

MEMORANDUM

TO: Judy Matsui-Drury, P.E., Loren Bloomberg, P.E., Leslie Regos
FROM: Kevin Stankiewicz
DATE: August 14, 2009
SUBJECT: Alternative Traffic and Safety Analysis
US-50 Camino Corridor Study

P/A No. 08123-000

Introduction

The significant traffic operations and safety issues in the Camino Corridor are at the unsignalized intersections along US 50. Conflicting turning movements, primarily left turns, result in delay for drivers and a safety concern. The improvement alternatives focus on eliminating or reducing these potential conflicts to improve safety and traffic flow, while also improving connectivity between the north side and the south side of US 50 through the Camino community.

The improvement alternatives have a minimal effect on the capacity of the US 50 facility. The number of through lanes will be unchanged, and through traffic will continue to be uninterrupted (uncontrolled) in the project vicinity. US 50 through-capacity is constrained by upstream conditions in both eastbound and westbound directions. On the west end, the section of US 50 in Placerville is limited by signalized at-grade intersections. On the east end, the capacity constraint is the two-lane section east of Pollock Pines.

Methodology

The analysis of traffic operations included the following elements:

- Assembly of available traffic count data from Caltrans and El Dorado County sources.
- Assembly of crash data for the years 2003 through 2007 from Caltrans.
- Selection of appropriate performance measures to evaluate the alternatives.
- Selection of an appropriate analysis time period (seasonal, day of week, time of day).
- Collection of field data, including traffic volumes and travel time / speeds.
- Analysis of existing conditions.
- Forecasting of future traffic volumes for each alternative for the opening year (2015) and design year (2035).
- Analysis of each alternative for the opening year (2015) and design year (2035).

The travel time, turning movement delay and network travel time was calculated using the SimTraffic traffic simulation software (part of the Synchro package). This stochastic

microscopic traffic simulation program models individual vehicles based on driver behavior and roadway conditions. The reported travel time, turning movement delays, and network travel time are based on the average of ten model runs due to the random nature of simulation models.

Analysis Time Periods and Performance Measures

Traffic volumes in the Camino/Apple Hill area fluctuate greatly by day of the week and by season due to recreation/tourist travel. Through traffic on US 50 to and from the Lake Tahoe area usually peaks on Friday and Sunday evenings, especially during summer and winter months, as well as days around holidays. Traffic to and from the Apple Hill area (including turns on/off US 50) is typically highest on weekends, especially during the fall harvest season and winery events. The “typical” PM peak commute hour occurs during the middle of a fall or spring week.

The Project Delivery Team (PDT) decided to use the typical PM peak commute hour during the middle of a fall week (fall Wednesday) and the combination of commute and recreational traffic on a summer Friday PM peak hour as the analysis periods for this study. The AM periods were not evaluated because of the lower volumes. Counted AM volumes were 16% lower than the middle of a fall week and 34% lower than the summer Friday PM at Camino Heights Drive. The Sunday afternoon recreational traffic return peak was considered but was dropped because volume of traffic turning onto and off of US 50 was significantly lower than the two chosen time periods.

The weekend afternoon Apple Hill Harvest Season traffic peak was also considered. However, this period of very high traffic volumes turning onto and off of US 50 occurs for just a few weekends a year and therefore will not be considered as a key demand criteria for the selection of a preferred alternative design. Information and analysis of this condition has been documented separately.

Level of Service Policies and Criteria

The Caltrans level of service (LOS) policy for the study area is detailed in the US 50 Corridor System Management Plan (May 2009). The 20 Year Concept LOS for this segment of US 50 is LOS F.

The El Dorado County General Plan (2003) also includes level of service policies. In the study area, the County’s goal is LOS D.

The Caltrans LOS policy is for the US 50 through traffic; however, the focus of this study was not the capacity and LOS of US 50. This study is focused on the operations of local traffic turning off of, turning onto, and crossing US 50. For the purposes of the traffic analysis, a LOS E threshold was used; therefore, a LOS F with more than 50 seconds of delay (unsignalized intersection) was considered deficient.

This traffic analysis focuses on unsignalized intersection operations. Table 1 summarizes level of service criteria for unsignalized intersections based upon vehicle delay.

Table 1 – Level of Service Criteria, Unsignalized Intersections	
Level of Service (LOS)	Total Delay Per Vehicle (seconds)
A	≤ 10
B	> 10 and ≤ 15
C	> 15 and ≤ 25
D	> 25 and ≤ 35
E	> 35 and ≤ 50
F	> 50

Source: Highway Capacity Manual, Transportation Research Board, Special Report No. 209, Washington, D.C., 2000.

Existing Conditions

Data Collection Program

Two-hour intersection turning movement counts were performed on four different days for two hours. The dates and times were approved by the PDT. The count date and times are below:

- Summer Friday PM commute peak plus Tahoe traffic – Friday, June 20th, 2008, 4–6 PM
- Summer Sunday afternoon peak return Tahoe traffic - Sunday, June 22nd, 2008, 1–3 PM
- Fall weekend afternoon peak Apple Hill Event traffic – Saturday, Oct 18th, 2008, 2-4 PM
- Fall-Spring midweek PM commute traffic – Wednesday, October 22nd, 2008, 2-4 PM

The traffic volumes US 50 at either end of the corridor are shown in Table 2 for all considered time periods to show how much the volumes fluctuate. As noted earlier, the PDT selected the Summer Friday and the Fall-Spring midweek time periods for analysis. Typically the Fall and Spring traffic patterns are similar, with normal commute traffic and vary little Lake Tahoe tourism traffic. Winter Friday conditions may be similar to Summer Friday conditions with people driving up to Lake Tahoe for the weekend. The peak hour of each time period was analyzed.

Table 2 - Existing US 50 Peak Hour Volumes (PM)

Location	Direction	Summer Friday	Summer Sunday	Fall Weekend	Fall-Spring Wednesday
Still Meadows Road	Eastbound	1657	1026	1688	1120
	Westbound	716	1770	1311	807
	Both Directions	2373	2796	2999	1927
Upper Carson Road	Eastbound	1443	877	1002	856
	Westbound	591	1632	789	605
	Both Directions	2034	2509	1791	1461

Source: DKS Associates, 2009.

Existing Traffic Operations

According to the Caltrans 2008 Traffic and Vehicle Data System, the existing daily volumes on US 50 in the study area are 25,000 ADT west of Upper Carson Road and 19,900 ADT east of Upper Carson Road. Figure 1 illustrates existing turning movement volumes in the study area for the PM peak commute hour and the summer Friday PM peak hour.

Existing US 50 peak hour through traffic average travel times and speeds are shown in Table 3. The travel time measurements were taken on an approximate 2.0 mile segment of US 50 between Still Meadows Road and Upper Carson Road. The through traffic on US 50 in the Camino (Apple Hill) area does not experience significant delays. The same is true for right-turning traffic. The posted speed limit in this area is 65 miles per hour, based on off peak surveys.

Table 3 - US 50 Peak Hour Average Travel Time and Speed through Study Area

Year	Season & Day	Direction	Travel Time (seconds)	Speed (mph)
Existing Year 2008	Fall-Spring Midweek	Eastbound	129	56
		Westbound	126	57
	Summer Friday	Eastbound	135	53
		Westbound	125	58

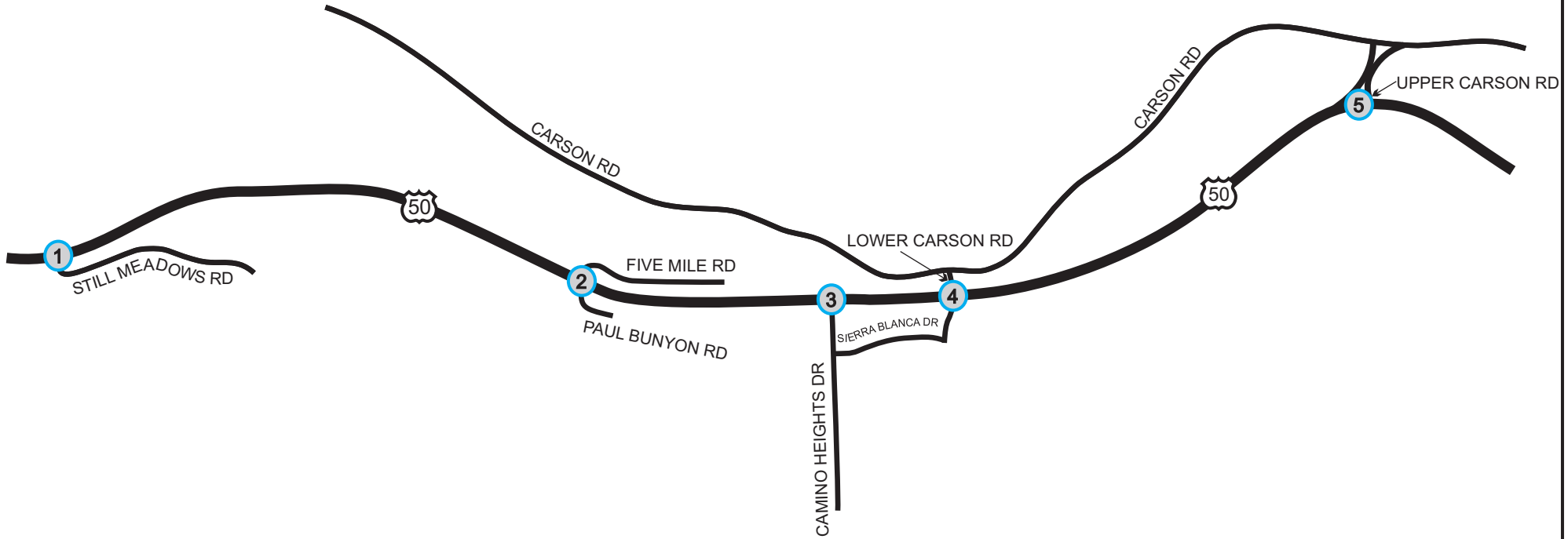
Source: DKS Associates, 2009.

LEGEND

= STUDY INTERSECTION

STOP = STOP-CONTROLLED INTERSECTION, ● = STOP SIGN

#,### (#,###) → = FALL-SPRING MIDWEEK (SUMMER FRIDAY) PM PEAK HOUR TRAFFIC VOLUMES



1	2	3	4	5
Still Meadows Rd / US-50	Paul Bunyon Rd / US-50	Camino Heights Dr / US-50	Lower Carson Rd / US-50	Upper Carson Rd / US-50

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Table 4 summarizes existing intersection turning movement delay and LOS for the study area intersections. These delays were calculated by a SimTraffic simulation. During the Fall-Spring Midweek PM peak hour, all movements are LOS C or better. During the Summer Friday PM peak hour, most movements operate at LOS C or better. However, the northbound left turns at Still Meadows Road operate at LOS F, and the northbound left turns at Paul Bunyan Road operate at LOS D.

Table 4 - Turning Movement Delay (Seconds) and Level of Service - Existing Year 2008								
Intersection With US 50	Eastbound		Westbound		Northbound		Southbound	
	Left Turn	Right Turn	Left Turn	Right Turn	Left Turn	Right Turn	Left Turn	Right Turn
Fall-Spring Midweek PM								
Still Meadows Road		5.4 A	7.7 A		24.1 C	5.6 A		
Paul Bunyan Road	5.3 A	1.6 A	5.5 A		10.3 B	4.0 A		4.0 A
Camino Heights Drive		2.1 A	4.7 A	0.5 A	11.9 B	0.5 A		
Lower Carson Road	3.5 A			0.1 A		0.1 A		0.4 A
Upper Carson Road	4.8 A			5.4 A			12.9 B	0.4 A
Summer Friday PM								
Still Meadows Road		6.4 A	10.3 C		52.3 F	10.6 B		
Paul Bunyan Road	5.7 A	3.2 A		1.2 A	30.9 D	7.5 A		3.2 A
Camino Heights Drive		3.1 A	9.7 A		20.5 C	0.5 A		
Lower Carson Road	3.3 A	1.1 A		0.0 A		0.1 A		0.4 A
Upper Carson Road	5.1 A			5.3 A			17.3 C	0.5 A
Source: DKS Associates, 2009.								

History of Collision Type

The most common type of collision at intersections is a broadside collision. A broadside collision is usually caused by the driver failing to yield to opposing traffic. Table 5 summarizes crash data at the study area intersections for 2003 through 2007. There are seven broadside collisions at the Still Meadows Road intersection, six broadside collisions at the Lower Carson Road intersection, and five broadside collisions at the Upper Carson Road intersection.

Intersection	Broadside	Rear End	Sideswipe	Hit Object	Head On
Still Meadows Rd	7	5	2	3	0
Paul Bunyan Rd	2	1	0	0	0
Camino Heights Dr	2	1	0	2	1
Lower Carson Rd	6	2	1	0	0
Upper Carson Rd	5	2	2	5	0

Source: California Department of Transportation, 2008.

Traffic Forecasting

The PDT agreed to an opening year date of 2015 for the selected alternative, resulting in the analysis years of 2015 (opening year) and 2035 (design year). The traffic forecasts were based on the El Dorado County General Plan model. The El Dorado County model is the official forecasting model for El Dorado County and was approved for use in this project by Caltrans. The model was refined, by splitting traffic analysis zones in the study area, to better reflect traffic loading at the project intersections. Existing land use in the split zones was determined proportionally from local traffic volumes. Future growth in land use in the split zones is based on County staff estimates.

To produce 2035 traffic volumes for LOS analysis, the traffic volume growth increment (between the modified El Dorado County 1998-1999 travel demand model and the modified El Dorado County 2025 travel demand model) was added to the existing traffic counts. The growth between the existing 1998-1999 model and the general plan 2025 model was used instead of using the growth between a new 2008 model and a new 2035 model, as these counts have shown no significant growth in traffic in the Apple Hill area in the last nine years. Additionally, the 2008 and 2035 versions of the El Dorado County travel demand model are not available for consideration. The number of years between the existing and future year is the same. This link and turning movement volume refinement post-processing is industry standard practice; it is

consistent with and outlined in National Cooperative Highway Research Project Report Number 255 (NCHRP 255). The forecasts for 2035 are based on the assumption that the growth in the Apple Hill area that was forecasted to occur by 2025 in the County General Plan will occur, but not until 2035. The 2015 forecasts will be based on linear interpolations of the growth between 2008 and 2035. As such, the 2015 forecast will have 26% of the 2035 growth.

The same growth increment was applied to both the fall Wednesday PM and summer Friday PM peak hours, as the growth is primarily associated with changes in local land use. The traffic generated by this local land use growth is relatively unaffected by seasonal factors when compared to the recreational tourist through traffic on US 50.

The changes in traffic volume from the “no build” condition to each alternative condition were performed by a manual rerouting of traffic based on turn prohibitions and new roads:

- In Alternative B, the northbound left turns from Still Meadows Road and Paul Bunyan Road would be converted to right turns onto the auxiliary road, left turns onto Camino Heights Drive and left turns onto US 50 at Camino Heights Drive.
- In Alternatives B, C1, and C2, the southbound left turns from Paul Bunyan Road would be converted to right turns that make a U-turn at Still Meadows Road.
- In Alternative B, the eastbound left turns at Lower Carson Road are shifted to Upper Carson Road.
- In Alternatives C1 and C2, the northbound left turns from Still Meadows Road and Paul Bunyan Road would be converted to right turns onto Sierra Blanca Road, left turns onto Vista Tierra Drive (the new undercrossing), left turns onto Carson Road, left turns onto Lower Carson Road, and right turns onto US 50 at Lower Carson Road.
- In Alternatives C1 and C2, the eastbound left turns at Lower Carson Road would be converted to right turn on Sierra Blanca Road, a left turn onto Vista Tierra Drive (the new undercrossing) and a right turn onto Carson Road.
- In Alternative C2, the eastbound left turns at Upper Carson Road would be converted to right turn on Sierra Blanca Road, a left turn onto Vista Tierra Drive (the new undercrossing), and a right turn onto Carson Road.
- In Alternative C2, the southbound left turns at Upper Carson Road would be converted to a left turn onto Vista Tierra Drive (the new undercrossing), a right turn on Sierra Blanca Road, and a right turn onto US 50.

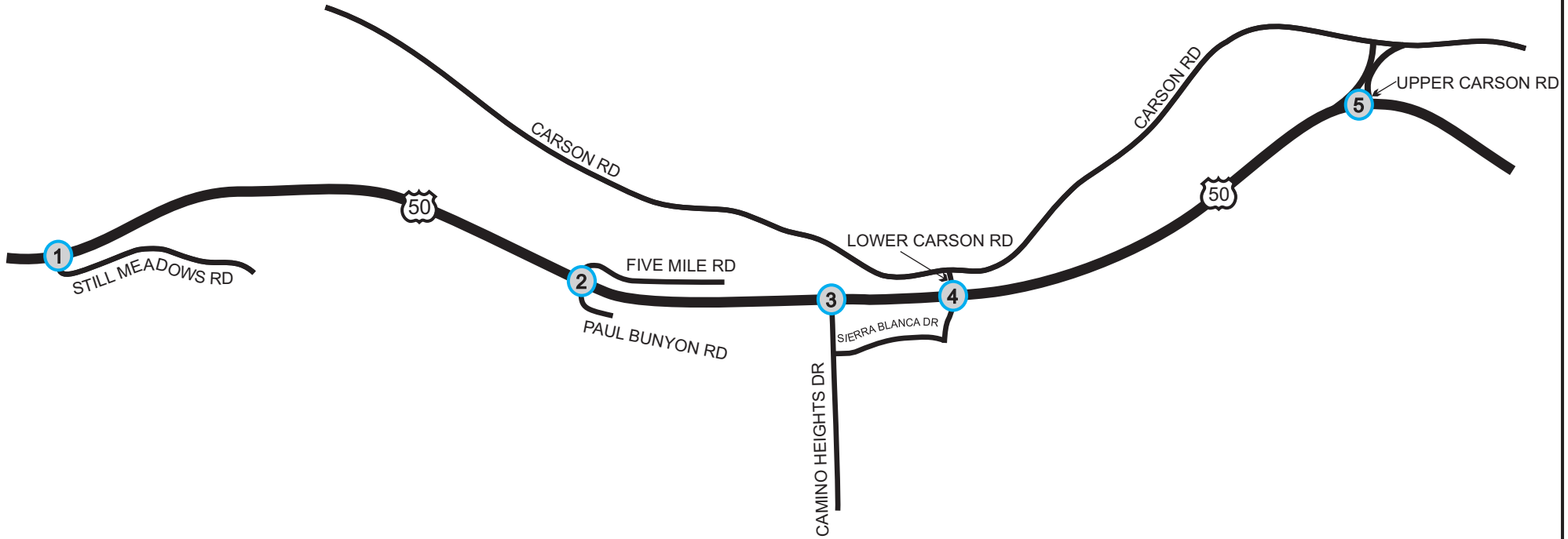
Opening Year 2015 and Design Year 2035 Conditions

Future Traffic Operations

The forecasted traffic volumes for 2015 and 2035 for both a Fall-Spring midweek and summer Friday PM peak hour are shown in Figures 2 through 9.

LEGEND

- # = STUDY INTERSECTION
- STOP = STOP-CONTROLLED INTERSECTION, ● = STOP SIGN
- #,### (#,###) → = FALL-SPRING MIDWEEK (SUMMER FRIDAY) PM PEAK HOUR TRAFFIC VOLUMES

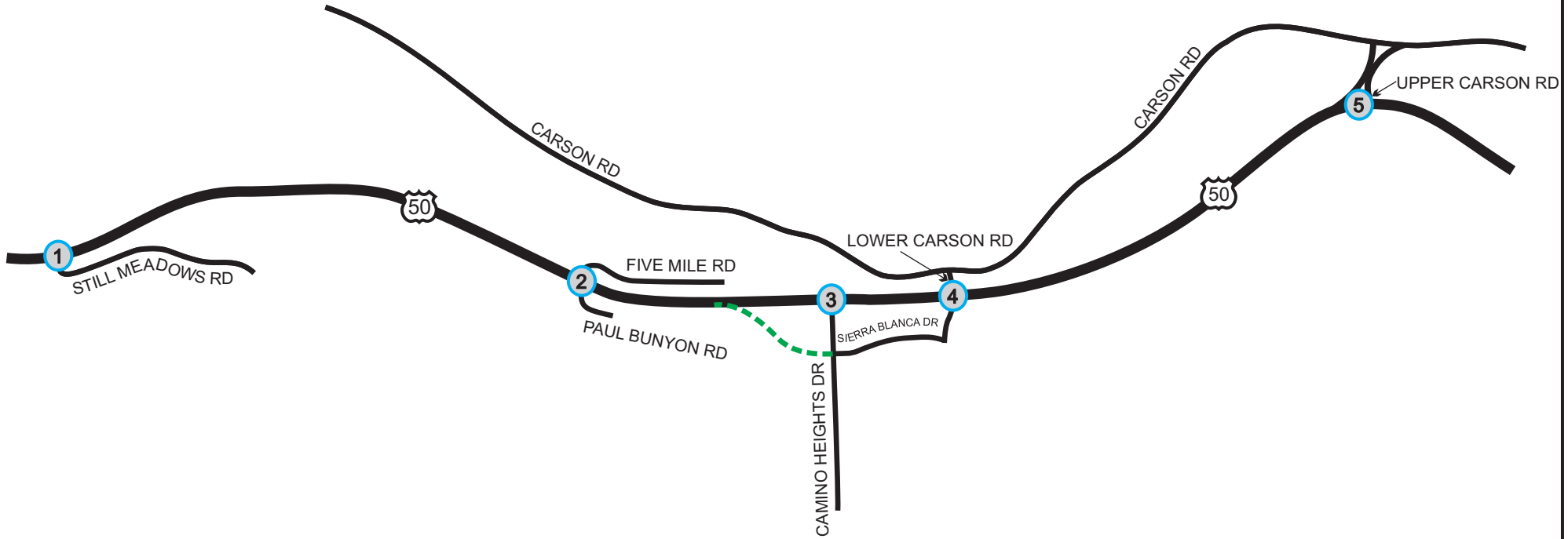


1	2	3	4	5
Still Meadows Rd / US-50	Paul Bunyon Rd / US-50	Camino Heights Dr / US-50	Lower Carson Rd / US-50	Upper Carson Rd / US-50

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- = PROPOSED ROADWAY



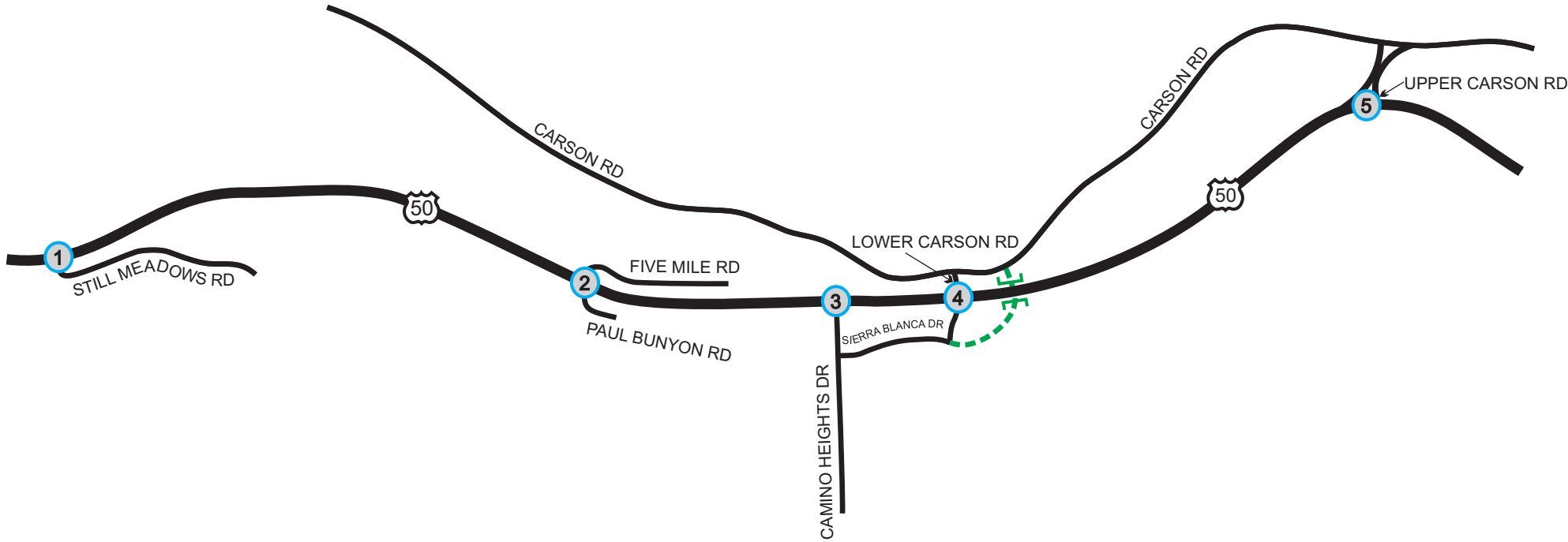
1	2	3	4	5
Still Meadows Rd / US-50	Paul Bunyon Rd / US-50	Camino Heights Dr / US-50	Lower Carson Rd / US-50	Upper Carson Rd / US-50
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> STOP ● </div> <div style="text-align: center;"> ← 960 (869) → 16 (6) </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="text-align: center;"> → 1,198 (1,737) ← 22 (20) </div> <div style="text-align: center;"> → 24 (24) </div> </div>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> ← 32 (7) </div> <div style="text-align: center;"> ← 19 (23) → 943 (861) </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="text-align: center;"> → 1,214 (1,752) ← 13 (6) </div> <div style="text-align: center;"> → 4 (10) </div> </div>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> ← 885 (817) → 20 (26) </div> <div style="text-align: center;"> ← 73 (63) → 21 (21) </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="text-align: center;"> → 1,127 (1,671) ← 91 (90) </div> <div style="text-align: center;"> → 73 (63) ← 21 (21) </div> </div>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> ← 61 (30) </div> <div style="text-align: center;"> ← 23 (23) → 846 (815) </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="text-align: center;"> → 1,142 (1,715) ← 0 (2) </div> <div style="text-align: center;"> → 9 (2) </div> </div>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> ← 171 (128) → 29 (44) </div> <div style="text-align: center;"> ← 14 (14) → 721 (707) </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="text-align: center;"> → 270 (219) </div> <div style="text-align: center;"> → 914 (1,486) </div> </div>

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FIGURE 3
OPENING YEAR 2015 ALTERNATIVE "B" CONDITIONS
PEAK HOUR TRAFFIC VOLUMES, LANE CONFIGURATIONS, AND TRAFFIC CONTROL
CAMINO CORRIDOR PROJECT STUDY

LEGEND

- # = STUDY INTERSECTION
- STOP = STOP-CONTROLLED INTERSECTION, ● = STOP SIGN
- #,### (#,###) → = FALL-SPRING MIDWEEK (SUMMER FRIDAY) PM PEAK HOUR TRAFFIC VOLUMES
- - - + - - - = PROPOSED ROADWAY



1	2	3	4	5
Still Meadows Rd / US-50	Paul Bunyon Rd / US-50	Camino Heights Dr / US-50	Lower Carson Rd / US-50	Upper Carson Rd / US-50
<div style="display: flex; justify-content: space-between;"> <div style="text-align: right;"> ← 960 (869) ← 16 (6) </div> <div style="text-align: left;"> → 1,198 (1,737) → 22 (20) </div> </div> <div style="text-align: center; margin-top: 10px;"> STOP </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="text-align: right;"> ← 24 (24) </div> <div style="text-align: left;"> → 4 (10) </div> </div>	<div style="display: flex; justify-content: space-between;"> <div style="text-align: right;"> ← 32 (7) </div> <div style="text-align: left;"> ← 19 (23) ← 943 (861) </div> </div> <div style="text-align: center; margin-top: 10px;"> STOP </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="text-align: right;"> ← 1,214 (1,752) ← 13 (6) </div> <div style="text-align: left;"> → 4 (10) </div> </div>	<div style="display: flex; justify-content: space-between;"> <div style="text-align: right;"> ← 958 (880) </div> <div style="text-align: left;"> ← 1,161 (1,709) ← 57 (52) </div> </div> <div style="text-align: center; margin-top: 10px;"> STOP </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="text-align: right;"> ← 21 (21) </div> <div style="text-align: left;"> → 4 (10) </div> </div>	<div style="display: flex; justify-content: space-between;"> <div style="text-align: right;"> ← 134 (93) </div> <div style="text-align: left;"> ← 43 (49) ← 826 (789) </div> </div> <div style="text-align: center; margin-top: 10px;"> STOP </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="text-align: right;"> ← 872 (1,496) ← 304 (259) </div> <div style="text-align: left;"> → 38 (46) </div> </div>	<div style="display: flex; justify-content: space-between;"> <div style="text-align: right;"> ← 171 (128) </div> <div style="text-align: left;"> ← 14 (14) ← 721 (707) </div> </div> <div style="text-align: center; margin-top: 10px;"> STOP </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="text-align: right;"> ← 943 (1,530) </div> <div style="text-align: left;"> → 4 (10) </div> </div>

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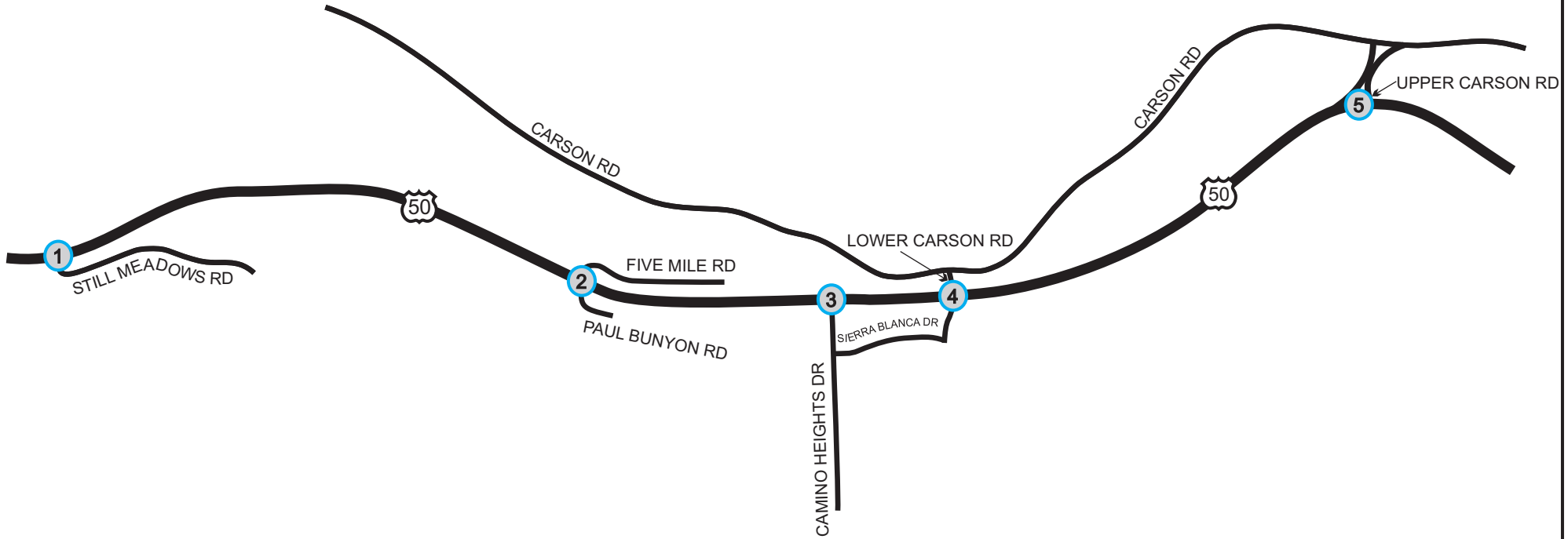
FIGURE 5
OPENING YEAR 2015 ALTERNATIVE "C2" CONDITIONS
PEAK HOUR TRAFFIC VOLUMES, LANE CONFIGURATIONS, AND TRAFFIC CONTROL

LEGEND

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STOP = STOP-CONTROLLED INTERSECTION, . = STOP SIGN

#,### (#,###) → = FALL-SPRING MIDWEEK (SUMMER FRIDAY) PM PEAK HOUR TRAFFIC VOLUMES



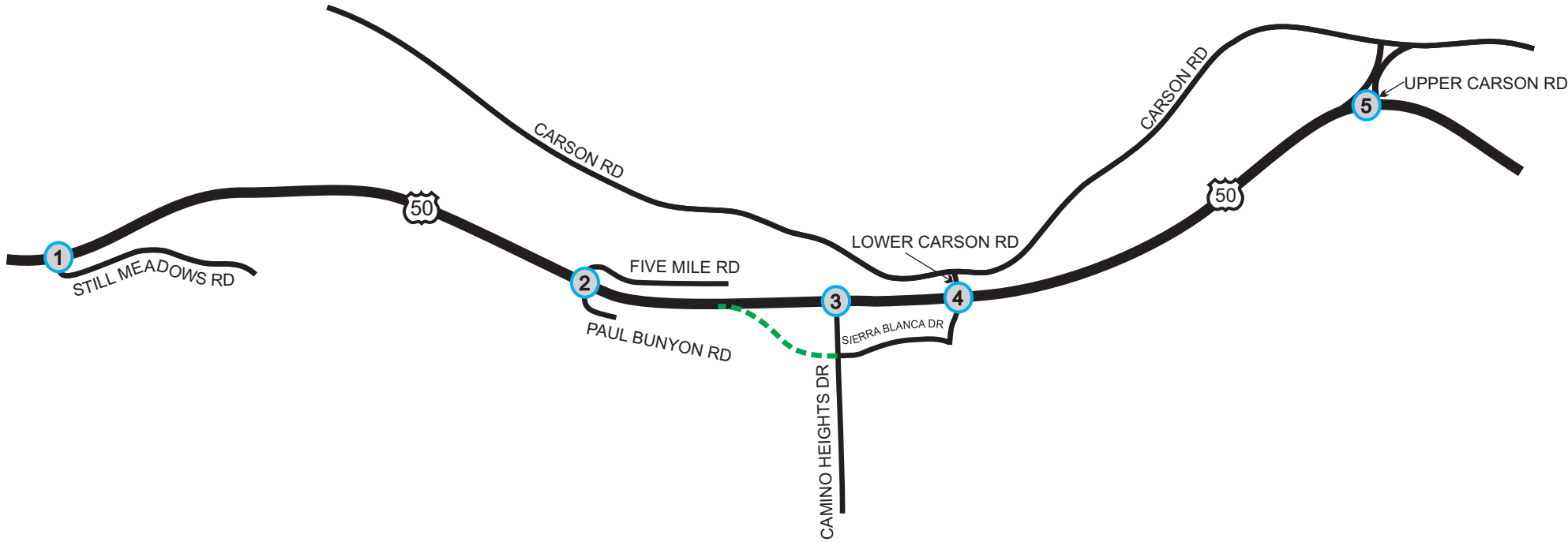
1	2	3	4	5
Still Meadows Rd / US-50	Paul Bunyon Rd / US-50	Camino Heights Dr / US-50	Lower Carson Rd / US-50	Upper Carson Rd / US-50

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- = PROPOSED ROADWAY

Not to Scale



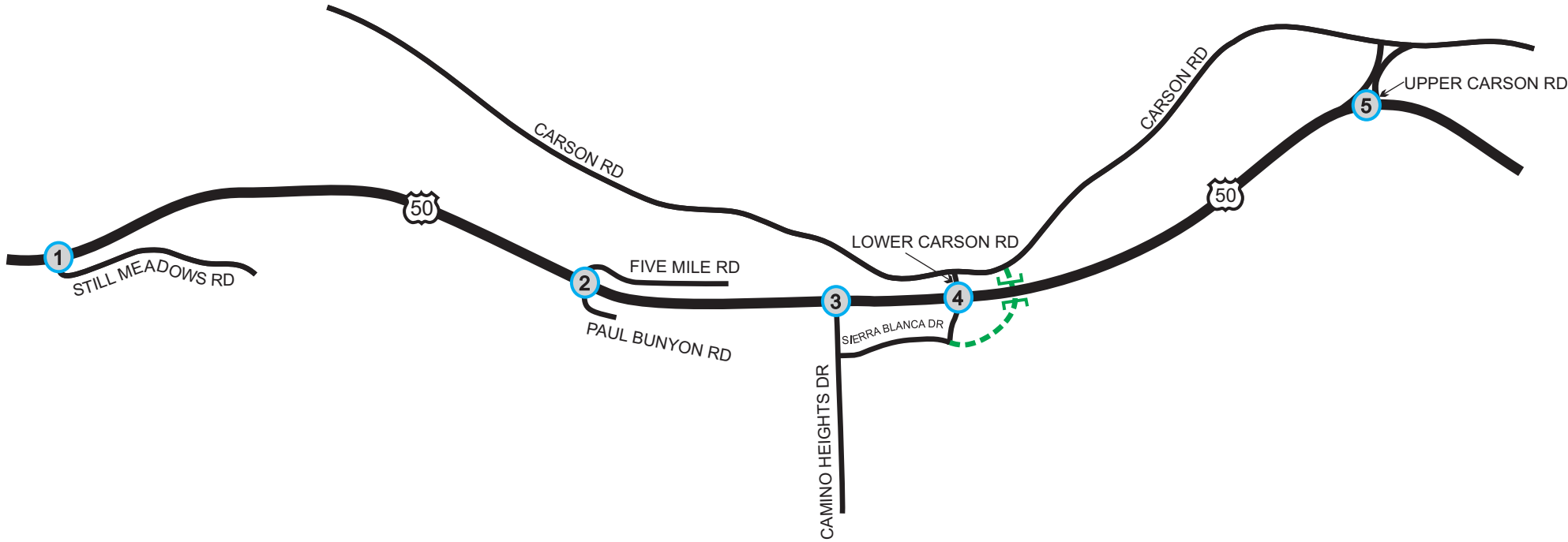
1	2	3	4	5
Still Meadows Rd / US-50	Paul Bunyon Rd / US-50	Camino Heights Dr / US-50	Lower Carson Rd / US-50	Upper Carson Rd / US-50
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> STOP ● 1,472 (2,011) 37 (35) </div> <div style="text-align: center;"> ● 44 (44) </div> <div style="text-align: center;"> 1,401 (1,310) 25 (15) </div> </div>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> STOP ● 1,507 (2,045) 17 (10) </div> <div style="text-align: center;"> ● 10 (16) </div> <div style="text-align: center;"> 32 (7) 19 (23) 1,393 (1,311) </div> </div>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> STOP ● 1,395 (1,939) 121 (120) </div> <div style="text-align: center;"> ● 106 (96) 28 (28) </div> <div style="text-align: center;"> 1,303 (1,235) 30 (36) </div> </div>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> STOP ● 1,417 (1,990) 0 (2) </div> <div style="text-align: center;"> ● 9 (2) </div> <div style="text-align: center;"> 63 (32) 54 (54) 1,272 (1,241) </div> </div>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> STOP ● 310 (259) 1,149 (1,721) </div> <div style="text-align: center;"> ● 254 (211) 47 (62) </div> <div style="text-align: center;"> 14 (14) 1,096 (1,082) </div> </div>

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- - - [] - - - = PROPOSED ROADWAY

Not to Scale



1 Still Meadows Rd / US-50	2 Paul Bunyon Rd / US-50	3 Camino Heights Dr / US-50	4 Lower Carson Rd / US-50	5 Upper Carson Rd / US-50

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Year	Season & Day	Direction	No Build	Alternative B	Alternative C1	Alternative C2
Opening Year 2015	Fall-Spring Midweek	Eastbound	130	131	130	129
		Westbound	129	128	128	128
	Summer Friday	Eastbound	136	136	135	134
		Westbound	127	127	127	127
Design Year 2035	Fall-Spring Midweek	Eastbound	132	133	132	132
		Westbound	132	133	132	132
	Summer Friday	Eastbound	138	138	137	137
		Westbound	131	132	132	131

Source: DKS Associates, 2009.

Operations on US 50 for east-west through traffic do not significantly change by 2015 or 2035. Table 6 illustrates the minimal changes in travel time through the study area under each alternative. The slight increases in US 50 travel times are due to increases in volumes on some segments due to out of direction travel. As a highways traffic volumes increase, travel time increases and speed decreases.

Delays for left turns onto US 50 increase significantly by 2035 under the “no build” condition. The turning movement delay for the intersections on US 50 for each study year and season day of week is summarized in Tables 7 through 10.

Opening Year 2015 – Fall or Spring Midweek PM Peak Hour

All of the movements would operate at a satisfactory delay and LOS at every intersection under every scenario on Fall or Spring Midweek PM peak hour in 2015. The worst delay and LOS would be experienced by the northbound left turn at Still Meadows Road under the “no build” condition and the southbound left turn at Upper Carson Road under Alternative B. They both are projected to operate at LOS D.

Opening Year 2015 – Summer Friday PM Peak Hour

All of the movements would operate at a satisfactory delay and LOS at every intersection under every scenario on Summer Friday PM peak hour in 2015, except for one. The northbound left turn at Still Meadows Road under the “no build” condition would operate at a deficient LOS F with 79.2 seconds of delay. The northbound left turn at Paul Bunyan Road under No Build would operate at LOS D. The northbound left turn at Camino Heights Drive under Alternative B would operate at LOS D. The southbound left turn at Upper Carson Road under Alternative B would operate at LOS D.

**Table 7 - Turning Movement Delay (Seconds) and Level of Service –
Opening Year 2015 – Fall-Spring Midweek PM**

Intersection With US 50	Scenario	Eastbound		Westbound		Northbound		Southbound	
		Left Turn	Right Turn	Left Turn	Right Turn	Left Turn	Right Turn	Left Turn	Right Turn
Still Meadows Road	No Build		5.9 A	12.2 B		29.2 D	5.8 A		
	Alternative B		6.0 A	4.8 A			0.1 A		
	Alternative C1		5.7 A	4.1 A			0.1 A		
	Alternative C2		5.6 A	5.1 A			0.1 A		
Paul Bunyan Road	No Build	7.4 A	1.7 A	4.5 A	0.0 A	6.5 A	4.2 A		4.9 A
	Alternative B		0.0 A		1.0 A		0.1 A		0.1 A
	Alternative C1		0.5 A		1.1 A		4.3 A		0.2 A
	Alternative C2		0.4 A		1.6 A		0.1 A		0.2 A
Camino Heights Drive	No Build		2.4 A	5.8 A		13.6 B	0.6 A		
	Alternative B			5.1 A		14.2 B	0.8 A		
	Alternative C1		1.6 A				0.5 A		
	Alternative C2		1.9 A				0.4 A		
Lower Carson Road	No Build	5.3 A	na		0.1 A		0.1 A		0.3 A
	Alternative B		na		0.0 A		0.1 A		0.4 A
	Alternative C1		0.9 A		0.6 A		0.5 A		0.8 A
	Alternative C2		1.5 A		0.7 A		1.7 A		2.7 A
Upper Carson Road	No Build	6.8 A			5.4 A			21.4 C	0.5 A
	Alternative B	9.1 A			5.7 A			29.7 D	0.7 A
	Alternative C1	7.2 A			5.2 A			19.9 C	0.6 A
	Alternative C2				7.3 A				1.2 A

Source: DKS Associates, 2009.

**Table 8 - Turning Movement Delay (Seconds) and Level of Service –
Opening Year 2015 - Summer Friday PM**

Intersection With US 50	Scenario	Eastbound		Westbound		Northbound		Southbound	
		Left Turn	Right Turn	Left Turn	Right Turn	Left Turn	Right Turn	Left Turn	Right Turn
Still Meadows Road	No Build		5.9 A	17.0 C		79.2 F	10.9 B		
	Alternative B		6.2 A	8.9 A			0.1 A		
	Alternative C1		5.9 A	6.7 A			0.1 A		
	Alternative C2		6.0 A	8.4 A			0.1 A		
Paul Bunyan Road	No Build	7.5 A	2.9 A	9.3 B	2.4 A	29.5 D	10.2 B		3.3 A
	Alternative B		1.0 A		2.0 A		0.3 A		0.5 A
	Alternative C1		0.5 A		2.1 A		0.1 A		0.2 A
	Alternative C2		0.5 A		2.0 A		0.1 A		0.1 A
Camino Heights Drive	No Build		3.1 A	10.2 B		20.6 C	0.6 A		
	Alternative B			9.4 A		32.2 D	0.8 A		
	Alternative C1		2.0 A				0.4 A		
	Alternative C2		2.3 A				0.4 A		
Lower Carson Road	No Build	4.6 A	1.1 A		0.1 A		0.1 A		0.4 A
	Alternative B		0.1 A		0.0 A		0.1 A		0.4 A
	Alternative C1		1.1 A		0.8 A		0.5 A		0.9 A
	Alternative C2		1.4 A		0.8 A		0.6 A		0.9 A
Upper Carson Road	No Build	6.4 A			5.7 A			21.5 C	0.5 A
	Alternative B	7.6 A			5.9 A			28.7 D	0.6 A
	Alternative C1	6.6 A			5.7 A			22.0 C	0.6 A
	Alternative C2				7.6 A				1.1 A

Source: DKS Associates, 2009.

**Table 9 - Turning Movement Delay (Seconds) and Level of Service –
Design Year 2035 - Fall-Spring Midweek PM**

Intersection With US 50	Scenario	Eastbound		Westbound		Northbound		Southbound	
		Left Turn	Right Turn	Left Turn	Right Turn	Left Turn	Right Turn	Left Turn	Right Turn
Still Meadows Road	No Build		6.3 A	13.9 B		154.1 F	7.5 A		
	Alternative B		6.1 A	7.9 B			0.2 A		
	Alternative C1		5.8 A	8.8 A			0.1 A		
	Alternative C2		5.9 A	7.8 A			0.1 A		
Paul Bunyan Road	No Build	10.2 B	2.8 A	10.0 A	na	66.6 F	7.1 A		7.3 A
	Alternative B		0.4 A		1.8 A		0.2 A		0.1 A
	Alternative C1		0.5 A		2.2 A		0.1 A		0.2 A
	Alternative C2		0.5 A		2.0 A		0.1 A		0.2 A
Camino Heights Drive	No Build		2.9 A	8.3 A		23.4 C	0.6 A		
	Alternative B			8.2 A		31.0 D	1.5 A		
	Alternative C1		2.0 A				0.5 A		
	Alternative C2		2.4 A				0.5 A		
Lower Carson Road	No Build	11.2 A			0.2 A		0.1 A		0.4 A
	Alternative B				0.8 A		0.2 A		0.7 A
	Alternative C1		0.9 A		0.9 A		0.4 A		0.9 A
	Alternative C2		1.6 A		0.9 A		0.5 A		0.7 A
Upper Carson Road	No Build	20.3 C			5.6 A			114.0 F	5.5 A
	Alternative B	33.4 D			5.9 A			278.8 F	21.2 C
	Alternative C1	17.9 C			6.1 A			122.8 F	6.3 A
	Alternative C2				7.5 A				1.4 A

Source: DKS Associates, 2009.

**Table 10 - Turning Movement Delay (Seconds) and Level of Service –
Design Year 2035 - Summer Friday PM**

Intersection With US 50	Scenario	Eastbound		Westbound		Northbound		Southbound	
		Left Turn	Right Turn	Left Turn	Right Turn	Left Turn	Right Turn	Left Turn	Right Turn
Still Meadows Road	No Build		6.2 A	27.6 D		1031.8 F	187.9 F		
	Alternative B		6.3 A	15.7 C			0.1 A		
	Alternative C1		6.4 A	15.0 C			0.1 A		
	Alternative C2		6.3 A	17.9 C			0.1 A		
Paul Bunyan Road	No Build	10.0 B	4.6 A	26.1 B	1.3 A	76.9 F	12.4 B	na	6.4 A
	Alternative B		0.5 A		1.8 A		0.1 A		0.1 A
	Alternative C1		0.5 A		2.2 A		0.1 A		0.1 A
	Alternative C2		0.6 A		2.1 A		0.1 A		0.1 A
Camino Heights Drive	No Build		3.6 A	14.8 B		47.6 E	0.6 A		
	Alternative B			15.3 C		136.0 F	8.6 A		
	Alternative C1		2.7 A				1.0 A		
	Alternative C2		2.6 A				0.4 A		
Lower Carson Road	No Build	10.7 B	0.0 A		0.1 A		0.1 A		0.4 A
	Alternative B		0.6 A		0.8 A		0.2 A		0.8 A
	Alternative C1		0.9 A		1.0 A		0.5 A		0.9 A
	Alternative C2		1.5 A		1.5 A		0.5 A		0.9 A
Upper Carson Road	No Build	17.1 B			5.9 A			139.7 F	15.8 C
	Alternative B	19.8 C			5.6 A			217.4 F	31.4 D
	Alternative C1	17.0 B			6.0 A			156.1 F	16.3 C
	Alternative C2				7.9 A				1.3 A

Source: DKS Associates, 2009.

Design Year 2035 – Fall or Spring midweek PM Peak Hour

Alternative C2 is the only alternative that does not have a LOS F movement under Fall or Spring midweek PM peak hour conditions in 2035. Under the No Build scenario there would be a LOS F with 154.1 seconds of delay for the northbound left turn at Still Meadows Road, LOS F with 66.6 seconds of delay for the northbound left turn at Paul Bunyan Road and there would be a LOS F with 114.0 seconds of delay at the southbound left turn at Upper Carson Road. Under Alternative B there would be a LOS F with 278.8 seconds of delay at the southbound left turn at Upper Carson Road. The large increase in delay for the southbound left turn at Upper Carson Road is due to the addition of the diverted eastbound left turning vehicles from Lower Carson Road. These eastbound left turns have the right of way before the southbound left turns; therefore the southbound left turns have to wait longer for a gap. This queuing and delay is so high that vehicles that want to enter US 50 eastbound might chose to divert to Carson Road through Camino and to the Cedar Grove interchange. Operations would be LOS D at the northbound left turn at Camino Heights Drive and LOS D for eastbound left turns at Upper Carson Road under Alternative B. Under Alternative C1 there would be LOS F with 122.8 seconds of delay at the southbound left turn at Upper Carson Road. These delays are lower than Alternative B because the eastbound left turn from Lower Carson Road is diverted to the undercrossing instead. Alternative C2 would not have any LOS F movements because those movements are closed and the traffic is diverted to the undercrossing.

Design Year 2035 – Summer Friday PM Peak Hour

Alternative C2 is the only alternative that does not have a LOS F movement under Summer Friday PM peak hour conditions in 2035.

Under the “no build” condition there would be LOS F movements at three of the five intersections. At Still Meadows Road operations are projected to be LOS F, with a delay of 1031.8 seconds for the northbound left turn and there would be LOS F with 187.9 seconds of delay at the northbound right turn. The reason for the delay is the high volume of traffic on US 50, so there are not enough gaps for traffic from Still Meadows Road to make a left turn and immediately merge into westbound traffic. This high delay causes significant queuing to back up into into the Apple Hill Café parking lot and onto Still Meadows Road. The queues may be long enough to block the northbound right turns, causing delay for the right turn movement. With this projected delay for the northbound left turn, some frustrated drivers could likely make a right turn onto eastbound US 50, and turn around at Paul Bunyan Road onto westbound US 50. The westbound left turn movement would be LOS D.

At Paul Bunyan Road there would be LOS F with a delay of 76.9 seconds for the northbound left turn. This intersection has the same issue as Still Meadows Road but is projected to have much

lower volumes attempting to make the left turn onto US 50. At Camino Heights Drive operations would be LOS E for the northbound left turn because at this intersection the left turns onto US 50 enter a separate merging or acceleration lane. Drivers making this maneuver only need to look for gaps in eastbound and westbound left turn traffic, not westbound through traffic. Once entering the merging lane, drivers can accelerate to near highway speeds and find a gap in through, westbound traffic. At Upper Carson Road there would be LOS F with 139.7 seconds of delay for the southbound left turn. With this much delay, vehicles wanting to enter US 50 eastbound might divert to Carson Road through Camino and to the Cedar Grove interchange. This would cause a queue that would occasionally reach Carson Road.

Under Alternative B there would be LOS F movements at two of the five intersections. At Camino Heights Drive operations will be LOS F with 136.0 seconds of delay for the northbound left turn. This is worse than the “no build” condition because the closed left turns at Still Meadows Road and Paul Bunyan Road will cause drivers to divert to the auxiliary road and this northbound left turn movement at Camino Heights Drive; therefore increasing the volume looking for the same few gaps, resulting in increased delays. This would result in queues on northbound Camino Heights Drive that would occasionally reach the auxiliary lane. At Upper Carson Road there would be LOS F with 217.4 seconds of delay for the southbound left turn. These delays are due to the addition of the diverted eastbound left turn from Lower Carson Road. Because these drivers have the right of way before the southbound left turns, the southbound left turn will have to wait longer for a gap. This would cause a queue that backs up to Carson Road. This delay is so high that vehicles wanting to enter US 50 eastbound might divert to Carson Road through Camino and to the Cedar Grove interchange. At Upper Carson Road there would be LOS D for the southbound right turn

Under Alternative C1 there would be just one movement at LOS F. At Upper Carson Road there would be LOS F with 156.1 seconds of delay for the southbound left turn. This would cause a queue that would occasionally back up to Carson Road. This queuing and delay is so high that vehicles wanting to enter US 50 eastbound might chose to divert to either the undercrossing or Carson Road through Camino and to the Cedar Grove interchange.

In none of the alternatives do vehicles making left turns off of US 50 ever queue beyond the storage bay and into the through lanes of US 50. The maximum queue for a left turn off of US 50 is at Upper Carson Road under the 2035 Fall or Spring midweek PM scenario B, at 300 feet. It only takes up almost half of the storage and deceleration distance, leaving about 200 feet for deceleration.

Diverted Vehicles

Alternative B would eliminate the high delay on the northbound left turn at Still Meadows Road; however, it is replaced by an out of direction movement. The out of direction movement is a right turn onto US 50, a right turn to the auxiliary road to Camino Heights Drive, a left turn onto northbound Camino Heights Drive, a left turn onto westbound US 50 and westbound on US 50 past Still Meadows Road. Travel times on this movement would be 206 seconds on a summer Friday in 2015 and 375 seconds on a summer Friday in 2035.

Alternative C1 would eliminate the high delay on the northbound left turn at Camino Heights Drive; however, it is replaced by an out of direction movement. Travel times on this movement would be 93 seconds on a summer Friday in 2035. With this alternative, the travel time on the Still Meadows Road out of direction movement would be 248 seconds on a summer Friday in 2035. The 248 seconds of extra travel time is less than the 1032 seconds of delay for this movement under the “no build” condition.

Neither Alternative B nor Alternative C1 relieves the large southbound left turn delay at Upper Carson Road. Alternative C2 eliminates this delay without introducing much out of direction travel. Alternative C2 does not create a significant amount of out of direction travel because the vehicles redirected from the eastbound left turn can just get off of US 50 earlier at Sierra Blanca Drive, go under the undercrossing and then take Carson Road to get to the same destination. Similarly, most of the vehicles redirected from the southbound left turn would come from Carson Road west of Upper Carson Road and can therefore get on eastbound US 50 earlier by going through the undercrossing and then turning onto Sierra Blanca Drive before turning right onto US 50. The small increase in travel time due to taking the slower local roads is offset by the not experiencing a large delay looking for a gap to make a left turn on US 50.

Future Roadway Network Travel Time

The improvement alternatives eliminate the critical left turn movements that result in excessive delay and the potential for collisions. However, each alternative also introduces longer travel paths due to the turn restrictions. The combined effect of converting the high delay left turns to out of direction travel was evaluated by calculating network travel time for all vehicles (vehicle hours of travel) and network travel distance (vehicle miles of travel). The extra time that diverted vehicles take to complete their journey increases the vehicle hours of travel. The extra distance that diverted vehicles take to complete their journey increases the vehicle miles of travel. Tables 11 and 12 summarize the results of the analysis in the SimTraffic network.

The alternatives increase overall network travel time in 2015. The alternatives increase network travel time on a 2035 midweek PM peak hour and on a 2035 Friday PM peak hour; however, Alternative C2 decreases vehicle hour of travel for a Friday PM peak hour in 2035 because the

extra travel time for out of direction travel is less than the left turn movement delay experienced under the “no build” condition. All alternatives increase vehicle miles of travel.

Table 11 - Study Area Vehicle Hours Travel (VHT) – All Vehicles – Peak Hour					
Year	Season & Day	No Build	Alternative B	Alternative C1	Alternative C2
Opening Year 2015	Fall-Spring Midweek	111	116 +5%	119 +7%	121 +9%
	Summer Friday	135	141 +4%	143 +6%	143 +6%
Design Year 2035	Fall-Spring Midweek	161	192 +19%	171 +6%	167 +4%
	Summer Friday	196	219 +12%	199 +2%	189 -4%

Source: DKS Associates, 2009.

Table 12 - Study Area Vehicle Miles Travel (VMT) – All Vehicles – Peak Hour					
Year	Season & Day	No Build	Alternative B	Alternative C1	Alternative C2
Opening Year 2015	Fall-Spring Midweek	5686	5899 +4%	5947 +5%	5920 +4%
	Summer Friday	6914	7173 +4%	7235 +5%	7130 +3%
Design Year 2035	Fall-Spring Midweek	7708	7929 +3%	8005 +4%	8014 +4%
	Summer Friday	8813	9174 +4%	9157 +4%	9201 +4%

Source: DKS Associates, 2009.

Future Safety Implications

The volume of left turns in the study area is projected to increase slightly by 2015 and significantly by 2035. As mentioned previously in the discussion of travel forecasting, the same growth increment of local turning traffic is applied to both the fall Wednesday and summer Friday PM peak hours. These increases in conflicting volumes increase the probability of collisions. As volumes increase, so do left turn delays. Increased left turn delays often lead to impatient motorists accepting shorter gaps in traffic, resulting in an increased chance of

collisions. Increased left turn delays also lead to longer queue lengths, increasing the possibility of rear-end collisions.

The largest increase in left turns is the eastbound left turn from US 50 to Upper Carson Road. It increases by 51 vehicles per hour by 2035. The second highest left turn volume increase is the number of southbound left turns onto US 50 at Upper Carson Road. The volume increases by 23 vehicles per hour by 2035. The westbound through traffic, a conflict for both movements, increases by 505 vehicles per hour by 2035. The third and fourth highest left turn volume increases are northbound left turns onto US 50 at Still Meadows Road and Camino Heights Drive. They increase by 20 and 19 vehicles per hour, respectively, by 2035. The eastbound and westbound US 50 through traffic, a conflict for northbound Still Meadows Road left turns, increases by 951 vehicles per hour by 2035. The eastbound US 50 through traffic, a conflict for northbound Camino Heights Drive left turns, increases by 374 vehicles per hour by 2035. Northbound Camino Heights Drive left turns only conflict with eastbound US 50 traffic (and westbound left turns) because they enter a separate median acceleration merge lane.

The alternatives restrict the number of locations where left turns can be made. Reducing the number of left turns could reduce the probability of collisions. The number of left turns in each alternative is shown in Table 13.

Alternative B prohibits left turns onto US 50 at Still Meadows Road, all left turns at Paul Bunyan Road and all left turns at Lower Carson Road. In Alternative B these left turns are just moved to another intersection and the number of left turns remains the same; however, there probably will be some safety benefit as left turns onto US 50 will be moved from locations where they need to look for a gap in both directions and immediately merge with traffic to locations where they only need to look for a gap in one direction of US 50 traffic and enter a separate median acceleration merge lane.

Alternative C1 prohibits left turns onto US 50 at Still Meadows Road, all left turns at Paul Bunyan Road, all left turns at Camino Heights Drive and all left turns at Lower Carson Road. In this alternative the left turns are converted to right turns and trip using the new undercrossing. Alternative C1 reduces the number of left turns by about 40% and would likely reduce the probability of accidents from the “no build” condition.

Alternative C2 prohibits left turns onto US 50 at Still Meadows Road, all left turns at Paul Bunyan Road, all left turns at Camino Heights Drive, all left turns at Lower Carson Road and all left turns at Upper Carson Road. In this alternative the left turns are converted to right turns and trip using the new undercrossing. Alternative C2 reduces almost all left turns and would likely reduce the probability of accidents from the “no build” Project condition.

Table 13 - Safety - Number of Peak Hour Left Turns						
Year	Season & Day	Intersection	No Build	Alternative B	Alternative C1	Alternative C2
Opening Year 2015	Fall-Spring Midweek	Still Meadows Rd	25	16	16	16
		Paul Bunyan Rd	25	0	0	0
		Camino Heights Dr	59	93	0	0
		Lower Carson Rd	74	0	0	0
		Upper Carson Rd	225	299	225	0
		Total	408	408	241	16
		Percent of No Build	100%	100%	59%	4%
	Summer Friday	Still Meadows Rd	19	6	6	6
		Paul Bunyan Rd	25	0	0	0
		Camino Heights Dr	51	89	0	0
		Lower Carson Rd	45	0	0	0
		Upper Carson Rd	218	263	218	0
		Total	358	358	224	6
		Percent of No Build	100%	100%	63%	2%
Design Year 2035	Fall-Spring Midweek	Still Meadows Rd	46	25	25	25
		Paul Bunyan Rd	31	0	0	0
		Camino Heights Dr	84	136	0	0
		Lower Carson Rd	76	0	0	0
		Upper Carson Rd	281	357	281	0
		Total	518	518	306	25
		Percent of No Build	100%	100%	59%	5%
	Summer Friday	Still Meadows Rd	40	15	15	15
		Paul Bunyan Rd	31	0	0	0
		Camino Heights Dr	76	132	0	0
		Lower Carson Rd	47	0	0	0
		Upper Carson Rd	274	321	274	0
		Total	468	468	289	15
		Percent of No Build	100%	100%	62%	3%

Source: DKS Associates, 2009.

Table 14 summarizes the number of collisions between 2003 and 2007 that could potentially have been eliminated if the improvement alternatives were in place in 2003. The potentially eliminated collisions are broadsides occurring during left turn movements. Although prohibited movement accidents would not have happened. Alternative B might just move accidents from Still Meadows Road and Paul Bunyan Road to Camino Heights Drive. Alternative C1 is more likely to prevent accidents than Alternative B, and Alternative C2 is more likely to prevent accidents than Alternative C1.

Table 14 - Accident Rate - Number of Accidents That Could Potentially Have Been Prevented – 2003 to 2007				
Intersection	Existing	Alternative B	Alternative C1	Alternative C2
Still Meadows Rd		5	5	5
Paul Bunyan Rd		2	2	2
Camino Heights Dr		0	2	2
Lower Carson Rd		6	6	6
Upper Carson Rd		0	0	5
Total Preventable		13	15	20
Total Accidents	183	170	168	163
Scenario Average Rate	0.76	0.70	0.69	0.67
State Average Rate	0.67	0.67	0.67	0.67
Source: California Department of Transportation, 2008 and DKS Associates, 2009				