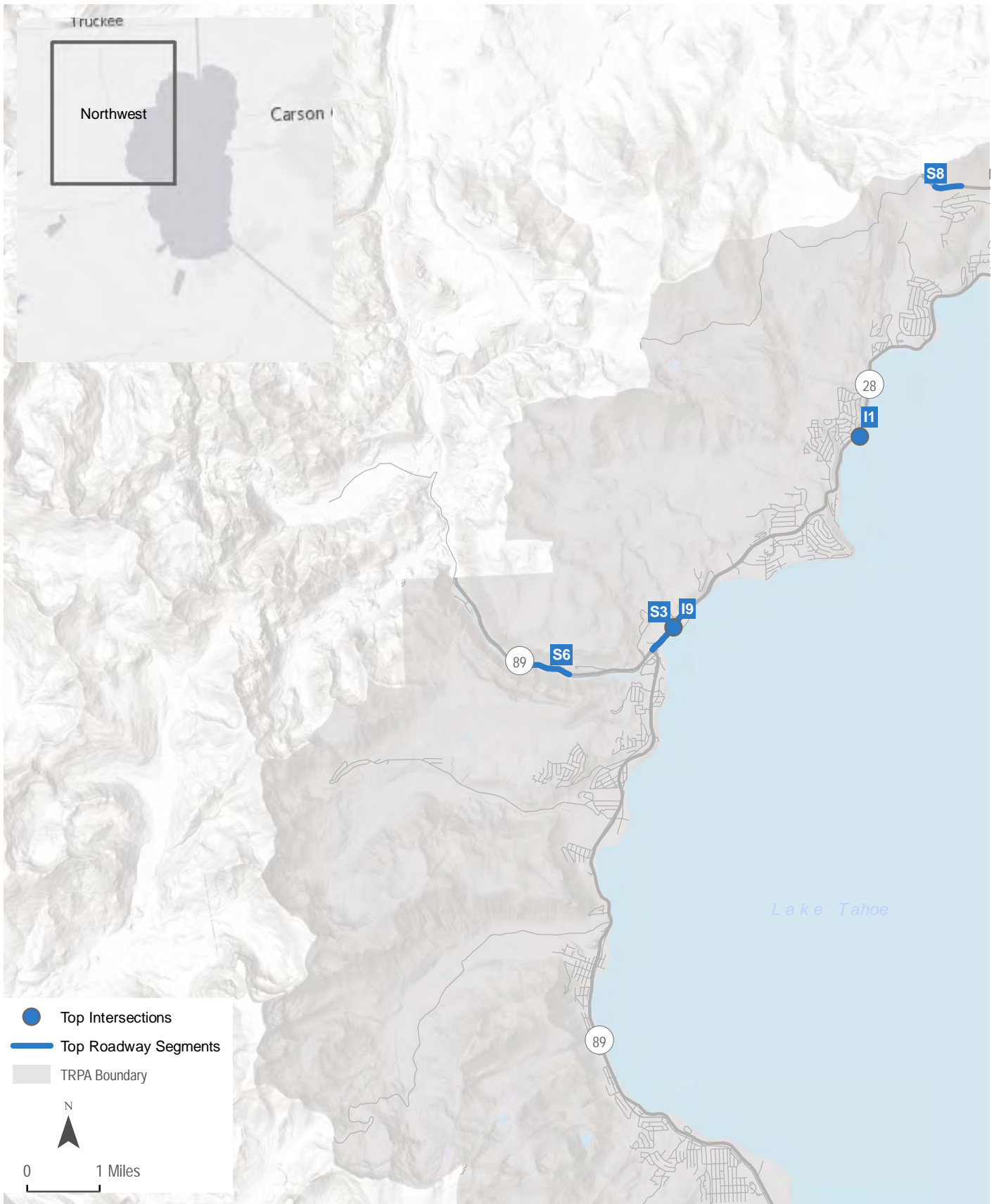


Exhibit 55

**Candidate Project Locations**  
Tahoe Regional Planning Agency  
Lake Tahoe Region Safety Strategy

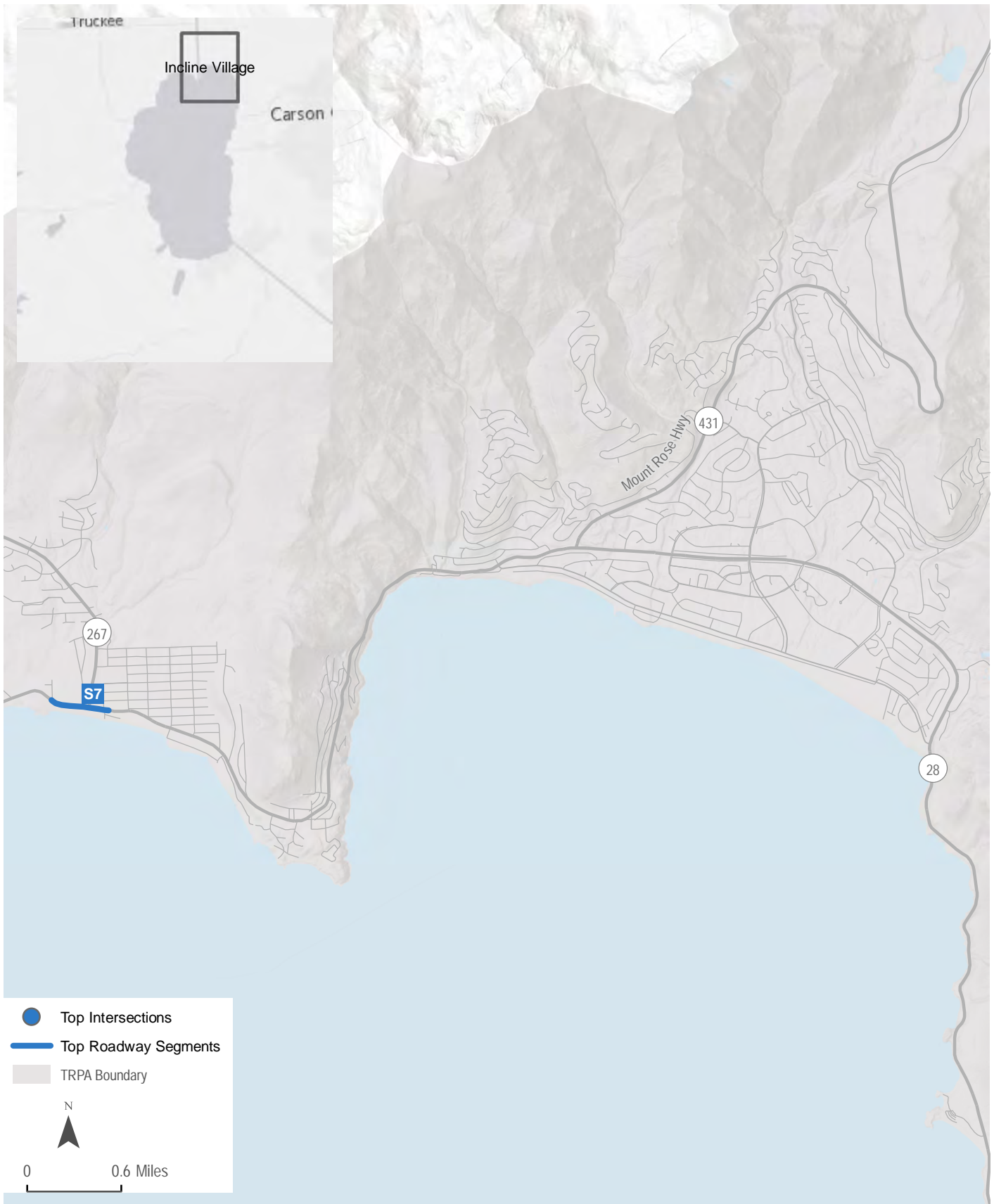


Exhibit 56

## 7.2 TOP EIGHT LOCATIONS FOR PROJECT SCOPES, CONCEPT DESIGNS AND PLANNING-LEVEL COST ESTIMATES

The eight locations are listed in Table 16. Each were identified as HSIP application or Nevada funding source candidates and as a result concept designs, planning-level cost estimates and benefit/cost ratios were developed for each. For the locations in California, three locations were off state-highway facilities and three locations were on state highway facilities. The two HSIP project locations in Nevada are on a state facility.

**Table 16: Top Eight Project Locations**

Location	Roadway Jurisdiction	Within which City or County	State	State HWY
Pioneer Trail/Edna Street Intersection	City of South Lake Tahoe	South Lake Tahoe	CA	No
Tamarack Avenue/Blackwood Road Intersection	City of South Lake Tahoe	South Lake Tahoe	CA	No
Emerald Bay Road (US 50/SR 89) between F Street and 13th Street	Caltrans	South Lake Tahoe	CA	Yes
North Upper Truckee Road/East San Bernardino Avenue Intersection and Approaches <sup>1</sup>	El Dorado County	El Dorado County	CA	No
US 50 between Old Meyers Grade Road and Echo Summit	Caltrans	El Dorado County	CA	Yes
SR 267 between Brockway Summit and 500 feet East of Brockway Summit Trailhead	Caltrans	Placer County	CA	Yes
US 50/Kahle Drive and Kahle Drive to Visitor Center/Bus Stop	Nevada DOT	Stateline	NV	Yes
US 50/Lake Parkway and Lakeway Parkway to Kingsbury Grade	Nevada DOT	Stateline	NV	Yes

<sup>1</sup>Two additional locations were in this HSIP applications: (1) North Upper Truckee Road/Mt. Rainier Drive, and (2) Lake Tahoe Boulevard from Mt. Rainier Drive to Mule Deer Circle.

Source: Kittelson 2018

### Concept Designs

For each location in California, Kittelson conducted a field visits with the agency that had jurisdiction over the roadway to review field conditions and identify potential treatments. Based on the field visits, the project team developed design concepts and initial cost estimates for the eight locations. The design concepts are shown in Exhibit 57 through Exhibit 67. Cost estimates for the concept designs are provided in Attachment D.

Countermeasures were identified using the Rapid Assessment and Response to Safety Issues Toolbox (Attachment A), which was developed with reference to Caltrans Local Roadway Safety Manual and in partnership with and under the review of the Safety Strategy's PDT members.



Exhibit 57: Pioneer Trail & Edna Street Intersection

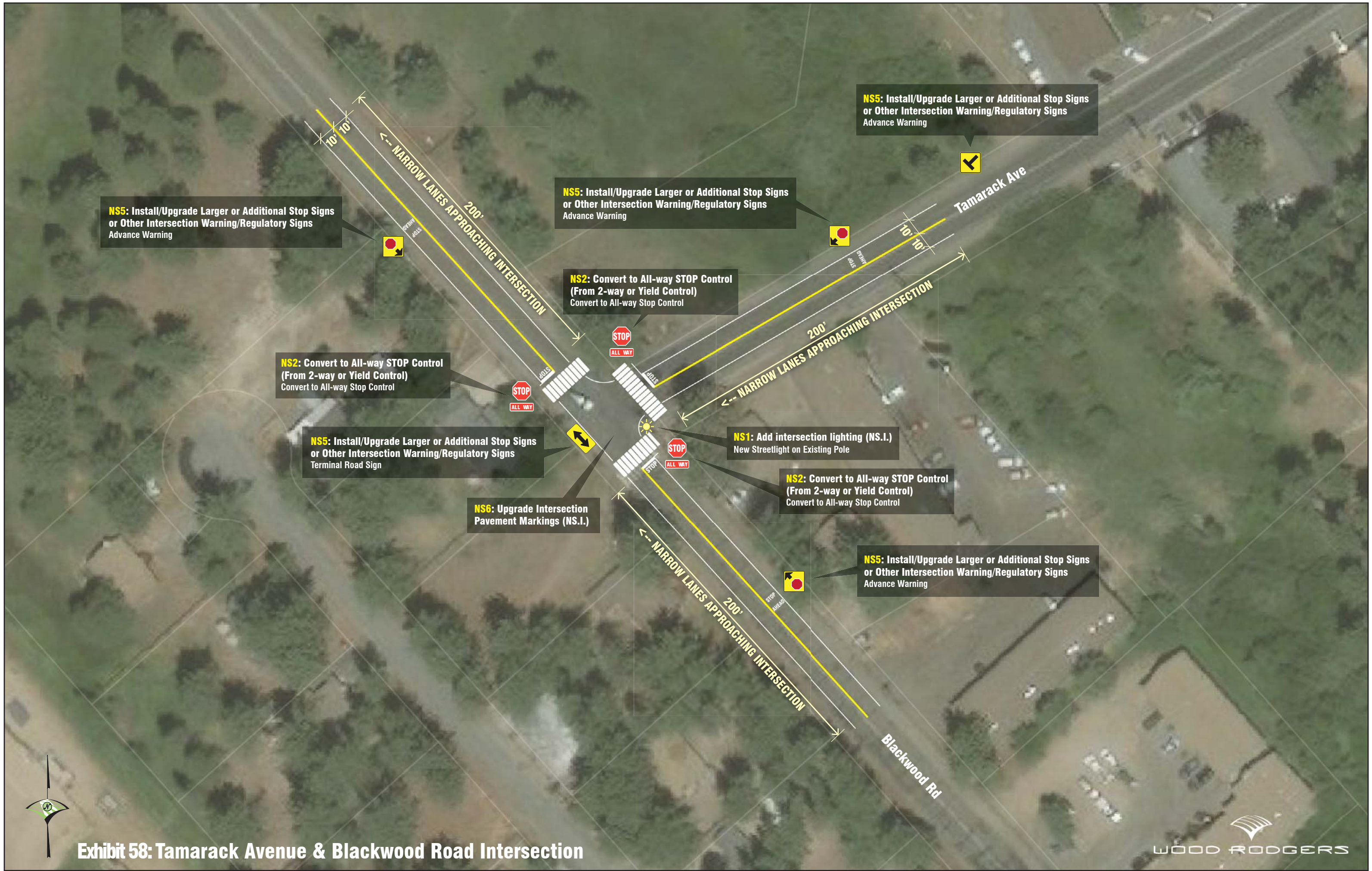
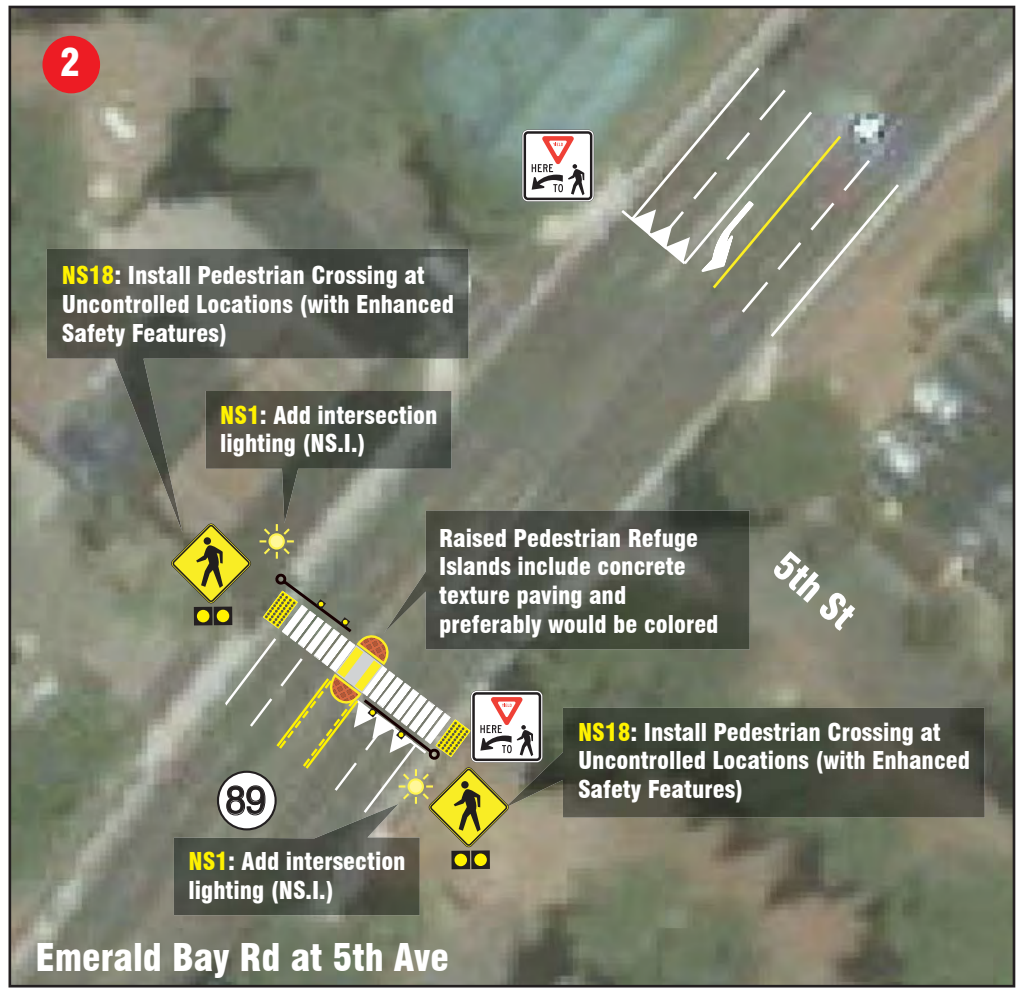


Exhibit 58: Tamarack Avenue & Blackwood Road Intersection



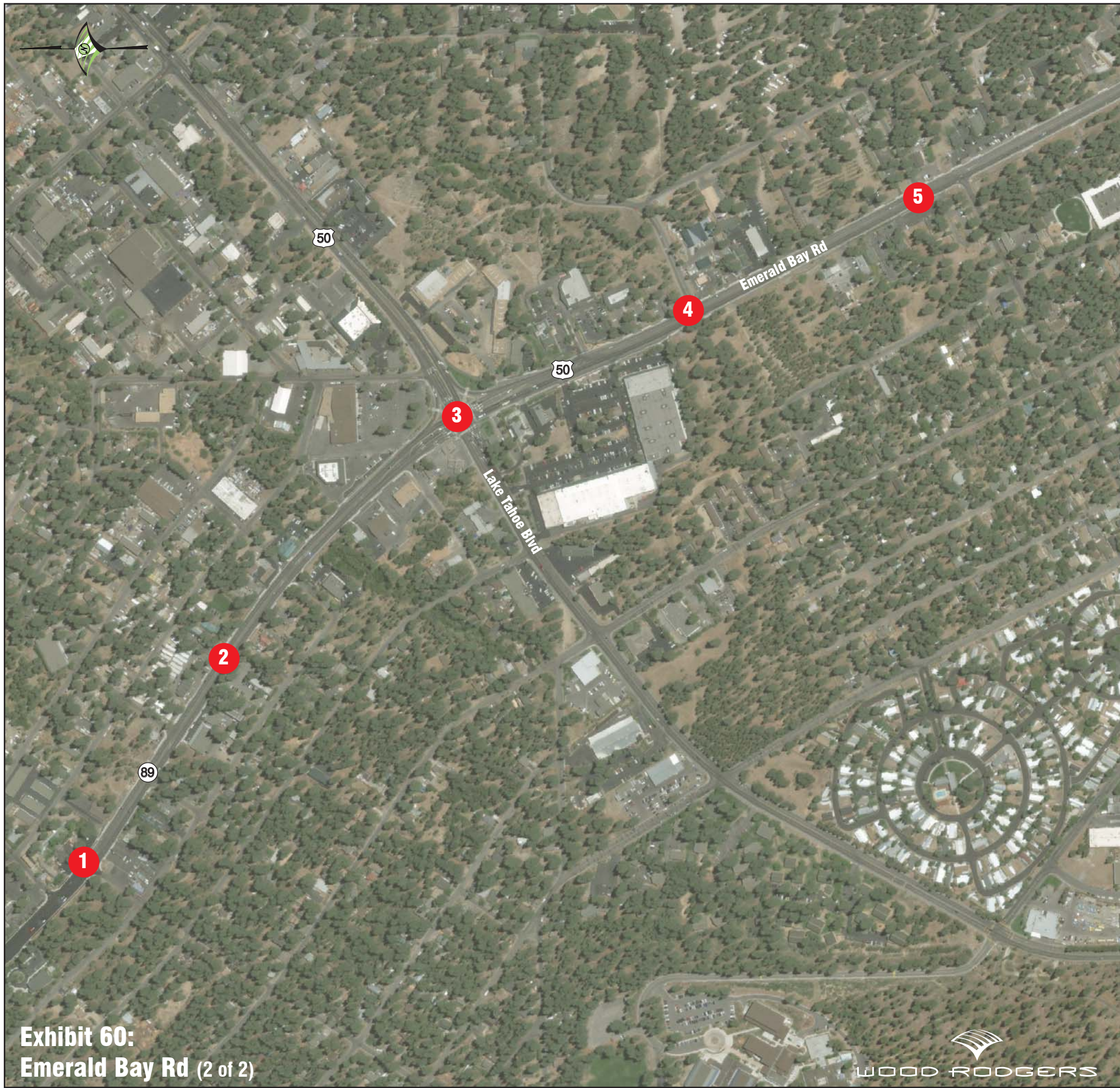


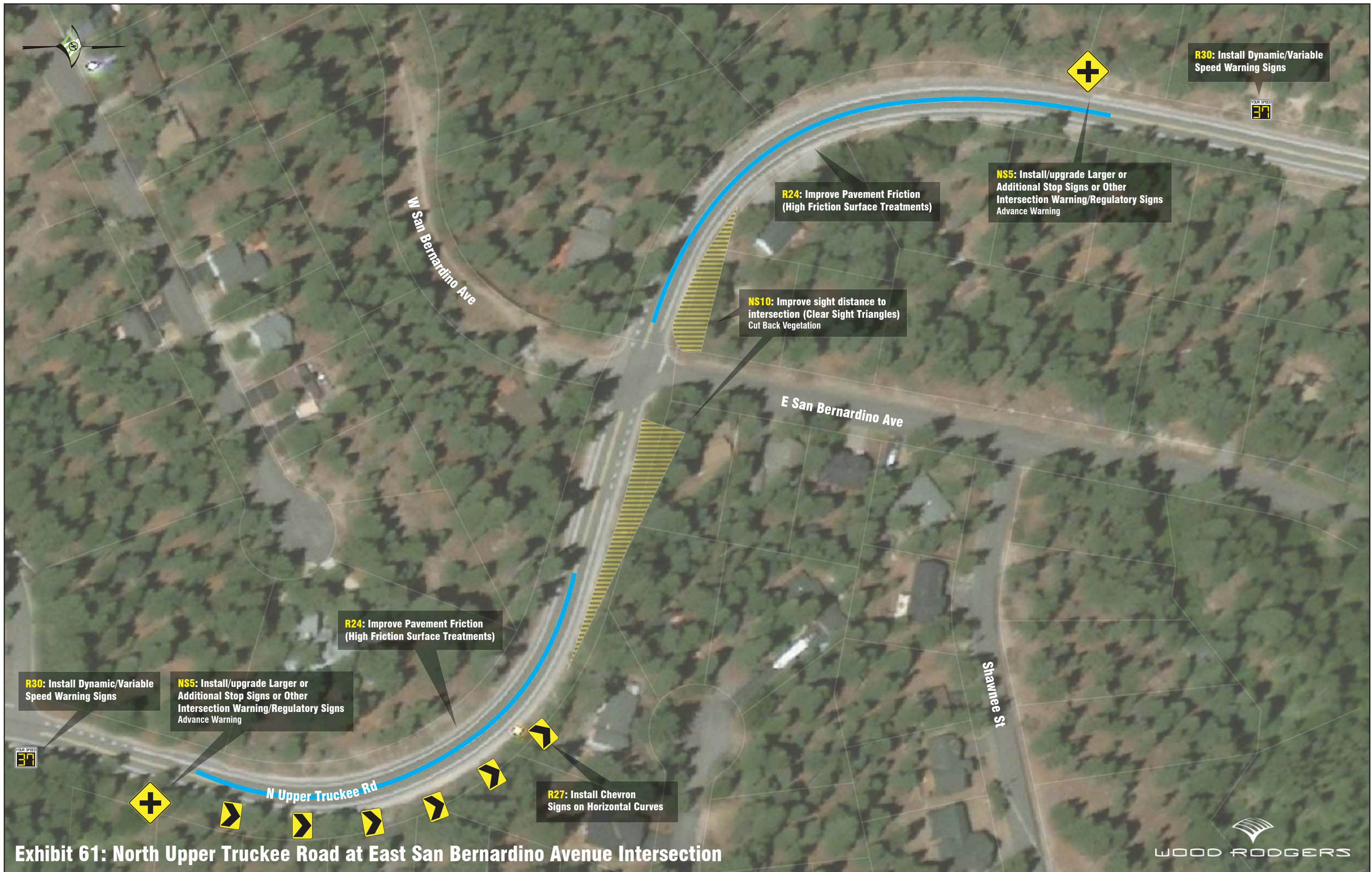
Exhibit 60:  
Emerald Bay Rd (2 of 2)



Emerald Bay Rd at B St



Emerald Bay Rd at C St



**Exhibit 61: North Upper Truckee Road at East San Bernardino Avenue Intersection**

**R30:** Install Dynamic/Variable Speed Warning Signs



**R28:** Install Curve Advance Warning Signs

**R27:** Install Chevron Signs at Horizontal Curves



**R24:** Improve Pavement Friction (High Friction Surface Treatments)

**R27:** Install Chevron Signs at Horizontal Curves



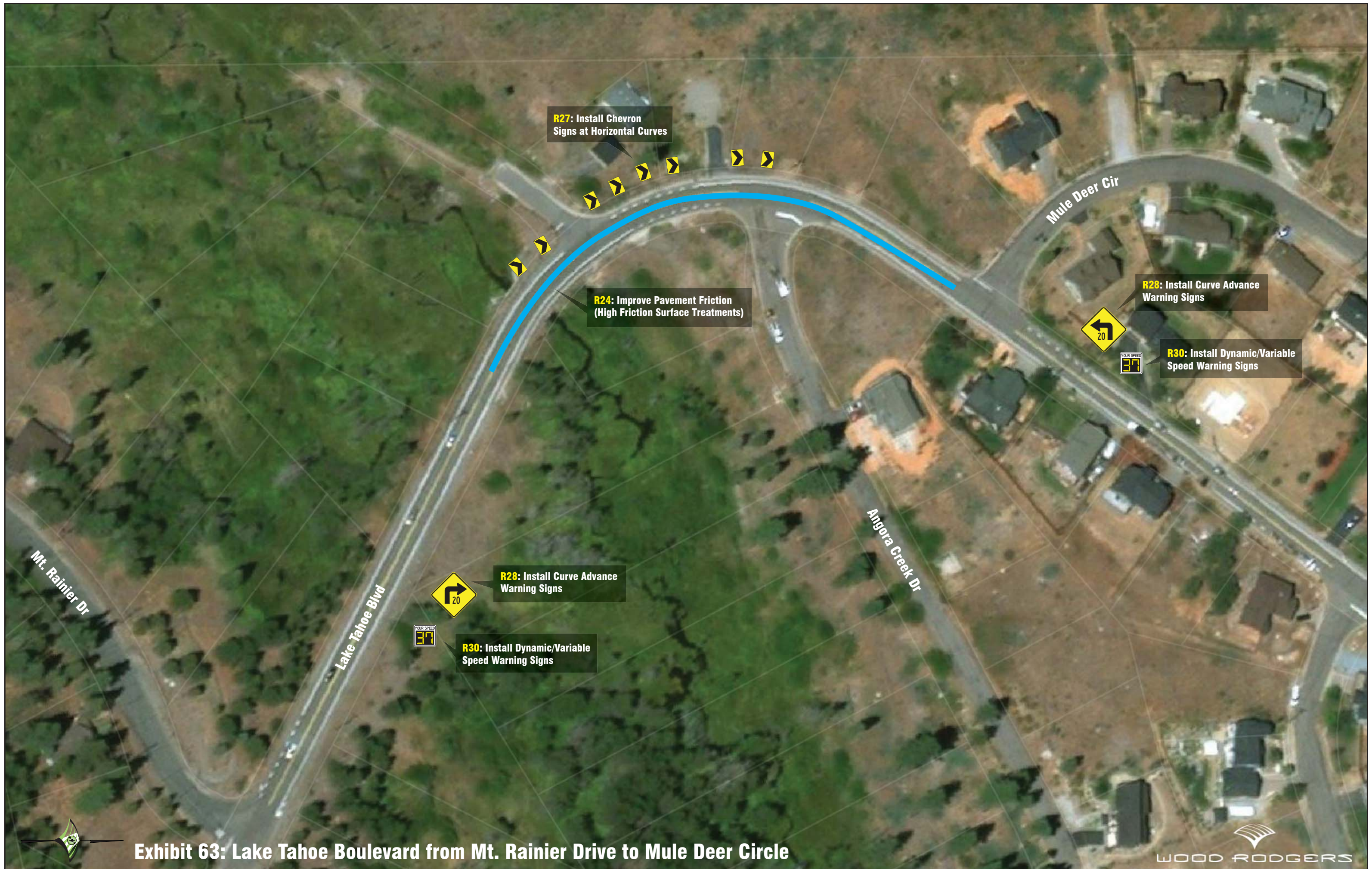
**R28:** Install Curve Advance Warning Signs



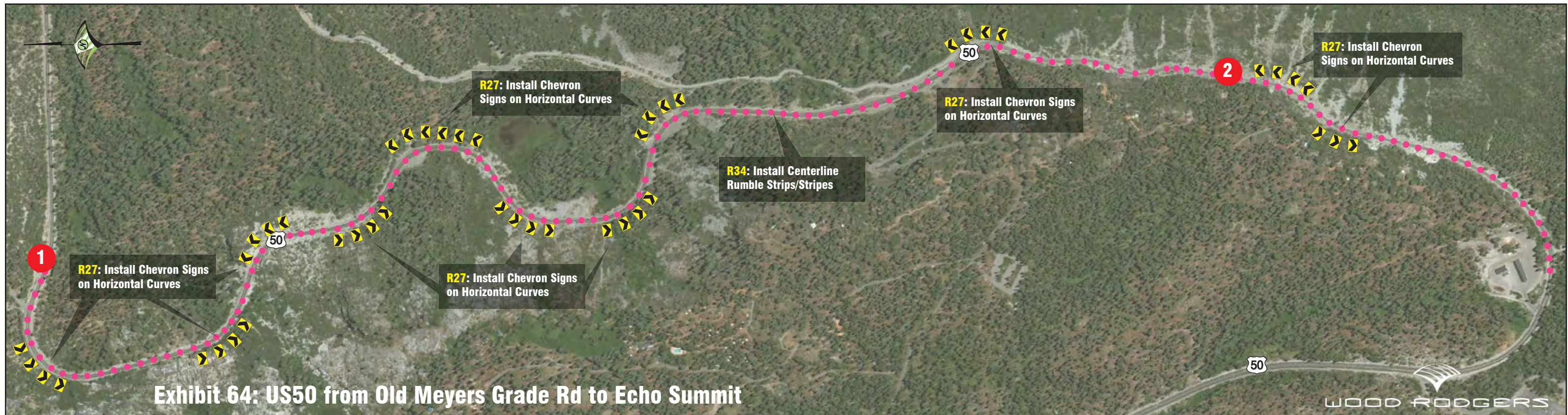
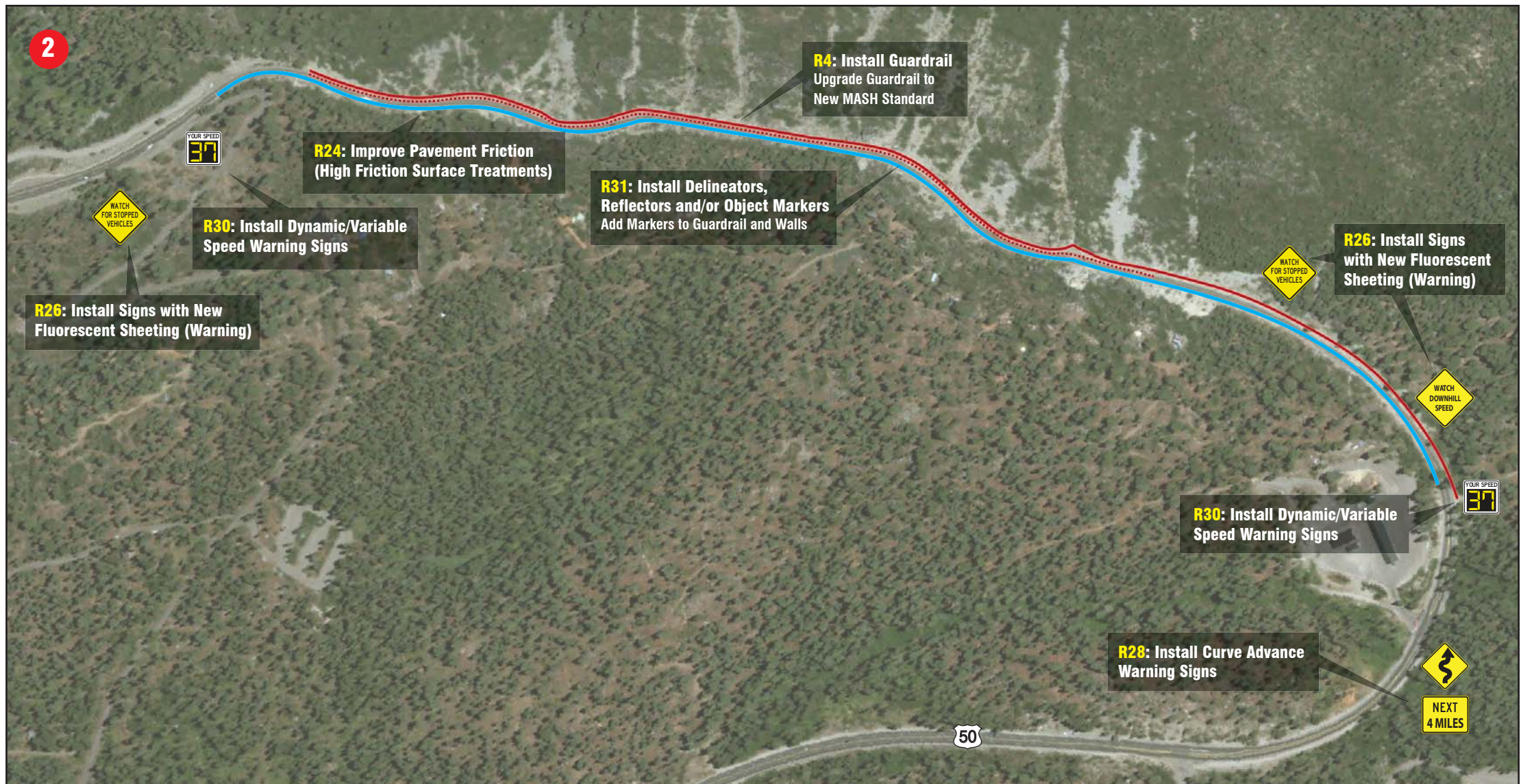
**R30:** Install Dynamic/Variable Speed Warning Signs

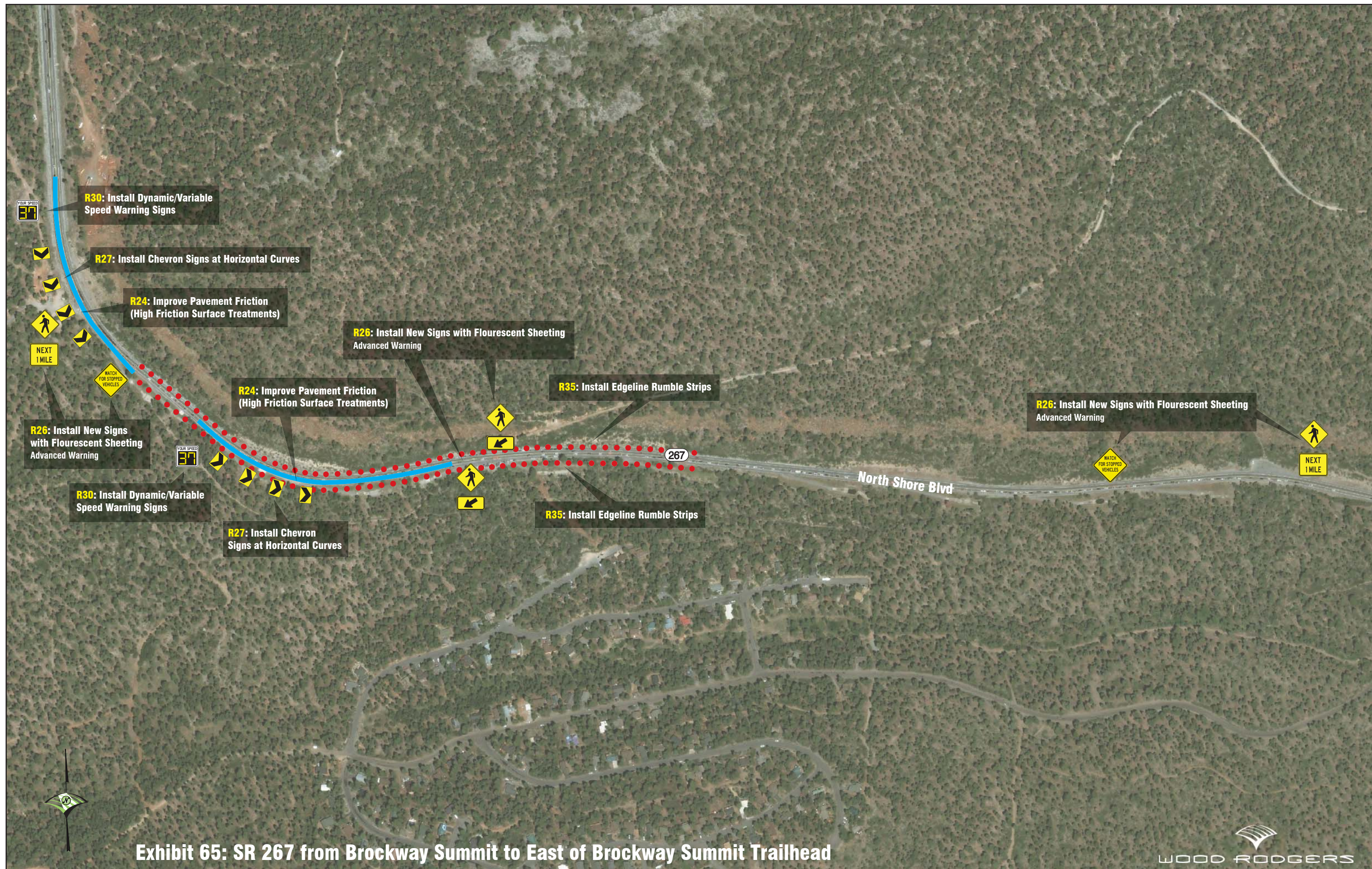


**Exhibit 62: North Upper Truckee Road at Mt. Rainier Drive**



**Exhibit 63: Lake Tahoe Boulevard from Mt. Rainier Drive to Mule Deer Circle**







Convert Access to  
Right-In/Right-Out Only  
Local Access Only

Split Phasing for East-West  
Movements to Allow Separation of  
Pedestrians Crossing US 50 and  
Conflicting Left-Turn Movements

Install No Turn on Red Sign  
for Westbound Right Turn

Improve ADA Connectivity  
at Driveway

Kahle Drive

Utility Boxes Adjacent to  
Intersection to be Relocated  
to Create Better Visibility at  
the Intersection

Install Bike Lane with  
Curb and Gutter

Extent of New Curb  
and Gutter

Install Sidewalk to Connect  
Bus Stop to Intersection

Install Crosswalks and ADA  
Ramps on all Legs

Install Sidewalk to Connect  
Businesses to Intersection

Protected Left-Turns for North-South  
Movements on US 50 to Separate  
Left-Turning Movements from People  
Crossing Kahle Drive

Install a Multi-Use Path  
Connect to Elks Point Road

Exhibit 66: Kahle Drive



**Exhibit 67: US50 Between Lake Parkway and Kingsbury Grade Road**



## HSIP Application Development

### *Off State Facilities*

Of the three locations off Caltrans facilities, two were submitted as part of Caltrans' HSIP Cycle 9 call for projects. Those were the applications for North Upper Truckee Road/East San Bernardino Avenue in El Dorado County and Pioneer Trail/Edna Street intersection in South Lake Tahoe. The Pioneer Trail/Edna Street location was submitted as an HSIP application with a single location.

The North Upper Truckee Road/East San Bernardino Avenue location was packaged with two additional locations in El Dorado county that shared similar road and crash characteristics. The final application included three locations where there were curves present and a high number of run-off-road, hit object crashes.

- North Upper Truckee Road at East San Bernardino Avenue
- North Upper Truckee Road at Mt. Rainier Drive
- Lake Tahoe Boulevard from Mt. Rainier Drive to Mule Deer Circle.

The Tamarack Avenue/Blackwood Road location was not submitted as an HSIP application because the cost estimate was below the \$100,000 HSIP threshold and additional locations that would benefit from similar treatments could not be identified in time for the HSIP Cycle 9 deadline. However, the recommended set of improvements at that intersection remains a valuable set of treatments if funding can be secured for it.

### *Caltrans Facilities*

The three Caltrans locations identified were not advanced as HSIP applications. For the improvements identified at these locations to advance to implementation, the local jurisdictions within which they were located would need to be the agency that submits the application for funding. While these three locations were among the highest ranked high-risk corridors in the Tahoe Region, Caltrans District 3 indicated that none of them rose to a high-enough level of concern on a statewide basis for Caltrans to directly apply state safety funds to construct

improvements along them. Therefore, for the Tahoe Region to see improvements for these three high-risk crash corridors, the local agencies would need to pay for or apply for HSIP funds, construct the improvement, and with most of the proposed countermeasures, financially support ongoing operations and maintenance. Additionally, many of the countermeasures proposed were not ultimately supported by Caltrans District 3, making the remaining supported improvements either too low-cost to apply for funds, or not meaningful enough to construct the project.

Ultimately, for all three locations, the local jurisdictions chose not to move the HSIP applications forward after receiving feedback from Caltrans that Caltrans would not be able to support the designs as scoped and reflected in the above concept designs. Caltrans specifically noted concern for all three locations about responsibility for maintaining treatments and cost of repairing damaged countermeasures. These concerns included potential complications of conducting snow removal without damaging treatments in the long term (beyond 3 years of useful life).



Photo: TRPA

- Location: SR 267 between Brockway Summit and 500 feet East of Brockway Summit Trailhead** – During the field review of this location with Caltrans District 3 staff, staff indicated support for the proposed countermeasures. However, in a subsequent conversation with Caltrans District 3, Caltrans District 3 staff stated they would not support either dynamic speed feedback signs or high-friction surface treatment at the location. They also questioned the implementation of the chevron signs along the curves within the corridor. One of Caltrans District 3 major concerns was maintenance of the treatments moving forward. These were the primary treatments proposed for the location, as a result, Placer County chose not to move forward with a scaled back version of the concept, which likely would not have met the minimum \$100,000 threshold for HSIP projects.
- Location: US 50 between Old Meyers Grade Road and Echo Summit** – During the field review of this location with Caltrans District 3 staff, staff indicated support for the proposed countermeasures. However, in a subsequent conversation with Caltrans District 3, Caltrans retracted support for the use of high friction surface treatment and stated they would not maintain the vehicle speed feedback signs proposed as part of the concept. Based on this outcome, El Dorado County chose not to move forward with a scaled back version of the concept which likely would not have met the minimum \$100,000 threshold for HSIP projects.
- Location: Emerald Bay Road (US 50/SR 89) between F Street and 13th Street** – Caltrans District 3 Initially indicated support for an HSIP application that included new enhanced pedestrian crossings including pedestrian refuge islands and pedestrian flashing beacons at the unsignalized intersections of 5th St, 10th St, B St, and D St and other safety improvements at the signalized intersection of Lake Tahoe Boulevard and Emerald Bay Road. However, in subsequent conversations, Caltrans District 3 retracted their support for the raised pedestrian refuge islands supporting only flush pedestrian refuges, stated the entire project would need to be implemented under an encroachment permit, and as a result the cost of maintaining the improvements would need to be paid for by the City of South Lake Tahoe. Additionally, Caltrans District 3 staff indicated concerns around the distance between crossing improvements. Based on these changes and conditions for implementation from Caltrans District 3, the City of South Lake Tahoe chose not to move forward with the HSIP application.

#### ***Nevada DOT Facilities***

The team worked with NDOT to identify locations in the Tahoe Region with crash history and potential for crash reduction through engineering treatments. The locations selected are both on NDOT facilities within Stateline, NV. They are focused on addressing safety needs for people walking and biking and were selected from Table 12 in Section 6.1.

## 7.3 SUMMARY OF FINAL PROJECTS

Table 17 presents the summary of the final projects. The benefit/cost ratios were calculated using the Caltrans HSIP Analyzer from HSIP Cycle 9. While not all these projects were submitted for HSIP funding due to lack of resolution between Caltrans and local agencies, these are the highest-risk locations in the Tahoe Region, based on the systemic safety analysis conducted for this Safety Strategy, and therefore, it would be appropriate for local jurisdictions, TRPA, and Caltrans to find resolution on implementing the safety improvements.

**Table 17: Highest Priority Safety Projects for the Tahoe Region**

Location	Jurisdiction	State	State HWY	Benefit	Cost	B/C
Pioneer Trail and Edna Street	South Lake Tahoe	CA	No	\$6,006,001	\$170,100	35.3
Tamarack Avenue and Blackwood Road	South Lake Tahoe	CA	No	\$3,644,038	\$41,200	88.4
Emerald Bay Road (US 50/SR 89) between F Street and 13th Street	South Lake Tahoe	CA	Yes	\$8,396,250	\$607,500	13.8
Local Roads in El Dorado County (3 locations)	El Dorado County	CA	No	\$4,183,377	\$682,300	6.1
US 50 between Old Meyers Grade Road and Echo Summit	El Dorado County	CA	Yes	\$16,000,000	\$1,200,000	13.3
SR 267 between Brockway Summit and 500 feet East of Brockway Summit Trailhead	Placer County	CA	Yes	\$8,000,000	\$250,000	32
US 50/Kahle Drive and Kahle Drive to Visitor Center/Bus Stop	Nevada DOT	NV	Yes	Not calculated <sup>2</sup>	\$1,349,000	Not calculated <sup>2</sup>
US 50/Lake Parkway and Lakeway Parkway to Kingsbury Grade	Nevada DOT	NV	Yes	Not calculated <sup>2</sup>	\$590,000	Not calculated <sup>2</sup>

<sup>1</sup>Benefit and cost estimates are preliminary and were not finalized after decision was made not to pursue HSIP applications for locations. Benefits estimates were calculated using the HSIP analyzer and costs were based on initial concept designs included in appendix.

<sup>2</sup>Benefit estimates were not calculated for these two projects.

## 7.4 BARRIERS TO IMPLEMENTING PROVEN SAFETY COUNTERMEASURES

While developing the Lake Tahoe Region Safety Strategy, challenges emerged regarding which proven safety countermeasures are appropriate in snow country due to conflicts with winter maintenance activities, and ongoing commitments to maintain implemented safety elements. This section is aimed at maintaining the necessary momentum to collaboratively overcome challenges and implement proven safety countermeasures.

### Approach to Systemic Safety

TRPA considers the Systemic Safety Analysis Report (SSAR) program as a means of proactively integrating State Department of Transportation (DOTs) and Federal Highway Administration approved safety countermeasures on documented or risk-based locations to improve safety performance in the Tahoe Region. However, there are challenges to implementing many, often low-cost proven safety countermeasures at Lake Tahoe due to various factors, which can limit the installation of roadway safety elements. This document acknowledges the thoughtful balance that is necessary between maintenance operations, mobility, and safety during all phases of planning and implementation. At Lake Tahoe, the state highway facilities have the majority of the safety issues, including injury and fatal crashes and are the roadways with risk factors for future crashes. The state DOTs continue to investigate and improve many aspects of their Tahoe roadways. Caltrans is currently considering additional lighting and mid-block crossings along U.S. Highway 50. These improvements and additional action are needed to assist regional partners and the State in meeting federally required safety performance measures and improving safety for all roadway users.

## Maintenance

As referenced above, both the activity itself such as operating a snow plow and responsibility for ongoing maintenance of proven safety countermeasure improvements are primary reasons many countermeasures are not implemented. While all committee members understand the resource limitations, the countermeasures considered in the Lake Tahoe Region Safety Strategy are recognized by the State DOTs and nationally by FHWA as proven safety countermeasures for reducing crashes. The purpose for highlighting these challenges is to continue to collaborate and act on creative ways to make the necessary investments or adjustments to implement recommended data-informed countermeasures. This could involve establishing additional maintenance resources, investing in appropriate maintenance equipment, and thoughtfully modifying maintenance activities. Examples of recommended safety countermeasures include pedestrian refuge or crossing islands, high friction surface treatment, curb extensions, and vehicle speed feedback signs. All implementing partners need to align around these challenges to find consensus on implementation and find ways to fund and maintain these treatments across the Tahoe Region.

## Use of Treatments

Interpretation of how some treatments are to be used and the cost/benefit between the life cycle of such treatments and maintenance is not consistent among local partners and DOTs. The Lake Tahoe Region Safety Strategy notes the utility and benefit of proven safety countermeasures and their range of uses. Many of these HSIP-approved treatments, such as vehicle speed feedback signs and high friction pavement treatment emphasize the need to slow vehicle speeds for site conditions to increase driver awareness to the roadway features and reduce crash risks.



Priority Intersection Example: Grove Street and SR 28

## 8.0 RECOMMENDATIONS AND NEXT STEPS

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The following are recommendations for TRPA and its regional partners to consider in their efforts to improve roadway safety in the Tahoe Region.

- Implement the high priority projects identified in Section 10.0. Based on the safety analysis conducted for the Safety Strategy, these represent the locations in the Tahoe Region with most potential to benefit from engineering countermeasures. This will require inter- and intra-agency coordination.
- Work with Caltrans and Nevada DOT to implement enhanced pedestrian crossings across the state facilities, including constructing pedestrian refuge islands and other proven safety countermeasures.
- Apply the performance evaluation approach described in the Performance Evaluation MOU to inform transportation project development in the Tahoe Region. This will help create transportation infrastructure that is appropriately sized thereby reducing the risk for people walking and biking. It will also help reduce the potential for higher than desired vehicle speeds in the off-peak travel periods, thus reducing motor vehicle related collisions.
- Apply the Rapid Assessment and Response to Safety Issues Toolbox<sup>15</sup> as part of regional and local agency efforts to respond to safety concerns raised by community members and those that are found via safety analysis.
- Work together to improve the quality of and access to crash data across the Tahoe Region consistent with the Data Improvement MOU.
- Establish a coordinated emergency and evacuation response plan across the jurisdictional boundaries within the Tahoe Region as time and capacity permits.
- Re-evaluate Tahoe Region Safety Performance in three to five years to gauge the impact of the actions taken as a result of this Safety Strategy including the projects that were completed after 2016, that were not completed at the time of the data collection for this document.

## 9.0 ATTACHMENTS

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- Attachment A – Rapid Assessment and Response to Safety Issues Toolbox
- Attachment B – Project Development Team Meeting Agendas, Participants, and Notes
- Attachment C – GIS Database Data Dictionary
- Attachment D – Project Concept Design Cost Estimates

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<sup>15</sup> Attachment C



[linkingtahoe.com](http://linkingtahoe.com)

## ATTACHMENT A – RAPID ASSESSMENT AND RESPONSE TO SAFETY ISSUES TOOLBOX

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# LAKE TAHOE REGION SAFETY PLAN **RAPID ASSESSMENT AND RESPONSE TO SAFETY ISSUES TOOLBOX**

## **Prepared By**

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Sacramento, CA 95816



**TAHOE  
REGIONAL  
PLANNING  
AGENCY**

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TREATMENT SUBGROUP	COUNTERMEASURE	CRASH REDUCTION POTENTIAL	HSIP ELIGIBILITY		Page
			CA	NV	
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# GUIDE TO COUNTERMEASURES TOOLBOX

## INTRODUCTION

Each page starts with the name of the treatment, a photo of typical implementation of the treatment, and the location type where it is applicable: *unsignalized intersection*, *signalized intersection*, or *roadway segment*.

## DESCRIPTION AND PLACEMENT DETAILS

This section provides a brief description of the treatment, including:

- How the treatment may improve safety performance
- Specific conditions in the Tahoe Region that may make the treatment a good fit
- Considerations for implementing the treatment

### SIGNS

#### DYNAMIC SPEED WARNING SIGNS

Dynamic speed warning signs provide a direct alert to drivers approaching a turn if they are exceeding the posted advisory speed.

##### WHY WAS THIS CHOSEN FOR TAHOE?

- Unsafe speeds are a common factor in crashes on state facilities in the Tahoe Region.
- Single-vehicle crashes are common at the outside edge of curved roads in the Tahoe Region.
- Dynamic signs respond to individual driver behavior to provide a targeted warning for unsafe speeds.

##### PLACEMENT CONSIDERATIONS

- Consider combining with the following treatments: chevron signs or curve advance warning signs.
- Use posts designed to break away or otherwise minimize damage if an errant motorist strikes them.



##### CRASHES

APPLICABLE TYPES  
**ALL**



POTENTIAL  
CRASH  
REDUCTION\*

##### PLANNING-LEVEL COST

**\$7,500**  
PER SIGN

##### EXPECTED DESIGN LIFE

**10**  
YEARS

##### HSIP ELIGIBILITY



\*Caltrans, Local Roadway Safety Manual, Version 1.4, April 2018.  
30% if flashing beacon is included.



## CRASH DETAILS

This section reports the treatment's impacts to expected crashes.

**Types addressed:** A simple classification of the types of crashes impacted: *all*, *pedestrian and bicycle*, or *night*. For treatments with California HSIP eligibility (see *HSIP Eligibility*), these are the crashes applicable for benefit calculations.

### Potential Crash Reduction:

Potential effectiveness of the treatment in reducing crashes, expressed as a percentage of historical crashes observed at a location. The expected reduction is based on the Caltrans *Local Roadway Safety Manual* or research found on the Federal Highway *Crash Modification Factors (CMF) Clearinghouse*.

## IMPLEMENTATION

Indicates implementation costs and lifespan. The cost are estimates for a 'standard' version of the treatment. The expected design life is based on the Caltrans *Local Roadway Safety Manual*, except where noted otherwise.

## NEVADA ELIGIBILITY

Provides the designated federal contribution level for approved projects in Nevada. Note that this is subject to change from year to year; check with the state HSIP coordinator.

## CALIFORNIA ELIGIBILITY

Provides the designated federal contribution level for approved projects in California. Note that this is subject to change from year to year; check with the state HSIP coordinator.

A dark gray trapezoidal graphic element with a diagonal cut on the left side, containing white text.

# 01 **ROADWAY SEGMENTS**

Rural or Limited Development

## DYNAMIC SPEED WARNING SIGNS

Dynamic speed warning signs provide a direct alert to drivers approaching a turn if they are exceeding the posted advisory speed.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Unsafe speeds are a common factor in crashes on state facilities in the Tahoe Region.
- Single-vehicle crashes are common at the outside edge of curved roads in the Tahoe Region.
- Dynamic signs respond to individual driver behavior to provide a targeted warning for unsafe speeds.

### PLACEMENT CONSIDERATIONS

- Consider combining with the following treatments: chevron signs or curve advance warning signs.
- Use posts designed to break away or otherwise minimize damage if an errant motorist strikes them.

### CRASHES

APPLICABLE TYPES  
**ALL**

**30%** POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$7,500**  
PER SIGN

### EXPECTED DESIGN LIFE

**10**  
YEARS

### HSIP ELIGIBILITY



**100%**



**100%**

\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.  
30% if flashing beacon is included.

## SIGNS

# OVERSIZED WARNING/ REGULATORY SIGNS

Large warning/regulatory signs improve visibility for drivers in advance of a stop or regulatory signs.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Stop-controlled intersections of highways and minor streets are a risk factor in crashes in the Tahoe Region.
- Large signs can help to improve driver awareness of approaching intersections or other conflict zones that may be hard to see or out of sight due to roadway curvature.

### PLACEMENT CONSIDERATIONS

- Signs must be within approaching drivers' line of sight.
- Plans should consider the presence and placement of other existing signs and look for opportunities to reasonably consolidate or remove unnecessary signs to avoid sign clutter.



### CRASHES

APPLICABLE TYPES

**ALL**



POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$500**

PER SIGN

### EXPECTED DESIGN LIFE

**10**  
YEARS

### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018

## SIGNS

# CHEVRON SIGNS ON HORIZONTAL CURVES

Chevron signs provide a visual cue and guidance to drivers navigating a curve.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Unsafe speeds and improper turning are associated with fatal and severe crashes in the Tahoe Region.
- Single-vehicle crashes are common at the outside edge of curved roads in the Tahoe Region.
- Chevron signs assist in managing speed through a curve by providing a clear visual cues regarding the degree of the curve as motorists approach and drive through the curve.

### PLACEMENT CONSIDERATIONS

- Use posts designed to break away or otherwise minimize damage if an errant motorist strikes them.
- Consider combining with the following treatments: curve advance warning signs or dynamic speed feedback signs.

### CRASHES

APPLICABLE TYPES

**ALL**

**40%** POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$500**

PER SIGN

### EXPECTED DESIGN LIFE

**10**  
YEARS

### HSIP ELIGIBILITY



**100%**



**100%**

\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

## SIGNS

# CURVE ADVANCE WARNING SIGNS

Curve advance warning signs provide a visual cue and guidance to drivers entering a curve.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Unsafe speeds and improper turning are associated with fatal and severe crashes in the Tahoe Region.
- Curve advance warning signs assist in managing speed through curves by alerting drivers and suggesting lower speeds.
- Single-vehicle crashes are common at the outside edge of curved roads in the Tahoe Region.

### PLACEMENT CONSIDERATIONS

- Use posts designed to break away or otherwise minimize damage if an errant motorist strikes them.
- Consider combining with the following treatments, chevron signs or dynamic speed feedback signs.



### CRASHES

APPLICABLE TYPES  
**ALL**

**25%\***  
↓  
POTENTIAL  
CRASH  
REDUCTION\*\*

### PLANNING-LEVEL COST

**\$500\*\*\***  
PER SIGN

### EXPECTED DESIGN LIFE

**10**  
YEARS

### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

\*\* 30% if flashing beacon is included.

\*\*\* \$7,500 if flashing beacon is included.

# IMPROVE PAVEMENT FRICTION



Improved pavement friction applications increase vehicle ability to remain on the roadway and can help reduce single-vehicle run off road crashes, particularly on curves.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Single-vehicle crashes are common at the outside edge of curved roads in the Tahoe Region.
- Improved pavement friction helps drivers remain in their travel lane on curves during inclement conditions.

### PLACEMENT CONSIDERATIONS

- Horizontal curves.
- Transitions from a high-speed to low-speed environment or intersections after a steep grade can also be considered.

### CRASHES

APPLICABLE TYPES

**ALL**

**40%** POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$1**

PER SQUARE FOOT

### EXPECTED DESIGN LIFE

**10**  
YEARS

### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

# TRPA APPROVED CENTERLINE RUMBLE STRIPS/STRIPES

Centerline rumble strips provide auditory and tactile feedback to drivers that their vehicles have left the travel lane. Pavement markings over the strips (called rumble stripes) enhance the markings in wet and dark conditions.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Head-on crashes are the largest contributor to fatal and severe injury crashes in the Tahoe Region.
- Undivided roadway alignments tend to create a higher risk for head-on crashes.

### PLACEMENT CONSIDERATIONS

- Apply continuously along an identified corridor.
- This treatment should be installed consistent with TRPA guidance to reduce roadway noise and applied continuously rather than as a spot treatment.

### CRASHES

APPLICABLE TYPES

**ALL**



POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$10**

PER LINEAR FOOT

### EXPECTED DESIGN LIFE

**10**  
YEARS

### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

## PAVEMENT TREATMENT

# TRPA APPROVED EDGELINE RUMBLE STRIPS/STRIPES



Centerline rumble strips provide auditory and tactile feedback to drivers that their vehicles are leaving the roadway. Pavement markings over the strips (called rumble stripes) enhance the markings in wet and dark conditions.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Single-vehicle crashes are common at the outside edge of curved roads in the Tahoe Region.
- Many roadways in the Tahoe Region lack recovery space; edgeline rumble strips would provide drivers with a warning before they leave the roadway.

### PLACEMENT CONSIDERATIONS

- When selecting locations, consider the potential for bicycle travel and available width for bicyclists to ride on the shoulder without needing to ride on the rumble stripes. A shoulder of at least 5 feet is desirable to provide space for bicyclists.
- This treatment should be installed consistent with TRPA guidance to reduce roadway noise and applied continuously rather than as a spot treatment.
- Gaps in the rumble strips should be installed on routes with bicycle activity at locations where bicycles are likely to enter or exit the shoulder.

### CRASHES

APPLICABLE TYPES

**ALL**



POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$10**

PER LINEAR FOOT

### EXPECTED DESIGN LIFE

**10**  
YEARS

### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

## EDGE TREATMENT

# DELINEATORS, REFLECTORS, OR OBJECT MARKERS

Delineators clarify the path of travel for vehicles through turns, and provide positive guidance to help motorists stay in the appropriate lane.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Wrong-side-of-road and unsafe lane change crashes are associated with fatal and severe injury outcomes in the Tahoe Region.
- Delineators, reflectors, or object markers would improve driver awareness of approaching turns and help drivers stay in their lane through curves.

### PLACEMENT CONSIDERATIONS

- Consider combining with the following treatments: chevron signs or dynamic speed feedback signs.
- Winter maintenance practices may need to be modified to accommodate these, or they may need to be removed during months when snowfall may occur.

### CRASHES

APPLICABLE TYPES

**ALL**



POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$50**

PER ITEM

### EXPECTED DESIGN LIFE

**10**  
YEARS

### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

## EDGE TREATMENT

# REMOVE, RELOCATE, OR PROTECT FIXED OBJECTS ADJACENT TO ROAD

This treatment provides clear space or protection for drivers to correct their path if they leave the roadway.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Single-vehicle crashes are common at the outside edge of curved roads in the Tahoe Region.
- Removing, relocating, or protecting fixed objects mitigates risk and crash severity when drivers leave the roadway, by either increasing available recovery time or reducing the severity of impact with the object.

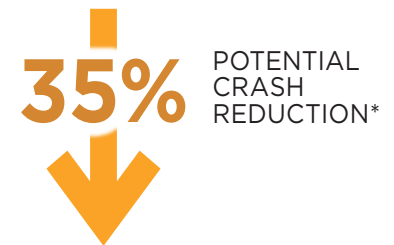
### PLACEMENT CONSIDERATIONS

- The width of the clear zone should be based on exposure, including traffic volumes, speeds, and side slopes. See the *AASHTO Roadside Design Guide* for more information.
- Where removal or relocation is not feasible, consider marking the object to make it more visible to motorists or installing safety systems such as crash attenuators or guard rail to help reduce the potential severity of a crash if someone strikes it.

### CRASHES

APPLICABLE TYPES

**ALL**



### PLANNING-LEVEL COST

**\$200-10K\*\***  
PER OBJECT

### EXPECTED DESIGN LIFE

**20**  
YEARS

### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

\*\* Costs depend on whether objects can be easily relocated/removed.

## EDGE TREATMENT

# WIDEN SHOULDER (UNPAVED)

A widened shoulder provides unpaved space between the roadway and fixed objects or slopes beside the road, and also provides more recovery time for drivers who leave the roadway.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Single-vehicle crashes are common at the outside edge of curved roads in the Tahoe Region.
- Shoulder space mitigates risk and reduces crash severity when drivers leave the roadway by increasing recovery space.

### PLACEMENT CONSIDERATIONS

- Increasing shoulder widths within horizontal curves can maximize the effectiveness of the treatment while minimizing costs.
- For locations with low ADT (fewer than 1,000 vehicles per day), narrowing lanes may be more cost effective.

### CRASHES

APPLICABLE TYPES

**ALL**



POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$3\*\***

PER LINEAR FOOT

### EXPECTED DESIGN LIFE

**20**  
YEARS

### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

\*\* Costs depend on whether objects can be easily relocated/removed. Cost estimate does not include right-of-way acquisition and assumes limited cut or fill is required.

## TRUCK CLIMBING LANE

Truck climbing lanes address conflicts between passenger vehicles and slower trucks on inclined roadways and can help reduce the likelihood of motorists passing slow-moving trucks in no-passing zones.

### WHY WAS THIS CHOSEN FOR TAHOE?

- In the Tahoe Region, potential conflicts are generated along state facilities by the presence of steep grades, trucks, and inconsistent weather conditions.
- Climbing lanes separate slower traffic, producing more consistent speeds and fewer crashes.

### PLACEMENT CONSIDERATIONS

- Truck climbing lanes should be considered where steep grades slow heavy vehicle speeds, resulting in vehicle platoons (typically 5% grades and steeper).
- Truck traffic volumes should be considered when determining if a climbing lane is appropriate.

### CRASHES

APPLICABLE TYPES

**ALL**

**20-33%** POTENTIAL CRASH REDUCTION\*

### PLANNING-LEVEL COST

**\$2K**

PER LINEAR FOOT

### EXPECTED DESIGN LIFE

**20**  
YEARS

### HSIP ELIGIBILITY



**0%**



**0%**

\* Fontaine et al. "Safety Impact of Truck Lane Restrictions on Multilane Freeways." TRB 88th Annual Meeting Compendium of Papers CD-ROM (2009).

A dark gray trapezoidal graphic element with a diagonal cut on the left side, extending from the bottom left towards the center of the page.

## 02 INTERSECTIONS

Any Land Use Condition

## INTERSECTION LIGHTING

Intersection lighting improves visibility and sight distance, especially for non-motorized users.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Appropriate along corridors with mixed land use and pedestrian or bicycle activity.
- Lighting illuminates crossings, helping pedestrians to navigate crossings; it increases pedestrian visibility and improves advanced warning for motorists.

### PLACEMENT CONSIDERATIONS

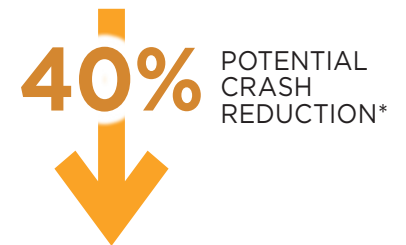
- Suitable for mixed land use corridors with a history of nighttime crashes
- TRPA-approved lighting should be designed to illuminate conflict areas at crossings and intersections as well as along paths of travel while being consistent with dark-sky guidelines to reduce light pollution.



### CRASHES

APPLICABLE TYPES

**NIGHT CRASHES**



### PLANNING-LEVEL COST

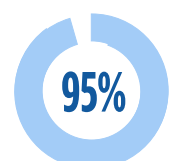
**\$7K**

PER LIGHT

### EXPECTED DESIGN LIFE

**20**  
YEARS

### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

## SIGNALIZED INTERSECTION

# PEDESTRIAN COUNTDOWN SIGNAL HEADS

Countdown signal heads clearly identify the available time for pedestrians to cross the street.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Appropriate along corridors with mixed land uses with pedestrian presence, or at intersections with pedestrian activity.
- Countdown signal heads allow pedestrians in a crosswalk to know how much time remains to cross, and have been shown to decrease pedestrian crossing during the "Don't Walk" interval.

### PLACEMENT CONSIDERATIONS

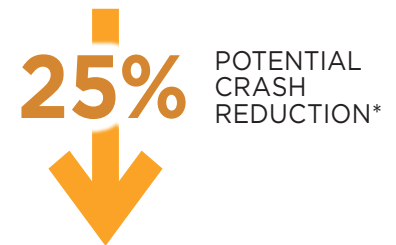
- Suitable for longer-distance crossings (when pedestrian interval is more than 7 seconds) to inform pedestrians of remaining time.
- Typically installed network-wide or subarea-wide to create consistency for pedestrians.
- When constructing or upgrading pedestrian crossings, review current ADA guidelines to ensure crossings meet current standards.\*\*



### CRASHES

APPLICABLE TYPES

**PEDESTRIANS  
AND BIKES**



### PLANNING-LEVEL COST

**\$1K**  
PER SIGNAL HEAD

### EXPECTED DESIGN LIFE

**20**  
YEARS

### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.  
\*\* The Accessible Pedestrian Signals Guide at [http://apsguide.org/chapter\\_overview.cfm](http://apsguide.org/chapter_overview.cfm) is a good reference for best practices.

## SIGNALIZED INTERSECTION

# SIGNAL TIMING ADJUSTMENTS

Signal timing modifications can help reduce turning conflicts and manage speeds along a corridor. Modifications may include re-timing the yellow change interval or all-red clearance interval, adding or adjusting signal phases, or coordinating signals to manage speed on a corridor.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Appropriate in areas with a concentration of rear-end or turning movement crashes at a signalized intersection or series of intersections and crashes involving turning vehicles and pedestrians or bicyclists crossing the street.
- Candidate locations for improved signal timing in the Tahoe Region include transition areas along state facilities that pass through corridors with mixed land uses.

### PLACEMENT CONSIDERATIONS

- Suitable for locations with frequent broadside or turning-related crashes.
- Latest MUTCD and best practice guidance should be used for determining appropriate phasing, clearance times, and timing strategies.
- Phasing and timing plans may be limited by available equipment and may require upgraded signal hardware.



### CRASHES

APPLICABLE TYPES  
**ALL**

**15%**  
POTENTIAL  
CRASH  
REDUCTION\*

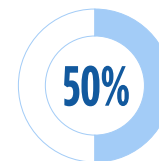
### PLANNING-LEVEL COST

**\$5K\*\***  
PER INTERSECTION

### EXPECTED DESIGN LIFE

**2\*\*\***  
YEARS

### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

\*\* Cost assumes changes are feasible with existing hardware and does not include hardware updates.

\*\*\* Design life may vary based on local signal timing practices.

## SIGNALIZED INTERSECTION

# ADVANCE DILEMMA ZONE DETECTION

Advance dilemma zone detection identifies oncoming vehicles and adjusts timing (e.g., extends a yellow phase) to reduce potential conflicts.

### WHY WAS THIS CHOSEN FOR TAHOE?

- This treatment would be appropriate at signalized intersections with a concentration of rear-end or angle crashes at signalized intersections in the Tahoe Region.
- Advance dilemma zone detection reduces the frequency of vehicles entering an intersection during a red phase.

### PLACEMENT CONSIDERATIONS

- Suitable for high-speed approaches of 40 mph or greater to a signalized intersection or locations with frequent red-light violations.
- It may be possible to leverage existing detector loops or cameras, although older signal controller equipment may need to be upgraded.



### CRASHES

APPLICABLE TYPES

**ALL**

**40%** POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$5K\*\***  
PER SYSTEM

### EXPECTED DESIGN LIFE

**10\*\*\***  
YEARS

### HSIP ELIGIBILITY



**100%**



**0%**

\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

\*\* Cost assumes changes are feasible with existing hardware and does not include hardware updates

\*\*\* Design life may vary based on local signal timing practices.

## SIGNALIZED INTERSECTION

# ADAPTIVE SIGNAL TIMING

Adaptive timing adjusts signal and phase timing in response to current traffic patterns to promote smooth flow of traffic.

### WHY WAS THIS CHOSEN FOR TAHOE?

- In the Tahoe Region, travel patterns vary significantly by season and can change unexpectedly due to weather, special events, and crashes.
- The presence of rear-end crashes at intersections indicates potential benefits to improving traffic flow.

### PLACEMENT CONSIDERATIONS

- Before implementing, consider evaluating the benefit of implementing at multiple locations along a corridor (and potential for crossing jurisdictions).
- Consider what adaptive technologies will work best under local conditions (there are a variety of systems that operate best in varied environments).
- For more information, see NCHRP Synthesis 403: "Adaptive Traffic Control Systems: Domestic and Foreign State of Practice."



### CRASHES

APPLICABLE TYPES

**ALL**



**17%**

POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$54K**

PER SYSTEM

### EXPECTED DESIGN LIFE

**2\*\***  
YEARS

### HSIP ELIGIBILITY



\* Ma et al., "Estimation of the Safety Effects of an Adaptive Signal Control System," *Journal of Transportation Engineering*, Volume 142, Issue 12 (2016).

\*\* Design life may differ depending on local signal timing practice.

## SIGNALIZED INTERSECTION

# LEADING PEDESTRIAN INTERVAL AT TRAFFIC SIGNAL



Leading pedestrian intervals (LPIs) allow pedestrians to start crossing in advance of turning motorists. The treatment makes pedestrians more visible to turning vehicles, making drivers more likely to yield to pedestrians crossing the street.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Multilane crossings along mixed land use corridors were noted as a pedestrian risk factor in the Tahoe Region.
- LPIs give pedestrians a head start, making them more visible to motorists.

### PLACEMENT CONSIDERATIONS

- LPIs provide a minimum head start of 3-7 seconds, depending on crossing distance.
- May be combined with curb extensions to improve visibility of pedestrians to motorists at high-conflict intersections.
- LPIs can be implemented in combination with signs reminding motorists that turning vehicles are required to yield to pedestrians.

### CRASHES

APPLICABLE TYPES  
**PEDESTRIANS  
AND BIKES**

**60%** POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$1K-2K**  
PER CROSSING

### EXPECTED DESIGN LIFE

**20**  
YEARS

### HSIP ELIGIBILITY



**100%**



**0%**

\* Caltrans "Local Roadway Safety Manual," Version 1.4, June 2018

## SIGNALIZED INTERSECTION

# EXCLUSIVE PEDESTRIAN PHASING

Exclusive pedestrian phasing stops all vehicular movement and allows pedestrians to cross in any direction (including diagonally).

### WHY WAS THIS CHOSEN FOR TAHOE?

- Appropriate for intersections that serve higher pedestrian volumes during peak tourist seasons.
- Record of multiple pedestrian crashes at intersections along mixed land use corridors in the Tahoe Region.

### PLACEMENT CONSIDERATIONS

- Exclusive pedestrian phasing is most effective in locations that serve 1,200 pedestrians per day and are less than 60 feet to cross.<sup>1</sup>
- This treatment may result in longer cycle lengths at intersections with long diagonal crossing distances, increasing total delay for road users.

### CRASHES

APPLICABLE TYPES  
**PEDESTRIANS**



POTENTIAL  
CRASH  
REDUCTION\*

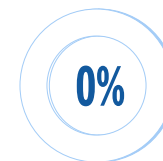
### PLANNING-LEVEL COST

**\$10K**  
PER INTERSECTION

### EXPECTED DESIGN LIFE

**10\*\***  
YEARS

### HSIP ELIGIBILITY



Chen et al., "The Relative Effectiveness of Pedestrian Safety Countermeasures at Urban Intersections - Lessons from a New York City Experience." Presented at the 91st Annual Meeting of the Transportation Research Board, January 22-26, Washington, DC (2012).

\*\* Design life may differ depending on local signal timing practice.

<sup>1</sup> Bonneson et al., Development of Guidelines for Pedestrian Safety Treatments at Signalized Intersections.

## SIGNALIZED INTERSECTION

### ADVANCE STOP BAR BEFORE CROSSWALK (BIKE BOX)

Bike boxes increase separation between stopped vehicles and crosswalks at intersections. They create designated, visible space for bicyclists to wait at a red light and also provide additional space between people crossing the street and motor vehicles.

#### WHY WAS THIS CHOSEN FOR TAHOE?

- Appropriate for corridors with mixed land uses with pedestrian and bicyclist presence or a history of pedestrian or bicyclist crashes.
- Bike boxes provide a buffer from vehicles for pedestrians crossing and provide space for bicyclists at the stop bar. Bike boxes increase motorist awareness of bicyclist presence.

#### PLACEMENT CONSIDERATIONS

- Suitable in locations where bikes are present or encroachment into crosswalk is common.
- Snow and ice can reduce the effective life of pavement markings. More frequent maintenance may be required depending on winter conditions.



#### CRASHES

APPLICABLE TYPES  
**PEDESTRIANS  
AND BIKES**



POTENTIAL  
CRASH  
REDUCTION\*

#### PLANNING-LEVEL COST

**\$1K**  
PER APPROACH

#### EXPECTED DESIGN LIFE

**10**  
YEARS

#### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

## UNSIGNALIZED INTERSECTION

# INTERSECTION PAVEMENT MARKINGS

Legible pavement markings enhance an approaching driver's awareness of an unsignalized intersection.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Pavement markings at the approach to an intersection alert drivers to the need to stop or be aware of cross traffic.
- Stop-controlled intersections of highways and minor streets are a risk factor in crashes in the Tahoe Region.

### PLACEMENT CONSIDERATIONS

- *Intersection ahead* pavement markings can be useful to increase motorist awareness of an upcoming, potentially difficult-to-see intersection.
- Snow and ice can reduce the effective life of pavement markings. More frequent maintenance may be required depending on winter conditions.

### CRASHES

APPLICABLE TYPES

**ALL**



POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$2,500**

PER INTERSECTION

### EXPECTED DESIGN LIFE

**10\*\***  
YEARS

### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

\*\* Design life may differ depending on local conditions.

## UNSIGNALIZED INTERSECTION

# ROUNABOUT

Converting a signal or stop-controlled intersection to a roundabout reduces turning conflicts and limits speeds through the intersection.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Improper turning and unsafe speeds are two of the most common collision factors in the Tahoe Region.
- Roundabouts help reduce the severity of crashes and manage speeds while continuing to serve mobility needs for vehicles, pedestrians, and bicyclists.

### PLACEMENT CONSIDERATIONS

- On state facilities within California, an intersection control evaluation (ICE) process would be required before a change of intersection control could occur.
- NCHRP Report 672: "Roundabouts: An Informational Guide, Second Edition," provides planning, operations, and design guidance for developing and implementing roundabouts. Includes best practices for designing roundabouts that meet current demand and provide flexibility for widening in future if appropriate.
- The Caltrans Highway Design Manual includes additional information on roundabouts.

### CRASHES

APPLICABLE TYPES

**ALL**

**50%** POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$1M-4M**

PER INTERSECTION

### EXPECTED DESIGN LIFE

**20**  
YEARS

### HSIP ELIGIBILITY



**100%**



**100%**

\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

\*\* Converting an Intersection to Roundabout is HSIP eligible if converting from a two-way stop control but is NOT eligible if converting from an all-way stop control.

A dark gray trapezoidal graphic element with a diagonal cut on the left side, containing white text.

## 03 ROADWAY SEGMENTS

Mixed Land Uses, Multimodal

## ACCESS MANAGEMENT

### RAISED MEDIAN

Raised medians clearly demark opposing directions of traffic and direct turning movements to appropriate locations.

#### WHY WAS THIS CHOSEN FOR TAHOE?

- Improper turning movements constitute the second-most-common collision factor in the Tahoe Region.
- Raised medians channelize turn movements to specific locations where storage and adequate site distance can be provided.

#### PLACEMENT CONSIDERATIONS

- Consider snow plow operations when selecting curb design. After installation, adjustments to snow plow operations may be needed.
- Consider median placement in the context of the broader corridor where it will be placed and the corresponding impact on access and circulation.



#### CRASHES

APPLICABLE TYPES  
**ALL**

**25%** POTENTIAL  
CRASH  
REDUCTION\*

#### PLANNING-LEVEL COST

**\$150**  
PER LINEAR FOOT

#### EXPECTED DESIGN LIFE

**20**  
YEARS

#### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

\*\* HSIP Eligibility does not include landscaping in medians.

# DIRECTIONAL MEDIAN OPENINGS

Medians and openings help to manage access and other conflicts, particularly near intersections.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Improper turning movements constitute the second-most-common collision factor in the Tahoe Region.
- Directional median openings can manage conflicts in the Tahoe Region by directing access-related movements away from an intersection, separating potential conflicts.

### PLACEMENT CONSIDERATIONS

- This treatment can be considered for locations with frequent turning-related crashes at access points.
- For higher speed approaches, consider vehicle storage needs based on the anticipated demand for left-turns to help reduce the risk of rear-end crashes on the major street approaches.
- Consider implementation as part of an access management plan, rather than as a spot treatment.
- Adjustments to snow plow operations may be needed during winter snow conditions.

### CRASHES

APPLICABLE TYPES

**ALL**

**50%** POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$20K**

PER MEDIAN OPENING

### EXPECTED DESIGN LIFE

**20**  
YEARS

### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

## PEDESTRIAN CROSSING

### RAISED MEDIANS/ REFUGE ISLANDS

Raised medians with refuge islands decrease pedestrian crossing distance lengths and exposure to vehicle traffic.

#### WHY WAS THIS CHOSEN FOR TAHOE?

- Multilane uncontrolled crossings are associated with a higher number of pedestrian crashes in the Tahoe Region.
- Refuge islands would shorten crossing length, allowing pedestrians to cross one direction of traffic at a time.

#### PLACEMENT CONSIDERATIONS

- Median must have at least 6 feet of clear width to accommodate people using wheelchairs.
- At crossing locations where bicyclists are anticipated, a width of 10 feet is desirable to accommodate bicycles with trailers or groups of bicyclists.

#### CRASHES

APPLICABLE TYPES  
**PEDESTRIANS  
AND BIKES**

**45%** POTENTIAL  
CRASH  
REDUCTION\*

#### PLANNING-LEVEL COST

**\$20**  
PER SQUARE FOOT

#### EXPECTED DESIGN LIFE

**20**  
YEARS

#### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

## PEDESTRIAN CROSSING

# ENHANCED PEDESTRIAN CROSSING AT UNCONTROLLED LOCATIONS



Treatments that enhance the visibility of pedestrian crossings help alert drivers to the need to slow their speed and potential need to stop if pedestrians are present.

### WHY WAS THIS CHOSEN FOR TAHOE?

- This treatment would be appropriate in mixed land use corridors with pedestrian and bicyclist presence or a history of pedestrian or bicyclist crashes.
- Enhanced pedestrian crossings help increase crossing visibility and promote motorist yielding behavior.

### PLACEMENT CONSIDERATIONS

- Consider combining with other speed management treatments, such as a dynamic speed warning sign, on high-speed roadways.
- Consider the need for lighting at the crossing to provide appropriate visibility of the crossing and pedestrians during dawn, dusk, and night conditions.

### CRASHES

APPLICABLE TYPES  
**PEDESTRIANS  
AND BIKES**

**20%\*** POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$2,500\*\***  
FOR NEW SIGNS AND MARKINGS

### EXPECTED DESIGN LIFE

**10\*\*\***  
YEARS

### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.  
20% for signs and markings; 30% if include flashing beacon.

\*\* \$2,500 for new signs and markings; \$15,000 if include flashing beacon.

\*\*\* 10 years for signs and markings; 20 years for flashing beacon.

## PEDESTRIAN CROSSING

# PEDESTRIAN HYBRID BEACON

By stopping motor vehicle traffic, pedestrian hybrid beacons help to create gaps in traffic for pedestrians to cross the street.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Multilane uncontrolled crossings in mixed land use corridors are a risk factor in the Tahoe Region.
- Pedestrian hybrid beacons would aid pedestrian safety by increasing driver awareness and yielding behavior.

### PLACEMENT CONSIDERATIONS

- Typically located at locations with 4 or more lanes and vehicle volumes greater than 15,000 per day.
- Time for button to activate beacon should balance need to serve pedestrians in a timely manner with providing sufficient flow and stopping time for vehicles.
- Before installation, confirm ability to provide power to the site (solar may be an option).
- Design so that the push button to activate the beacon is accessible to all users.
- There is no warrant that needs to be met or satisfied for installation of a PHB.
- Consider installing signs to inform drivers and pedestrians on how to read the beacon.

### CRASHES

APPLICABLE TYPES  
**PEDESTRIANS  
AND BIKES**

**55%** POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$80K**  
PER SYSTEM

### EXPECTED DESIGN LIFE

**20**  
YEARS

### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

## PEDESTRIAN CROSSING

# PEDESTRIAN SIGNAL

Pedestrian signals provide pedestrians with a signal-controlled crossing at a previously uncontrolled location where pedestrian volumes warranted a signal. The signal remains green until actuated by a push button call.

### WHY WAS THIS CHOSEN FOR TAHOE?

- This treatment would be appropriate in mixed land use corridors with significant pedestrian presence or a history of pedestrian crashes.
- Pedestrian signals have a nearly 100% rate of motorist yielding behavior.

### PLACEMENT CONSIDERATIONS

- Implementation in California should meet the traffic signal warrant for pedestrians as defined in the California MUTCD.
- The push button to activate the pedestrian signal should be easily accessible to pedestrians, including wheelchair users, and to bicyclists.
- Time for button to activate signal should balance need to serve pedestrians in a timely manner with providing sufficient flow and stopping time for vehicles.

### CRASHES

APPLICABLE TYPES  
**PEDESTRIANS  
AND BIKES**

**55%** POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$120K**  
PER SIGNAL

### EXPECTED DESIGN LIFE

**20**  
YEARS

### HSIP ELIGIBILITY



**100%**



**100%**

\* Chen et al.. "The Relative Effectiveness of Pedestrian Safety Countermeasures at Urban Intersections - Lessons from a New York City Experience." Presented at the 91st Annual Meeting of the Transportation Research Board, January 22-26, Washington, DC (2012).

## ROADWAY CONFIGURATION

### SIDEWALK/PATHWAY

Sidewalks and separated pathways provide separate space for pedestrians to walk, reducing exposure to motor vehicles and decreasing the likelihood of walking in the roadway.

#### WHY WAS THIS CHOSEN FOR TAHOE?

- The Tahoe Region includes road segments with no sidewalk provision and a history of pedestrian crashes.
- Sidewalks reduce potential conflicts between pedestrians and vehicles by providing physically separated space for walking.

#### PLACEMENT CONSIDERATIONS

- The Lake Tahoe Active Transportation Plan prioritizes using shared-use paths and only installing sidewalks when right of way for a shared-use path is not available.
- Sidewalks may be most appropriate in mixed-use or community contexts.
- Shared-use paths may connect to activity generators off the roadway or serve as parallel facilities in rural/natural contexts.

#### CRASHES

APPLICABLE TYPES  
**PEDESTRIANS  
AND BIKES**

**80%** POTENTIAL  
CRASH  
REDUCTION\*

#### PLANNING-LEVEL COST

**\$25**  
PER LINEAR FOOT

#### EXPECTED DESIGN LIFE

**20**  
YEARS

#### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

## ROADWAY CONFIGURATION

### BIKE LANES (TRADITIONAL, BUFFERED, SEPARATED)

Bike lanes provide dedicated space for bicyclists. Designs may include degrees of physical separation from parked vehicles and moving vehicles.

#### WHY WAS THIS CHOSEN FOR TAHOE?

- Streets through commercial areas in the Tahoe Region often lack bicycle infrastructure.
- Bike lanes would reduce bicycle/vehicle conflicts by separating uses and encouraging more predictable movements from all parties.

#### PLACEMENT CONSIDERATIONS

- Adding buffers or physically separating bike lanes increases safety and comfort for bicyclists.
- Add additional separation to right of lane if angled parking is present.
- Snow and ice can reduce the effective life of pavement markings. More frequent maintenance may be required depending on winter conditions.
- For more information, consult the AASHTO *Guide for the Development of Bicycle Facilities, 4th Edition*, or the NACTO *Urban Bikeway Design Guide*.



#### CRASHES

APPLICABLE TYPES  
**PEDESTRIANS  
AND BIKES**

**35%** POTENTIAL  
CRASH  
REDUCTION\*

#### PLANNING-LEVEL COST

**\$50\*\***  
PER LINEAR FOOT

#### EXPECTED DESIGN LIFE

**20**  
YEARS

#### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.  
Crash reduction applies to traditional bike lane installation.

\*\* Cost estimate is for a traditional bike lane.

\*\*\* HSIP eligibility limited to installation of traditional bike lanes.

## ROADWAY RECONFIGURATION

# ROADWAY RECONFIGURATION

A roadway reconfiguration reduces the number of vehicle travel lanes and reallocates roadway space to help manage speeds and reduce crash risk for all users.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Unsafe speed is a contributing factor to many crashes in the Tahoe Region.
- A roadway reconfiguration reduces crash risk in commercial and visitor corridors in the Tahoe Region by slowing vehicle speeds, shortening pedestrian crossings, and designating space for bicyclists.

### PLACEMENT CONSIDERATIONS

- Roadway reconfigurations may be implemented as part of reconstruction or pavement rehabilitation projects.
- FHWA considers locations with less than 20,000 ADT or fewer than 750 vehicles in the peak hour as good candidates for 4-to-3-lane reconfigurations.<sup>1</sup>



### CRASHES

APPLICABLE TYPES

**ALL**



POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$10**

PER LINEAR FOOT

### EXPECTED DESIGN LIFE

**20**  
YEARS

### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

<sup>1</sup> FHWA, "Road Diet Informational Guide," 2014.

# BUS PULL-OUT

Pull-out stops allow buses to move out of the bicycle lane and complete boarding at the curb.

### WHY WAS THIS CHOSEN FOR TAHOE?

- In the Tahoe Region, there are few locations where buses can complete loading and unloading outside of travel lanes along existing and future transit routes.
- Allowing for buses to pull out of the travel lanes without blocking the bike lane improves conditions for all road users.

### PLACEMENT CONSIDERATIONS

- Bus pull-outs are preferred over in-lane stops when transit service includes long dwell times, such as at stops where drivers change or where a high percent of boarding passengers have baggage.
- Care is needed to manage conflicts on routes where bicyclists are present. Buses should be able to pull fully out of the vehicle travel lane and bicycle lane.
- In lane stops are preferred if there is insufficient space for a bus to fully pull out of the travel lane.



### CRASHES

APPLICABLE TYPES

**ALL**

**N/A**

POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$150**

PER LINEAR FOOT

### EXPECTED DESIGN LIFE

**20**  
YEARS

### HSIP ELIGIBILITY



**00%**



**00%**

\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

## BUS BOARDING ISLANDS



Bus boarding islands are dedicated boarding locations separated from the sidewalk that enable buses to stop without crossing a bike lane, thereby reducing bus-bike conflicts.

### WHY WAS THIS CHOSEN FOR TAHOE?

- In the Tahoe Region, mixed land use corridors serve the bus network and bike trips. This stop type increases safety by reducing bus-bike conflicts at bus stops.

### PLACEMENT CONSIDERATIONS

- Consider existing and planned bike facilities to identify where islands help maintain separated bike lanes.
- Rider safety can be increased by adding space for passengers to wait.

### CRASHES

APPLICABLE TYPES

**PEDESTRIAN  
AND BIKES**

**N/A**

POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$180**

PER LINEAR FOOT

### EXPECTED DESIGN LIFE

**20**  
YEARS

### HSIP ELIGIBILITY



**00%**



**00%**

\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

## DYNAMIC SPEED WARNING SIGN

Dynamic speed warning signs provide a direct alert to drivers approaching corridors where lower speeds are appropriate due to a mix of modes and frequent pedestrian crossings.

### WHY WAS THIS CHOSEN FOR TAHOE?

- Presence of multiple locations where state facilities transition from regional connections to mixed land use corridors.
- Dynamic signs respond to individual driver behavior to provide a targeted warning for unsafe speeds.

### PLACEMENT CONSIDERATIONS

- This treatment is often appropriate when combined with accompanying countermeasures for multimodal corridors.
- Signs should be located to warn drivers prior to entry to a lower-speed roadway section.



### CRASHES

APPLICABLE TYPES

**ALL**



POTENTIAL  
CRASH  
REDUCTION\*

### PLANNING-LEVEL COST

**\$7.5K**

PER SIGN

### EXPECTED DESIGN LIFE

**10**  
YEARS

### HSIP ELIGIBILITY



\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

## SIGNS

### GATEWAY SIGN

Treatment adds stylized signs along major arterials at city/town borders to clearly mark the transition into the town and help naturally slow motorists.

#### WHY WAS THIS CHOSEN FOR TAHOE?

- State roads in the Tahoe Region cross through multiple cities and towns; state roads are bordered with more-dense mixed land uses, and lower speeds are appropriate.
- Gateway signs can assist with wayfinding by alerting drivers that their destination is approaching.

#### PLACEMENT CONSIDERATIONS

- Consider combining with dynamic speed warning sign to reinforce for drivers the change in appropriate speed.



#### CRASHES

APPLICABLE TYPES

**N/A**

**N/A** POTENTIAL  
CRASH  
REDUCTION\*

#### PLANNING-LEVEL COST

**VARIES\*\***

#### EXPECTED DESIGN LIFE

**VARIES**

#### HSIP ELIGIBILITY



**00%**



**00%**

\* Caltrans, "Local Roadway Safety Manual," Version 1.4, April 2018.

\*\*Gateway treatments can vary by location and type of configuration selected. Costs vary accordingly."

ATTACHMENT B –  
PROJECT DEVELOPMENT TEAM MEETING AGENDAS, PARTICIPANTS, AND  
NOTES

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**Mail**

PO Box 5310  
Stateline, NV 89449-5310

**Location**

128 Market Street  
Stateline, NV 89449

**Contact**

Phone: 775-588-4547  
Fax: 775-588-4527  
[www.trpa.org](http://www.trpa.org)

**Lake Tahoe Safety Plan PDT Meeting #1  
AGENDA**

*November 30, 2017 – 9am -11am  
Tahoe City Public Utility District  
221 Fairway Dr, Tahoe City, CA 96145*

- |                          |   |
|--------------------------|---|
| <b>9:00am -9:05am</b>    | <b>Welcome and Introduction</b>   |
| <b>9:05am -9:10am</b>    | <b>Project Orientation</b> <ul style="list-style-type: none"><li>• Overview</li><li>• Key Topics and Outcome Goals</li></ul>  |
| <b>9:10am –9:40am</b>    | <b>Crash Reporting (first of two discussions with PDT)</b> <ul style="list-style-type: none"><li>• What we have learned thus far about crash reporting practices and databases (15 mins)<ul style="list-style-type: none"><li>○ Information sharing from consultant team</li><li>○ Input and comments from PDT</li></ul></li><li>• Initial ideas for improvements (15 mins)<ul style="list-style-type: none"><li>○ Information sharing from consultant team</li><li>○ Input and comments from PDT</li></ul></li></ul>   |
| <b>9:40am – 10:50am</b>  | <b>Design Volumes (first of three discussions with PDT)</b> <ul style="list-style-type: none"><li>• Current practice and approaches (25 mins)<ul style="list-style-type: none"><li>○ What the consultant team has learned from PDT members and recent projects in the region</li><li>○ Input and comments from PDT</li></ul></li><li>• Impacts and Challenges with Current Practices/Concerns about Modifying the Approach – Group Discussion (25 mins)</li><li>• Different Approaches to Addressing Design Volumes (15 mins)<ul style="list-style-type: none"><li>○ Information sharing from consultant team</li><li>○ Input and comments from PDT</li></ul></li><li>• Proposed Framework and Next Steps for this Topic (5 mins)</li></ul> |
| <b>10:50am – 10:55am</b> | <b>Overview of Initial Locations of Concern</b> <ul style="list-style-type: none"><li>• Provide Summary List and Map of Locations</li></ul>   |
| <b>10:55am -11:00am</b>  | <b>Overview of Upcoming Activities, Next Steps, Next Meeting Planning</b>   |

**Mail**

PO Box 5310  
Stateline, NV 89449-5310

**Location**

128 Market Street  
Stateline, NV 89449

**Contact**

Phone: 775-588-4547  
Fax: 775-588-4527  
[www.trpa.org](http://www.trpa.org)

**Lake Tahoe Safety Plan PDT Meeting #1  
Meeting Notes**

*November 30, 2017 – 9am -11am  
Tahoe City Public Utility District  
221 Fairway Dr., Tahoe City, CA 96145*

**Attendees:**

1. Marc Birnbaum, Caltrans
2. Darryl Chambers, Traffic Safety, Caltrans District 3
3. Marty Earles, Traffic Safety, Caltrans District 3
4. Scott Waksdal, Caltrans District 3
5. Steve Pyburn, FHWA
6. Lori Campbell, NDOT
7. Hoang Hong, NDOT
8. Christopher Wright, NDOT
9. Jon Erb, Douglas County
10. Rebecca Solomon, Placer County
11. John Kahling, El Dorado County
12. Officer Peter Mann, California Highway Patrol, Truckee – North Tahoe
13. Cheryl Surface, Washoe County
14. Dennis Troy, Washoe County
15. Sgt. William Dawson, Nevada Highway Patrol
16. Jeff Gartener, California Highway Patrol – South Lake Tahoe
17. Curtis Fong, Lake Tahoe Bicycle Coalition
18. Capt. Dan Coverly, Douglas County Sherriff

**Project Team:**

1. Morgan Beryl, TRPA
2. Reid Haefer, TRPA
3. Kira Smith, TRPA
4. Michelle Glickert, TRPA
5. Erin Ferguson, Kittelson & Associates, Inc.
6. Brian Ray, Kittelson & Associates, Inc.
7. Matt Braughton, Kittleson & Associates.

**Welcome and Introduction**

- Why was this PDT formed?
  - Emphasis on making new connections
  - Integrating new perspectives
- What is the purpose of the Lake Tahoe Safety Plan
  - Data collection
    - Reporting of crashes critical for funding
    - Building a consistent dataset for the region
  - Help local jurisdictions get to constructible projects
    - Identify preliminary projects and start design process.
  - How to design for all users
    - Motorists, bicyclists, pedestrians
    - Integrating an understanding of roadway characteristics into our evaluation of safety

## **Project Orientation**

- Key Topics and Outcome Goals
  - Develop Projects
    - Develop toolbox for quick-response, low cost, and near-term solutions
    - Develop 8 Grant-competitive projects, on and off state highway (HSIP, ATP)
  - Improve Crash Data
    - Completeness
    - Consistency/access to the data
  - Process for Design Volumes
  - PDT Meetings:
    - Six meetings over the course of the project
    - #1 – Crash Data + Design Volumes. First of two discussions around these issues – this session is more about questions than answers.
    - Project wrap-up in July/ August 2018
  - PDT Roles: Information sharing, problem solving & implementation of recommendations
    - How do we address safety concerns as a region?
    - How do we improve our processes/data to be most effective?
    - Homework assignments after the meeting from time to time.

## **Crash Data Overview and Initial Motor Vehicle Crash Analysis**

- The Crash reporting task is made up of three components:
  - Roadway and intersection framework
    - How do we approach our analysis and build a consistent database?
    - The project approach to safety analysis includes more than just crash data; it also incorporates roadway characteristic data to be able to identify recurring risk factors that contribute to crashes.
    - How can we develop systemic treatments to address these locations?
  - Data analysis and priority locations
    - What are the key trends and what are the priority locations?
  - Design recommendations
    - How do we plan to address the highest priority locations?
- Safety database being built:
  - Roadway Segment Data
    - Cross-sections
    - Additional considerations:
      - Access, crossings, transit stops
      - Roadway alignment (horizontal/vertical)
  - Intersections
    - Turn lanes, free movements
    - Signal phases
    - Visibility
    - Additional considerations such as transit stop locations.

- Initial Crash Data Findings Feedback:
  - Year over year crashes are relatively stable – no big picture trends
  - Run off road is the most common type of crashes
  - Angle or broadside crashes #2 and rear-end #3
  - Peaking of crashes in the summer and winter (Dec / January)
  - Comparison of the number of crashes by agency was presented to provide an initial sense of the data ( but is not normalized yet).

**PDT Discussion:**

- **FHWA:** Are crash statistics comparable to other regions? Kittelson will investigate
- **NDOT:** Fatal and severe crashes are most important for HSIP
- **Caltrans:**
  - Have we looked alcohol-involved, DUI crashes?
  - Also consider the types of vehicles and times of year that crashes are occurring?
    - E.g., summer/winter, motorcycles?
  - Look into contributing factors, parties involved
- **FHWA:** Are we looking at the number of people injured versus the number of crashes?
  - Answer: Data is crash based so it could be multiple people in the same crash
  - Provide more detail on number of injuries/fatalities (not just by crash)
- **Kittelson:** Can't engineer into safety – need to also look at programs and elements that support engineering.
- **NDOT:** Will we look for behaviorally-oriented grants? – Answer: Yes
  - Caltrans Office of Traffic Safety, National Highway Traffic Safety Administration
- **Douglas County:** Increased volume as well as increased unfamiliar drivers during those peak crash periods.
- **CHP:**
  - Hit object crashes: Snow plows are not considered vehicles in the data – considered an object if hit while it is moving or fixed object based on when it is stopped (in California, follow up with NDOT to confirm true for Nevada)
- **Douglas County:**
  - Breakout of data is consistent with their experience.
  - More crashes in Douglas County are affected by road design where there is no center turn lane – rear-end/turning crashes more prevalent. Something to evaluate.
    - Working with NDOT to address these issues currently.
    - Also, in Douglas County, NV-207 into Carson Valley has safety concerns where people who haven't driven in snow before results in crashes (PDO crashes mostly). Peak shown is a result of snow + people in the Region, not just SNOW.
    - Parking at resorts / beaches is a consistent issue for all visitors

- Visitors park on the road and/or across the roadway and end up “playing frogger” across the road, they aren’t using the crosswalk because not located in their direct path – lots of activity crossing the roads
  - Not having a turn lane in some areas causes conflicts
- **NHP:** Icy roadways and inclement conditions on the NV side of the lake because it is in the shaded side of the Basin slope. Also more lane miles of highway.
- **Placer County:**
  - Popular season/design volumes -> how do we collect that data and how is that included in the collision analysis? Will a focus on heavy volume areas will be part of the plan? What are the attractors and generators of activities and how can we make improvements around them.
- **Kittelson:** We won’t be collecting counts but would appreciate any counts agencies have to assist in our analysis.
  - TRPA and Placer can assist.
- **Caltrans:**
  - Can we drill down into day of week and hourly patterns of the data?
  - Are the crashes occurring during local circulation or when people are moving in and out of the Region.
- **NHP:**
  - Filter out deer and bear from non-collision data (crashes are very common involving deer and bears). Near misses all the time as well.
  - How to address secondary crash events?
  - Most problems during the commute, Monday through Friday. Contractors not used to the weather.
  - Sand Harbor does keep traffic volumes in and out of the park (large volumes)
    - Cave Rock may have a counter as well
    - TRPA to assist in getting the data.
  - Working theory by NHP staff is that December/January peaking is when the roads don’t seem “bad” yet, so people aren’t ready to slow down.
- **FHWA**
  - Show concentration maps of serious injuries/fatals and PDOs.
  - Use rates to guide investments
  - Use concentration and rates and road user breakdowns to find lower-cost improvements.
    - E.g., LPI, reflective backplates, etc.
  - Drill down into the data to rates and types.
- **NDOT:**
  - Rates will be very difficult
  - Required for NDOT HSIP

### **Initial Bicycle and Pedestrian Crash Analysis**

- Need to follow up with NDOT on the crash database for key bicycle- and pedestrian-related fields for clarification.
- Seeing more crashes in hospital data than in the reported crash data
  - This data includes solo bike crashes.
  - Limitations of the crash data from hospitals
    - We can't separate out mountain bike/off-road crashes.
    - More crashes in hospital data and also more severe injuries
    - Different coding than reported crashes.
- How can we improve this going forward?
- General trend is underreporting of bike/ped reporting of crashes
- National challenge of underreporting – trying to understand within the context of Tahoe.
  - Lower severity less likely to be reported, solo crashes also less likely to be reported.
  - Pedestrian crashes often hit on private roadways.
  - PDO crashes are often underreported because of value involved.
  - Police may not respond - looking into dispatch data to under crash patterns or trends.

### **PDT Discussion:**

- **CHP:** A lot of bicycle crashes are very mundane. Not as severe as one might think. This is consistent with what is reflected in the reported bicycle crashes.

### **Reconciling Crash Data**

- Working to reconcile two datasets (NDOT and CHP)
  - How to make the data more consistent and make it available to everyone in that consistent format.
  - Near-term versus long-term.
- Supplement with dispatch and local jurisdiction data, hospital data well as.

### **PDT Discussion:**

- **Lake Tahoe Bicycle Coalition:** In relation to the hospital data – can we track how many are mountain biking versus others going forward?

### **Design Volumes (first of three discussions with PDT)**

- We talk about design volumes at two different levels: the peak 15 minutes versus broader, regional contexts.
- As a practice we are moving away from hunting “black spots” (locations with higher frequencies of crashes) to looking at risk through roadway characteristics.
- *Challenge:* When thinking about volume...

- Are we obligated to think about visitors to the Tahoe Region in the same way that we think about the local circulation?
- Tahoe has a special role, unique character.
- Project designs have a big impact on project planning and design.
  - The bigger the project the more complicated.
  - Projects are going to be hard in the Region given varied constraints
  - Great range of population and communities
- Two ways of thinking about design volumes
  - Regional forecasting/historic counts
  - Peak volumes applied to each project
- Unique opportunity to think about proactive safety – design volumes as a piece of that discussion.
- Regional forecasts are more difficult in Tahoe Region
  - Unique demand/environment
  - Applicable on a regional level but how to connect to the ground level (corridor, intersection, etc.)
  - What are we trying to do with the demand forecasts? (don't just try to satisfy LOS, how do we address demand as a larger issue).
  - How do we find the balance between regional forecasts and what we need to make good project-level decisions?
- What peak do we use?
  - Traditional? Weekend? Combination?
  - Special Peaks
  - How do we derive them? Historical perspective?
  - What is most appropriate for Tahoe?
- What are the risks?
  - Too High Estimates
    - Overbuilding
    - Not feasible to construct
    - Overserving motorized users, impacts quality of service for all roadway users
    - Decreased safety performance
  - Too Low
    - Congestion
    - EM response times
    - Secondary crashes
    - Quality of Life for visitors, locals, who?
    - Do we need to serve that demand?
- Current Practices

- *5<sup>th</sup> busiest seasonal traffic day* – where does it come from and is it applicable. Does it apply to every facility?
- *Future expansion is critical* – For whom? For all facilities? Do we need to plan for that footprint or do we need to not preclude the possibility?
- *Some days of significant delay* – What is significant? Who determines what is significant? Is delay the only measurement. Volume-to-capacity? Queues? Are there risks we might consider?
- **Discussion Question: What peak volume is used?**
  - **Placer County:**
    - Working a lot on neighborhood traffic management programs.
      - Focus on weekend peaks during the season.
      - School and commute peaks during the off-season.
  - **NDOT:** Evaluated a road diet on East Shore, U.S. Highway 50. Community was opposed.
    - Normal peak doesn't apply for Tahoe, applied summer peak for Saturday during the summer. Don't design for special holidays but do currently design for peak season.
  - **Kittelson:** What is the basis for why you must serve that peak?
  - **NDOT:** Summer population is higher and don't want to discount the increased population in the summer to avoid delays.
  - **Placer County:**
    - If we don't plan for that summer peak, community won't support it. We can't design for the lightest season traffic. It is very difficult to plan for different peaks. From a community support perspective, it is hard to move away from peaks. But that peak that currently used is situational.
    - We have 5-6 months out of the year where the peaks are terrible. Roundabouts are safer and more efficient. Never going to fix the heavy weekends, but what is safer for the other 75% of the year? Everything is situational and there is lot of gray.
    - Need to consider pedestrian safety versus throughput volume. Need a balance.
  - **FHWA:**
    - What does underbuilt mean?
    - Caltrans is looking at the process of safety, operations, and cost. How do we balance the different aspects of a project? Are we going to serve demand, optimize for safety, or some other aspects?
    - In looking at peaks, we need to understand the effect of multiple peaks but need to understand different impacts as well.
  - **Caltrans:**
    - What are we trying to accomplish before we talk about what we are designing for? What is the reserve capacity of the system?

- Before that we need to understand what we are trying to do – do we have concepts about what we are trying to address during the peak periods?
- Are we focusing on local circulation except for “X” hours of the day to focus on moving people in and out of the Region?
- We need to understand these questions to determine the peak volume to use.
- **NDOT:**
  - The challenge is to segment the sections around the Lake because of the context. Some stretches have no driveways, while others are where people live and cross the roadway actively.
- **NHP:**
  - Sand Harbor are looking at a 15-year plan. Currently implementing off-street, congestion priced parking in combination with busing people to manage demand (East Shore Express).
  - What are the resorts/ beaches and other key stakeholders planning for?
- **Kittelson:**
  - What does service mean? Whom are we trying to serve and what are we trying to do?
  - May need to integrate an educational approach to broach the topic and help set expectations with agencies and the public.
  - Existing limitations to accessing the Region.
    - Entry and Exit, very limited options.
    - Interior, how do we get around communities in the Region?
    - Between the communities – how do the roadways work between these communities ?
  - Are there benefits of planning for different capacities in different places?
  - What about uniformity in operations? Move people slowly but in a steady state.
  - What is the value of the investment? What is the cost of the infrastructure?
  - Serving peaks can lead to unbalanced capacity and higher speeds. Why plan for something higher than the bottleneck capacity can serve.
  - What happens when having to cross wider roadways. How do we understand the impacts on key nodes?
  - What methods and assumptions might we be using? Variable peak hours, MMLoS, LOS? Are we all comfortable with the existing performance measures?
  - Are there risk-based approaches to thinking about design volumes?
  - Understand the balance of the system – no more capacity than can get in or out.
  - Preserve space but build less now (obtain/preserve right of way, but build less until need is clear). Prioritize projects that don’t preclude – lower priority for less flexible alternatives.
  - Prioritize quantitative safety performance, we don’t want to overprioritize design elements.
- **Caltrans:**

- How do we flush traffic out of the Region? Roundabouts may be one solution but need to consider ability to be flexible in how we plan the system (signal timings adjustments, etc.).
- **FHWA:**
  - We can be a little more innovative in the Tahoe Region.
  - Adaptive signal control needed on U.S. Highway 50 but Caltrans doesn't want to do it. We need to think outside the box with ITS solutions. Need to optimize the system for both safety and operations. ASC would be perfect for the Tahoe Region.
- **Kittelson:**
  - Where and how do the inputs to our projects influence the way we prioritize projects?
  - Things to think about
    - How do we address and estimate demand?
    - How do we address partner agencies needs?
    - How can we document best practices?
    - Are there policy or institutional limits?
    - Who are the key decisionmakers that we need to engage over time?
  - Where and how does this discussion of demand fit your needs?
- **TRPA:**
  - We don't want a plan that sits on the shelf
  - We want a plan that results in actionable items and a framework to carry things forward.

#### **PDT Review of Initial Locations of Concern**

- **Web Map:**
  - <http://kai.maps.arcgis.com/apps/webappviewer/index.html?id=a420e1d728e84274aab0059119ee659e>
- **PDT Homework:**
  - Are there other known locations of concern? Is there any additional input you would like to provide?
  - Need input to help provide context and understand those issues across the Region.
  - We don't want to **not** address a community issue.
  - If you have available traffic or bike/ped volume data you can share, please send it to Morgan.

#### **Overview of Upcoming Activities, Next Steps, Next Meeting Planning**

- Database will be used to do more detailed analysis of the crash data.
  - This will inform initial ideas of rapid response ideas and priority locations.
- Next PDT will further discuss crash data and design volumes.
- Next PDT will be at TRPA offices on February 14<sup>th</sup> – 1:30pm. Morgan to send out invitation.
- Send contacts for data OR data links to Morgan.

## **Appendix: Follow-Up Comments from PDT Members**

### ***Caltrans:***

1. Alcohol is a major contributor to accidents. It is important to understand if the area has an even more excessive rate. Clearly actions taken to address drunk driving are a lot different than design solutions for accidents. Also, it would help to know where and when alcohol related accidents are taking place. Is it tied to casino activity and is manifest in the evenings when people are leaving or what?
2. We need to understand the days of the week and hours of non-alcohol related the accidents. This will help us to understand if there is a relationship between a particular traffic pattern and the incidents.
3. I suggest that we consider using July volume peak period data both coming to and leaving the basin as our initial focus. We can eliminate any holiday type peaking and average the rest.
4. If we find in our accident data we have significant safety issues during the off seasons then we should focus on that like a laser. That may indicate a more intrinsic problem.

**Mail**

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**Location**

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**Lake Tahoe Safety Plan PDT Meeting #2  
AGENDA**

*February 14, 2018; 1:30 – 3:30 p.m.  
128 Market Street, Stateline, NV*

- |                        |   |
|------------------------|---|
| <b>1:30pm -1:35pm</b>  | <b>Welcome and Roll Call</b>  |
| <b>1:35pm -1:40pm</b>  | <b>Project Status Overview</b> <ul style="list-style-type: none"><li>• Schedule Review</li><li>• Key Topics and Outcome Goals</li></ul>   |
| <b>1:40am -2:40pm</b>  | <b>Design Volumes (second of three discussions with PDT)</b> <ul style="list-style-type: none"><li>• Review of Key Points from Meeting #1</li><li>• Framework for Different Approach<ul style="list-style-type: none"><li>○ Draft Roadway Typologies &amp; Specific Roadways in Region per Typology</li><li>○ Draft Performance Measures &amp; Criteria per Typology</li><li>○ Example Application of Different Approach</li></ul></li><li>• Discussion with PDT Integrated Throughout</li></ul>  |
| <b>2:40pm – 3:15pm</b> | <b>Crash &amp; Roadway Data Analysis Findings</b> <ul style="list-style-type: none"><li>• Highlights of Descriptive Crash Analysis</li><li>• Highlights from Roadway Network Screening</li><li>• Review of Draft Roadway Risk Factors for Crashes</li><li>• Review and Discuss Draft Priority Locations for Improvements<ul style="list-style-type: none"><li>○ Comparison Previous Locations of Concern by PDT</li><li>○ Comparison to Planned or Pending Projects</li></ul></li><li>• Questions for PDT<ul style="list-style-type: none"><li>○ How do the priority locations compare to your expectations and concerns?</li><li>○ What have we missed by only looking the data? Are we capturing off-state highway needs?</li></ul></li></ul> |
| <b>3:15pm -3:30pm</b>  | <b>Overview of Upcoming Activities, Next Steps, Next Meeting Planning</b> <ul style="list-style-type: none"><li>• Upcoming Memos for TRPA and PDT Review<ul style="list-style-type: none"><li>○ Draft Recommendations for Improving Crash Data</li><li>○ Draft Recommendations for Alternative Approach to Design Volumes</li><li>○ Draft Crash &amp; Roadway Data Analysis Findings with Priority Locations</li></ul></li><li>• Next PDT Meeting – March 22<sup>nd</sup> (Thursday) or 23<sup>rd</sup> (Friday)<ul style="list-style-type: none"><li>○ Discuss Draft Recommendations in Memos</li></ul></li></ul>  |

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**Lake Tahoe Safety Plan PDT Meeting #2**

**AGENDA - RECAP**

*February 14, 2018; 1:30 – 3:30 p.m.  
128 Market Street, Stateline, NV*

**Attendees:**

Scott Waksdal – Caltrans District 3 Traffic Operations  
Eric Royer – Caltrans District 3 Traffic Operations  
Curtis Fong – Bike The West / Lake Tahoe Bicycle Coalition  
Lori Campbell – NDOT Traffic Safety Engineer  
John Erb – Douglas County Public Works  
John Kahling, El Dorado County – Deputy Director Department of Transportation  
Danielle Hughes – Tahoe Transportation District  
Lt. Mike Edgell – Nevada Highway Patrol  
Lt. Matt Foxworthy – El Dorado County Sheriff (South Lake Tahoe office)

**On the Phone:**

Steve Pyburn – FHWA, California  
Rebecca Solomon – Placer County Traffic Engineer  
Marc Birnbaum – Caltrans Headquarters  
Christopher Wright – NDOT Traffic Operations

**Project Team:**

Morgan Beryl, TRPA  
Reid Haefer, TRPA  
Kira Smith, TRPA  
Erin Ferguson, Kittelson & Associates, Inc.  
Brian Ray, Kittelson & Associates, Inc.  
Matt Braughton, Kittelson & Associates, Inc.

**Welcome and Roll Call**

- Agenda
  - The meeting will refresh from the last PDT meeting and build on that background
  - Project overview:
    - The core activities of the project are to develop a regional roadway safety plan. This plan will consist of:
      - data analysis, identifying treatments at high-priority locations;
      - writing HSIP or other grant applications for the top locations; and
      - and documenting and making recommendations for safety in the Region.
    - The safety plan will be both reactive to sites with a high frequency of crashes and proactive to address sites before crashes happen.
    - In addition to the safety component, the project is also:
      - Developing recommendations to improve crash data for consistency across the region for real-time monitoring of safety
      - Working to establish a consistent approach to project design volumes for the Region that is appropriate to the Tahoe context.

- **Lori, NDOT:** The proactive and reactive approach is consistent with FHWA guidance for both NDOT and Caltrans funding.

#### **Schedule Review**

- Schedule Review
  - Developing draft recommendations – highlight of findings
  - For PDT review in early March
  - Draft priority location recommendations: Located [online here](#) and provided in table format as separate attachment.
  - Morgan: Crash data is important to help TRPA be able to show a need for improvement construction funding.
  - Identify locations and scope projects in April
  - Develop grant applications and concept designs for selected locations in May/June
  - June/July – Final revisions and documentation
- Key Topics and Outcome Goals for today
  - Discuss alternative approach to design volumes
  - Findings from crash analysis

#### **Design Volumes (second of three discussions with PDT)**

- Overview and Intended Outcomes
  - Design volumes are critical to broad planning efforts as well as project-specific contexts. The design volume used often influences how successful a project can be in terms of being constructed.
  - We want to get input on how we should approach design volumes.
  - **Lori, NDOT:** Need to keep in mind that we shouldn't be designing for the worst day. Public perception is that we need to design for 4th of July traffic, but we don't need to do that. It is difficult because of all the tourism but it is important to think outside the box and create a framework.
- Review of Key Points from Meeting #1
  - Project volumes have a huge effect on project planning and design
  - Design volumes can be regional/historic or peak hours at the project level
  - It is appropriate to assess and concur on an approach for consistency across the Region.
  - The Tahoe Region has a unique geography and demand patterns (attracting people from multiple states). Typical peaking patterns don't apply to the Region.
  - How do we bring regional forecasting down to specific projects?
  - Forecasts reflect a demand but may not reflect available capacity of how many vehicles can actually move through or into the Region. Regional forecasts less useful for *project-specific* design hour volumes.
  - How can we be sensitive to each agency's needs and what are the criteria we should use to determine the design volumes? What is most appropriate to the Tahoe Region context now and into the future?
  - **Morgan, TRPA:** no current policy, but a common practice. We want to land on the best method moving forward and then adopt that as a policy for the Region.
  - Does the project need to reflect future footprint now or can it simply not preclude it in the future?
- Do you support the TRPA Travel Shed concept?
  - **Curtis, LTBC:** Yes, on-board with the concept/approach
  - **Lori, NDOT:** We do it for air quality, why not for Tahoe?

- **Eric, Caltrans:** We think it is worth exploring
- **John, EDC:** Agree with Caltrans, we can talk about it
- **Danielle, TTD:** I would like to know more about the thresholds before being committed to the concept
- **Lori, NDOT:** The challenge with the travel shed is that the communities around the lake don't like the way that things were done in other parts. "We're not California". Can we model this on a policy so that it is something that can be pointed to and has been agreed upon.
- **Eric, Caltrans:** We have had similar complaints. "We're not Europe".
- **Marc, Caltrans:** Are we talking about cordoning off the Region?
- **Brian, KAI:** The basic idea is that each agency would adapt and reflect the criteria from the Tahoe travel shed. Not about who owns each trip, but like a "watershed" where the same criteria for evaluation apply throughout the Basin.
- **Danielle, TTD:** We need to look beyond just the Basin watershed boundary. We would want to look at the Resort Triangle area as well. How would that be included?
- Are you aware of and do you support 2017 RTP goals?
  - No comments
- Additional questions
  - How do we address each partner agency policies and guidelines?
  - What steps can we take to best document the issues and needs to support concurrence?
  - Are there existing policies or institutional limits we should first consider?
  - Who are the key decision makers we need to engage to explore these topics? This is likely to be an on-going discussion and forum.
  - What are the best ways to forecast demand?
  - **John, EDC:** The key decisionmakers for El Dorado County are the board members. They are very sensitive to business owners and their concerns. They tend to pay a lot of attention when people in uniform show up and make a statement about public safety. Proposed policy decisions need to be mindful of impacts to businesses, law enforcement, and first responders. Concerns with any of those can cause the issue to bind up.
  - **Rebeca, Placer County:** We look at safety as part of our project development. There is a fine line between making a corridor safe and forcing traffic into neighborhoods. It is important to keep that balance in mind and not just focus on the main corridors.
  - **John, EDC:** Agree, these are issues we have in EDC as well.
  - **Brian, KAI:** We need to balance between network connectivity and neighborhood traffic management. There may be a need for new efforts and energy to do off system evaluations of where we can carry the load and where there are impacts (*systems approach*).
- Are there benefits in having more capacity on a given link or node than can be served by a source or destination?
  - Significant existing capacity constraints on getting into the Region. From topography and environmental clearance perspective, are those able to change ever? Probably not.
  - How do we look at the form and function of roadways within the region?
- Tahoe's Corridor Approach
  - Done in collaboration with TTD, taking deeper dive into the data within the corridors.
  - Linking Tahoe: Defining functions, data, corridor recommendations.
  - Beginning to capture demand and capacity internally and between communities.
  - Best ways to estimate demand?
  - How do we reflect the different contexts?
- How does TRPA define demand for larger and smaller projects? Are they different?

- How is demand used for project evaluation? How do we work around it?
- Can we make appropriate incremental improvements to achieve a benefit?
- **Marc, Caltrans:** There's a lot to unwind. There are a number of ways to look at this from a safety perspective:
  - When do we have the issues and how does that affect us?
  - In certain scenarios we aren't looking for capacity solutions, but then we are looking at operational improvements that make things more predictable, reliable, less frustrating.
  - Like ramp metering – where are we going to stick all the people that can't make it through while we are adjusting the flow. Picture a "basin ramp meter" – where should the delay be? Could we run shuttles or buses to get people from the "meter" to the Basin?
  - Can we step our way out from the constraints?
- **Rebeca, Placer County:** I agree with Marc. One other point about people getting around the Region is the frustration of not knowing how long it is going to take to get somewhere. People aren't aware of how long they will be waiting in a queue. We might need to consider ITS solutions to tell them "X minutes to Y destination".
- **Morgan, TRPA:** We are integrating travel time reliability for monitoring/performance measurement. It is important to make people aware of the issues and delays.
- **Lori, NDOT:** When we reference issues, are we talking about delay, safety, or something else? We need to understand and define what we mean. Regional needs to be defined because the perspective is different for everyone.
- **Brian, KAI:** Just to define the term for everyone, travel time reliability allows one to plan and trust an estimate of how long something is going to take. This allows people to make the choice about when (or whether) they will travel.
- **Lori, NDOT:** Travel time reliability is not unique to the Basin, but when it occurs is unique (ski weeks, 4th of July, etc.)
- **Eric, Caltrans:** In the valley, there is a lot of thought around evacuation routes. Evacuation capacity caused major issues and gridlock for tens of miles when evacuating the Oroville area. Fires/evacuation capacity may be a consideration when making decisions.
- **Morgan, TRPA:** We have a grant in partnership with EDCTC and Caltrans District 3 to evaluate evacuation routes and to address when gridlock is so bad that people can't access their daily needs. We can't know when an emergency situation will occur, but we can be ready with an approach/plan to address it. Adaptive roadway management is an option we are wanting to explore. For example, we could evaluate making traveling over Echo Summit one direction (**John, EDC:** to Ice House Road).
- **Eric, Caltrans:** I agree but we can't just allow county roads to be gridlocked for miles – we need to consider emergency services when talking about solutions, not designing for the busiest days.
- **Brian, KAI:** How do we make sure that this is a comprehensive approach? Early implementation of the structure and then managing it. Establish what to do with the emergency situation.
- **Danielle, TTD:** We are looking at expanding the WayCare system (software company to integrate DOT with emergency management systems). We are working with OES to help get the software systems operating and communicating. The first step is the Tahoe fire alert system.

- **Lori, NDOT:** We are using a predictive system that has helped improve response times to crashes for NHP. GIS-based software uses Waze and fleet sensors to predict crashes based on changes in traffic flow.
- **Marc, Caltrans:** I have a question on demand. Is there the potential to understand how many days of the year that we have major congestion issues and operational concerns (and the days we don't). And from a forecasting perspective, do we think that is going to change?
- **Morgan, TRPA:** Yes and no, in the summers, we can we work to document that (Kittelsohn will work with Reid at TRPA to explore this issue). For winters, it is harder to address because of the variation in snow/weather and its impacts on congestion.
- **Eric, Caltrans:** We have a trend data collection station in Stateline and Meyers for 24-hour monitoring. There is another one near Bedford Avenue in Placerville that can be used for comparison for travel to the Basin.
- **Danielle, TTD:** People are already re-routing to get around by the time they reach the Meyers station – it would be nice to know coming into the Basin.
- **Lori, NDOT:** We can compare with our data monitoring as well.
- **Performance Framework**
  - Should we identify performance metrics for different road types and users?
  - How do we use context to inform project decision making?
  - What tools and metrics do we choose to help develop a framework? E.g., not only queues, LOS, delay, but maybe reliability, safety, etc.
  - **John, EDC:** Using a performance framework is possible but people don't like to be told or feel like they are being manipulated into thinking they are being forced to give up their cars. The key is to make people *want* to get out of their cars if we aren't going to increase capacity. How do you provide the opportunity to get to their destination without driving?
  - **Eric, Caltrans:** More congestion also means less reliable transit.
  - **Steve, FHWA:** Can we expand the framework based on business types? For example, different options for gambling versus skiing areas. We need to understand the customer base and where those people want to go and are willing to get there.
  - **Brian, KAI:** We've been doing things a long time the same way and some parts of it aren't working well. From a safety perspective, can we align our safety plan with the RTP, design volumes, etc? This is a course change and not all of the pieces are there yet, but do we want to change course?
  - **John, EDC:** For some locations in the Basin people want to stay and walk/bike around for a day or two, but then they want to move to a new location and they will default to driving. There are 50 days a year that you are probably not going to solve the congestion/capacity issue but there is an opportunity to make connections via transit (e.g., Emerald Bay to Tahoe City).

## Crash & Roadway Data Analysis Findings

- Highlights of Descriptive Crash Analysis
  - We have been working to identify draft priority locations within the region. We will send out an interactive map to the PDT to review and provide comments on the locations.
    - The map also includes areas that were identified by the PDT as being areas of concern.
    - Red – Vehicles, Blue – Pedestrian, Green – Bicycle
    - **PDT Action: Get online, zoom in and evaluate the results.**
  - From these draft locations we'll develop systemic treatments that can be applied at multiple locations and what are the specific projects we want to prioritize for grant applications.
  - Locations are based on crash and roadway data. We are looking for feedback on whether we have a good mix of local/state facilities or do we want to add/subtract based on planned projects, community feedback, or other reasons?
- Highlights from Roadway Network Screening
  - *Bicycle and Pedestrian Crashes (2012-2016):*
    - Differences may be because of how Nevada and California collect data or based on population.
    - There are more bicycle crashes than pedestrian crashes.
    - More severe crashes involve pedestrians compared to bicyclists.
    - Solo bike crashes are more severe than bike crashes involving a vehicle.
    - Pedestrian crashes have risen but fatal and severe crashes have fallen.
    - 46% of pedestrian crashes and 75% of fatal or severe crashes occur at night
    - More crashes are occurring at unsignalized intersections.
    - 30% ped/bike at 25 – 30 mph, 50% at 35- 40 mph posted speeds.
    - Crashes seem to be occurring where we have traffic of all modes.
    - We see more crashes occurring when we have more bicycle activity in the summer
    - Tuesday has a high percentage of fatal/severe, we are investigating why?
  - **Jon, Douglas County:** I am curious to know about year to year variation given that 2016 was an extreme winter versus 2017 being relatively mild.
  - **Lori, NHP:** NHP data may exclude solo bike crashes, since they don't respond to bike only crashes.
  - **Morgan, TRPA:** This where we want to go by identifying issues with our data collection and reporting procedures, so we want your ideas to make recommendations on improvement and we need your help implementing those improvements.
  - **Danielle, TTD:** Can we correlate bike crashes based on local biking events?
  - **Curtis, LTBC:** During events we are safe. Second ride of the year is during low vehicle volume times. There is monitoring and traffic control on those days. Safety in numbers.
  - **Morgan + Danielle, TRPA/TTD:** Is there any tracking with the lead up to events?
  - **Curtis, LTBC:** Riders will generally come in early and spend 3-4 nights with training rides. Many go from the Casino to Spooner and Alpine County. We only had one phone call from someone who hit a cone during road work. We were asked to warn riders about the road work being done.
  - **Lori, NDOT:** There is a lot of extra signage during the events. (**Curtis, LTBC:** Yes).
  - **Eric, Caltrans:** Often with "Not Stated" or "Unknown" there may not be witnesses or there are conflicting statements from the two parties involved.
  - **Steve, FHWA:** Distracted pedestrians are also important to track and understand.
  - *Motor Vehicle Crash Trends:*

- Head-On and Overturned are the more severe crashes. Wrong Side of the Road, and Other Equipment are also relatively more severe.
  - There is a spike in DUI crashes during summer (and a bit during winter peak as well). We also see an increase in DUI crashes on the weekends (Friday/Saturday)
- **Lori, NDOT:** What is the difference between non-collision versus hit object.
- **Matt, KAI:** It is hard to parse completely due to the differences across state lines in how the collisions are coded. In Nevada, non-collisions include run off the road/hit object. In California they are coded separately.
- *Intersection Risk Factors:*
  - 3-legged controlled highway with minor streets
  - No turn lane storage
  - Undivided major approaches to intersections
- *Roadway Risk Factors:*
  - Two-lane cross sections
  - High speed
- **Eric, Caltrans:** Do we have any specifics about the bikeway facility for bike crashes?
- Upcoming Review of Draft Materials
  - Review and Discuss Draft Priority Locations for Improvements
  - Review of Draft Roadway Risk Factors for Crashes
  - Questions for the PDT when reviewing?
    - Compare these locations with your prior locations of concerns
    - Are there any planned or pending projects in these areas?
    - How do the priority locations compare to your expectations and concerns?
    - What have we missed by only looking at the data? Are we capturing off-state highway needs?
  - **Morgan, TRPA:** Please respect the deadlines. One of our highest priorities is how can we improve data collection processes. Caltrans and NDOT – we need your help in having the discussion up the ladder to implement an effective policy. Think about the draft priority locations for what you think is a good opportunity based on community feedback, RTP project list, etc.

### **Overview of Upcoming Activities, Next Steps, Next Meeting Planning**

- Upcoming Memos for TRPA and PDT Review
  - Draft Recommendations for Improving Crash Data
  - Draft Recommendations for Alternative Approach to Design Volumes
  - Draft Crash & Roadway Data Analysis Findings with Priority Locations
- Next PDT Meeting:
  - March 22<sup>nd</sup> (Thursday)
    - Discuss Draft Recommendations in Memos
- Link to Web Map:
   
<http://kai.maps.arcgis.com/apps/webappviewer/index.html?id=a420e1d728e84274aab0059119ee659e>

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**Lake Tahoe Safety Plan PDT Meeting #3  
AGENDA**

*March 22, 2018; 10:00 a.m. – 12:00 p.m.  
948 Incline Way, Incline Village, NV 89451*

- |                          |  |
|--------------------------|--|
| <b>10:00am – 10:05am</b> | <b>Welcome and Roll Call</b>   |
| <b>10:05am -10:10am</b>  | <b>Project Status Overview</b> <ul style="list-style-type: none"><li>• Schedule Review</li><li>• Key Topics and Outcome Goals</li></ul>  |
| <b>10:10am –10:50am</b>  | <b>Design Volumes</b> <ul style="list-style-type: none"><li>• Reminder of Recommendations</li><li>• Discussion of Comments as a Group</li></ul>  |
| <b>10:50am – 11:20am</b> | <b>Crash &amp; Roadway Data Analysis Findings</b> <ul style="list-style-type: none"><li>• Reminder of Priority Locations</li><li>• Discussion of Comments as a Group</li></ul>   |
| <b>11:20am -11:50am</b>  | <b>Crash Data Recommendations</b> <ul style="list-style-type: none"><li>• Reminder of Recommendations</li><li>• Discussion of Comments as a Group</li></ul>  |
| <b>11:50am - 12:00pm</b> | <b>Overview of Upcoming Activities, Next Steps, Next Meeting Planning</b> <ul style="list-style-type: none"><li>• Memos<ul style="list-style-type: none"><li>○ Each Memo Finalized</li><li>○ If needed, follow-up on Design Volumes at PDT Meeting #4</li></ul></li><li>• Next PDT Meeting – April 23<sup>rd</sup> (Monday), April 27<sup>th</sup> (Friday), May 4<sup>th</sup> (Thursday)<ul style="list-style-type: none"><li>○ Follow-up on Design Volumes, as needed</li><li>○ Discuss Countermeasures Toolbox</li><li>○ Candidate Locations for HSIP Projects</li></ul></li></ul> |

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**Lake Tahoe Safety Plan PDT Meeting #3  
MEETING NOTES**

*March 22, 2018; 10:00 a.m. – 12:00 p.m.  
948 Incline Way, Incline Village, NV 89451*

**Attendance:****PDT Members**

- Officer Terry Lowther, CHP, Meyers
- Chris Wright, NDOT
- John Kahling, El Dorado County
- Matthew Foxworthy, El Dorado County Sheriff
- Eric Royer, Caltrans District 3
- Scott Waksdal, Caltrans
- Curtis Fong, LTBC
- Rebecca Solomon, Placer County
- Dan Coverly, Douglas County Sheriff's Office
- Steve Pyburn, FHWA

**Project Team**

- Morgan Beryl, TRPA
- Erin Ferguson, Kittelson & Associates, Inc.
- Brian Ray, Kittelson & Associates, Inc.
- Matt Braughton, Kittelson & Associates, Inc.

**What We Heard and Agreed on During Meeting #3**

- Support for the Lake Tahoe Travel Shed concept
- Support for context-based design volume framework including a charter and memorandum of understanding to establish performance criteria for evaluating projects in the Tahoe Region
- Support for an Tahoe Region evacuation plan
- Need to ensure that language for charter and memorandum is not inflammatory and recognizes the importance of motor vehicle travel as well as other modes
- Accommodating peak and non-peak motor vehicle performance should be given greater weight
- Emphasis to gain support from Caltrans and NDOT to move forward with charter and memorandum of understanding (MOU) since they operate the critical roadways

**Project Status Overview**

- Schedule Review
  - March: Discuss and resolve draft recommendations
  - April: Countermeasure toolbox – what are the treatments we can implement and what are the priority locations?
  - May/June: HSIP applications and concept designs for selected locations
  - June/July: Final revisions and documentation
- Key Topics and Outcome Goals
  - Direction on the design volume alternative process
  - Consensus on recommendations for crash analysis and data

### **Overview of Technical Memoranda Comments Received**

- General editorial clean-up
- Design Volume Recommendations and Procedure:
  - Stronger consideration of amount of people driving
  - Routes in and out of the region are key for driving
  - Support for context sensitive approach – linking to corridors
  - More specific performance measures
  - Support for evacuation and MOU
  - Need to consider seasonal and demand variation
  - Balance of modal criteria
  - How to move from the vision to performance measures that are clearly articulated and supportive of the vision?
- Crash and Roadway Data Analysis Findings
  - Checking aspects that do not match expectations
  - Draft priority location threshold
  - Additional risk factors
  - Verifying additional contributing factors
- Crash Data Recommendations
  - Working to make the hospital data regional and specific to on-road crashes
  - How to address underreporting of minor injuries?
  - How to manage cross-state databases?
  - Improving onsite reporting for crashes that do not warrant a full crash report
  - Integrating data with the non-motorized count program

### **Design Volumes**

- Reminder of Recommendations
  - Memo was pushing the limits and cutting edge. We are charting new territory and words have meaning. We need to be clear, concise, and jointly determine the language.
  - We are trying to balance how we look at each mode, not prioritize one over the other. We recognize the importance and dominance of the automobile in traveling in and around the Tahoe Region. We are not trying to knock motor vehicles down, but we are trying to consciously raise and ensure proper consideration of other modes as well.
  - How do we move from where we are today and make advances, while recognizing that some RTP objectives (such as increases in transit frequency) will take some time to implement?
- We are working toward developing design volumes and measuring project performance.
- How can we add or augment metrics to consider other needs beyond automobile delay?
- Lake Tahoe Travel Shed
  - Parallel with the bi-state compact for watersheds. Treat Lake Tahoe as a travel shed with unique thresholds that contextually addresses metrics within the boundary area.
- Contextually address transportation metrics
  - Travel Shed Charter:
    - Document the agreed upon transportation vision for the TRPA area.

- Identify locations, concepts, principles for each agency that may require special attention or focus.
  - Develop a plan for conflict resolution to be able to move forward.
  - Agree to jointly approach design volumes/metrics for the Region.
- Expand on Six Corridor Contexts
  - Expand the view within these corridor areas to make sure we are moving beyond the corridor itself. Recognize each transportation/land use context within these areas may be different. This will help identify the best performance metrics consistent with each land use and transportation concept.
  - Let the metrics for each facility be guided by the broader context in each area.
  - Consider transitions between areas to smooth travel flow between context zones.
- Context-Sensitive Performance Metrics
  - Consider each mode, not prioritizing one of the other.
  - Consider roadway function, context, and time periods between peaks. If we make a roadway wide to serve the peak period, what are the secondary impacts of those decisions (e.g, longer crossing distances)?
- Memorandum of Understanding
  - Outline a process for using context sensitive solutions (CSS)
  - Build off the RTP
  - Address how long-range forecasts will be used to address projects
  - Develop performance metrics for which context type.
  - Consider future opportunities to expand beyond TRPA to the broader geography (the resort triangle)
- Emergency Evacuation Plan
  - Consider the Region comprehensively
  - Consider access and circulation needs around the lake, as well as between communities and portals
  - Special emergency needs – may not rely on roadway evacuation (airlifting, sheltering in place, non-evacuation care protocols and procedures)
  - Account for ways to address services on congested roadways
  - Integration of ITS and other technology improvements
- Questions or Comments:
  - **John (El Dorado County):** Charter would be an overarching document and the MOU would be specific to the performance metrics?
    - The Charter would document the agreed upon understanding and how to resolve conflicts. The MOU would be to document the performance metrics and how to apply them. MOU would be updated as needed to account for changes in the practice/technology.

- **John (El Dorado County):** The Design Volume memo struck him as pedestrian and bicycle centric. The document would be inflammatory to the public (especially if this was received on the West Slope). We need to revise the memo to be more inclusive of motorists. As written, it needs to better emphasize that it is about bringing up other modes, not bringing down motorists.
    - We want to emphasize not one mode over the other, but each mode **with** the others.
- Performance Metrics Beyond Delay
  - Measures that serve each user and vary over different roadway types.
  - Higher priority category would drive decision-making where metrics conflict.
    - Prioritize, accommodate, awareness
  - Roadway Types:
    - Routes In/Out
      - **Morgan (TRPA):** Auto – Peak Mobility should be a higher priority.
        - **Agreement:** John
        - **Kittelson:** We don't want to make auto delay the driver of a project decision making process for those areas.
        - **John (El Dorado County):** We can chose to address the priority of auto mobility in ways other than in adding more lanes – this may be more of a traffic management process than a capacity solution.
        - **Kittelson:** We want to be thoughtful about how ultimate capacity (that will never change) influences upstream capacity. If it is two lanes at the pass and will never be widened, then that is the bottleneck.
        - **Morgan (TRPA):** Move Auto – Peak Mobility to “Accommodating” category.
        - **Kittelson:** We will update to be consistent with your comments.
      - Transitions Between Zones and At Portals
      - There is a difference in user types, friction, access needs, and land use context
    - Safety:
      - Easy to say it is a priority, but key will be how this gets addressed when it conflicts with other metrics
      - Highway Safety Manual prediction methods are useful for motorists, but not as useful for bicyclists/pedestrians. Need to establish a framework for consideration within the Region.
    - Pedestrian:
      - Highway Capacity Manual methodologies for signalized and unsignalized, uncontrolled marked crosswalks to measure them in a consistent manner.

- Signalized Methodology is an index based on delay and the experience of the crossing.
- Uncontrolled Crosswalks is delay-based connected to potential risky crossing behavior.
- **Steve Pyburn (FHWA):** These methods are not pedestrian safety metrics, but capacity-related?
  - **Kittelson:** Yes, they are quality of service, not necessarily safety.
  - **Steve:** These measures would be used to rate different crossings?
  - **Kittelson:** Yes, this would be one of the metrics that would be used to evaluate alternatives and guide decision-making. This would just be one of the metrics used, not the only metric.
  - **Steve:** How are we going to quantitatively balance all of these metrics? In the bigger context, if you want to improve pedestrian safety, you need to sacrifice vehicle LOS.
  - **Kittelson:** The MOU will establish what the metric priorities are to allow for effective decision-making.
  - **Steve:** Caltrans ICE process provides a way of quantitatively evaluating safety and ped/bike. Taking the ICE process to augment and add transit to quantitatively evaluate. This process gives you a way to rank projects.
  - **John (El Dorado County):** I would love to see a completed ICE analysis with the how costs are attached to the ICE analysis.
  - **Steve:** Caltrans has been on a two-year training cycle to role out the ICE process.
  - **Kittelson:** ICE is a good example of pulling the different metrics into a single metric (Benefit/Cost Ratio - BCR) and could be one way to move forward. The way we have framed things here aren't as locked into one BCR. Not everything will monetize well. What we are really trying to do is establish a performance-based approach for the Region. Part of the value of separating out the metrics is to avoid putting them in competition from the start but evaluating each separately and then considering the interactions.
  - **FHWA Follow-Up:** Steve to send John an example ICE document that monetizes safety, etc.
- Local Access:
  - Evaluate delay on side streets and establish performance targets.
  - **Morgan (TRPA):** Not sold on LOS targets in the table and will need more time to consider potential changes.

- **Terry (CHP):** Residents feel like they have to shelter in place during the worst peaks and we want to make sure that they are able to go out and enjoy where they live.
- **John (EDC):** For off-peak, LOS F will not be acceptable for off-peak on routes in and out of the Region. Most of the opposition will come from the locals related to delay. Probably need to align the off-peak with the LOS requirements in the 2017 Tahoe RTP.
- **Steve (FHWA):** How has Caltrans interpreted this from an operations perspective? Steve will follow-up with Caltrans.
- **Kittelson:** You may sacrifice through mobility to serve side street access. What do we need to explore to establish the MOU/Charter?
- Bicyclists:
  - Level of Traffic Stress
  - **John (El Dorado County):** This is reasonable. When people are at locations where they are apt to get out of their car, we should focus on how to keep them out of their car. We want to make it easier for them to walk and bike around town. Some of the links between communities will need to be more contextually-based where LTS may need to vary across the Region.
- Transit:
  - Comparing transit travel time to existing using a relative difference. Maintaining current travel time or improve (decrease) travel time.
  - **Morgan (TRPA):** Please clarify the maintain/decrease. We are trying to make transit more attractive across the board, especially getting in and out of the Region. How do we incentivize transit when people are sitting in the same traffic getting into the Region? Is the goal to decrease across all categories?
  - **Kittelson:** Transit and autos are linked but want to focus on what the transit-specific improvements may be.
  - **Rebeca Solomon (Placer County):** Routes in and out could probably be decrease versus leave it as existing since we are trying to improve transit into the Tahoe Region.
  - **Kittelson:** The impact is measured within the project being evaluated, not the broader service goals for transit.
  - **Terry (CHP):** There may be a difference (and difference in need) between peak time and holiday peak times in transit.
- **Auto Mobility Peak Hour and Off-Peak Hour:**
  - Peak Hour: Average Sunday evening during a non-holiday weekend.
  - Off-Peak Hour: Average mid-week day during non-holiday week, evening peak hour.

- **Terry (CHP):** Peak period on Sundays should start earlier. Check-out times drive when people leave. Most people do not stay until 4pm on their travel day (it is usually more like 11am – noon).
- **Morgan (TRPA):** For the off-peak hour, is the measurement for the shoulder season or peak season? One of the issues is that there is variability in peak hours within peak season and the shoulder season.
- **Kittelson:** We are proposing using an average of all off-season and peak season Sundays. There would be data points from the peak and some from the shoulder season – a blended average of the two seasons.
- **Steve (FHWA):** Caltrans' opinion will be vital here because of their operations of the roadway.
- **John (El Dorado County):** Caltrans owns the roads and so they are going to be a major player in the discussions. Ultimately, they will need to buy-in on this concept for it to move forward.
- **Steve (FHWA):** When I talk to Caltrans Traffic Operations they are talking about typical conditions but when you talk to Planning they are discussing peak periods – we need to make sure they are all on the same page and in agreement.
- **Kittelson:** Our sense is that it will be easier to address the metrics with Caltrans if as a Region there is a united voice behind the framework to discuss with Caltrans/NDOT.
- **John (El Dorado County):** From the perspective of the peak, I would prefer a Sunday starting at 11am for the peak hour in June/August. If we average these heavier travel times with the shoulder season it might dilute things to the point where we don't have enough capacity for a long period of time in higher activity seasons.
- **Rebeca (Placer County):** We have worked with Caltrans to change signal timings recently. The biggest thing they are having trouble with is getting feedback from different interested parties on what should be the peak or priority. From a traffic signal perspective, it is also based on the equipment and ability to change timings based on the peaks.
- **Steve (FHWA):** Signal timing is a different operational strategy. Adaptive signal control would help even out the variations in traffic. We need the signals to consider if this is the right timing plan for current conditions on the corridor.
- **Kittelson:** We will update and change the priorities including looking at an earlier peak hour. We will evaluate what impact the shoulder season has on changes in design volume targets as currently defined. We understand that local access in the off-peak needs to be a higher target to be a viable part of the framework.

### **Crash & Roadway Data Analysis Findings**

- Reminder of Priority Locations
  - Assumption that we are okay with the current priority locations based on the comments received. Please let Morgan know if you think there is an inconsistency or if you think certain locations should be shifted between the tiers of priority that we identified.
  - We will move forward with those locations to return with a short list of sites that are likely to be grant competitive. Out of the end of April meeting we will take that short list and establish the 8 most competitive locations for HSIP grant funding.
  - **Homework:** Please take another look and provide your feedback back to TRPA by March 30.

### **Crash Data Recommendations**

- Reminder of Recommendations
  - We had identified a number of solutions to integrate and improve the connections between two state crash databases.
  - No change in direction from the recommendations based on comments received, so we will move forward with our current roadmap for future actions.
  - If we missed anything, please send your comments to TRPA by March 30.
  - **Morgan (TRPA):** How can we make reporting easier for law enforcement on-site for a crash even if it doesn't result in a full report? It would be helpful for our rapid-response toolbox to quickly identify and address potential problems.

### **Overview of Upcoming Activities, Next Steps, Next Meeting Planning**

- Memos
  - Each memo finalized
  - If needed, follow-up on Design Volumes at PDT Meeting #4
- Next PDT Meeting –**May 4<sup>th</sup> (Thursday)**
  - Follow-up on Design Volumes, as needed
  - Discuss Countermeasures Toolbox
  - Candidate Locations for HSIP Projects

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**Lake Tahoe Safety Plan PDT Meeting #4  
AGENDA**

*May 3, 2018; 9:00 a.m. to 11:00 a.m.  
128 Market St, Stateline, NV 89449*

- |                          |  |
|--------------------------|--|
| <b>9:00am – 9:05am</b>   | <b>Welcome and Roll Call</b>   |
| <b>9:05am -9:10am</b>    | <b>Project Status Overview</b> <ul style="list-style-type: none"><li>• Schedule Review</li><li>• Key Topics and Outcome Goals</li></ul>  |
| <b>9:10am –9:20am</b>    | <b>Design Volumes Quick Update</b> <ul style="list-style-type: none"><li>• Advancing the Recommendations to:<ul style="list-style-type: none"><li>○ Develop a Charter</li><li>○ Prepare a MOU to Capture New Project Evaluation Process (e.g., Multimodal Performance Measures, Redefining Peak Period, Adding Off-Peak Analysis)</li></ul></li><li>• PDT to Receive the Above Materials for Review in Later May</li></ul>   |
| <b>9:20am – 10:00am</b>  | <b>Countermeasures Toolbox</b> <ul style="list-style-type: none"><li>• Purpose of Countermeasures Toolbox</li><li>• Draft Countermeasures Identified for Toolbox</li><li>• PDT Input/Discussion</li></ul>  |
| <b>10:00am -10:50am</b>  | <b>Priority Locations for Grant Applications</b> <ul style="list-style-type: none"><li>• Approach to Identifying Priority Locations</li><li>• Moderately Long List of Priority Locations</li><li>• Group Discussion</li><li>• Group Voting<ul style="list-style-type: none"><li>○ PDT members will identify up to 10 locations they want to specifically indicate support for advancing</li></ul></li></ul>  |
| <b>10:50am - 11:00am</b> | <b>Overview of Upcoming Activities, Next Steps, Next Meeting Planning</b> <ul style="list-style-type: none"><li>• Next PDT Meeting – June 19<sup>th</sup> (Tuesday), June 20<sup>th</sup> (Wednesday), June 21<sup>st</sup> (Thursday), June 22<sup>nd</sup> (Friday)<ul style="list-style-type: none"><li>○ Design Volume Follow-up<ul style="list-style-type: none"><li>▪ Draft Charter</li><li>▪ Draft MOU</li></ul></li><li>○ Final Countermeasures Toolbox</li><li>○ Update on HSIP Projects and Scopes</li></ul></li></ul> |

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**Lake Tahoe Safety Plan PDT Meeting #4  
AGENDA**

*May 3, 2018; 9:00 a.m. to 11:00 a.m.  
128 Market St, Stateline, NV 89449*

**Attendees in Person:**

1. Morgan Beryl, TRPA
2. Erin Ferguson, Kittelson
3. Brian Ray, Kittelson
4. Matt Braughton, Kittelson
5. Ed Falkenstein, El Dorado County Sherriff
6. Jim Marino, City of South Lake Tahoe Public Works
7. Danielle Hughes, Tahoe Transportation District
8. Michelle Glickert, TRPA
9. Clara Lawson, Washoe County
10. Eric Royer, Caltrans
11. John Kahling, El Dorado County

**Attendees by Phone:**

12. Alex Garbier, Kittelson
13. Steve Pyburn, FHWA - California
14. Ed Yarbrough, Caltrans District 3 - Traffic Safety
15. Eric Royer – Caltrans District 3 – Traffic Operations
16. Juan Hernandez, NDOT – Traffic Operations
17. Casey Sylvester, NDOT - Traffic Operations
18. Rebeca Solomon, Placer County

**PROJECT STATUS OVERVIEW**

- Schedule Review
  - Now: Transitioning to identifying locations for improvements and countermeasures for safety improvements
  - May/June: Draft Charter and MOU as well as developing grant applications
- Key Topics and Outcome Goals
  - Countermeasure Toolbox:
    - Are we missing any countermeasures?
    - Are there countermeasures that should be removed?
  - Priority Locations:
    - Need to identify the top eight locations for HSIP applications
    - Consultant team would do approximately 75% to 80% of the work, support would be needed to move the application forward and assistance with the project understanding.
    - TRPA would like to spread the projects across agencies in the Region.

## DESIGN VOLUMES UPDATE

- What we heard from the last PDT:
  - Support for the Tahoe Travel Shed Concept
  - Support for a MOU and Charter
  - Incorporate multimodal performance measures
  - Incorporate peak analysis and off-peak analysis
  - Include future action for an emergency evacuation plan
  - **TTD:** Who will be in the charter?
    - TRPA: Everyone that is in the Tahoe Region that implements transportation projects. We don't expect public safety to be on the charter, but that is a possibility. In terms of signatories that is something TRPA is determining.
    - EDC: It will depend on how binding it is and what it is establishing.
    - TTD: Are we going to FHWA with this one?
    - FHWA: Makes sense to go to Federal Lands but not broader FHWA since the funding is completely different.
    - TTD: Important to include Office of Emergency Services because of how critical the communications systems are in the region. Everything is currently piecemeal and there is no coordination or integration across the Region.
    - KAI: This is something that should be included in the Evacuation Plan.
    - TRPA: We need to make sure safety infrastructure is referenced in the Charter.
- Advancing the Recommendations to:
  - Develop a Charter
  - Prepare a MOU to Capture New Project Evaluation Process (e.g., Multimodal Performance Measures, Redefining Peak Period, Adding Off-Peak Analysis)
    - **John, EDC:** It is important to see how much buy-in we can have with NDOT and Caltrans. It might be more difficult for them to buy off.
    - **Morgan, TRPA:** We've begun meeting with them separately to discuss concerns/issues and get an understanding of how far up the chain things need to go to get buy-in.
    - **Ed, Caltrans:** Can you talk about what kinds of projects you are talking about?
    - **Kittelson:** Any transportation infrastructure project. This evaluation process would be used to look at any change to the transportation system.
    - **Caltrans:** We all understand that Caltrans/NDOT have programs/processes that need to be maintained.
    - **Kittelson:** Not trying to change the process but how do we set the parameters for the project evaluation. This would establish how the evaluations for a project would be completed and provide guidance on priorities for the different performance targets. The specific project decisions would still be up to each respective project's PDT.

- **Morgan, TRPA:** We'd be happy to set up a meeting to talk outside of this meeting to catch you up and address any questions. We also have a bi-state coordination group that is specifically addressing the barriers of working across state boundaries. We want to understand where those barriers/limits are so that we can discuss them with our bi-state group.
- PDT to Receive the Above Materials for Review in Later May

## COUNTERMEASURES TOOLBOX

- Two basic questions:
  - Are we missing countermeasures? E.g., things that you have used and have been effective.
  - Are there countermeasures you are not comfortable implementing and need to be removed?
- Purpose of Countermeasures Toolbox
  - Resource to more quickly implement safety improvements
  - Based off of crash trends and patterns as well as roadway characteristics that are associated with higher crash risk.
  - Countermeasures that are likely to be eligible for HSIP funding.
  - Striving for both short-term rapid response as well as longer-term implementation.
- Draft Countermeasures Identified for Toolbox
  - **Overall PDT Input:**
    1. **Overall:** In the toolbox document, provide a summary table listing the countermeasures and identifying key considerations as part of that table (e.g., where they are applicable, effectiveness, have specific winter maintenance considerations).
    2. **TRPA:** Include range for costs. Planning vs. implementation vs. operational?
    3. **SLT:** Is it detailed to type and size of roadway?
    4. **TRPA:** Context sensitive for a range of types?
    5. **Kittelson:** We can add a category for design guidance, help guide where a facility might be appropriate (or not)
    6. **Washoe:** Table summary of where each countermeasure might be applicable.
  - **Intersections**
    1. Convert to Roundabout
    2. Intersection Lighting
      - **EDC:** We wouldn't put these in a very rural location to avoid light pollution.
      - **Kittelson:** You can still meet dark sky standards by keeping light low and focused.
      - **SLT:** We might want to revisit the planning level cost, probably more likely \$10,000.
    3. Improve Signal Timing
      - **Washoe:** Design life is typically 2-3 years for just adjusting our timing, not 10 years shown.

- **EDC:** We should highlight adaptive signal timing for time of day patterns, actuated signals, etc. It might make a big difference for low-cost.
  - **TTD:** Especially with the event center coming, we need to look at strategies to be adaptive for timing for when events are happening to coordinate timing across state lines.
  - **SLT:** We have a winter and summer timing plan to account for Heavenly in the winter and then switch to summer to adjust for forecasted loading. But it does require someone to get to the box. It increases labor.
  - **SLT/EDC:** We should include signal cameras. The technology has improved and it is eligible for CMAQ funding. Local agencies have relatively few signals; this is probably more of a NDOT/Caltrans topic for consideration.
  - **TRPA:** Please adjust countermeasure to focus on adaptive signals and taking into account time of day/seasonality questions.
  - **Ed, Caltrans:** We are way off the pedestrian interval. FHWA adjusted this to 3.5 feet per second in 2009.
  - **Kittelson:** This is independent of the crossing time. This is to provide a head start to cross the roadway.
  - **Caltrans:** This is something that has been implemented on SR-65 so it shouldn't be a problem. Pedestrian crossing intervals are set in the signal timing. This does reduce the capacity of the intersection by reducing the cycle time available to vehicles.
4. Advance Dilemma Zone Detection
    - **Caltrans:** How is this different from advance loops that you have in the roadway?
    - **Kittelson:** Advance loops may not extend the yellow clearance time based on approaching vehicles in the dilemma zone.
    - **Caltrans:** This would impact the capacity of the signal during the cycle.
    - **Kittelson:** We may need to show a range to discuss different options based on loops or video.
    - **EDC:** Interesting, but wouldn't want the public to speed up to take advantage
  5. Install Pedestrian Countdown Signal Heads
    - **EDC/Caltrans:** These are standard where making changes to a signal.
  6. Upgrade Intersection Pavement Markings
    - **Multiple Participants:** Additional markings will need to be refreshed on an annual basis. The design life in Tahoe is a year at most.
  7. Install Advance Stop Bars/Bike Box
    - No comments
  8. Missing Treatments?
    - **Steve, FHWA:**

- Safety improvements are likely to affect traffic operations for certain parts of the day. There is no way around it.
- Reference FHWA Proven Safety Countermeasures.
- **Multiple Participants:** Interest in having developers contribute their fair share to safety improvements. Which in some instances may include things like pedestrian or bike overpass/underpass. However, we need to be cautious in assuming that a pedestrian and bike overpass/underpass eliminates risk; the out of direction travel and perception of personal security can result in people not using them.
- **Kittelson:** Might be in TRPA's interest to look at how safety performance is included in development review.
- **SLT:** Ped scramble/Barnes Dance would also be a good treatment to include.
- **Segments**
  1. Install/Upgrade Large Warning/Regulatory Signing
  2. Direction Median Openings
    - **EDC:** These are super-effective but they can be tough politically where you have a business with a left out.
    - **Kittelson:** Anything like this needs to be integrated into an access management evaluation, not just a spot treatment.
    - **Ed, Caltrans:** This directional median opening is difficult in Tahoe because we have snow and plows. I don't want to disappoint and say we can't do this but I am not sure how we would do this in Tahoe.
    - **Morgan, TRPA:** We are very aware that there are areas where this won't work at Lake Tahoe. But we need to recognize that there are many locations across the US that do have snow and are able to implement these treatments and there may be some places within Tahoe's roadways that this is appropriate.
    - **TTD:** I think that snow in Tahoe is fast and heavy and is very different than other snow areas in the US. We need to qualify and recognize the constraints.
    - **Washoe:** We will obviously need to look at location-specific context. This is an option to consider, not something that we are going to blanket across the Tahoe Region.
    - **SLT/EDC:** I would absolutely include this in the toolbox. Maintenance are much more skilled than we give them credit. We also need to consider the other 8 months out of the year where snow is not a possibility and so not an issue. The safety should take precedence over maintenance.
    - **SLT:** We have an existing and on-going agreement with Caltrans to remove snow from a pedestrian refuge island that is on Caltrans facility.
    - **Kittelson:** As part of the permitting process, you might focus on access management, so this isn't a problem that needs to be addressed later.

3. Install Raised Medians/Refuge Islands
  - Update cost to square foot
  - **TRPA:** Only appropriate in certain locations
4. Enhanced Pedestrian Crossings
  - **TRPA:** Only appropriate in certain locations
5. Install Pedestrian Hybrid Beacons
  - **TRPA:** Has there been any development around fine-tuning how they operate? People don't go on flashing red.
  - **Caltrans:** Cost is low.
  - **SLT:** Agree the cost is low.
  - **EDC:** If the signal head configuration was different then people would understand what to do. Is this a MUTCD requirement or not? The black signal can confuse.
  - We should note that pedestrian signal should be installed when the pedestrian volumes are high enough.
  - **Kittelson will add pedestrian signals to the toolbox**
6. Bike Lanes:
  - Provide range of costs based on type of facility.
7. Sidewalk/Pathway:
  - Provide a range of cost estimates
8. Roadway Reconfiguration:
  - Planning level cost for striping only
  - **TRPA:** It would be nice to have a cost for reprofiling the roadway
  - **EDC:** We did this on Lake Tahoe Blvd and it was pretty cheap – just some drainage issues.
9. Intermittent Raised Median:
  - **Kittelson:** We will acknowledge median maintenance concerns
10. Removing/Relocation Fixed Objects:
  - **Caltrans:** This is something that is MUTCD and is required.
  - **Kittelson:** This would be on a safety-need basis.
  - **TRPA:** This helps us balance impacts from an environmental perspective versus safety.
11. Widen Shoulders:
  - No comments
12. Chevron Signs on Horizontal Curves:
  - **TRPA:** Is there a TRPA barrier to this type of signage?
  - **SLT:** We have them.
  - **EDC:** I know that this means there is a sharp curve or spiral curve and to slow down.
13. Curve Advance Warning Signs

- No comments
14. Install Dynamic Speed Warning Signs
- **SLT:** We are going to be doing a few of these soon on Pioneer Trail.
15. Install Delineators/Object Markers:
- This should note winter maintenance issues.
  - **TRPA:** This is a good traffic calming measure.
  - **SLT:** With respect to the table, we should have considerations that address winter conditions or environmental constraints in the Tahoe Region.
  - **TRPA:** Also should note temporary solutions for spring, summer, fall that can be removed during winter months.
16. Improve Pavement Friction
- **Eric:** How do bicyclists and motorcyclists feel about these?
  - **FHWA:** There are fewer downsides than you would think.
  - **EDC:** There weren't problems in our applications. They've had a lot of success with these in the north coast.
17. Centerline Rumble Strips
- No comments
19. Edgeline Rumble Strips
- **Kittelson:** We are aware of bicyclist concerns and will provide a suggested minimum shoulder width for where these are implemented
  - **TRPA:** There have been issues with noise concerns with rumble strips. Bicyclist advocates have actually requested rumble strips with appropriate bicycle gaps.
  - **SLT:** They also provide a water quality benefit to catch sediment for sweepers.
  - **TRPA:** Highlight potential benefit for water quality.
20. Truck Climbing Lanes:
- **TRPA:** NDOT wants to do these on SR-50.
  - **Caltrans:** Would also like to see SR-267
  - **SLT:** Road Closures due to wet/inclement weather conditions.
- Additional Countermeasures Topics to Consider
    - **TTD:** We should include transit safety improvements
      - ✓ Bus pull-outs.
      - ✓ Interactions challenges with ADA access and bike lanes.
      - ✓ Significant pressure to add chariot systems. How do we incorporate safety and deal with separation between TNCs and transit access.
      - ✓ Appropriately designed bus pull-outs
    - **SLT:** Big cost is the right of way cost. Where does the TTD plug in on that?
    - **TTD:** We don't own our facilities at this time.

## **10:00am -10:50am      Priority Locations for Grant Applications**

- Approach to Identifying Priority Locations
  - **Ed, Caltrans:** Send a copy of prior memorandums and presentations.
  - **Washoe:** Concerns about data in Incline Village.
    - a. Kittelson:** This is something that we are working to address as part of the plan.
    - b. TRPA:** Let's look again at the data in Washoe to see if there is a location we can support.
  - **SLT:** Highest priority locations based on crash severity score should be what we move forward.
  - **TRPA:** But we also want to identify locations around the Region to ensure we have projects in all jurisdictions and on and off highway.
  - **SLT:** We need to be sure of the complexity and willingness of the agency to take on the project.
  - **Kittelson:** As homework, tell us locations where it doesn't make sense or there is already funding for an improvement so we can remove them from the list. If there is a location that you want to address, let us know that too.
  - **TRPA:** We'll send out a survey.
  - **Ed, Caltrans:** I can go through and run our data versus our databases to see what the crash rates are on those areas. It needs to meet our safety program requirements if we are going to do a safety project. It has to meet a safety index analysis before it can go into the safety program.
  - **Kittelson:** To follow up with Ed at Caltrans with a separate conference call.
  - **EDC:** Suggest that when we recommend the locations, that the agency is made aware so they can go out and see the locations in the field to understand.
  - **Washoe:** If NDOT has one project, then they will look at safety and fold that into another project at their cost.
  - **TTD:** As we move forward with the corridor planning, we need to integrate these into that process.
  - **Rebecca, Placer County:** The location for Grove Street (I9) is in the CIP to install a signal. The Jackpine (S3) location might be able to be coordinated with our upgrade at Grove Street.

## **Overview of Upcoming Activities, Next Steps, Next Meeting Planning**

- Next PDT Meeting –**June 20<sup>th</sup> (Wednesday) 1-3pm**
  - Design Volume Follow-up
    - Draft Charter
    - Draft MOU
  - Final Countermeasures Toolbox
  - Update on HSIP Projects and Scopes

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**Lake Tahoe Safety Plan PDT Meeting #5  
AGENDA**

*June 20, 2018; 1:00 p.m. to 3:00 p.m.  
128 Market St, Stateline, NV 89449*

- |                        |   |
|------------------------|---|
| <b>1:00pm – 1:05pm</b> | <b>Welcome and Roll Call</b>  |
| <b>1:05pm -1:10pm</b>  | <b>Project Status Overview</b> <ul style="list-style-type: none"><li>• Schedule Review</li><li>• Key Topics and Outcome Goals</li></ul>   |
| <b>1:10pm -2:30pm</b>  | <b>Priority Locations for Grant Applications</b> <ul style="list-style-type: none"><li>• Update on Approach to Locations in Nevada<ul style="list-style-type: none"><li>○ Working directly with Lori Campbell to develop two locations</li></ul></li><li>• Update on Approach to Locations in California<ul style="list-style-type: none"><li>○ Targeting up to six HSIP applications</li><li>○ Overview of input via online survey and meeting with Caltrans</li><li>○ Discuss the locations and potential countermeasures where there appears joint interest<ul style="list-style-type: none"><li>▪ On-state facilities</li><li>▪ Off-state facilities</li></ul></li><li>○ Arrive at six locations total to advance</li></ul></li></ul> |
| <b>2:30pm – 2:40pm</b> | <b>Countermeasures Toolbox</b> <ul style="list-style-type: none"><li>• Final comments on countermeasures toolbox</li><li>• Deadline for written comments to Morgan is July 9<sup>th</sup></li></ul>   |
| <b>2:40pm –2:50pm</b>  | <b>Design Volumes Quick Update</b> <ul style="list-style-type: none"><li>• Meeting on June 28<sup>th</sup> with PDT to focus on this topic</li><li>• Highlights from Morgan of recent activities on this topic</li></ul>  |
| <b>2:50pm - 3:00pm</b> | <b>Overview of Upcoming Activities, Next Steps, Next Meeting Planning</b> <ul style="list-style-type: none"><li>• Late July/Early August PDT Meeting – July 31<sup>st</sup>, August 1<sup>st</sup>, August 2<sup>nd</sup> (morning), August 3<sup>rd</sup></li><li>• Anticipated Topics for July Meeting<ul style="list-style-type: none"><li>○ Comments on draft HSIP Projects</li><li>○ Design Volume MOU Follow-up, as needed</li><li>○ Discuss draft report</li></ul></li></ul>   |

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**Lake Tahoe Safety Plan PDT Meeting #5  
AGENDA and NOTES**

*June 20, 2018; 1:00 p.m. to 3:00 p.m.  
128 Market St, Stateline, NV 89449*

**Attendance:**

Brian Ray, Kittelson & Associates, Inc.  
Erin Ferguson, Kittelson & Associates, Inc.  
Matt Braughton, Kittelson & Associates, Inc.  
Morgan Beryl, TRPA  
LaShonn Ford, NDOT  
Juan Hernandez, NDOT  
John Kahling, El Dorado County  
Jon Erb, Douglas County  
Jonathan Steiner, California Highway Patrol  
Eric Royer, Caltrans  
Teresa Limon, Caltrans  
Fernando Rivera, Caltrans  
Rebeca Solomon, Placer County  
Matt Foxworthy, El Dorado County Sherriff  
Dave Stephenson, City of South Lake Tahoe Police Department (only for 5 minutes)  
Jim Marino, City of South Lake Tahoe

**1:00pm – 1:05pm**

**Welcome and Roll Call**

**1:05pm -1:10pm**

**Project Status Overview**

- Schedule Review
- Key Topics and Outcome Goals
  - Getting to six locations on the California side for HSIP
  - Continue work on the MOU in July
  - August will be focused on finalizing the HSIP applications and concept designs
  - August will also begin the final drafting of the safety plan
  - Developing a tool to support the project evaluation MOU
- Overview of the Safety Plan: (from Morgan):
  - Where do we have gaps?
  - What crash patterns and trends exist?
  - What countermeasures can we use to address these crash patterns and trends (rapid response versus long-term)?
  - How do we design projects? How do we accommodate all roadway users?
- Current activities
  - HSIP applications for California and Nevada
  - MOUs to address the unique character in the Tahoe Region:
    - Project evaluation framework to account for Tahoe Region context and different road user needs
    - Safety management – data analysis, countermeasures, and recommendations

- John Kahling, EDC: Specific to law enforcement, we have been working across the Region to develop a solid approach to improving crash data.
- Note for cutsheets: Increase FONT SIZE

**1:10pm -2:30pm**

**Priority Locations for Grant Applications**

- Update on Approach to Locations in Nevada
  - Working directly with Lori Campbell to develop two locations.
  - Safety project development is not as “scripted” a process as in California, so we will be working through that with Lori to determine the appropriate locations and treatments
  - Late July for draft designs and cost estimates
- Update on Approach to Locations in California
  - Targeting up to six HSIP applications
  - Overview of input via online survey and meeting with Caltrans
  - Discuss the locations and potential countermeasures where there appears joint interest
    - On-state facilities
    - Off-state facilities
  - Today we want to arrive at six locations total to advance
  - Long list from prior applications, and we have narrowed the list down to a short list of locations as well as a long list of countermeasures that might be applied at those locations.
  - Approach to California HSIP Cycle 9:
    - We can group similar treatments into a single application if the benefit is there.
    - Different kinds of application categories including five set asides.
    - 7 on-state facilities and 6 off-state facilities to discuss today
  - One-page cutsheets that summarize the location, why it was chosen, and some potential countermeasures to address those issues.
- **Location S1: US 50/SR 89 – F St to 13<sup>th</sup> St (Discussion below covers locations I2 and S 12, as well)**
  - Need local jurisdictions or DOTs to be willing to submit the HSIP application. Kittelson will prepare it.

- For locations on state highways, there will need to coordination with Caltrans and the local agency to be sure both are in agreement regarding the proposed project.
- Specific to this location, Caltrans will review and follow-up regarding countermeasures they would be comfortable with for this segment.
- Initial discussions reflect concern about raised medians due to snow plows and concern about adding pedestrian crossings.
- The City of South Lake Tahoe has previously looked at a crossing at B Street. Prefer to funnel everyone to the signalized intersection at the Y to cross the street.
- Recent water quality project finished here so would want to make clear to public that another project here would be adding to those improvements by improving safety (vs. removing or negatively impact the recent changes built).
- Outcome: Investigate further to try to arrive at an agreed upon project and HSIP application.
- **Location S3: SR 28, Approx. SR 89 to East of Safeway:**
  - Given roundabouts going in at the Fanny Bridge intersection and area as well as the RSA and traffic counts at Grove/SR 28 that could lead to a traffic signal, PDT agreed to not pursue an HSIP grant for this segment or locations within this segment.
  - Outcome: Do not try to develop a project or HSIP application within this corridor.
- **Location S4: US 50 – Old Meyers Grade Road to Echo Summit Road**
  - Constrained space for improvements.
  - Observations that the short passing lane within the segment may create more conflicts than it eliminates.
  - A note that centerline rumble strips were already present. A field visit by Kittelson after the meeting determined there are not centerline rumble strips present on this portion of US 50.
  - General input reflected that potential countermeasures could include increased roadside delineation, high friction surface treatment, dynamic speed warning signs (adjustable for weather conditions) and potentially removing the passing lane.
  - Outcome: Investigate further to try to arrive at an agreed upon project and HSIP application.
- **Location I1: SR 28 and Robert Avenue:**

- Interest from Placer County in considering impact of access and vehicles parking adjacent to the roadway on crashes.
- General observations that sight distance is challenging given location of the intersection on the curve.
- Caltrans indicated they are not supportive of a project at this location. Would prefer to prioritize other locations.
- May be a location that could be added to a systemic HSIP application depending on improvements identified.
- Outcome: Do not try to develop a project or HSIP application for this corridor. If feasible to combine with another application, then consider doing so.
- **Location S8: SR 267 by Brockway Summit Trailhead**
  - Caltrans: Truck climbing lanes? Speed differential on crashes?
    - There is a big cut through the summit, so objects may not be appropriate.
    - Chevron signs could be an option
    - Curve advance warning signs are also something that could be done.
  - Outcome: Investigate further to try to arrive at an agreed upon project and HSIP application.
- **Off-state Road Locations**
  - The three off-state locations selected for further investigation, project development and HSIP applications were:
    - Tamarack Avenue & Blackwood Road (City of South Lake Tahoe)
    - North Upper Truckee Road & East San Bernardino Avenue (El Dorado)
    - Pioneer Trail & Edna Street (City of South Lake Tahoe)

**2:30pm – 2:40pm**

**Countermeasures Toolbox**

- Final comments on countermeasures toolbox
- Deadline for written comments to Morgan is July 9<sup>th</sup>

**2:40pm – 2:50pm**

**Design Volumes Quick Update**

- Meeting on June 28<sup>th</sup> with PDT to focus on this topic
- Highlights from Morgan of recent activities on this topic
- An updated version of the MOU will be shared before next week's PDT meeting.

- Morgan: Reorganized to be in a more formal format. Started with meetings with the DOTs to make sure there is buy-in. A couple different requests from Caltrans:
  - Add roadway types:
    - Routes in Community
    - Routes between Communities
    - Routes in and out of the Region
    - **Proposed by Caltrans: South Lake Tahoe Urbanized Area? US 50 is the most complicated roadway in the Region**
  - Consideration of freight
  - Consideration of emergency vehicle access
- Safety Improvement MOU to house the recommendations for crash data recommendations and commitment to the countermeasure toolbox to help move things forward for the plan going forward.
- Safety MOU is more relevant for public safety to integrate data while the design volumes MOU is more project-oriented.
  - Who are the right signatories? May require individual meetings and any other negotiations around the MOU. Your part is to help us get the right people and help us implement the MOU. Likely to be policy in the RTP as well as in an update in the code.

**2:50pm - 3:00pm**

**Overview of Upcoming Activities, Next Steps, Next Meeting Planning**

- Late July/Early August PDT Meeting – Date Selected for August 9<sup>th</sup> from 9am to 11am at TRPA.
- Anticipated Topics for August Meeting
  - Comments on draft HSIP Projects
  - Design Volume and Overall safety Plan MOU Follow-up, as needed
  - Discuss draft report

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**Lake Tahoe Safety Plan PDT Meeting #6  
AGENDA**

*June 28, 2018; 9:00 a.m. to 11:00 a.m.  
128 Market St, Stateline, NV 89449*

- |                          |   |
|--------------------------|---|
| <b>9:00am – 9:05am</b>   | <b>Welcome and Roll Call</b>  |
| <b>9:05am -9:10am</b>    | <b>Project Status Overview</b> <ul style="list-style-type: none"><li>• Schedule Review</li><li>• Key Topics and Outcome Goals</li></ul>   |
| <b>9:10am -10:30am</b>   | <b>Project Evaluation MOU (Previously called Design Volume MOU)</b> <ul style="list-style-type: none"><li>• Review of Activities and Discussions since PDT Meeting #4<ul style="list-style-type: none"><li>○ TRPA Coordination</li><li>○ Meetings with Caltrans and NDOT</li></ul></li><li>• Revisions made to the MOU include:<ul style="list-style-type: none"><li>○ Changes to performance measure priorities</li><li>○ Changes to performance measure targets</li><li>○ Added considerations specific to freight and emergency vehicles</li></ul></li><li>• Interest from Caltrans in creating 4<sup>th</sup> roadway type group specific to a portion of US 50</li></ul> |
| <b>10:30am – 10:45am</b> | <b>Safety MOU</b> <ul style="list-style-type: none"><li>• Overview of Purpose</li><li>• Highlights of Content</li><li>• Draft provided for specific PDT comments (can discuss again at future PDT meeting, if needed)</li></ul>   |
| <b>10:45am - 11:00am</b> | <b>Overview of Upcoming Activities, Next Steps, Next Meeting Planning</b> <ul style="list-style-type: none"><li>• Next PDT Meeting – August 9th</li><li>• Anticipated Topics for August Meeting<ul style="list-style-type: none"><li>○ Comments on draft HSIP Projects</li><li>○ Project Evaluation MOU Follow-up, as needed</li><li>○ Safety MOU Follow-up, as needed</li><li>○ Discuss approach to draft report</li></ul></li><li>• After August PDT meeting, we anticipate the final PDT meeting will occur in early Fall related to final documentation</li></ul>   |

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**Lake Tahoe Safety Plan PDT Meeting #6  
AGENDA**

*June 28, 2018; 9:00 a.m. to 11:00 a.m.  
128 Market St, Stateline, NV 89449*

**9:00am – 9:05am      Welcome and Roll Call**

**On the Phone:**

1. John Kahling, EDC
2. Bill Story, NDOT
3. Devin Cartwright, NDOT
4. Eric Royer, Caltrans
5. Teresa Limon, Caltrans
6. Rebecca Solomon, Placer County
7. Clara Lawson, Washoe County

**In the Room:**

8. Morgan Beryl
9. Terry Lawler, CHP
10. Travis Cabral, CSLT PD
11. Lori Campbell, NDOT HSIP
12. James Weston, NDOT HSIP
13. Jim Marino, CSLT
14. Matt H. (Douglas County?)
15. Officer Falkenstein, El Dorado County Sherriff

**9:05am -9:10am      Project Status Overview**

- Schedule Review
- Key Topics and Outcome Goals
  - MOUs are a key outcome of the project and are intended to be supportive of safety, transportation, and mobility with the Tahoe Region.
  - MOUs are a reflection on the unique character and context of the Tahoe Region
  - For the safety MOU, can we do more to share data to help data-informed decisions?
  - MOUs go beyond our project and out into the future.
  - Design volumes are a key focus for local agencies and for law enforcement the safety MOU
- TRPA and Kittelson to follow-up with NDOT on the HSIP process (James)
- NDOT: Concern about putting all of the project development into the same bucket.
  - Kittelson: The two sets of projects will be developed consistent with each states' requirements.

**9:10am -10:30am      Project Evaluation MOU (Previously called Design Volume MOU)**

- Review of Activities and Discussions since PDT Meeting #5
  - TRPA Coordination
    - Meetings with Caltrans and NDOT to discuss design volumes MOU.
- Approach to MOUS:
  - One size fits all approach to evaluating projects isn't applicable and we are looking for ways to move away from one-size fits all approach to understanding the role and the types of facilities within the region.
  - There is a wider range of criteria beyond motorized traffic. There is no intent to penalize motorist traffic but to recognize that other types of users are important parts of the area. We are trying to elevate these as important criteria for consideration.
  - The MOU is trying to establish a consistent procedure while maintaining flexibility and allowing for a quantitative multimodal approach.
  - The intent of the performance measure framework is to identify what the safety and operational characteristics are between the two conditions (project/no project). What are the *implications* and *trade-offs* of the choices that we make.
  - The focus should be on considering the context of where a project is being implemented.
  - The intent of both MOUs is to bring everyone together at the same table and "agree to play nice" when making project evaluation decisions.
- Revisions made to the MOU include:
  - Revisions have been made based on coordination with TRPA and part of earlier conversations with PDT.
  - We updated the MOU to broaden the analysis to determine the peak and non-peak conditions.
  - **City of South Lake Tahoe:** We are onboard with the performance measures, but we don't know if we have the staff and resources to make it happen. Updating and integrating our data systems are a high-cost and all of the criteria require additional data.
  - **TRPA/Kittelson:** The project evaluation criteria are not intended to require a lot of data to calculate.
  - **City of South Lake Tahoe:** These performance metrics are ultimately based on the funding that we have to complete a study. Concern about using the criteria given current funding. It is also unclear how this relates to safety.
  - **Kittelson:** We are developing a safety plan to identify highest priority projects (for developing safety projects). The MOUs are two additional deliverables to set a foundation outside of this project evaluation to help implement safety improvements on the ground.

- **TRPA:** The MOUs are the way to make change and see the recommendations from the safety plan happen on the ground. They are a way to be proactive towards safety, not reactive.
- **Kittelson:** The Safety MOU has costs associated with it, but the Design Volume MOU is not intended to increase costs – just to change the framework and approach to analysis.
- Changes to performance measure priorities including:
  - Increasing the priority of transit and auto mobility in the peak for Routes In and Out
  - Safety is the priority. To the extent that we can use data to drive our decisions, we should
  - Added references to the HSM and more modally balanced references
  - Guidance on how to evaluate risk and provide references
  - Move away from touchy-feely “safety” and other performance metrics to documented effectiveness.
  - Updated pedestrian LOS to be more realistic of conditions and ability to reduce delay
  - Update transit routes in and out to try and address the need to increase transit service and delay into and out of the Region. Trying to provide the incentive to serve transit to help achieve mode shift by making it more convenient and efficient.
  - Updates to the local access performance metrics.
  - Updated peak and off-peak motorists criteria.
  - Peak and off-peak hours were updated based on PDT feedback. We are not trying to catch the peak of the peak but a very representative peak condition. We also wanted to reflect an average mid-week day during a non-holiday week for the off-peak hours.
  - Intent to add a fourth roadway type specific to US 50. Is there a need for a separate category and what is the performance metrics targets that need to be prioritized? We need to be thoughtful about how we approach any changes.
- Routes In and Out have an important role where mobility is critical, other location contexts have different priorities.
- We want to address the changes in context and transitional character of each roadway.
- We are looking at ways to optimize and increase safety by not building for the peak of the peak but for a facility that considers the peak as well as typical conditions.

- We are not going to forecast traffic volumes to inform project design decisions. We will use the volumes that we have but not look out at demand. We don't want to use demand as a driver but consider sensitivity analysis to understand tradeoffs given that the population is not expected to increase and volumes in and out of the Region are bottlenecked by available capacity.
- Added considerations specific to freight and emergency vehicles
- The MOU applies the concept of a "control vehicle" and a "design vehicle." We will accommodate a control vehicle that passes through infrequently while designing for the common vehicle types (design vehicles). The guidance is intended to encourage the smallest footprint required to accommodate a control vehicle in order to balance the safety risk of increasing the roadway/intersection size versus serving road users appropriately.
- **City of South Lake Tahoe:** Does the MOU mesh with the California HDM/MUTCD
- **Kittelson:** Yes, we will serve design vehicles, but for a control vehicle we will accommodate since they would not necessarily frequently come through the location.
- **City of South Lake Tahoe:** Is there a standard of what frequently means?
- **Kittelson:** It should be based on the context. We are not trying to limit and restrain design approaches but to encourage flexibility and context-sensitivity.
- Language related to a new approach to outside turning radii was added to the MOU.
- Consideration of emergency vehicle access has been added. Project evaluation should consider whether there is redundancy for emergency response routes and the context. Other locations will not have any resiliency and ensuring emergency response routes will be key.
- Interest from Caltrans in creating 4<sup>th</sup> roadway type group specific to a portion of US 50 (Elk's Point to the US 50/SR 89 "Y")
  - This recommendation will be processed and shared back to the PDT once we have settled on the areas.
  - The area is still being discussed and is not finalized but US 50 is the most complex road within the Region with ingress/egress, etc.
  - The interest from Caltrans is to reflect that it is a complex facility.
- **NDOT:** assuming that they want to pull it out of a bigger context for that specific area.
- **TRPA:** In general, US 50 is considered as "within a community" category. Are you supportive of a fourth category or do you think it should belong in this more multimodal category.
- **NDOT:** The US 50 corridor has more bicyclists and pedestrians.
- **City of South Lake Tahoe:** We've struggled to address pedestrian and safety improvements on the corridor. How would the metrics be different from the community categories?

- **Caltrans:** It would be a multilane urban arterial.
- **TRPA/Kittelson:** We have not reviewed Caltrans suggested performance metrics and did not feel it was appropriate to share without a prior review.
- The intent of the overall MOU is that the role is the same but the context changes for each location. Not sacrificing the role of the facility but trying to address the context.
- **El Dorado County:** Generally, I concur with having US 50 as a separate category. If it can help Caltrans justify moving forward with this MOU, it is at least worth looking at in more detail.
- **Kittelson:** As US 50 changes across California and Nevada we want to make sure that we are not treating it as unique to just Caltrans/California.
- **Devin, NDOT:** There is a lot here and there are a lot of people that need to see these MOUs. The July 16<sup>th</sup> review deadline is too aggressive.
- **Lori, NDOT:** We have been coordinating with NDOT higher-ups and Bill Story to try and make the meeting happen. They are aware of the MOU and its intent, but they have not grasped what it is doing yet.
- **Kittelson:** Even if it is just the categories of topics that are of concern or specific topics of interest, your comments will help frame up the important items to help us plan accordingly for our revisions.

#### **10:30am – 10:45am      Safety MOU**

- First and foremost, the Safety MOU it is trying to commit us to talking about safety data. How it happens need to be customized.
- The MOU represents a commitment to improving transportation safety for each user within the Lake Tahoe Region.
- Core Expectations:
  - How to make incremental improvement and advance the best information available at the time.
  - Agreeing that it is something that we believe in and want to move forward.
  - Work collaboratively to help advance transportation safety.
  - Recommendations are all pulled from the memos that were developed over the last six months.
  - We want to understand the parties involved in managing safety data and the benefits of collective action.
  - We are starting from information that we have now to help guide and inform us going forward.
- **TRPA:** Section 6 is the meat of the MOU that outlines the roles and responsibilities.
- **City of South Lake Tahoe:** The timeline is an important consideration – the ability to fund and achieve these changes would depend on the timeline that is established.

- **Kittelson:** The MOU is not trying to obligate agencies but get everyone to agree to try and move things forward. Maybe we identify what is near-term achievable and what some of the challenges or incremental benefits that could be achieved over time.
- **Washoe County:** Because there are actual projects listed, it would be good to include a reevaluation process or move the specific projects to an attachment so that the MOU does not become outdated. In five years will you redo the crash analysis to keep it relevant?
- **TRPA/Kittelson:** Locations are not intended to obligate you to develop projects at those locations but to help you integrate them into your CIP or a development review as opportunities arise. This list probably has a shelf-life. We will add some information to obligate a reevaluation of safety data to improve relevance and give a way to track progress.
- **TRPA:** Here are some examples of why these recommendations are in the MOU. We had a very hard time getting data from the City of South Lake Tahoe because it is very labor intensive to pull crash reports and data. How can TRPA help you improve your system? We are not trying to obligate you to upgrade right now but how do we work to move things forward. As a regional agency it is hard to integrate the two state databases and in some cases it isn't possible to make "apples to apples" comparisons. TRPA would like to bring these data sources together and facilitate these changes.
- **CHP:** There are also policies that may affect how crash data is reported, such as where certain PDO crashes are reported or not.
- **City of South Lake Tahoe:** I concur, there has always been confusion about who is responsible on US 50 and how it gets reported. We also want to know what information you want to be reported.
- **TRPA:** We also have cabinet-level bi-state conversations where TRPA may be able to help bring the issue to the cabinets to help accomplish the big policy goals.
- **EDC Sheriff:** Have you considered developing a reporting application to help get the correct data in the same format? ArcGIS is a good platform.
- **City of South Lake Police:** We did not go to any crashes that did not have ambulatory injuries. We have a spreadsheet of this data but it is not applied to our CAD program. The data is available but we are not doing anything with it currently.
- **CHP:** Is it about the reported crashes or the dispatch because you might be able to get dispatch data faster.
- **TRPA:** There is a time lag between SWITRS and being able to obtain real-time crash data would be a huge improvement. We are committed to being that agent and clearinghouse for the Region's data.
- **EDC Sheriff:** Just giving us an app that we are able to quickly fill out the data would allow us to quickly report crash data.
- **City of South Lake Tahoe:** Making this data reporting integration work is critical to making everything else in the MOU move forward.

- **CHP:** We are all willing to help but it is just a matter of what that help looks like. We keep a record of our data we submit to SWITRS and could share that.
- **City of South Lake Tahoe:** We would need to create a policy that a staff person will update the data on a consistent basis.
- **Kittelson:** Are there tiers of information that are shared and what is the most important? The first tier would be what is available and out there, and the second tier is how can TRPA help. A third tier might be policy or longer-term items.
- **EDC Sheriff:** Everyone collects information a little differently. It is important to recognize this limitation.
- **NDOT/TRPA:** It seems like just developing an ArcGIS application to collect the data would be helpful. ESRI 1-2-3 is an option to develop an app.
- **TRPA:** We will go back and make edits based on what we talked about today and then send them out for your review. We would like to capture this conversation but we also want any other comments you have on the Safety MOU.
- **EDC Sheriff:** Who is going to manage a Lake Tahoe Regional Emergency Plan? When things go bad in the Region, they go bad.
- **City of South Lake Tahoe:** It should be a 20,000 foot plan, not hyper-specific.
- **Kittelson:** In some cases, it might just be providing the understanding and finding connections for communication and coordination.
- **TRPA:** The evacuation plan would be a next step and is not part of this current project. I also consider gridlock an issue for emergency response. How do we deal with those situations to protect people at the Lake.
- **City of South Lake Tahoe:** For consideration as part of the safety plan, shortly after the Angora fire, the city was proposing a road diet on a roadway and there was so much concern about emergency situations that the project was changed so as not to impact evacuation.
- **Kittelson:** The context of whether there is an opportunity for redundancy will inform project context from emergency response/evacuation approach.
- Emergency situations will also dictate which resources can be brought in and out.
- **EDC Sheriff:** Why aren't we talking about improving/widening roads within the Region?
- **TRPA/Kittelson:** Induced demand after widening results in more people driving and/or driving faster before the road becomes congested again. There are also the capacity limitations in and out of the Region that limit the effectiveness of any widening. Widening also decreases the desire of people to walk or bike because of the difficulty of getting around.
- **City of South Lake Tahoe:** There is also the cost of acquiring and constructing roadways.
- **NDOT:** Congestion also increases safety.
- **TRPA:** The draft has been provided for specific PDT comments. We can discuss this MOU again at future PDT meeting, if needed.

**10:45am - 11:00am      Overview of Upcoming Activities, Next Steps, Next Meeting Planning**

- Next PDT Meeting – August 9<sup>th</sup>. Now changed to August 15<sup>th</sup> at 9am.
- Anticipated Topics for August Meeting
  - Comments on draft HSIP Projects
  - Project Evaluation MOU Follow-up, as needed
  - Safety MOU Follow-up, as needed
  - Discuss approach to draft report
- After the August PDT meeting, we anticipate the final PDT meeting will occur in early Fall related to final documentation for the safety plan.
- Please share anything you can by the 16<sup>th</sup>, even if it is just guidance.
- We will also want you to start thinking about how we want to close out this project and deliver our products.

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**Lake Tahoe Safety Plan PDT Meeting #7  
AGENDA**

*August 15, 2018; 9:00 a.m. to 11:00 a.m.  
128 Market St, Stateline, NV 89449*

- |                          |  |
|--------------------------|--|
| <b>9:00am – 9:05am</b>   | <b>Welcome and Roll Call</b>   |
| <b>9:05am -9:10am</b>    | <b>Project Status Overview</b> <ul style="list-style-type: none"><li>• Schedule Review</li><li>• Key Topics and Outcome Goals</li></ul>  |
| <b>9:10am -10:10am</b>   | <b>Projects and HSIP Applications</b> <ul style="list-style-type: none"><li>• Present and discuss projects and applications to be submitted<ul style="list-style-type: none"><li>○ California Locations</li><li>○ Nevada Locations</li></ul></li></ul>   |
| <b>10:10am – 10:30am</b> | <b>Safety and Project Evaluation MOUs</b> <ul style="list-style-type: none"><li>• Safety MOU<ul style="list-style-type: none"><li>○ Additional comments on updated MOU</li></ul></li><li>• Project Evaluation MOU<ul style="list-style-type: none"><li>○ Update on conversations and input</li><li>○ Next steps</li></ul></li></ul>  |
| <b>10:30am – 10:50am</b> | <b>Overview of Final Deliverables</b> <ul style="list-style-type: none"><li>• Safety Plan Documentation<ul style="list-style-type: none"><li>○ Documentation per Caltrans SSAR Requirements</li></ul></li><li>• Anticipated Resources with the Safety Plan<ul style="list-style-type: none"><li>○ Safety MOU with Countermeasures Toolbox</li><li>○ Project Evaluation MOU</li></ul></li></ul> |
| <b>10:50am - 11:00am</b> | <b>Overview of Upcoming Activities, Next Steps, Next Meeting Planning</b> <ul style="list-style-type: none"><li>• Last PDT Meeting – September</li><li>• Anticipated Topics for September Meeting<ul style="list-style-type: none"><li>○ Final deliverables</li></ul></li></ul>  |

**Lake Tahoe Safety Plan PDT Meeting #7  
AGENDA**

*August 15, 2018; 9:00 a.m. to 11:00 a.m.  
128 Market St, Stateline, NV 89449*

**Welcome and Roll Call**

- Eric Royer, Caltrans
- Ryan, El Dorado County Sherriff
- Matt, El Dorado County Sherriff
- Officer Piner, California Highway Patrol
- Mike, Nevada Highway Patrol
- Bill Story, Nevada DOT
- City of South Lake Tahoe Police
- Juan Hernandez, Nevada DOT
- Nevada DOT HSIP
- Kevin Yoss, Teresa Limon, Darlene, Fernando, Caltrans District 3
- Rebecca Soloman, Placer County
- Steve Pyburn, FHWA

**Project Status Overview**

- The team is currently working on completing the California HSIP applications
- Next PDT meeting will be the last and will focus on the draft final deliverables

**Update on HSIP Projects**

- We are currently working with NDOT on their potential locations
- Six locations were identified in the first round: 3 Caltrans, 2 CSLT, 1 El Dorado County
- Field reviews were conducted in July and follow up with concept designs and cost estimates.
- **#1 Emerald Bay Road between F Street and 13<sup>th</sup> Street:** Overhead RRFBs, lighting, pedestrian crossings with refuge islands, and pedestrian countdown timers with LPI on appropriate.
  - **Morgan, TRPA:** Exciting project with enhanced crossings, and if it is awarded it will be the first in-Basin pedestrian refuge islands. Thankful for Caltrans and CSLT for moving the project forward. CSLT will submit and manage the project but Caltrans would maintain going forward.
  - **Caltrans:** Not sure about maintenance.
  - **TRPA:** We should have that conversation immediately with Sergio.
- **#2 SR 267 near Brockway Summit Trailhead:** chevron signs, high-friction surface treatment (HFST), dynamic speed feedback signs, and advance warning. This project will not move forward at this time.
  - **NDOT:** Should last for ten years and has been implemented in cold weather climates.
  - **TRPA:** We should have a follow-up conversation. Caltrans experience has been that it gets removed after three years because of snow plowing.
- **#3 US 50 between Echo Summit and Old Meyers Grade Road:** similar concept to SR 267. The project is not moving forward.
- **#4/#5 City of South Lake Tahoe:**
  - moving forward with two applications:

- **Blackwood/Tamarack:** AWSC, advance warning, illumination, upgraded pavement markings
- **Pioneer Trail/Edna St:** Restriping to realign, improving sight distance, lighting, speed feedback signs
- **TRPA:** We also looked at improving access to the Sierra House School but the project would not be competitive for an HSIP grant application. Kittelson will develop a concept to help in the future for this site.
- **#6 El Dorado County:**
  - **North Upper Truckee (NUT) Rd and San Bernardino Ave:** HFST, chevron signs, advance warning signs with speed feedback, improving sight distance.
    - Expanded to two additional locations: NUT + Angora Creek Rd, and Mt. Rainier.
    - This route is used as a loop to avoid going through Meyers;
  - **CHP:** This is a lot of cut-through traffic as people try to avoid US 50 traffic during peaks – causes major back-ups on local roadways limiting access.

#### **Safety Commitment MOU**

- The MOU represents a commitment by agencies to improving transportation safety for each user within the Lake Tahoe Region.
- Core Expectations:
  - Cooperative to review and assess safety, using the countermeasure toolbox, and priority locations as a baseline.
  - Each agency will assist in implementing recommendations depending on their existing roles and responsibilities. This may include: data collection, reporting, etc.
- **TRPA:** We would love any input from you on the Safety MOU.
- **Caltrans:** Safety is going to need more time to look at the MOU. Caltrans has not had a chance to look at it. We will need a couple weeks to let management look at it.
- **TRPA:** We will extend the review time until the end of August.
- **NDOT HSIP:** We will try to piggyback a discussion on this to move things forward on our side. We will also provide some comments on the memo.
- **NHP:** Who is going to be equipping the technology for GPS/iPads? NHP has the ability to do that but we are not going to adjust crash reporting protocols.
- **NDOT:** This will line up with NDOT's NCAT format. NDOT is trying to get the entire state on the same system. We will need to check on the status of the reporting system. It would be in the same format that was provided before.
- **TRPA:** Can you provide information on the NCAT database/formatting? GPS coordinates are important to accurately reporting crashes.
- **CHP:** GPS is not perfect given the terrain in the Basin - sometimes it defaults to the CHP office location when the GPS is not able to find a signal.
- **NDOT:** How do we account for crashes that are not reported like pedestrian and bicycle crashes?
- **TRPA:** When they don't meet the minimum reporting requirements at that location they are not reported into the databases. TRPA is envisioning a minimal report to provide information on calls.
- **CHP:** We would want to share the dispatch call information on bike/ped or PDO crashes to help locate these crashes and identify how to collect this information.
- **NDOT:** We are also trying to figure out how to collect close calls as part of our on-going safety work.
- **TRPA:** We do have the ability to collect close calls via self-reporting but it is hard to confirm and we don't get a lot of use of the interactive map we have created. We will also be reaching out to the hospitals to work within the HIPPA requirements to get more information on admittance records for crashes – we need help to determine if they are mountain bike or biking on roads.
- **CHP:** Will there will be lighting for the pedestrian crossings on Emerald Bay Road, and will there be pedestrian signals?
- **Caltrans:** If we find enough pedestrian activity through the RRFB installation then we might consider upgrading them to a pedestrian signal or pedestrian hybrid beacon (PHB) in the future.
- **TRPA:** We are reticent to install more PHBs until we figure out how to effectively operate the first one in the Basin. There will be poles and indicators and snow-plow-friendly island designs.
- **Caltrans:** You can also do a heated island to prevent the snow from accumulating on the locations.
- **TRPA:** Interested in looking into how to update the PHB pattern/design. We are doing some analysis on the PHB

to see if there is a way to work around the edges to improve the operations for both pedestrians and vehicles.

- **Kittelson:** There is a national conversation around how PHBs operate and will be used going forward.
- **Placer County:** The biggest item for us is that there isn't a plan ahead of this MOU to reference when discussing with our CEO. The CEO's office isn't comfortable with signing until the plan is finalized. There is also some other wording that is confusing for who is responsible for doing what in the MOU. We need to better define roles and responsibilities. Placer County is not going to change how we collect data from CHP or from hospitals.
- **Kittelson/TRPA:** TRPA willing to meet with each agency to adapt and adjust for each agencies' needs. A marked-up version of the MOU will help us understand where the questions are for your agency. The draft will be available in September. You have already seen everything that will be in the plan itself – the pieces you have reviewed will be formed into the report. We will discuss the overview of the plan later in the meeting. One of TRPA's main missions is to act as a data clearinghouse to facilitate regional coordination on data. We don't want to duplicate, but in any way that we can provide a service, that is the role that we want to play.
- **TRPA:** Deadline is the end of August for comments. Please share any comments by the deadline, as well as who will be the signatory of your agency and what the process to have that occur would be.

## Project Evaluation MOU

- Purpose:
  - The MOU seeks to establish a consistent analysis procedure for the Lake Tahoe Region. The MOU would also broaden analysis to consider peak and off-peak in the region.
- Revisions:
  - Revised considerations specific to freight and emergency vehicles
  - Added a fourth roadway type and associated performance measures
  - *Design Vehicles and Freight Considerations:*
    - We removed the concept of the control vehicle and design vehicle.
    - The MOU now focuses on accommodating design vehicles and specific movements at an intersection or along a facility.
    - The MOU continues to encourage the smallest possible footprint appropriate to accommodate the design vehicle and to consider the tradeoffs between increasing the size of intersections vs. the exposure/crash risk for vulnerable road users.
    - **CHP:** I am an expert on STAA truck routes within the region and could provide support.
    - **TRPA:** We will add language to make sure that law enforcement is included in initial design discussions to capture their input.
  - *Specific Considerations for Corridors*
    - Considerations were added for peak tourist queues where shoulders are "parked out" to think through emergency access.
    - Guidance was added for projects to consider opportunities to address those issues when they are in an area with a known queue/parking issue that could affect emergency access.
    - **TRPA:** This is a problem we are highly aware of and are focused on addressing. It is something we are currently working through on SR 89 and the parking that occurs along the roadway.
  - *Fourth Roadway Type – Multilane Urban Arterial*
    - US 50 between SR 89 and Kahle Drive
    - Naming is still being adjusted – it may be signalized multilane urban arterial
    - **NDOT:** We have a lot of community driveways that aren't signalized at this point.
    - **TRPA:** We still need to talk with NDOT and everything is still open to negotiation.
    - **Caltrans:** We've been talking with some managers, and they would like to extend the location south to where the roadway changes to a 40 mph posted speed and the cross section changes to four lanes. This would include the area where there has been discussion around creating a more walkable area.
    - **TRPA:** We will make that edit and send it out to everyone.
    - Performance Metrics:
      - Highest priority to safety, transit, and peak auto mobility.
      - The other three are in the accommodating category: ped/bike, local access, and off-peak mobility.

- Revisions are being made relative to the Connectivity and Circulation within Communities category.
- Safety remains the same.
- Pedestrian LOS: This metric has been adjusted down for signalized intersections to LOS C and is still being discussed for uncontrolled crossings. There are few uncontrolled marked crossings so we are going to do some yield rate studies to understand what the typical yield rate is within the Lake Tahoe Region. This would also be used to assess how drivers yielding response to different treatments compared to prior existing conditions.
- **Caltrans:** In the 6<sup>th</sup> edition of the Highway Capacity Manual, most people think of speed, delay, or volume. For pedestrians it includes geometric characteristics. The delay for pedestrian crossings is only part of the calculation and some things you cannot change at an intersection – so LOS B or A may not be possible on US 50.
- **NDOT:** These are also aspirational goals.
- **TRPA:** We want them to be realistic goals.
- Bicycle LTS: Lowered from LTS 1 to LTS 2 for most categories.
- **TRPA:** Emerald Bay was strategically included in the links between communities because it is an important recreational area to try and encourage improved facilities parallel to SR 89.
- **Kittelson:** The roadway does not need to make the connection. We will clarify that it can be a parallel facility. We will also define what the allowable deviation from the primary route would be (to avoid routes that are too circuitous for pedestrians/bicyclists).
- Transit Travel Time: the metric was changed to be “decrease relative to existing.”
- **Caltrans:** Preemption for transit vehicles should be considered. It is something that could be easily accommodated but would require coordination with each agency. It would not be a hard thing to implement.
- **TRPA:** We have records where we have preemption and that is something that we would like to share to make sure that we have the latest data on locations. This generally reflects our desire to improve the transit system to encourage people to use it to manage traffic congestion and improve safety.
- Local Access: We have separated out delay for signals and stop/yield controls. We also added targets for the fourth category to match links between communities except for signals in the off peak (which has a slightly higher threshold).
- **TRPA:** We are going to be looking at this with Caltrans to evaluate signals and improvements to handle differences between peak and off-peak traffic. A multimodal signalization corridor study has been identified in TRPA’s RTP.
- **Caltrans:** We cannot seasonally adjust software. Signals are currently managed using Caltrans’ in-house software and it does not allow for that level of signal timing customization. Getting the ITS elements in place is a more arduous process.
- **Kittelson:** May need to consider US 50 as a master plan to make sure that it is coordinated across both states.
- **Caltrans:** At roundabouts we can’t control timing. There is a proposal from Placer County to put in a roundabout at SR 267 and SR 28.
- **Kittelson:** We will add some guidance specific to roundabouts.
- **Steve Pyburn, FHWA:** In this table, the yield control isn’t referring to a roundabout. It is premature to talk about delay without looking at a specific context.
- Comments by August 31<sup>st</sup>, identify specific signatories for agencies (and any process that is required to obtain the signature).
- **TRPA:** These MOUs will be identified as an action item for the bistate compact.

## Overview of the Final Deliverables

- Key interim deliverables:
  - collected, analyzed, and identified gaps in crash data
  - regional crash trends and risk factors
  - countermeasure toolbox
  - crash data recommendations to address gaps and streamline (basis for the Safety MOU)
  - design volume (basis for Project Evaluation MOU)
- All of these deliverables that have been shared with the PDT will flow into the overall safety plan.
- The MOUs are the “action” to help get away from plans sitting on the shelf. We want to identify how to make improvements.
- HSIP project scopes: We won’t be doing eight as originally scoped, but four applications for Caltrans HSIP. We will also work with NDOT to determine potential HSIP project scopes/concepts.
- A concept will be developed for the Sierra House Elementary School area if there is available funding at the conclusion of the project.
- Kittelson will also be creating a tool for project evaluations to help implement the MOUs.

## Next Steps

- HSIP applications are due by August 31<sup>st</sup>.
- Comments on both MOUs by August 31<sup>st</sup>.
- Next PDT in late September and/or early October to discuss the final plan – October 11<sup>th</sup>.
  - **TRPA:** Focus on the things that are most relevant and important to you. Most of the content has been provided to you in the prior memos.
- Draft Plan will be provided two weeks in advance of the final PDT meeting.

## ATTACHMENT C – GIS DATABASE DATA DICTIONARY

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File name	Field Name	Field Description	Data Type	Notes
tahoe_roads_enhanced	LINK_ID	Linear Reference System Route ID – roadway identification for all attribute layers	Integer	
tahoe_roads_enhanced	ST_NAME	Street name.	Text	
tahoe_roads_enhanced	FEAT_ID	Unique feature ID.	Text	
tahoe_roads_enhanced	ST_NM_PREF	Directional Prefix to street name, if applicable.	Text	
tahoe_roads_enhanced	ST_NM_BASE	Street Name, excluding directional modifiers	Text	
tahoe_roads_enhanced	ST_NM_SUFF	Directional Suffix to street name, if applicable.	Text	
tahoe_roads_enhanced	ST_TYP_AFT	Street Type (e.g., Road, Drive, Boulevard)	Text	
tahoe_roads_enhanced	FUNC_CLASS	Functional class, 2 through 5.	Integer	
tahoe_roads_enhanced	TUNNEL	Categorical variable indicating whether roadway segment is a tunnel.	Text	<b>“Y” or “N”</b>

File name	Field Name	Field Description	Data Type	Notes
tahoe_roads_enhanced	Actual_Speed	“Actual speed” value taken from County travel demand model.	Integer	
tahoe_roads_enhanced	AB_Speed	Posted speed, directional.	Integer	
tahoe_roads_enhanced	AB_Lanes	Number of lanes, directional.	Integer	
tahoe_roads_enhanced	AB_FC	Functional class, directional.	Integer	Values include: 1, 2, 3
tahoe_roads_enhanced	BA_Speed	Posted speed, directional.	Integer	
tahoe_roads_enhanced	BA_Lanes	Number of lanes, directional.	Integer	
tahoe_roads_enhanced	BA_FC	Functional class, directional.	Integer	Values include: 1, 2, 3
tahoe_roads_enhanced	Volume_Category	TRAP travel demand model link volumes categorized to the nearest 1,000 vehicles per day.	Text	
tahoe_roads_enhanced	Median	Median type and descriptions: Only recorded for segments where AB_FC=1 or 2.	Text	Values include:  Left Turn Lane, Reverse Curve and Pocket, Separated Roadway, Separated Roadway with Barriers, Tapered Stripes, Left Turn Lane, Wide Striped.

File name	Field Name	Field Description	Data Type	Notes
trpa_intersections	INTERSECTI	Cross streets at intersection	Text	
trpa_intersections	NS_ST; EW_ST	North/South cross street at intersection; East/West cross street at intersection.	Text	
trpa_intersections	OWNER	Jurisdiction in charge of road maintenance at each intersection. Attributes that do not specify ownership under this field are assumed as private intersections along privately maintained roads.	Text	
trpa_intersections	CROSSWALKS	Number of painted crosswalks at intersection.		
trpa_intersections	NORTH_CROSS; SOUTH_CROSS; EAST_CROSS; WEST_CROSS	Indicator variable for presence of North/South/East/West crosswalk	Integer	1=Crosswalk; 0=No crosswalk
trpa_intersections	MIDBLOCK	Indicator variable for whether crosswalk is a midblock crosswalk.	Integer	1=Midblock crossing; 0=Not midblock crossing
trpa_intersections	DISTANCE	Distance of each crosswalk identified at intersection. Order is specified in NOTES field.	Integer	

File name	Field Name	Field Description	Data Type	Notes
trpa_intersections	STRIPING	Crosswalk striping at intersection with crosswalks present. For locations with multiple crosswalk markings at one intersection, the term "MIXED" is used and differences noted in the NOTES field.	Text	
trpa_intersections	SIGNAL	Specified whether the intersection is signal.	Text	"Yes" or "No"
trpa_intersections	PED_HEAD	Specifies whether intersection contains pedestrian signal heads for crossings.	Text	"Yes" or "No"
trpa_intersections	ACTIVATED	Specifies whether intersection contains activated pedestrian crossings.	Text	"Yes" or "No"
trpa_intersections	ADA	Specifies whether intersection contains pedestrian signal heads for crossings.	Text	"Yes" or "No"
trpa_intersections	STOP_SIGN	Specifies whether there is a stop sign at the intersection.	Text	"Yes" or "No"

File name	Field Name	Field Description	Data Type	Notes
trpa_intersections	OTHER_SIGN	Notes any additional signage at each intersection. Signage is noted based on California MUTCD codes.	Text	
trpa_intersections	NS_SPEED/EW_SPEED	Posted or assumed (i.e., residential streets assumed to be posted at 25 mph) on North/South or East/West cross street at intersection.	Integer	
trpa_intersections	SCHOOL	Specifies whether intersection is located directly at a school or along a street that leads directly to a school.	Text	
trpa_intersections	PRIMARY_RD	Specifies whether the crosswalk crosses a primary road.	Text	
trpa_intersections	OFFSET	Specifies whether the crosswalk is offset several meters from the intersection.	Text	
trpa_intersections	AT_INTERSE	Specifies whether the crosswalk is located directly at the intersection on one of the North, South, East, or West legs.	Text	
trpa_intersections	NB_LANE_CO; SB_LANE_CO;	Approach lane configuration.	Text	T=Through lanes; L=Left turn lanes;

File name	Field Name	Field Description	Data Type	Notes
	EB_LANE_CO; WB_LANE_CO;			R=Right turn lanes; TR=Through/Right Lanes; TL=Through/Left Lanes. Number precedes movement to indicate number of lanes; e.g., "2T1R" equals 2 through lanes, 1 right turn lane.
trpa_intersections	ENHANCED_C	List of all enhanced pedestrian/trail crossing elements (pedestrian refuge, flashing beacon, curb extension, RRFB, et al)	Text	
trpa_intersections	OTHER_FACI	Any non-crossing related facilities (channelized turn islands, striped/curbed median, etc.)	Text	
trpa_intersections	NOTES	Additional notes about intersections or data.	Text	

**'tahoe\_roads\_enhanced' feature class** -- This represents the roadway shapefile supplied by TRPA, with supplemented information transferred from a TRPA modeling file as described below.

Attributes copied over from the model output shapefile to the TRPA-supplied centerline file.

- a. Speed (directionality preserved in two fields – AB\_Speed and BA\_Speed, but all segments are the same in each direction)
- b. Number of lanes (directionality preserved in two fields – AB\_Lanes and BA\_Lanes)
- c. Functional Class (directionality preserved – AB\_FC, BA\_FC, but all segments are the same)
- d. Actual speed (bidirectional – Actual\_Speed). Note that it's unclear at this point if this represents 85th percentile or mean. We'll follow up with details as we get them.
- e. Modeled link volumes (bidirectional – DAILYVOLUM – categorized by 1,000s (1000-1999, 2000-2999, ...))
- f. Median presence data (internally recorded for all roads with functional class 1 or 2)

Also note that there are several existing links with LINKID==0 that are seemingly redundant. We have not deleted them from the dataset but did not transfer any data to them, and have found it worth querying them out for any use purposes. We'll follow up with additional details or decisions as appropriate.

**'trpa\_2018\_intersections\_kai' feature class** -- This file was put together by TRPA and includes data for intersections in the study area. I have copied the file's metadata below, which serves as a data dictionary. Additional information about Kittelson's analysis filtering process can be found in the "Kittelson intersection filtering notes" file.

INTERSECTI = Cross streets at intersection

NS\_ST = North/South cross street at intersection

EW\_ST = East/West cross street at intersection

OWNER = Jurisdiction in charge of road maintenance at each intersection. Attributes that do not specify ownership under this field are assumed as private intersections along privately maintained roads.

CROSSWALKS = Number of painted crosswalks at each specified intersection.

NORTH\_CROS = Crosswalk on north leg of intersection (0 = no crosswalk; 1 = crosswalk present; N/A = no north leg of intersection)

SOUTH\_CROS = Crosswalk on south leg of intersection (0 = no crosswalk; 1 = crosswalk present; N/A = no south leg of intersection)

EAST\_CROSS = Crosswalk on east leg of intersection (0 = no crosswalk; 1 = crosswalk present; N/A = no east leg of intersection)

WEST\_CROSS = Crosswalk on west leg of intersection (0 = no crosswalk; 1 = crosswalk present; N/A = no west leg of intersection)

MIDBLOCK = Crosswalk is a midblock crossing, not at an intersection (1 = midblock crosswalk; N/A = not a midblock crosswalk)

DISTANCE = Distance of each crosswalk identified at intersection. Order is specified in NOTES field. \*Distance is measured on Google satellite view and may not be statistically accurate.

STRIPING = Crosswalk striping at intersection with crosswalks present. For locations with multiple crosswalk markings at one intersection, the term "MIXED" is used and differences noted in the NOTES field.

SIGNAL = Specifies whether intersection is signalized.

PED\_HEAD = Specifies whether intersection contains pedestrian signal heads for crossings.

PED\_COUNTD = Specifies whether intersection contains pedestrian countown times at crossings.

ACTIVATED = Specifies whether intersection contains activated pedestrian crossings.

ADA = Specifies whether intersection contains ADA-compliant curb ramps.

STOP\_SIGN = Specifies whether there is a stop sign at the intersections.

OTHER\_SIGN = Notes any additional signage at each intersection. Signage is noted based on California MUCTD codes ([http://www.dot.ca.gov/trafficops/tcd/docs/CA\\_SignChart\\_2014Rev1\\_Tabloid.pdf](http://www.dot.ca.gov/trafficops/tcd/docs/CA_SignChart_2014Rev1_Tabloid.pdf)). Signage that is not specifically identified by code in the MUCTD manual is spelled out in quotes "XXXX."

NS\_SPEED = Posted or assumed (residential 25 mph) speed on North/South cross street at location of intersection.

EW\_SPEED = Posted or assumed (residential 25 mph) speed on East/West cross street at location of intersection.

SCHOOL = Specifies whether intersection is located directly at a school or along a street that leads directly to a school. (If the intersection is within the 2 mile school zone, this is noted in the "SCHOOL\_2MI" field).

PRIMARY\_RD = Specifies whether the crosswalk crosses a primary road.

OFFSET = Specifies whether the crosswalk is offset several meters from the intersection. Primarily used to identify offset bike path crossings.

AT\_INTERSE = Specifies whether the crosswalk is located directly at the intersection on one of the North, South, East, or West legs.

Lane Configurations (Northbound = NB\_LANE\_CO; Southbound = SB\_LANE\_CO; Eastbound = EB\_LANE\_CO; Westbound = WB\_LANE\_CO)

Number of Approach Lanes by Movement: T = Through Lanes L = Left Turn Lanes R = Right Turn Lanes TR = Through/Right Lanes\*TL = Through/Left Lanes\*# = Number of Lanes for each lane type. E.g., #(Lane Code) --> 2T1R = 2 Through Lanes, 1 Right Turn Lane 1L1TR = 1 Left 1 Through/Right\*only code as TR/TL if explicitly striped, otherwise with Through/Turn arrows, otherwise code a "T" for implicit through+turn movements

ENHANCED\_C = List of all enhanced ped/trail crossing elements (ped refuge, flashing beacon, curb extension, RRFB, etc.)

OTHER\_FACI = Any non-crossing related facilities (channelized turn islands, striped/curbed median, etc.)

NOTES = Additional notes and details about intersections as they arise.

## ATTACHMENT D – PROJECT CONCEPT DESIGN COST ESTIMATES

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Prepared by  
Date

S. Robinson  
08/27/18

**PRELIMINARY COST ESTIMATE**

***LAKE TAHOE REGION SAFETY STRATEGY***

North Upper Truckee Road and E San Bernardino Avenue Intersection

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL AMOUNT
1.	Mobilization	1	LS	\$9,000.00	\$9,000.00
2.	Clearing and Grubbing	1	LS	\$15,000.00	\$15,000.00
3.	Traffic Control	1	LS	\$3,000.00	\$3,000.00
4.	Remove Traffic Stripe	3,900	LF	\$2.00	\$7,800.00
5.	High Friction Surface Pavement	31,200	SF	\$4.00	\$124,800.00
6.	Traffic Stripe	3,900	LF	\$4.00	\$15,600.00
7.	Traffic Sign	6	EA	\$600.00	\$3,600.00
8.	Install Speed Feedback Sign	2	EA	\$7,500.00	\$15,000.00
<b>SUBTOTAL CONSTRUCTION</b>					<b>\$194,000.00</b>
<b>CONTINGENCY</b>					<b>25% of Subtotal</b> <b>\$49,000.00</b>
<b>GRAND TOTAL (SUBTOTAL + CONTINGENCY)</b>					<b>\$243,000.00</b>

**PRELIMINARY COST ESTIMATE**

***LAKE TAHOE REGION SAFETY STRATEGY***

Lake Tahoe Boulevard Between Mt Rainier Drive and Mule Deer Circle

ITEM NO.	CM ID	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL AMOUNT
1.	R24	Improve Pavement Friction	14,400	SF	\$4.00	\$57,600.00
2.	R27	Install Chevron Signs on Horizontal Curves	5	EA	\$500.00	\$2,500.00
3.	R28	Install Curve Advance Warning Signs	2	EA	\$500.00	\$1,000.00
4.	R30	Install Dynamic/Variable Speed Warning Signs	2	EA	\$7,500.00	\$15,000.00
<b>SUBTOTAL</b>						<b>\$76,100.00</b>
<b>CONTINGENCY (20%)</b>						<b>\$15,220.00</b>
<b>GRAND TOTAL (SUBTOTAL + CONTINGENCY)</b>						<b>\$91,300.00</b>

**PRELIMINARY COST ESTIMATE**

***LAKE TAHOE REGION SAFETY STRATEGY***

North Upper Truckee Road at Mt Rainier Drive

ITEM NO.	CM ID	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL AMOUNT
1.	R24	Improve Pavement Friction	10,800	SF	\$4.00	\$43,200.00
2.	R27	Install Chevron Signs on Horizontal Curves	8	EA	\$500.00	\$4,000.00
3.	R28	Install Curve Advance Warning Signs	2	EA	\$500.00	\$1,000.00
4.	R30	Install Dynamic/Variable Speed Warning Signs	2	EA	\$7,500.00	\$15,000.00
<b><u>SUBTOTAL</u></b>						<b>\$63,200.00</b>
<b><u>CONTINGENCY (20%)</u></b>						<b>\$12,640.00</b>
<b><u>GRAND TOTAL (SUBTOTAL + CONTINGENCY)</u></b>						<b>\$75,800.00</b>

Prepared by  
Date

S. Robinson  
08/14/18

**PRELIMINARY COST ESTIMATE**

***LAKE TAHOE REGION SAFETY STRATEGY***

Tamarack Avenue and Blackwood Road Intersection

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL AMOUNT
1.	Mobilization	1	LS	\$3,000.00	\$3,000.00
2.	Traffic Control	1	LS	\$3,000.00	\$3,000.00
3.	Remove Traffic Stripe	3,100	LF	\$2.00	\$6,200.00
4.	Remove Pavement Marking	130	SF	\$3.00	\$390.00
5.	Remove Traffic Sign	5	EA	\$200.00	\$1,000.00
6.	Traffic Stripe	1,900	LF	\$4.00	\$7,600.00
7.	Pavement Marking	350	SF	\$6.00	\$2,100.00
8.	Traffic Sign	11	EA	\$600.00	\$6,600.00
9.	Install Street Light (Existing Pole)	1	EA	\$3,000.00	\$3,000.00
<b><u>SUBTOTAL CONSTRUCTION</u></b>					<b>\$33,000.00</b>
<b><u>CONTINGENCY</u></b>					<b>25% of Subtotal \$9,000.00</b>
<b><u>GRAND TOTAL (SUBTOTAL + CONTINGENCY)</u></b>					<b>\$42,000.00</b>

Prepared by  
Date

S. Robinson  
08/14/18

**PRELIMINARY COST ESTIMATE**

***LAKE TAHOE REGION SAFETY STRATEGY***

Pioneer Trail and Edna Street Intersection

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL AMOUNT
1.	Mobilization	1	LS	\$5,000.00	\$5,000.00
2.	Traffic Control	1	LS	\$3,000.00	\$3,000.00
3.	Remove Traffic Stripe	3,100	LF	\$2.00	\$6,200.00
4.	Traffic Stripe	3,300	LF	\$4.00	\$13,200.00
5.	Pavement Marking	300	SF	\$6.00	\$1,800.00
6.	Traffic Sign	2	EA	\$600.00	\$1,200.00
7.	Install Street Light (Existing Pole)	2	EA	\$3,000.00	\$6,000.00
8.	Install Speed Feedback Sign	2	EA	\$7,500.00	\$15,000.00
<b>SUBTOTAL CONSTRUCTION</b>					<b>\$52,000.00</b>
<b>CONTINGENCY</b>					<b>25% of Subtotal</b>
<b>GRAND TOTAL (SUBTOTAL + CONTINGENCY)</b>					<b>\$65,000.00</b>

Prepared by  
Date

S. Robinson  
08/20/18

**PRELIMINARY COST ESTIMATE**

***LAKE TAHOE REGION SAFETY STRATEGY***

US 50 - Emerald Bay Road

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL AMOUNT
1.	Mobilization	1	LS	\$23,000.00	\$23,000.00
2.	Traffic Control	1	LS	\$20,000.00	\$20,000.00
3.	Roadway Excavation	20	CY	\$200.00	\$4,000.00
4.	Remove Traffic Stripe	1,500	LF	\$2.00	\$3,000.00
5.	Concrete Curb	370	LF	\$30.00	\$11,100.00
6.	Median Concrete	1,050	SF	\$10.00	\$10,500.00
7.	Traffic Stripe	1,200	LF	\$4.00	\$4,800.00
8.	Pavement Marking	980	SF	\$6.00	\$5,880.00
9.	Traffic Sign	8	EA	\$600.00	\$4,800.00
10.	Install Pedestrian Countdown Heads	8	EA	\$1,000.00	\$8,000.00
11.	Modify Traffic Signal Phasing	1	LS	\$5,000.00	\$5,000.00
12.	Install Rectangular Rapid Flashing Beacon System	4	EA	\$35,000.00	\$140,000.00
13.	Install Street Lighting	4	EA	\$7,000.00	\$28,000.00
<b><u>SUBTOTAL CONSTRUCTION</u></b>					<b>\$269,000.00</b>
<b><u>CONTINGENCY</u></b>					<b>25% of Subtotal</b> <b>\$68,000.00</b>
<b><u>GRAND TOTAL (SUBTOTAL + CONTINGENCY)</u></b>					<b>\$337,000.00</b>

**PRELIMINARY COST ESTIMATE**  
***LAKE TAHOE REGION SAFETY STRATEGY***  
 US 50 - Old Meyers Grade

ITEM NO.	CM ID	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL AMOUNT
1.	R4	Install Guardrail	3,100	LF	\$100.00	\$310,000.00
2.	R24	Improve Pavement Friction	135,000	SF	\$1.00	\$135,000.00
3.	R26	Install New Signs with Flourescent Sheeting	3	EA	\$500.00	\$1,500.00
4.	R27	Install Chevron Signs on Horizontal Curves	54	EA	\$500.00	\$27,000.00
5.	R28	Install Curve Advance Warning Signs	2	EA	\$500.00	\$1,000.00
6.	R30	Install Dynamic/Variable Speed Warning Signs	3	EA	\$7,500.00	\$22,500.00
7.	R31	Install Delineators, Reflectors	120	EA	\$50.00	\$6,000.00
8.	R34	Install Centerline Rumble Strips	14,300	EA	\$10.00	\$143,000.00
<b><u>SUBTOTAL</u></b>						<b>\$646,000.00</b>
<b><u>CONTINGENCY (20%)</u></b>						<b>\$129,200.00</b>
<b><u>GRAND TOTAL (SUBTOTAL + CONTINGENCY)</u></b>						<b>\$775,200.00</b>

**PRELIMINARY COST ESTIMATE**

***LAKE TAHOE REGION SAFETY STRATEGY***

North Shore Boulevard (SR 267) at Brockway Summit Trailhead

ITEM NO.	CM ID	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL AMOUNT
1.	R24	Improve Pavement Friction	57,600	SF	\$1.00	\$57,600.00
2.	R26	Install New Signs with Flourescent Sheeting	6	EA	\$500.00	\$3,000.00
3.	R27	Install Chevron Signs on Horizontal Curves	10	EA	\$500.00	\$5,000.00
4.	R30	Install Dynamic/Variable Speed Warning Signs	2	EA	\$7,500.00	\$15,000.00
5.	R35	Install Edgeline Rumble Strips	6,000	LF	\$10.00	\$60,000.00
<b>SUBTOTAL</b>						<b>\$140,600.00</b>
<b>CONTINGENCY (20%)</b>						<b>\$28,120.00</b>
<b>GRAND TOTAL (SUBTOTAL + CONTINGENCY)</b>						<b>\$168,700.00</b>

Prepared by  
Date

SH / SR  
12/21/18

**PRELIMINARY COST ESTIMATE**

***LAKE TAHOE REGION SAFETY STRATEGY***

US 50 - Kahle Drive

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL AMOUNT
1.	Mobilization	1	LS	\$75,000.00	\$75,000.00
2.	Traffic Control	1	LS	\$45,000.00	\$45,000.00
3.	Roadway Excavation	1,600	CY	\$200.00	\$320,000.00
4.	Clearing and Grubbing	1	LS	\$18,000.00	\$18,000.00
5.	Remove Traffic Stripe	7,900	LF	\$2.00	\$15,800.00
6.	Remove Pavement Marking	750	SF	\$3.00	\$2,250.00
7.	AC Paving	6,660	SY	\$50.00	\$333,000.00
8.	Concrete Curb	80	LF	\$30.00	\$2,400.00
9.	Concrete Curb and Gutter	2,510	LF	\$32.00	\$80,320.00
10.	PCC Sidewalk - NW Quadrant of Kahle Intersection	160	SF	\$15.00	\$2,400.00
11.	PCC Sidewalk - NE Quadrant of Kahle Intersection	1,630	SF	\$15.00	\$24,450.00
12.	PCC Sidewalk - SW Quadrant of Kahle Intersection	345	SF	\$15.00	\$5,175.00
13.	PCC Sidewalk - SE Quadrant of Kahle Intersection	1,300	SF	\$15.00	\$19,500.00
14.	ADA Pedestrian Ramp	7	EA	\$3,500.00	\$24,500.00
15.	Commercial Driveway	1	EA	\$5,000.00	\$5,000.00
16.	Traffic Stripe	8,350	LF	\$4.00	\$33,400.00
17.	Crosswalk Pavement Markings	470	SF	\$6.00	\$2,820.00
18.	Arrow Pavement Markings	950	SF	\$6.00	\$5,700.00
19.	Overhead Utility Relocation	1	LS	\$25,000.00	\$25,000.00
20.	Gas Pipeline Modification	1	LS	\$20,000.00	\$20,000.00
21.	Traffic Sign	6	EA	\$600.00	\$3,600.00
22.	Install Pedestrian Countdown Heads	2	EA	\$1,000.00	\$2,000.00
23.	Install and Upgrade Pedestrian Push Buttons	8	EA	\$1,000.00	\$8,000.00
24.	Modify Traffic Signal Phasing	1	LS	\$5,000.00	\$5,000.00
SUBTOTAL CONSTRUCTION					\$1,079,000.00
CONTINGENCY			25% of Subtotal		\$270,000.00
GRAND TOTAL (SUBTOTAL + CONTINGENCY)					\$1,349,000.00

Prepared by  
Date

SR  
12/21/18

**PRELIMINARY COST ESTIMATE**

***LAKE TAHOE REGION SAFETY STRATEGY***

US 50 - Lake Parkway to Kingsbury Grade

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL AMOUNT
1.	Mobilization	1	LS	\$50,000.00	\$50,000.00
2.	Traffic Control	1	LS	\$15,000.00	\$15,000.00
3.	Roadway Excavation	420	CY	\$200.00	\$84,000.00
4.	Clearing and Grubbing	1	LS	\$5,000.00	\$5,000.00
5.	AC Paving	155	SY	\$50.00	\$7,750.00
6.	Concrete Curb and Gutter	700	LF	\$32.00	\$22,400.00
7.	PCC Sidewalk	18,225	SF	\$15.00	\$273,375.00
8.	ADA Pedestrian Ramp	4	EA	\$3,500.00	\$14,000.00
<b><u>SUBTOTAL CONSTRUCTION</u></b>					<b>\$472,000.00</b>
<b><u>CONTINGENCY</u></b>					<b>25% of Subtotal \$118,000.00</b>
<b><u>GRAND TOTAL (SUBTOTAL + CONTINGENCY)</u></b>					<b>\$590,000.00</b>