U.S. Department of Transportation
Federal Highway Administration

Memorandum

Subject: NV FLAP US50(1)
Round Hill Pines Access Intersection
Design

Date: 2/5/20

From: Thomas Sohn
Project Manager
Central Federal Lands Highway Division

To: Nevada Department of Transportation
Tahoe Regional Planning Agency
United States Forest Service

The purpose of this memo is to outline the process and procedures used to evaluate three proposed alternatives requested by the Tahoe Regional Planning Agency's (TRPA) Memorandum dated October 16, 2019.

Background

The existing entrance to the Round Hill Pines Resort from US 50 has safety concerns due to poor sight distance, lack of turn lanes, and acceleration/deceleration lanes. Poor sight distance is due to the existing intersection being located within a horizontal curve and a vertical crest just south of the intersection. Additionally, the existing entrance road has an inconsistent width that cannot allow for two-way traffic in certain locations, as well as sharp curves.

The existing conditions, information from the 2017 Nevada Federal Lands Access Program (NV FLAP) application, other supporting documents, and the project scoping process resulted in a Purpose and Need statement for the project (Appendix F). Central Federal Lands Highway Division (CFLHD) and the project partners determined that the purpose of the project is to increase safety and improve accessibility for visitors entering and exiting the Round Hill Pines Resort from US 50. The purpose and need statement for the project was presented during a public meeting on April 23, 2019. Feedback received during the public meeting was positive and attendees were supportive of the project.

CFLHD and the project partners determined that the existing entrance into the Round Hill Pines Resort should be relocated to the north to a tangent section of US 50. This location provides better sight distance conditions and allows for construction of a new entrance road to tie into a future United States Forest Service (USFS) project that includes new parking lots at the resort. Additionally, the project team discussed safety improvements to US 50. These discussions included widening US 50 to accommodate a northbound left turn lane onto the proposed entrance road with a northbound acceleration lane for those turning left onto US 50 from the new entrance road and widening US 50 to accommodate a southbound right turn lane onto the proposed entrance

road and a southbound acceleration lane for those turning right onto US 50 from the new entrance road. The configuration for this layout and lane/taper values were taken from the NDOT Access Management System and Standards, Figure 4-10 (Appendix E).

For the 30% design phase, CFLHD provided plans, an estimate, and supporting documentation for the design described above; relocation of the existing entrance road and widening of US 50 at the intersection. At the 30% review meeting, the TRPA expressed concern about the widening and associated impacts. These concerns have been documented and elaborated on in comment response forms and during review meetings.

Based on this feedback, two additional alternatives were analyzed. A preliminary roundabout design and a traffic signal warrant analysis/design was conducted and presented to the project partners in July 2019. All three alternatives were presented during a public meeting on September 25, 2019. The roundabout and traffic signal alternatives were considered but dismissed from further evaluation because:

- Roundabout alternative had more environmental impact compared to the 30% design alternative.

- This intersection did not meet the traffic signal warrant.

In October 2019, in a memorandum prepared by TRPA (Appendix G), it was requested that additional alternatives be considered and analyzed. These alternatives are:

1. Moving the location of the entrance road to improve sight distance with no widening on US 50.
2. Moving the location of the entrance road to improve sight distance and only widening US 50 to include a northbound left turn lane onto the proposed entrance road with a northbound acceleration lane for those turning left onto US 50 from the new entrance road.

Intersection Sight Distance

The existing intersection was analyzed for left turn intersection sight distance. Based on existing conditions, the required sight distance is 588 ft. for passenger vehicles. For vehicles turning left onto US 50 from the existing entrance road, the existing sight distance to the north is approx. 760 ft., but only 310 ft. to the south (due to the location of a crest vertical curve). Therefore, the existing configuration has insufficient sight distance to the south and is an unsafe condition.

For the proposed design, the entrance road was relocated to the north within a tangent section of US 50. The exact location was selected such that intersection sight distance is maximized and evenly distributed. By moving the entrance road, an increased sight distance of approx. 665 ft. is achieved in both directions, which is sufficient for passenger cars. Because of the improved sight distance to a level that exceeds the minimum, the relocation of the entrance road is justified.

Displays showing the intersection sight distance are included in Appendix A.

Interactive Highway Safety Design Model Analysis

The Interactive Highway Safety Design Model (IHSDM) is a software analysis tool used to evaluate the safety and operational effects of geometric design decisions on highways. The software allows the user to import roadway geometry and assign attributes (such as lane widths, traffic data, turn lanes, etc.) for analysis. With this information, the software applies crash reduction factors (CRFs) and predicts total number and types of crashes for a specified time range.

For this analysis, three separate alternatives were analyzed: (1) moving the entrance road north with no widening on US 50, (2) moving the entrance road north and widening US 50 to include a left turn and acceleration lane, and (3) moving the entrance road north and widening US 50 to include a left turn and right turn lane as well as acceleration lanes in both directions (the 30% design). The results are available in Appendix B and summarized in the table below:

Table 1: IHSDM Results

	Crash Reduction by Crash Type (for years 2020-2036)			
Alternative	**Total**	**Fatal/Injury**	**Property Damage Only**	**Located at Intersection**
(1) Move Intersection ONLY[1]	-	-	-	-
(2) Add Left Turn/Accel ONLY	11.5%	14.1%	10.3%	33.0%
(3) 30% Design	14.8%	18.1%	13.2%	42.4%

[1] The "Move Intersection ONLY" alternative is considered the base alternative for this analysis. The crash reduction columns show the percent decrease in crash type from the base.

These results are based on the three alternatives, but with the following software limitations:

1. The software does not take intersection sight distance into account, therefore the existing condition is not any different than the "move intersection only" alternative in IHSDM. The previous section of this memo provides justification for moving the intersection despite the software not being able to account for improved sight distance. For the purposes of this analysis, the move intersection only alternative will be considered the base alternative.

2. There is not enough existing data available for acceleration lanes to apply a CRF, so the software does not account for acceleration lanes in its analysis. Research has shown that acceleration lanes at intersections function effectively and do not create safety problems, but there isn't enough information to quantify what the expected safety impact would be. Alternatives (2) and (3) add one and two acceleration lanes, respectively. It is likely the actual number of crashes will be lower than the results presented in the IHSDM analysis due to the addition of acceleration lanes.

3. The software has an option to include a local calibration factor, as different designs can be more/less effective in different areas. There was not a local calibration factor available for this region.

Keeping the limitations described above in mind, the results from the software show a significant reduction in crashes by adding a left turn lane. This is supported by a 2017 publication by NDOT

(Appendix C), which shows, based on DOT state-wide reported crash data, the most common vehicle actions for fatal and serious injury crashes are going straight or turning left. Adding the left turn lane will help mitigate the safety issues of this intersection.

On the Federal Highway Administration Proven Safety Countermeasures website (Appendix D), it is shown that the benefit of left turn lanes is typically higher than for right turn lanes. This is supported by the IHSDM results, which show a significant reduction in crashes between alternatives (1) and (2), with a smaller reduction in crashes between alternative (2) and (3). Installing a right turn lane does have safety benefits, but they are less significant than those gained from adding a left turn lane.

In addition to safety, some other important factors for the proposed alternatives are summarized in the table below.

Table 2: Proposed Alternatives Comparison

Alternative	Length of Project on US 50 (ft)	US 50 Project Impervious Area (acre)	US 50 Pavement Width (ft)	Cost Estimate
(1) Move Intersection ONLY	N/A	3.0	56	$2.2M - $2.7M
(2) Add Left Turn/Accel ONLY	2210	3.5	72	$3.7M - $4.2M
(3) 30% Design	2420	4.8	84	$4.8M

Alternative 3 would be a slightly longer project with more impervious area/impacts and a higher cost estimate due to the additional acceleration/deceleration lane.

Pavement Width

In the TRPA memo, it was also requested to restripe through lanes to 11 feet and reduce shoulder width to 2 feet. The AASHTO Green Book states in Section 7.3.3 that 12 foot lanes are desirable on high-speed, free-flowing, principal arterials such as US 50. Additionally, in Section 2.2.6 of the Green Book, when discussing driver expectancy, it is stated that design elements should be applied consistently throughout a highway segment and from one segment to another. Existing US 50 has 12 foot through lanes with an approximate 4 foot west shoulder and 6 foot east shoulder. Reducing the through lanes and shoulders for a relatively short stretch of the corridor would not provide consistency, would violate drivers' expectations, and would likely decrease the safety benefits presented above.

This is further supported by the Nevada DOT Design Manual (see excerpts in Appendix H). Section 3.6 of the manual states that through lanes and auxiliary lanes should be 12 feet wide. This does allow for a reduction of the median left turn bay/acceleration lane from 14 feet (as seen in the 30% design and used in the IHSDM analysis) to 12 feet. This would decrease the US 50 pavement width for Alternative 2, shown above in Table 2, to 70 feet. Additionally, Section 3.7 of the Nevada

DOT Design Manual states that on National Highway System (NHS) routes, which US 50 is, NDOT prefers a 4 foot inside shoulder and 8 foot outside shoulder. The current design incorporates both 4 and 6 foot outside shoulders, already below the preference of the department, to match existing conditions. The proposed design also matches the existing centerline in order to keep the solid double yellow striping on the roadway crown. Shifting the proposed centerline east to reduce the shoulder width from 6 feet to 4 feet (thus reducing overall impacts) was briefly discussed and quickly dismissed, as this would place the roadway crown within the wheel path, creating a new safety concern.

Conclusion

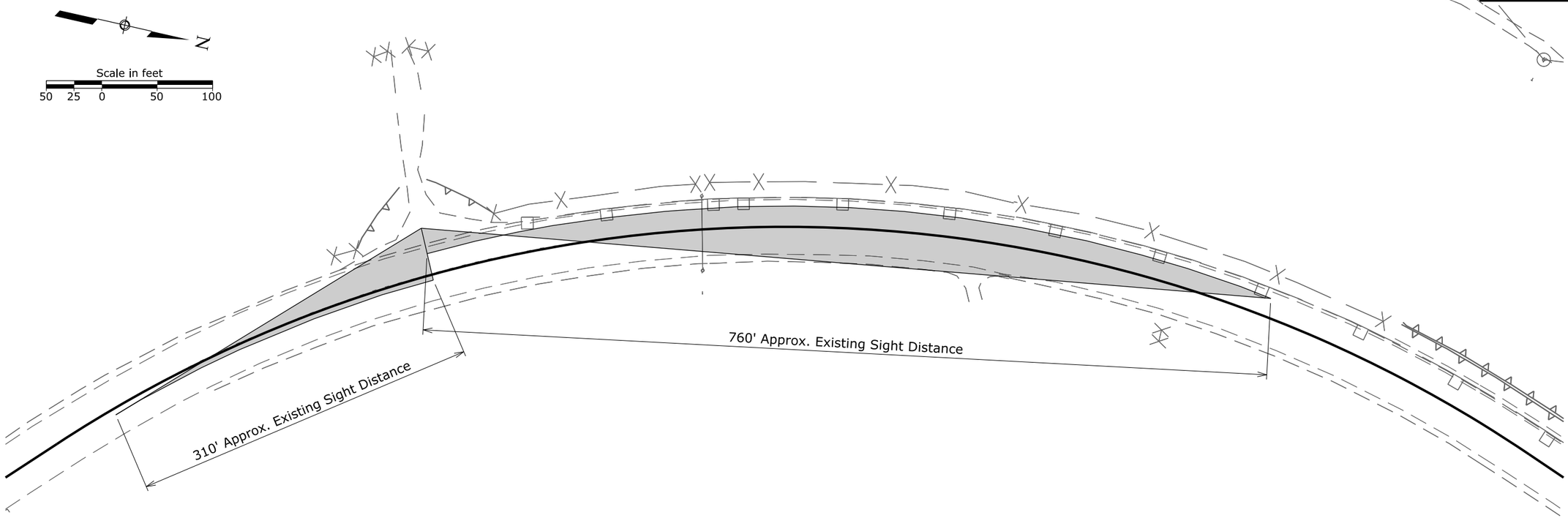
Moving the intersection to the north significantly improves sight distance from the existing condition and is justified. Additionally, the new entrance road improves access for cyclists, as the proposed road has less sharp turns, will provide a better surface to ride on, and a wider, consistent roadway (without precluding a future bike lane project on US 50). However, Alternative 1 (moving the intersection with no widening) is not recommended because it does not adequately address existing safety concerns, such as lack of left turn lane and left-turn acceleration lane. There are clear and significant safety benefits by providing additional turn lanes as proposed in Alternative 2. Therefore, it is CFLHD's opinion that safety benefits gained by improved sight distance alone are not significant enough to recommend Alternative 1.

While Alternative 3 (the design presented at 30%) shows the largest reduction in crashes by the IHSDM analysis, the safety improvements of adding the additional accel/decel lane from Alternative 2 are incremental and outweighed by other factors. Compared to Alternative 2, there are more project impacts due to a longer length of project, increased impervious area (and the associated pavement width), and wider construction limits (resulting in more tree removals). With the project located in a sensitive and scenic area, project partners have stressed the importance of minimizing project impacts with context sensitive design solutions. Additionally, it has been noted that while there are multiple locations of 5 lanes of pavement on US 50 within a few miles of the project area, there are no other locations of 6 lanes of pavement on US 50 near the project area. TRPA expressed their concern that the Alternative 3 design would be compromising the character of the corridor by adding a section with an extra lane of pavement wider than anywhere else.

CFLHD recommends Alternative 2 (relocation of the entrance road to the north and providing a northbound left turn lane and northbound acceleration lane along US 50) for this project going forward. It is also recommended that through lanes remain 12 feet wide, the median left turn bay/acceleration lane be reduced to 12 feet wide (from 14 feet), and the shoulders remain 4 feet (west) and 6 feet wide (east) to match existing widths. Through different analyses presented in this memo, this alternative provides significant safety benefits while maintaining the character of the existing US 50 corridor and reduced environmental impacts from the 30% design alternative.

Appendix A – Intersection Sight Distance Displays

STATE	PROJECT	SHEET NUMBER
NV	NV FLAP US50(1) ROUND HILL PINES ACCESS	Plan 1



EXISTING LEFT TURN INTERSECTION SIGHT DISTANCE

For Passenger Vehicles, Design Speed = 50 mph
Required Sight Distance = 588 ft

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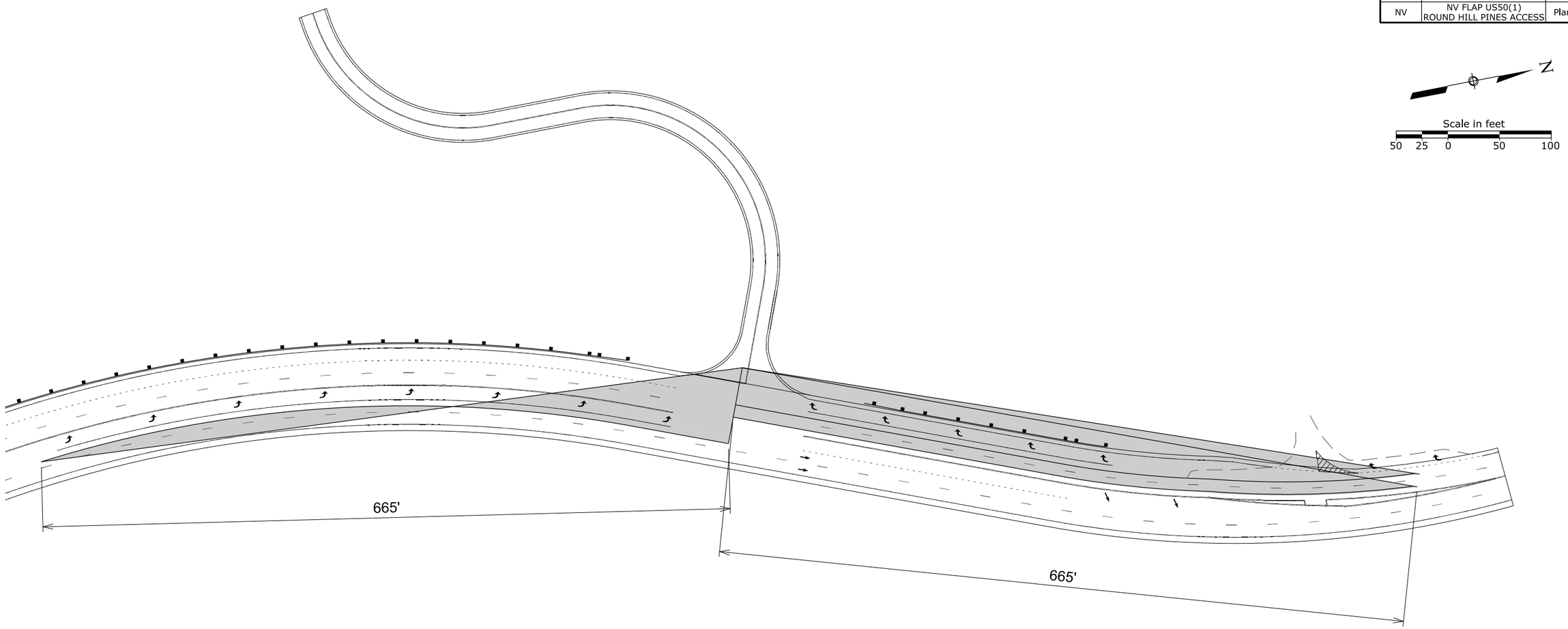
9/12/2019

STATE	PROJECT	SHEET NUMBER
NV	NV FLAP US50(1) ROUND HILL PINES ACCESS	Plan 1



LEFT TURN INTERSECTION SIGHT DISTANCE

For Passenger Vehicles, Design Speed = 50 mph

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9/23/2019

Appendix B – IHSDM Results

Alt1 Predicted Highway Crash Rates and Frequencies Summary

First Year of Analysis	2020
Last Year of Analysis	2036
Evaluated Length (mi)	0.5166
Average Future Road AADT (vpd)	23,384
Predicted Crashes	
Total Crashes	94.52
Fatal and Injury Crashes	31.62
Property-Damage-Only Crashes	62.9
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	33
Percent Property-Damage-Only Crashes (%)	67
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	10.7629
FI Crash Rate (crashes/mi/yr)	3.6006
PDO Crash Rate (crashes/mi/yr)	7.1623
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	74.95
Travel Crash Rate (crashes/million veh-mi)	1.26
Travel FI Crash Rate (crashes/million veh-mi)	0.42
Travel PDO Crash Rate (crashes/million veh-mi)	0.84

Alt2 Predicted Highway Crash Rates and Frequencies Summary

First Year of Analysis	2020
Last Year of Analysis	2036
Evaluated Length (mi)	0.5166
Average Future Road AADT (vpd)	23,384
Predicted Crashes	
Total Crashes	83.62
Fatal and Injury Crashes	27.17
Property-Damage-Only Crashes	56.45
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	32
Percent Property-Damage-Only Crashes (%)	68
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	9.5225
FI Crash Rate (crashes/mi/yr)	3.0937
PDO Crash Rate (crashes/mi/yr)	6.4288
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	74.95
Travel Crash Rate (crashes/million veh-mi)	1.12
Travel FI Crash Rate (crashes/million veh-mi)	0.36
Travel PDO Crash Rate (crashes/million veh-mi)	0.75

Alt3 Predicted Highway Crash Rates and Frequencies Summary

First Year of Analysis	2020
Last Year of Analysis	2036
Evaluated Length (mi)	0.5166
Average Future Road AADT (vpd)	23,384
Predicted Crashes	
Total Crashes	80.53
Fatal and Injury Crashes	25.9
Property-Damage-Only Crashes	54.62
Percent of Total Predicted Crashes	
Percent Fatal and Injury Crashes (%)	32
Percent Property-Damage-Only Crashes (%)	68
Predicted Crash Rate	
Crash Rate (crashes/mi/yr)	9.1699
FI Crash Rate (crashes/mi/yr)	2.9496
PDO Crash Rate (crashes/mi/yr)	6.2203
Predicted Travel Crash Rate	
Total Travel (million veh-mi)	74.95
Travel Crash Rate (crashes/million veh-mi)	1.07
Travel FI Crash Rate (crashes/million veh-mi)	0.35
Travel PDO Crash Rate (crashes/million veh-mi)	0.73

Alt 1 Predicted Crash Frequencies and Rates by Highway Segment/Intersection

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)	Predicted Intersection Travel Crash Rate (crashes/million veh)
1	10+00.000	12+55.363	0.0484	5.759	0.3387	0.0999	0.2389	7.004	0.82	
2	12+55.363	26+62.450	0.2665	31.731	1.8665	0.5502	1.3163	7.004	0.82	
3	26+62.450	30+80.498	0.0792	9.427	0.5545	0.1635	0.3911	7.004	0.82	
US_50 Access Road Alt1	27+66.620			33.009	1.9417	0.7934	1.1483			0.22
4	30+80.498	36+88.788	0.1152	13.717	0.8069	0.2378	0.5691	7.004	0.82	
5	36+88.788	37+27.459	0.0073	0.872	0.0513	0.0151	0.0362	7.004	0.82	
All Segments			0.5166	61.506	3.618	1.0665	2.5515	7.004	0.82	
All Intersections				33.009	1.9417	0.7934	1.1483			0.22
Total			0.5166	94.515	5.5597	1.8599	3.6998	10.7629		

Alt 2 Predicted Crash Frequencies and Rates by Highway Segment/Intersection

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)	Predicted Intersection Travel Crash Rate (crashes/million veh)
1	10+00.000	12+55.363	0.0484	5.759	0.3387	0.0999	0.2389	7.004	0.82	
2	12+55.363	20+66.620	0.1536	18.294	1.0761	0.3172	0.7589	7.004	0.82	
3	20+66.620	26+62.450	0.1128	13.436	0.7904	0.233	0.5574	7.004	0.82	
4	26+62.450	27+66.620	0.0197	2.349	0.1382	0.0407	0.0975	7.004	0.82	
US_50 Access Road Alt2	27+66.620			22.116	1.301	0.5316	0.7693			0.15
5	27+66.620	30+80.498	0.0594	7.078	0.4164	0.1227	0.2936	7.004	0.82	
6	30+80.498	36+88.788	0.1152	13.717	0.8069	0.2378	0.5691	7.004	0.82	
7	36+88.788	37+27.459	0.0073	0.872	0.0513	0.0151	0.0362	7.004	0.82	
All Segments			0.5166	61.506	3.618	1.0665	2.5515	7.004	0.82	
All Intersections				22.116	1.301	0.5316	0.7693			0.15
Total			0.5166	83.622	4.919	1.5981	3.3209	9.5225		

Alt 3 Predicted Crash Frequencies and Rates by Highway Segment/Intersection

Segment Number/Intersection Name/Cross Road	Start Location (Sta. ft)	End Location (Sta. ft)	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)	Predicted Intersection Travel Crash Rate (crashes/million veh)
1	10+00.000	12+55.363	0.0484	5.759	0.3387	0.0999	0.2389	7.004	0.82	
2	12+55.363	20+66.620	0.1536	18.294	1.0761	0.3172	0.7589	7.004	0.82	
3	20+66.620	26+62.450	0.1128	13.436	0.7904	0.233	0.5574	7.004	0.82	
4	26+62.450	27+66.620	0.0197	2.349	0.1382	0.0407	0.0975	7.004	0.82	
US_50 Access Road Alt3	27+66.620			19.02	1.1188	0.4572	0.6616			0.13
5	27+66.620	30+80.498	0.0594	7.078	0.4164	0.1227	0.2936	7.004	0.82	
6	30+80.498	36+88.788	0.1152	13.717	0.8069	0.2378	0.5691	7.004	0.82	
7	36+88.788	37+27.459	0.0073	0.872	0.0513	0.0151	0.0362	7.004	0.82	
All Segments			0.5166	61.506	3.618	1.0665	2.5515	7.004	0.82	
All Intersections				19.02	1.1188	0.4572	0.6616			0.13
Total			0.5166	80.526	4.7368	1.5237	3.2132	9.1699		

Appendix C – NDOT Intersections Fact Sheet

NEVADA Strategic Highway Safety Plan

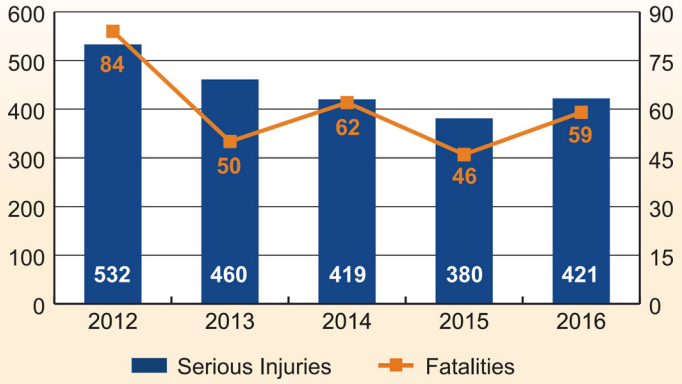
Zero Fatalities
Drive Safe Nevada

Always Buckle Up | Don't Drive Impaired | Focus on the Road | **Stop on Red** | Be Pedestrian Safe | Ride Safe

NEVADA'S INTERSECTION SAFETY PROBLEM

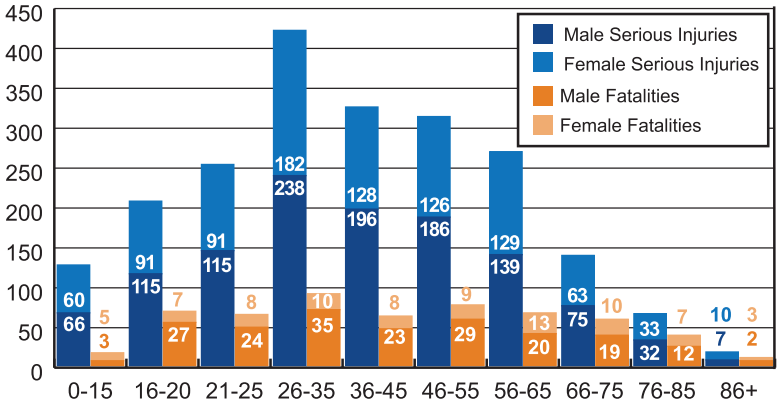
Between 2012 and 2016, 301 people lost their lives and a staggering 2,212 were seriously injured in intersection-related crashes on Nevada roadways.

The goal of the Nevada Strategic Highway Safety Plan (SHSP) is to reach zero fatalities. This fact sheet provides information on who is involved in intersection-related fatal and serious injury crashes, where and when these crashes occurred, and why they happened. It also outlines how the State plans to reduce intersection-related fatalities and serious injuries.



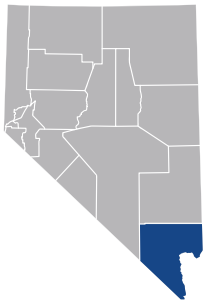
WHO?

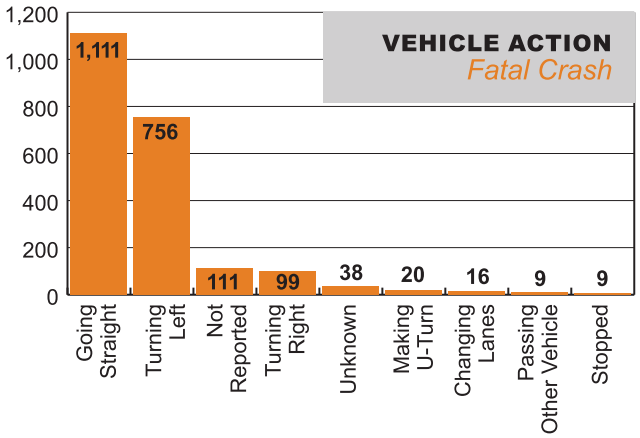
Male drivers aged 26 to 35 years old are involved in most intersection-related fatalities and serious injuries.

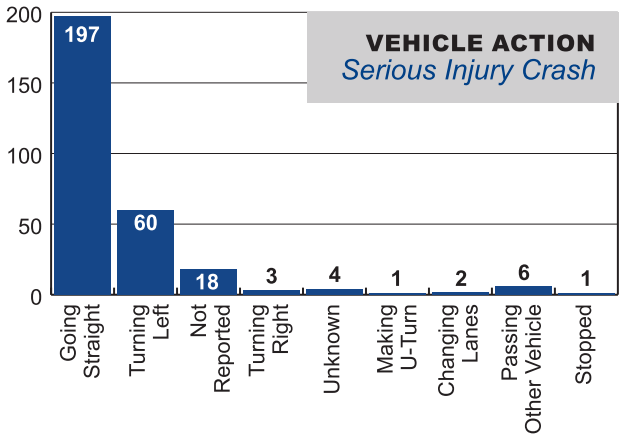


WHERE?

Between 2012 and 2016, three-quarters (75 percent) of the intersection-related fatalities and serious injuries occurred in **Clark County.**



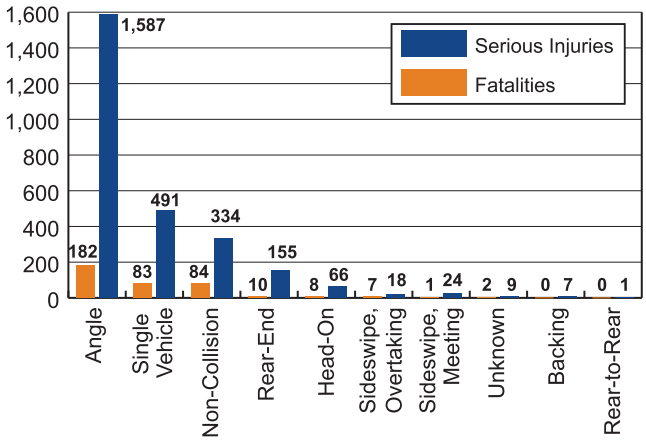




Source: Nevada DOT, 2017.

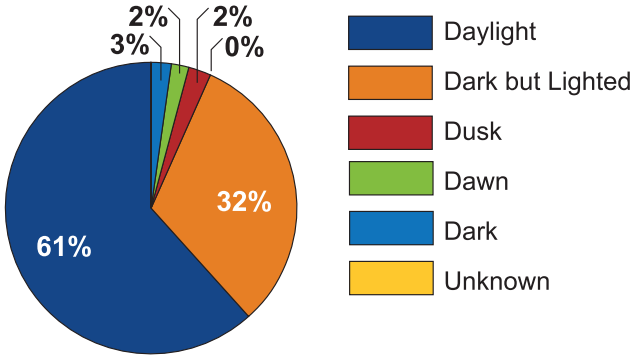
WHY?

Most of the intersection-related fatalities and serious injuries involve angle crashes followed by single vehicle crashes.



WHEN?

Most of the intersection-related fatalities and serious injuries occurred during daylight hours (61 percent) and 32 percent occurred in dark but lighted conditions.



HOW DO WE REACH OUR GOAL?

CRITICAL STRATEGIES TO REDUCE INTERSECTION FATALITIES

The Nevada SHSP identified several strategies that have the greatest potential to reduce intersection fatalities and serious injury crashes. By focusing on these strategies we can begin to reduce the terrible toll caused by intersection fatalities.

Implement geometric improvements:

- Develop a systemic intersection safety improvement program.
- Improve safety through design standard improvements.

Use appropriate traffic controls to reduce conflicts:

- Use Intersection Control Evaluations (ICE) to determine appropriate traffic control at intersections.
- Educate other NDOT and local agency employees of the benefits of roundabouts.
- Install Flashing Yellow Arrows (FYAs) at traffic signals with protected permissive phasing.

Improve sight distance and traffic control visibility:

- Install retroreflective backplates at traffic signals.

Improve access management to reduce conflicts:

- Update NDOT Access Management Manual.
- Implement access management guidelines at the state and local level.

Improve behavior at intersections through the use of education and enforcement:

- Educate the public on the benefits of roundabouts through a roundabout Public Relations (PR) campaign.

Source: Nevada DOT, 2017.

Appendix D – FHWA Proven Safety Countermeasures

U.S. Department of Transportation
Federal Highway Administration

PROVEN SAFETY COUNTERMEASURES

Left and Right Turn Lanes at Two-Way Stop-Controlled Intersections

SAFETY BENEFITS:

LEFT-TURN LANES

28-48%

Reduction in total crashes

RIGHT-TURN LANES

14-26%

Reduction in total crashes

Source: *Highway Safety Manual*

Auxiliary turn lanes—either for left turns or right turns—provide physical separation between turning traffic that is slowing or stopped and adjacent through traffic at approaches to intersections. Turn lanes can be designed to provide for deceleration prior to a turn, as well as for storage of vehicles that are stopped and waiting for the opportunity to complete a turn.

Example of left-turn lanes.

Source: FHWA

While turn lanes provide measurable safety and operational benefits at many types of intersections, they are particularly helpful at two-way stop-controlled intersections. Crashes occurring at these intersections are often related to turning maneuvers. Since the major route traffic is free flowing and typically travels at higher speeds, crashes that do occur are often severe. The main crash types include collisions of vehicles turning left across opposing through traffic and rear-end collisions of vehicles turning left or right with other vehicles following closely behind. Turn lanes reduce the potential for these types of crashes.

Installing left-turn lanes and/or right-turn lanes should be considered for the major road approaches for improving safety at both three- and four-leg intersections with two-way stop control on the minor road, where significant turning volumes exist, or where there is a history of turn-related crashes. Pedestrian and bicyclist safety and convenience should also be considered when adding turn lanes at an intersection.

Example of a right-turn lane.

Source: FHWA

→For more information on this and other FHWA Proven Safety Countermeasures, please visit https://safety.fhwa.dot.gov/provencountermeasures.

FHWA-SA-17-053

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Appendix E – Elements of an Intersection

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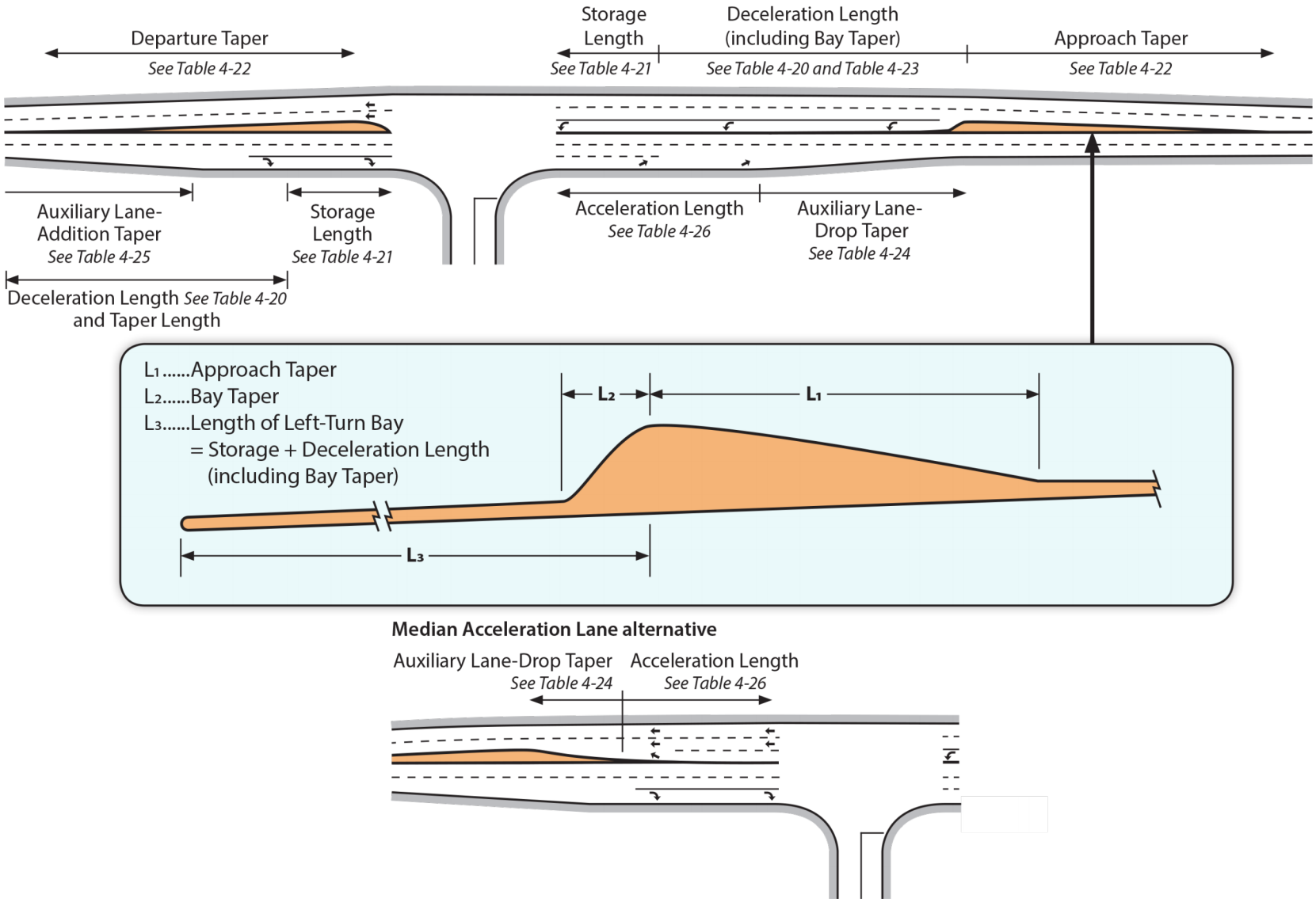
Figure 4-10: Elements of an Intersection



Appendix F – Purpose and Need Statement

The purpose of the project is to increase safety and improve accessibility for visitors entering and exiting the Round Hill Pines Resort from U.S. Highway 50 (US 50) in Douglas County, Nevada.

The project is needed because the current US 50 entrance configuration into the Round Hill Pines Resort has safety concerns due to limited sight distance for vehicles traveling in both directions along US 50 and unprotected turning movements across US 50. In addition to the current configuration, the Round Hill Pines Resort access road contains a narrow roadway width, steep grades, and sharp curves. This limits the flow for two-way traffic containing transit and recreational vehicles. The specific needs driving the project are discussed in further details below.

- The existing Resort access road is located at the crest of a vertical curve along US 50, which results in limited sight distance for both travel directions. Sight distance for passenger vehicles south of the existing Resort access road is below the recommended AASHTO sight distance values. This substandard sight distance measurement presents a safety hazard for vehicles exiting the Resort and turning north onto eastbound US 50, as well as eastbound US 50 traffic.

- During the peak season, eastbound US 50 experiences vehicle queuing and congestion in the inside lane. This is caused by Resort visitors making unprotected turning movements across westbound US 50 onto the access road.

- The existing access road is narrow with sharp turns and a steep grade, which limits two-way traffic and access for larger vehicles such as; recreation vehicles, transit, and trailers.

Objectives for the project includes the following:

- Align the Round Hill Pines Beach and Resort functions with the LTBMU's long term vision for the area.

- Improve alternate transportation options into RHPR such as bike, pedestrians, and transit.

- Minimize environmental and scenic quality impacts.

- Construct permanent water quality improvements to reduce sedimentation and runoff into the Lake Tahoe basin.

References:

NV FLAP application 2017 and supporting documentation

NDOT Roadside Safety Audit December 2016

NDOT Roadside Safety Audit October 2013

FHWA CFLHD, Scoping Report August 2018

FLAP Project Memorandum of Agreement July 2018

Appendix G – TRPA Memo

TAHOE REGIONAL PLANNING AGENCY
TRANSPORTATION

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

MEMORANDUM

DATE: 10/16/19
TO: FHWA Central Federal Lands & Round Hill Pines Project Team
FROM: TRPA TMPO
RE: Round Hill Pines Intersection Design

Background:
The Round Hill Pines Access Project is an important project aimed at increasing the safety and improving accessibility for motorists, pedestrians, and bicycles entering and exiting the Round Hill Pines Resort from U.S. Highway 50 (US50) in Douglas County, Nevada. The Tahoe Regional Planning Agency (TRPA) has been working with the Federal Highway Administration – Central Federal Lands (FHWA-CFL), Nevada Department of Transportation (NDOT), and the US Forest Service (USFS) to identify improvements to the resort access for near term implementation. The current conceptual designs from the FHWA-CFL design team propose increasing the roadway width from 48-feet to 84-feet (including shoulders of 4-feet (west side) and 12-feet (east side), with additional impact outside of the roadway including tree removal, grading and scenic impacts. The conceptual designs follow NDOT freeway design standards for vehicle acceleration/ deceleration, traveled way, median turn bays and shoulders which is out of character with this section of road which is mountain/forest and not a freeway.

The TRPA, as a project partner, has participated in project design meetings and provided comments on the alternatives analysis and conceptual designs. Previous TRPA comments and concerns have been expressed to the project team regarding consistency with TRPA policies. Some of those comments focused on the entrance design, which widens the roadway significantly and is out of character with the US 50 corridor in Douglas County, does not provide for safe bicycle access and does not include elements that slow vehicles down. The comments provided reflect the regulatory requirements of the TRPA, which is charged by the 1980 Bi-State Compact (P.L. 96-551) to achieve environmental thresholds to establish a balance between the natural environment and the human-made environment to preserve Lake Tahoe.

Specifically, The Bi-State Compact calls for the development of an integrated transportation plan addressing all modes of travel to “reduce dependency on the private automobile,” “reduce air pollution which is caused by motor vehicles,” and provide “public transportation and public programs and projects related to transportation.” The

previous issues raised by TRPA are supported by several adopted plans including the TRPA Regional Plan, the Regional Transportation Plan (RTP), the Lake Tahoe Safety Strategy, the Active Transportation Plan and the Corridor Connection Plan.

TRPA Regional Goals and Policies:

The TRPA Code of Ordinances relative to reducing environmental impacts and the Transportation policies within the Regional Plan substantiate our comments to avoid or minimize widening of the roadway, potential to reduce lane widths, the length of the acceleration and deceleration lanes, and speed limits; for incorporation of on-street bicycle facilities into project designs, and to preserve and link existing Tahoe Trail path segments to project improvements.

In order to permit a project TRPA must make findings that applicable Goals and Policies have been addressed. The following Goals and policies are an example of considerations for the project:

- TRPA Code Section 36.5.1: Existing natural features shall be retained including minimizing vegetation removal and maintaining natural slope of the project site.
- TRPA Code Section 66.1.3 & 66.1.4: Cannot implement a project that will negatively impact a scenic resource or viewpoint (both highway shoreline)
- TRPA Code Section 30.4.2.A.2 Linear Public Facilities and Public Health and Safety Facilities: Additions to linear public services (which includes a roadway) may be permitted so long as the application can show that there is no feasible alternative that will reduce the impacts to scenic resources, tree removal, additional coverage, grading, cut and fill slopes.
- TRPA Code Section 36.5.2.B: Design Standards for Public Service Projects shall include Active Transportation
- RTP Policy 1.8: strongly encourages traffic calming and noise reduction strategies when planning transportation improvements
- RTP Policy 2.14: calls for construction, upgrades and maintenance of pedestrian and bicycle facilities consistent with the active transportation plan
- RTP Policy 2.15: calls for accommodation of the needs of all categories of travelers by designing and operating roads for safe, comfortable, and efficient travel of roadway users of all ages and abilities such as pedestrians, bicyclists, transit riders, motorists, commercial vehicles, and emergency vehicles
- RTP Policy 2.18: calls for roadway improvements to construct, upgrade and maintain active transportation and transit facilities along major travel routes. In constrained locations, all design options should be considered, including but not limited to restriping, roadway realignment signalization and purchase of right of way

- RTP Policy 4.8: prohibits the construction of roadways to freeway design standards in the Tahoe Region
- RTP Policy 5.2: calls for multimodal access to recreation sites

The Safety Strategy calls for designated Class II (striped) or other specific space for bicyclists (such as bikeable shoulders) be installed on roadways to close gaps in the bicycle network. Further, the strategy seeks treatments for motor vehicles, such as reconfiguring roadways to reduce the number of through vehicle lanes, to increase safety at intersections. Data analysis conducted for the strategy identified the top two contributing factors to motor vehicle crashes within the study period were unsafe speed (31 percent of total) and improper turning (10 percent). Reducing roadway width, lane widths and posted speed limits, as well as incorporating HSIP-approved treatments, such as vehicle speed feedback signs and high friction pavement treatment, can also be used to emphasize the need to slow vehicle speeds, to increase driver awareness to roadway features and reduce crash risks.

The Active Transportation Plan identified the need for an on-street bicycle lane in the project area, designated the Round Hill intersection as a priority needing active transportation improvements, and calls for completion (and at a minimum, maintenance) of the regional shared-use path connecting around the lake (the Tahoe Trail). A possible location of this trail could utilize the existing NDOT right of way within this roadway segment (per TTD Stateline to Stateline Trail Feasibility Study, 2011).

The Corridor Connection Plan upholds these policies, strategy and plan by seeking to support transformational change through shifting a majority of trips in the basin to multimodal options; to manage congestion by improving access for all users by prioritizing safety for all users; to enrich the quality of life of residents and visitors through an enhanced multimodal transportation system; to improve the environment through reducing congestion, vehicle miles traveled, greenhouse gas emissions and roadway impacts to improve the clarity of Lake Tahoe; and to support economic vitality by supporting, among other things, recreation and tourism by efficiently moving people and goods.

Additionally, TRPA public engagement processes have consistently fielded requests from the public for increased safety for people walking, riding bicycles and driving in this area.

We share this information with you now to further clarify the origin and purpose of our submitted comments so that the project design meets the purpose and need of the project while also being consistent with TRPA environmental thresholds and the TRPA Regional Plan.

To those ends, we request a reevaluation of the existing acceleration/deceleration lane NEPA design option be evaluated in the NEPA and in the TRPA environmental document so that safety benefits and environmental impacts can be evaluated and commented upon by NDOT and TRPA.

- Evaluate the location of the existing Round Hill Pines approach to improve sight distance with no acceleration or decelerations lanes. This would include restriping through lanes to 11’ to provide 2’ shoulders.
- Evaluate relocating the existing approach to improve sight distance and include only a 12’ wide left-in (storage lane) and left-out (acceleration lane) with 11’ lanes and 2’ shoulders.

We look forward to working with FHWA-CFL and NDOT in delivering this important project that satisfies the unique mobility, environmental, and safety concerns of the Lake Tahoe Basin.

Appendix H – Nevada DOT Road Design Guide Excerpts

Ramps: Direct and semi-direct ramps generally are designed with a high speed exit and a high speed entrance and are designed with Method 5. For ramps designed for speeds less than 45 mph, Method 2 can be used for the ramp proper. For loop ramps with a design speed less than 45 mph, use "Table 3-13," *2018 Green Book,* Page 3-54 for superelevation. Superelevation development at ramp entrances and exit terminals is shown in "9.6.4 Superelevation for Turning Roadways at Intersections", *2018 Green Book*, Page 9-83.

Axis of Rotation: For undivided highways, the axis of rotation for superelevation is usually the centerline of the traveled way. However, in special cases where curves are proceeded by long, relatively level tangents, the plane of superelevation may be rotated about the inside edge of the pavement to improve perception of the curve.

For divided highways, if future widening is to the inside median, then rotate dual roadbeds in a single plane about centerline. When considering facilities for future widening to the outside shoulder, roadbeds should be rotated independently to reduce earthwork, and to reduce the length of the superelevation transitions. For example, the longer superelevation transitions can have an adverse impact to closely spaced ramps. ("Methods of Attaining Superelevation", *2018 Green Book*, Page 3-81)

The preferred axis of rotation for ramps is along the outside shoulder line in the direction of travel. It is occasionally placed along the inside shoulder line to better facilitate drainage or earthwork concerns. The axis of rotation for multi-lane ramps and direct connects is usually at centerline and one lane for number of lanes rotated. Appearance and drainage should always be taken into consideration in selection of the axis of rotation.

3.6 Lanes

Width: Traffic lanes intended for use by motor vehicles should be 12′ wide with an additional 2′ added when the lane is directly adjacent to a curb or other physical feature. A project intended to be used as "Complete Streets" may reduce lane width less than 12′. See *FHWA Road Diet Informational Guide* for more information on "Complete Streets".

To make bicycle travel safer on urban streets, the Department has agreed to stripe State owned and maintained roadways within Clark County using a marking standard established by the RTC of Southern Nevada as a guideline. The intent is to provide a shared outside travel lane of 14′ for bicyclists by reducing our standard 12′ travel lanes to 11′. Any lane next to a median barrier or curb will be a minimum 12′ wide with a desirable width of 13′. On preservation projects, it will not always be possible to provide the desired lane configuration and judgment will have to be used to determine an acceptable compromise between lane widths and the desire to provide a 14′ outside travel lane. The Principal Road Design Engineer shall review all compromises.

On reconstruction projects or new roadway projects, it is desirable to use a 15′ outside travel lane width while maintaining 12′ travel lanes. If this will cause the need for new right-of-way or significantly increase the size of takes, then the RTC standard may be used as described in the paragraph above. If Federal funds are involved, then any planned bicycle facility must be accommodated.

Minimum Acceleration and Deceleration Lengths for Entrance and Exit Terminals: See "Table 10-4. Minimum Acceleration Lanes Lengths for Entrance Terminals with Flat Grades of Less Than 3 Percent", *2018 Green Book*, Page 10-132 and "Table 10-6. Minimum Deceleration Lane Lengths for Exit Terminals with Flat Grades of Less Than 3 Percent", *2018 Green Book*, Page 10-138 for information on determining minimum lengths on entrance and exit terminals.

Auxiliary Lanes: Auxiliary lanes are defined as the portion of the roadway adjoining the traveled way for speed change, turning, and storage for turning, weaving, truck climbing, and other purposes supplementary to through traffic movements. The width of an auxiliary lane should be equal to the through lanes (12′ preferred). An auxiliary lane may be provided to comply with the concept of lane balance, with capacity needs, or to accommodate speed changes, weaving and maneuvering of entering and exiting traffic. Where auxiliary lanes are provided next to freeway mainline lanes, the adjacent shoulder should desirably be 8′-12′ in width, with a minimum 6′ wide shoulder. ("10.9.5.10 Auxiliary Lanes," *2018 Green Book,* Page 10-90)

Lane Balance: To provide efficient traffic operation through and beyond an interchange, there shall be a balance in the number of lanes on the freeway and ramps. The basic number of lanes should be established for a substantial length of freeway and should not be changed through pairs of interchanges; variations in traffic demand should be accommodated by means of auxiliary lanes where needed.

At a freeway entrance, the number of lanes beyond the entrance should not be less than the sum of the merging roadway lanes and the freeway minus one but may be equal to the sum of all traffic lanes on the merging roadway. At a freeway exit, the number of approach lanes before the exit should be equal to the number of the lanes on the freeway beyond the exit, plus the number of lanes on the exit, minus one.

Exceptions to these principles occur at cloverleaf loop ramp exits that follow a loop-ramp entrance and at exits between closely spaced interchanges. The traveled way on the freeway should not be reduced by more than one traffic lane at a time. Examples of proper lane balance can be seen in "10.9.5.9 Coordination of Lane Balance and Basic Number of Lanes," *2018 Green Book*, Page 10-87.

Lane Tapers: For freeway lane tapers, see "Figure 10-72. Typical Single-Lane Entrance Ramps," *2018 Green Book,* Page 10-129**.** Refer to the *Access Management System and Standards, current version* for lane tapers other than freeways.

Ramps: The desirable single lane ramp width is 24′ (Striped 4′-12′-8′). On 3R projects, substandard ramp widths should be addressed during the Preliminary Design Field Study (PDFS) where it is economically feasible to widen them to meet current standards. See Section 2.1 for shoulder width criteria.

Bike lanes: Bike lanes are used when it is desirable to delineate a portion of the pavement for preferential use by bicyclists or to provide for more predictable vehicle movements. Bike lanes are delineated with signs and pavement markings. They should be one-way facilities located within the limits of the paved shoulder. The minimum width of a bike lane is 4′. In areas with raised curb or longitudinal barriers, the minimum width is 5′. The open graded plantmix surface wearing course is to be paved flush with the lip of the gutter pan and inlet grates. A width of 5′ or greater is preferred where substantial truck traffic is present, or where motor vehicle speeds exceed 50 mph.

On highways without full control of access where a bridge deck is being replaced or rehabilitated, and where bicycles are permitted to operate at each end, the bridge should be reconstructed so that bicycles can be safely accommodated when it can be done at a reasonable cost. Consultation with local groups of organized bicyclists is encouraged in the development of projects with bicycle facilities.

In situations where the lateral offset of an existing longitudinal traffic barrier from the shoulder stripe is less than 5′ then, in consideration of bicycle traffic, the placement of a rumble strip must be justified by an engineering study. The study should consider: [a] the consequences of omitting the rumble strip adjacent to the traffic barrier, and [b] adjusting the lateral offset of the traffic barrier to at least 5′. On new roads or new traffic barrier installations on existing roads, the minimum distance from the shoulder line to the face of the traffic barrier is 6′ if the road also serves as a bikeway.

Additional resources: For further guidance refer to AASHTO's Guide for Development of Bicycle Facilities. Information is requested through Transportation/Multimodal Planning for bicycle facilities, bus lanes and turnouts.

3.7 Shoulders

Interstate: An adopted criterion for Interstate highways specifies the paved width of the right shoulder shall not be less than 10′. Where truck traffic exceeds 250 DDHV a 12′ right shoulder should be considered. On freeways with six or more lanes the usable paved width of the median shoulder should also be 10′ and preferably 12′ where the truck traffic exceeds 250 DDHV. On four-lane freeways, the left shoulder is normally 4′ to 8′ wide, at least 4′ of which should be paved, and the remainder stabilized. ("8.2.4 Traveled Way and Shoulders", *2018 Green Book*, Pages 8-3 and 8-4) The Department prefers a 4′ inside shoulder and 8′ outside shoulders on NHS routes and 2′ inside shoulders and 4′ outside shoulder minimum on State Routes. In the event these widths cannot be achieved, coordinate with the Principal Road Design Engineer.

Drainage: Consult with the Hydraulic Division if shoulder widths adjacent to barrier rail or curb and gutter are proposed to be reduced as this may affect onsite drainage design criteria.