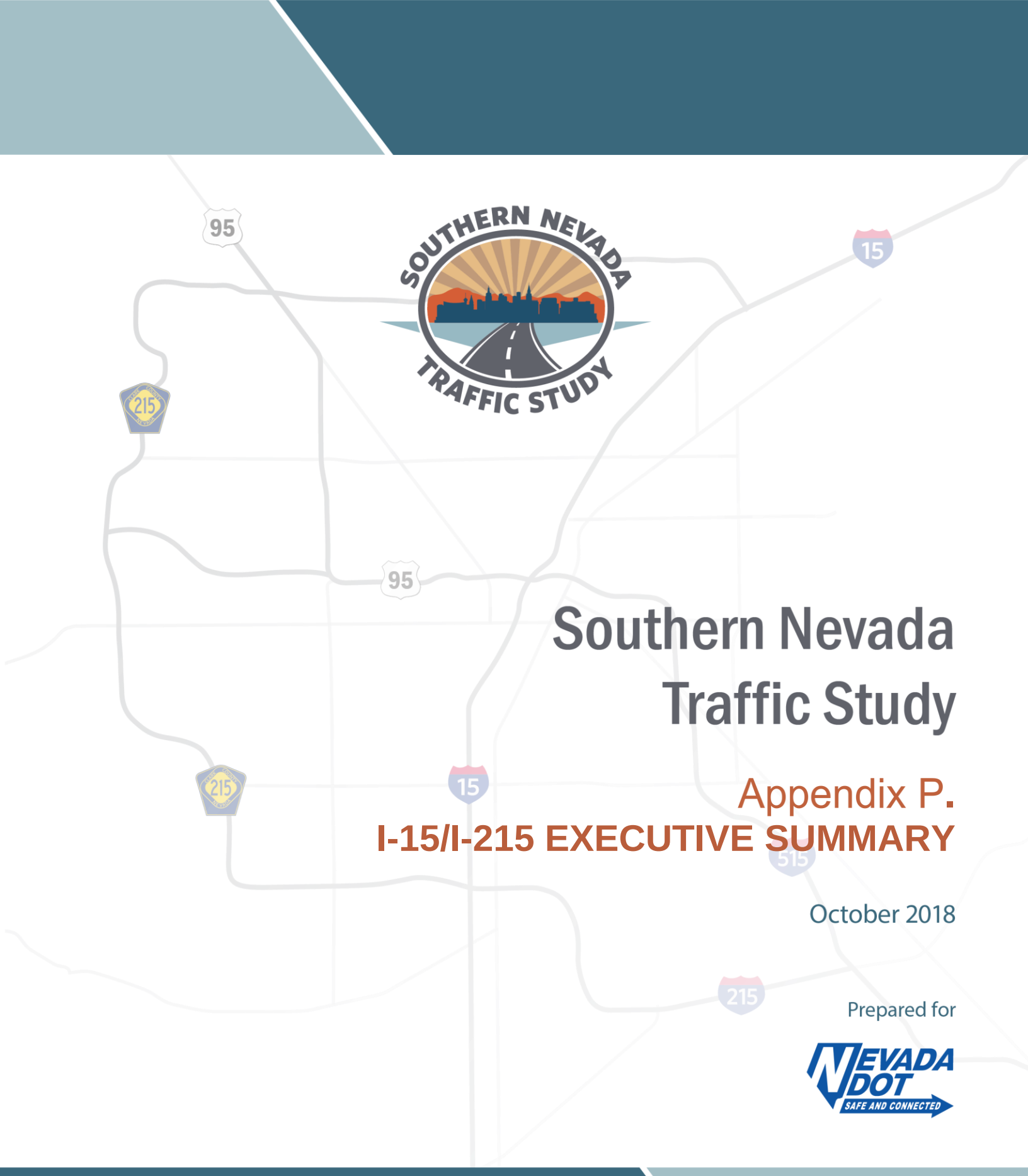

Southern Nevada Traffic Study

Appendix P.

I-15/I-215 EXECUTIVE SUMMARY

October 2018

Prepared for

NEVADA DOT
SAFE AND CONNECTED

Prepared by HDR

Traffic Operations Report

I-15 North Phase 4

I-15/CC215 Interchange

December 28, 2015

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I-15 North Phase 4

Traffic Operations Report

1. Introduction

The Nevada Department of Transportation (NDOT) proposes to improve the existing freeway interchange connecting Interstate 15 (I-15) to Bruce Woodbury Beltway (CC-215) to provide a fully developed system interchange. To assist this effort, Parsons Brinckerhoff (PB) is providing project scoping and project management assistance services to identify the most desirable interchange layout given multiple constraints. In support of this analysis, CA Group has developed traffic operations analysis for the I-15 North Phase 4 project.

Purpose

The purpose of this document is to describe the details of the traffic operations analysis procedure and discuss the results for the existing scenario (year 2015), future no-action (year 2035), and two future build scenarios (year 2035) for the project.

Study Area

The study area includes I-15 between Lamb Boulevard and Speedway Boulevard, Lamb Boulevard between I-15 and CC-215, and I-15/CC-215 Interchange including Range Road. Figure 1 shows the existing study intersections and roadway segments for this study. Additional intersections are included in future scenarios depending on the interchange configuration.

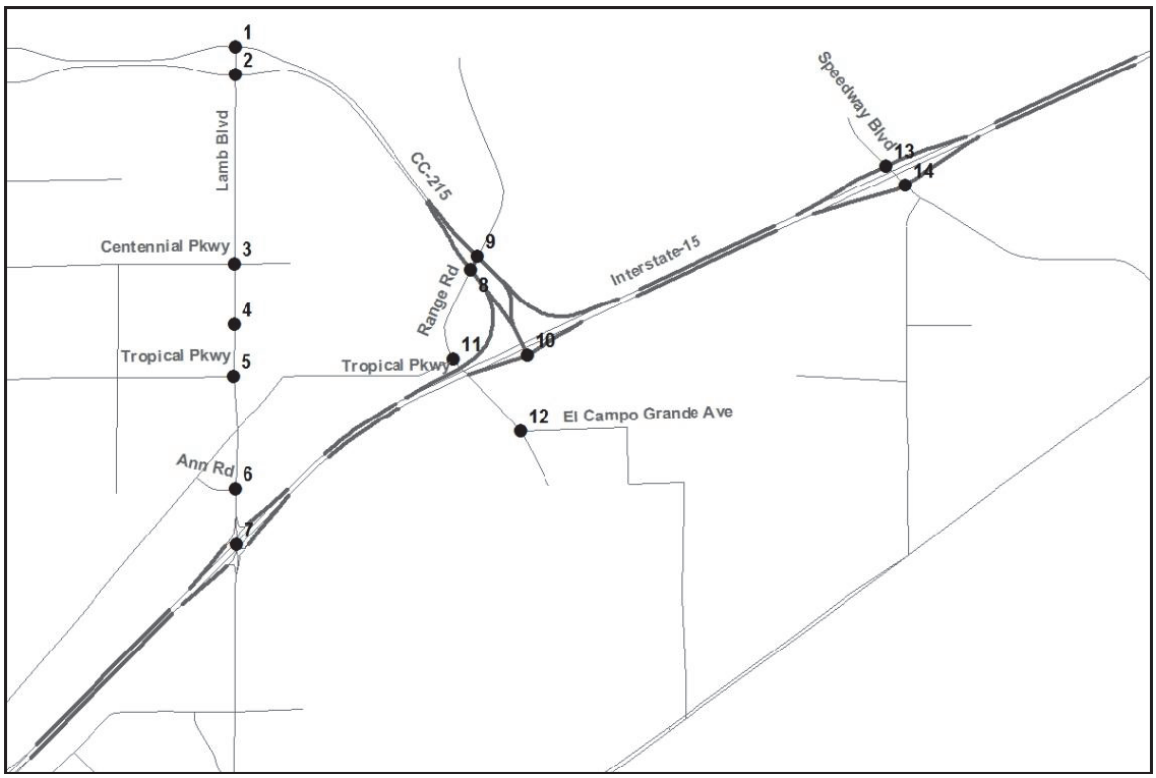


Figure 1: Study Intersections and Roadway Segments

2. Traffic Analysis Methodology

Prior to performing the traffic analysis, a traffic operation analysis methodology memorandum[1] was prepared and accepted by NDOT on April 21, 2015. The traffic volumes used for the operations analysis were approved by NDOT and provided in the project traffic forecasting memorandum.[2]

A micro level traffic modeling and analysis was performed using Synchro 9 and Highway Capacity Software 2010 (HCS 2010). Synchro 9 was used to evaluate the performance of signalized/unsignalized intersections while HCS 2010 was used for freeway and ramps. The various measures of effectiveness (MOEs) considered were level-of-service (LOS), delay, density, speed and volume-to-capacity (v/c) ratios. All the MOEs were calculated based on the Highway Capacity Manual 2010 (HCM 2010). The LOS criteria for the arterial streets (signalized/unsignalized intersections) and freeway sections (basic/merge/diverge) are shown in Table 1 through Table 5 and Figure 2. The ramp roadway capacities were calculated using the values from Table 6. All the exhibits from HCM 2010 were used as a reference for calculating the MOEs for traffic operations.

[1] *Traffic Operations Analysis Methodology Memorandum* for I-15 North Phase 4, CA Group
[2] *Traffic Forecasting Memorandum* for I-15 North Phase 4, Parsons Brinckerhoff, August 21, 2015

Table 1: LOS Criteria for Signalized Intersections (HCM 2010 Exhibit 18-4)

Control Delay (s/veh)	LOS by Volume-to-Capacity Ratio[a]	
	≤ 1.0	≥ 1.0
≤ 10	A	F
>10-20	B	F
>20-35	C	F
>35-55	D	F
>55-80	E	F
>80	F	F

Note: [a] For approach-based and intersectionwide assessments, LOS is defined solely by control delay.

Table 2: LOS Criteria for Two-Way Stop Controlled Intersections (HCM 2010 Exhibit 19-1)

Control Delay (s/veh)	LOS by Volume-to-Capacity Ratio	
	v/c ≤ 1.0	*v/c* ≥ 1.0
0-10	A	F
>10-15	B	F
>15-25	C	F
>25-35	D	F
>35-50	E	F
>50	F	F

Note: The LOS criteria apply to each lane on a given approach and to each approach on the minor street. LOS is not calculated for major-street approaches or for the intersection as a whole.

Table 3: LOS Criteria for All-Way Stop Controlled Intersections (HCM 2010 Exhibit 20-2)

Control Delay (s/veh)	LOS by Volume-to-Capacity Ratio*	
	v/c ≤ 1.0	*v/c* ≥ 1.0
0-10	A	F
>10-15	B	F
>15-25	C	F
>25-35	D	F
>35-50	E	F
>50	F	F

Note: * For approaches and intersectionwide assessment, LOS is defined solely by control delay.

Table 4: LOS Criteria for Basic Freeway Segments (HCM 2010 Exhibit 11-5)

LOS	Density (pc/mi/ln)
A	≤11
B	>11-18
C	>18-26
D	>26-35
E	>35-45
F	Demand exceeds capacity >45

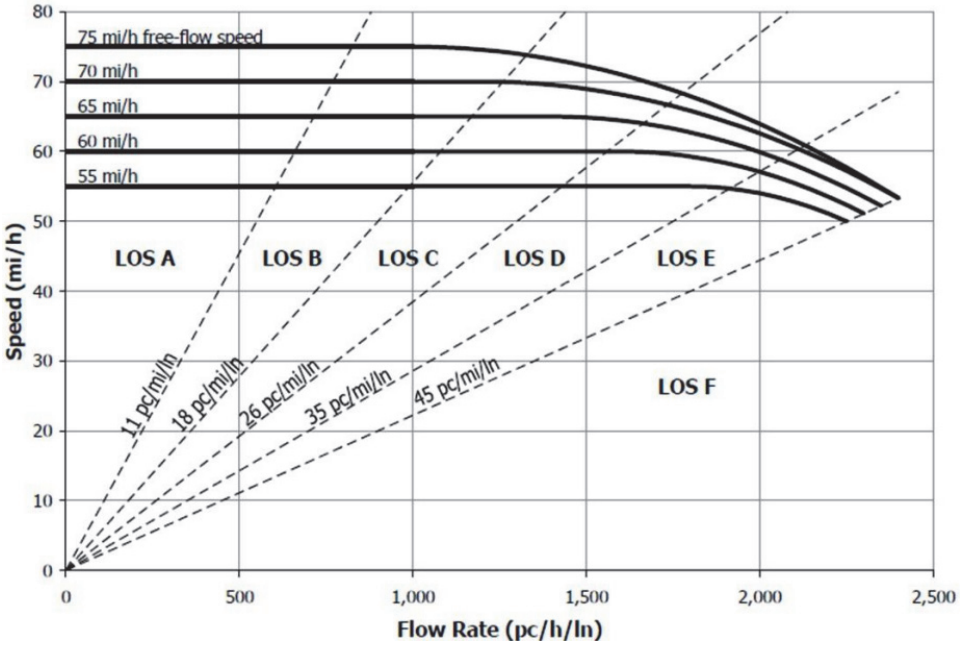


Figure 2: LOS for Basic Freeway Segments (HCM 2010 Exhibit 11-6)

Table 5: LOS Criteria for Freeway Merge & Diverge Segments (HCM 2010 Exhibit 13-2)

LOS	Density (pc/mi/ln)	Comments
A	≤ 10	Unrestricted operations
B	>10-20	Merging and diverging maneuvers noticeable to drivers
C	>20-28	Influence area speeds begin to decline
D	>28-35	Influence area turbulence becomes intrusive
E	>35	Turbulence felt by virtually all drivers
F	Demand exceeds capacity	Ramp and freeway queues form

Table 6: Capacity of Ramp Roadways (HCM 2010 Exhibit 13-10)

Ramp FFS (mi/h)	Capacity of Ramp Roadway	
	Single-Lane Ramps	Two-Lane Ramps
>50	2,200	4,400
>40-50	2,100	4,200
>30-40	2,000	4,000
≥20-30	1,900	3,800
<20	1,800	3,600

Note: Capacity of a ramp roadway does not ensure an equal capacity at its freeway or other high-speed junction.

Traffic operations analysis was performed for current (2015) and future years (2035) for both AM and PM peak-hours. The 2015 analysis was performed for the existing interchange condition while the 2035 analysis was performed for the following three scenarios.

- ***2035 No-Action***: Assumed no major improvements to the I-15/CC-215 interchange other than realignment of Range Road intersections to accommodate the addition of Centennial Parkway. Centennial Parkway was assumed to have two through lanes in each direction at the intersections of Range Road and CC-215. All intersections are assumed to be at-grade.
- ***2035 Alternative 1***: It is a full system-to-system I-15/CC-215 interchange with Range Road on its current alignment including the Centennial Parkway connector to the east of CC-215. On the west side of CC-215, Centennial Parkway meets Range Road at a new intersection that mirrors the east side of the intersection. The existing one-way frontage roads and ramps are realigned to avoid interference with the new Range Road/Centennial Parkway intersections. The conceptual design of Alternative 1 is shown in Figure 3.
- ***2035 Alternative 2***: It is a full system-to-system interchange with Centennial Parkway having a straight east-west alignment. Range Road is realigned, creating intersections with Centennial Parkway, one on each side of CC-215. The existing one-way frontage roads are eliminated and replaced with a two-way extension of Tropical Parkway on a north-south alignment east of CC-215. Figure 4 shows the conceptual design of Alternative 2.

In addition, all the 2035 traffic analyses models (No-Action and Alternatives 1 & 2) assumed completion of the programmed improvements per the Regional Transportation Plan (RTP) 2013-2035, and other improvements programmed into RTC's regional travel-demand model.

- *I-15* will have *three* lanes in each direction, plus an *auxiliary lane* between the ramps from Craig Road to Speedway Boulevard (RTP Project #4353).
- *Centennial Parkway* will have *six* lanes west of Lamb Boulevard with three lanes in each direction (RTP Project # 5035).
- *Tropical Parkway* will have *six* lanes west of Lamb Boulevard with three lanes in each direction (per RTC Travel-Demand Model).
- *Lamb Boulevard* will have *four* lanes in each direction north of Centennial Parkway to the CC-215 interchange (per RTC Travel-Demand Model).
- *CC-215 and Tropical Parkway* connection will be constructed at the I-15 NB ramps intersection. Tropical Parkway will be a *four* lane roadway with two through lanes in each direction (per RTC Travel-Demand Model).

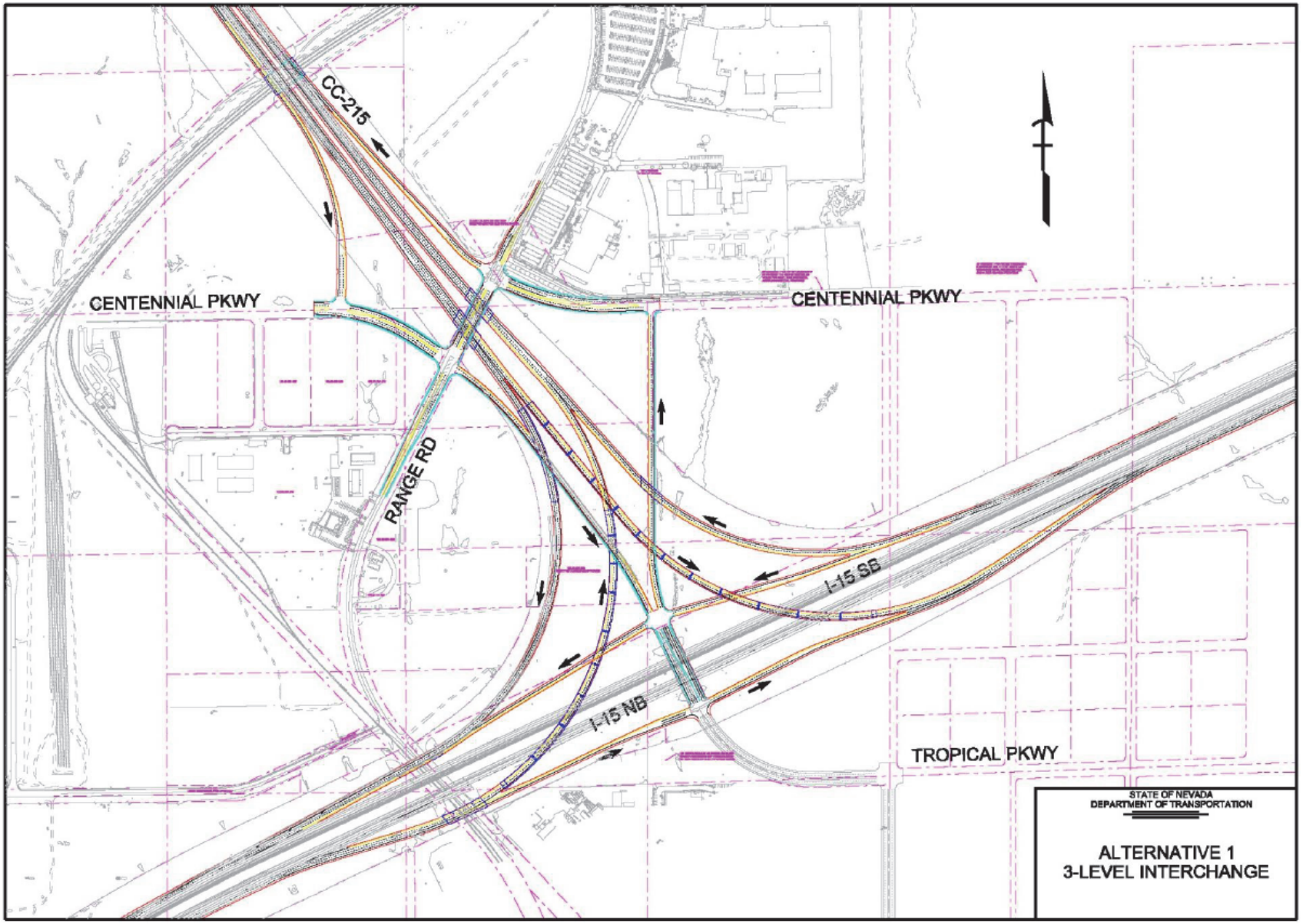


Figure 3: 2035 Alternative 1 Preliminary Drawing

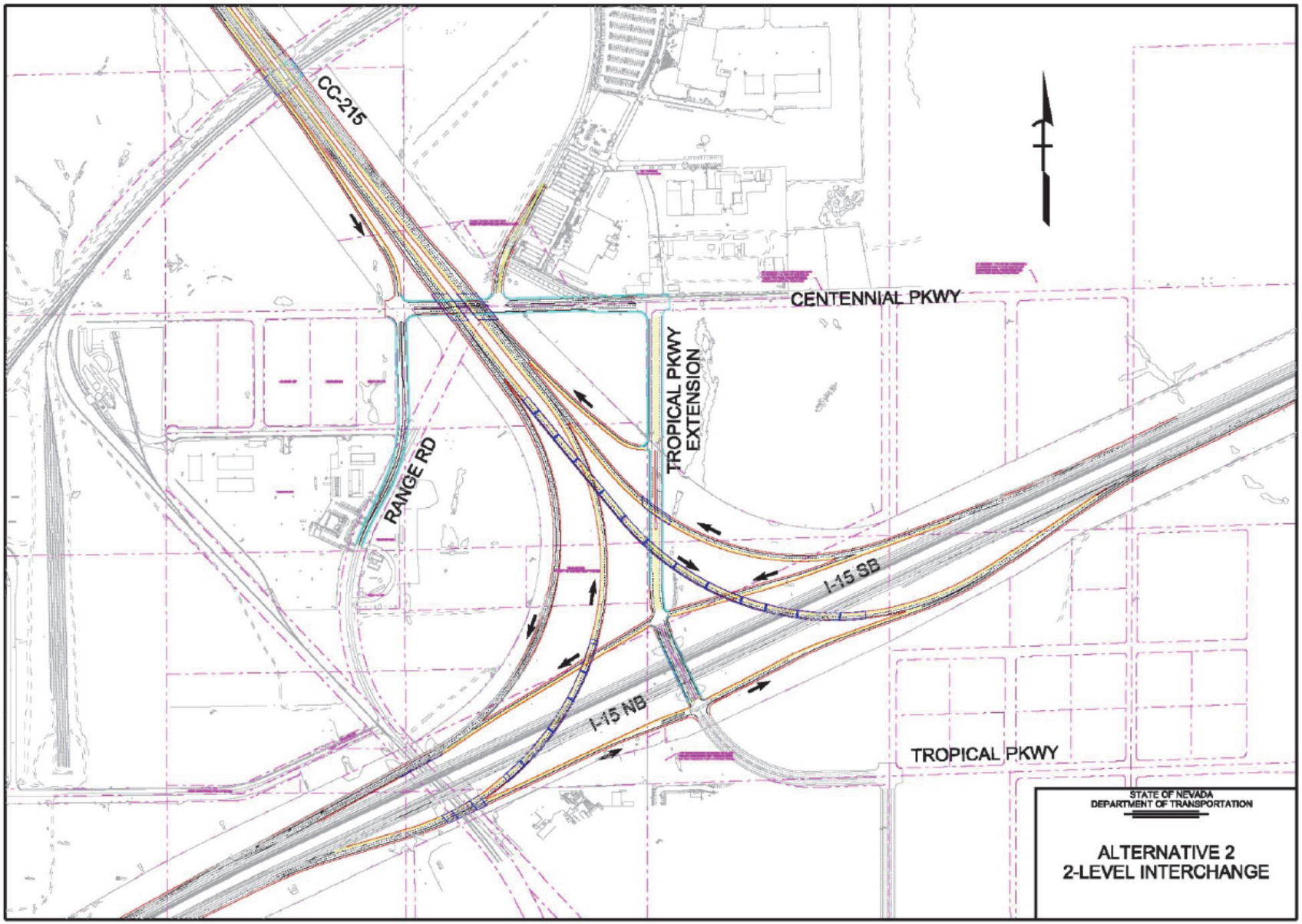


Figure 4: 2035 Alternative 2 Preliminary Drawing

The following is the list of various data required for the traffic analysis which were gathered by a combination of field visits/observations, existing topography/mapping, Clark County GISMO, online resources like Google maps/Bing maps and research of other existing documents.

- Intersection Geometry (Number of Right/Through/Left lanes, Signalized/Unsignalized)
- Peak-Hour Volumes (AM & PM)
- Traffic Signal Timing (provided by RTC FAST)
- Roadway Segment Length
- Roadway Classification
- Percent Trucks and RVs
- Speed Limit (Freeway/Local Roads/Ramps)

A *Synchro* model was developed for the 2015 existing condition including Lamb Boulevard from I-15 to CC-215 and all cross streets along the stretch. Also, Range Road from CC-215 to El Campo Grande Avenue and the interchanges at I-15/CC-215 and I-15/Speedway Boulevard were built into the same *Synchro* model. Screenshots of the 2015 *Synchro* model at various intersections are shown in Figure 5. This model was used as a base to build all the future networks (2035 no-action, Alternatives 1 and 2).

The existing traffic signal timing obtained from RTC FAST was used as a base for the 2015 existing condition. The cycle lengths vary from 60 seconds to 120 seconds. RTC FAST informed that Lamb Boulevard is not a coordinated corridor and the traffic signals run on free mode. Once the traffic signal time was incorporated into the *Synchro* model, optimization was performed for each intersection to evaluate the performance based on the peak-hour volumes. While performing the traffic signal optimization, care was taken to maintain the cycle lengths between 60 to 160 seconds which is a Valley-wide standard. A quality check was performed after optimizing the signal time to make sure the time splits work for all approaches. If needed, minor adjustments were made to the signal timing splits.

A desired LOS was set for all the scenarios except for the 2015 existing condition since all the suggested improvements were based on the performance of 2035 conditions. For intersections, the overall intersection LOS of D or better with no individual movement worse than LOS E was desired. Similarly, LOS of D or better was targeted for the basic freeway segments and ramps. LOS E and/or F and freeway speeds less than 50 mph were considered unacceptable.

First, the approach was to analyze the 2015 existing conditions to determine which intersections, approaches and movements were failing (operating at LOS F). No geometric improvements were made to any of the 2015 existing condition intersections/approaches/movements if they were operating at LOS F since the goal was to evaluate how the existing conditions operate.

A separate *Synchro* model was developed for the 2035 no-action scenario with the various RTP and other improvements described earlier in this section. Traffic signal times were optimized similar to the 2015 existing conditions by keeping the range of cycle lengths (60 to 160 seconds) and adjusting the splits as part of the quality check. Lamb Boulevard was maintained as an uncoordinated corridor for all 2035 traffic analyses. Based on the performance of each intersection, for locations operating worse than

the desired LOS, various geometric improvements were recommended to be included in the Alternatives design. The recommended improvements would improve the operation to a desired LOS.

The procedure mentioned above was used for the analysis of arterials, freeway and the interchanges. Arterials and interchange intersections were analyzed using *Synchro* to identify improvements that can be recommended while the *HCS 2010* was used for I-15 and ramps.

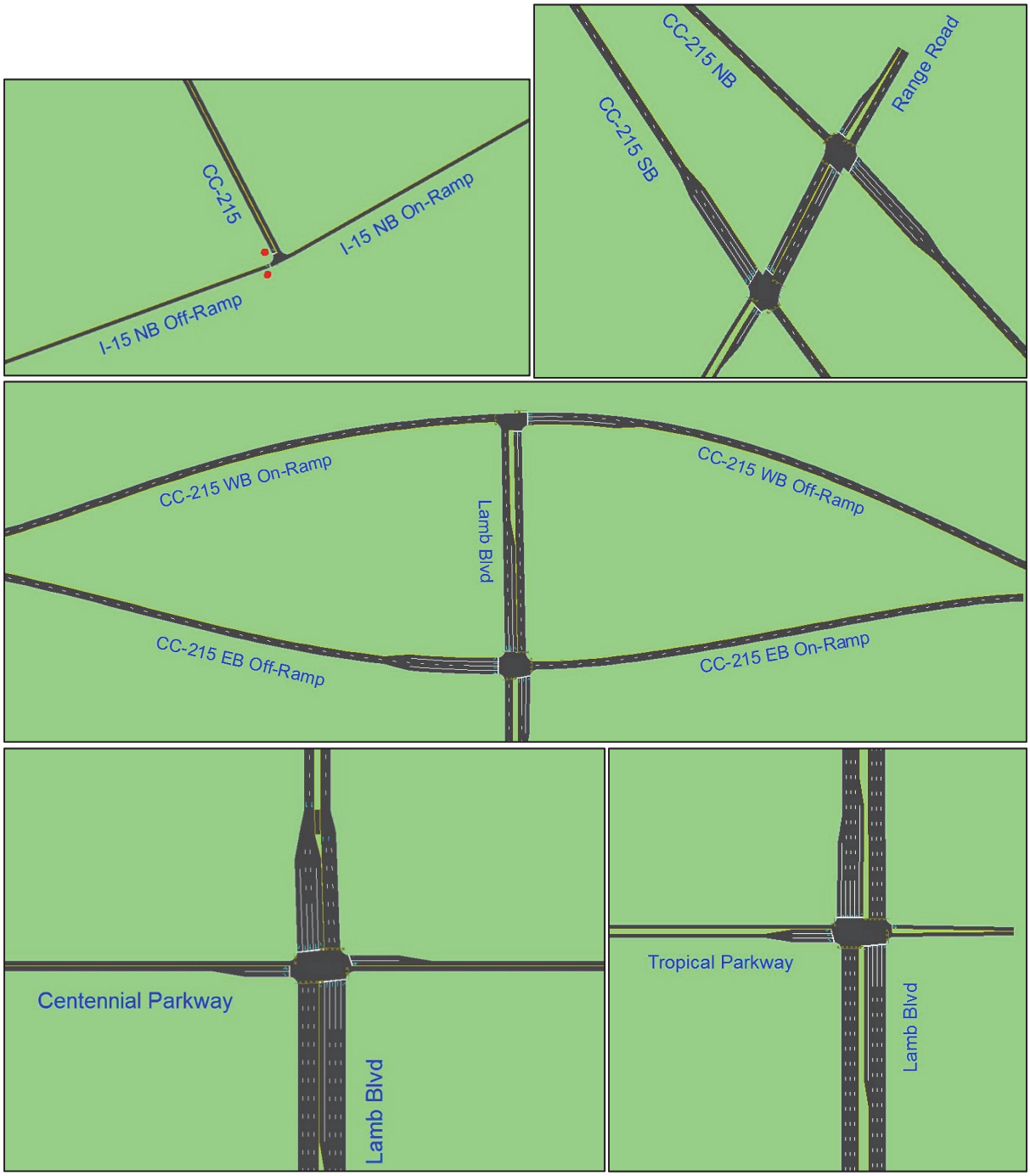


Figure 5: Screenshots of Synchro Network for 2015 Existing Condition

3. Traffic Modeling

As mentioned in the previous section, *Synchro* models were developed for various alternatives. For all 2035 models, the 2015 existing conditions *Synchro* file was used as a base and existing intersections were modified or new intersections were added based on the proposed interchange configurations. The limits of the roadway network in the *Synchro* model were extended at each intersection to observe the traffic flow. This was useful in understanding the vehicles pre-positioning for various turning movements at the intersections including the queues developed. The major changes in the 2035 networks based on the programmed RTP and RTC's travel-demand model, improvements on Lamb Boulevard at CC-215, Centennial Parkway and Tropical Parkway intersections can be seen by comparing Figure 6 to Figure 5. Figures 7 through 9 show snapshots of the 2035 *Synchro* models for no-action, Alternative 1 and Alternative 2. For clarity, only the I-15/CC-215 interchange is shown along with Centennial Parkway and Range Road.

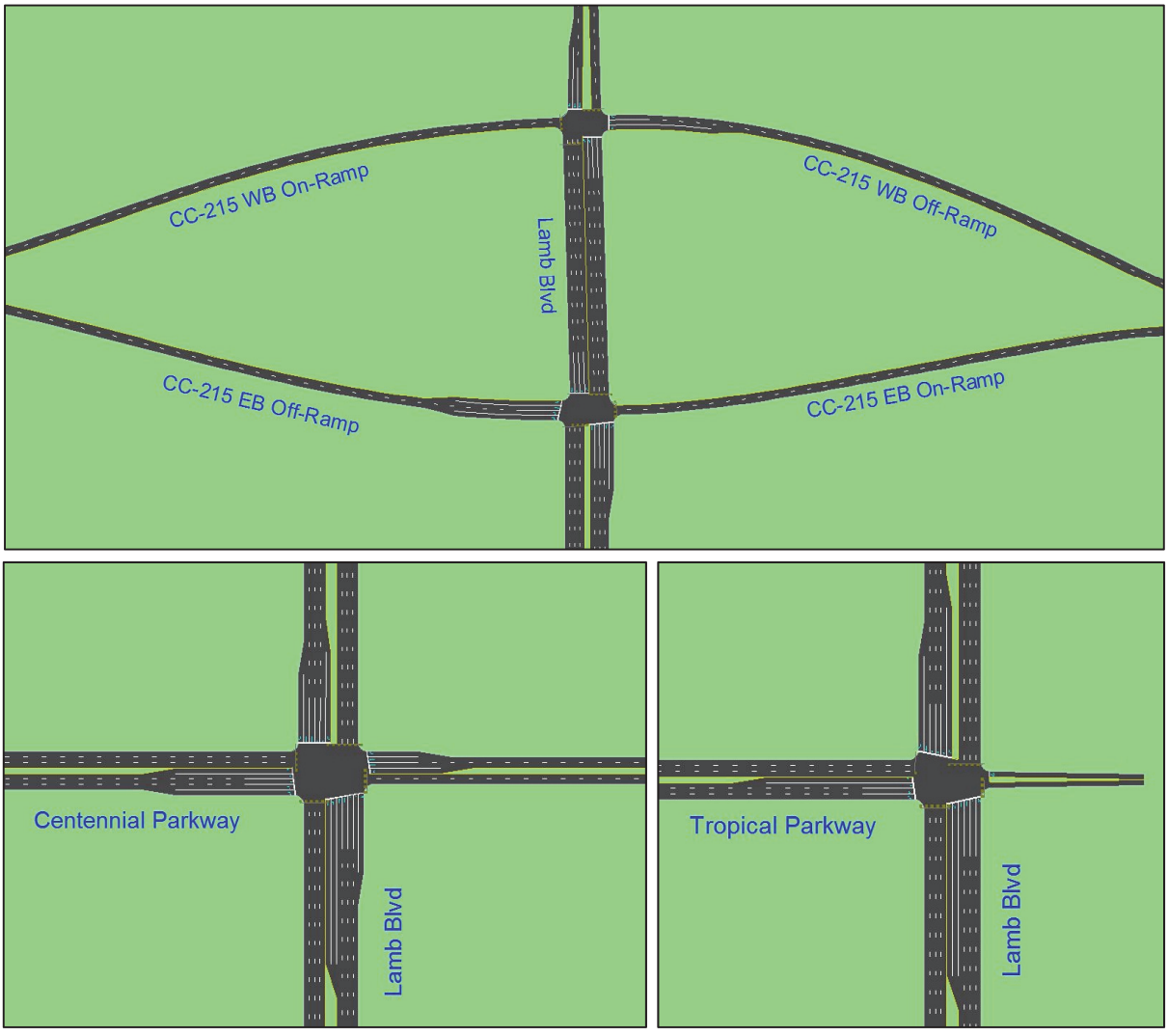


Figure 6: Screenshots of Synchro Network (2035 Lamb Boulevard Improvements)

Figure 7: Synchro Network for 2035 No-Action

Figure 8: Synchro Network for 2035 Alternative 1

Figure 9: Synchro Network for 2035 Alternative 2

4. Traffic Analysis Results

Results from the traffic analysis are discussed in the following sections. The *Synchro* results for intersections summarized in section 4.1. The *HCS 2010* results for freeway and ramps are summarized in section 4.2.

4.1 Synchro Results (Intersections, Arterial & Interchange)

4.1.1 2015 Existing Conditions

Analysis of the 2015 existing conditions network revealed that most of the intersections were performing at an acceptable LOS D or better.

The *CC-215/I-15 NB Ramps* intersection is operating at LOS B during AM with an average delay of 14.5 sec/veh and LOS C with an average delay of 21.9 sec/veh in the PM peak-hour. Range Road at CC-215 EB and CC-215 WB intersections are operating at LOS D in the PM peak-hour. Figure 10 shows the intersection LOS at I-15/CC-215 intersections.

Off-site Intersections: Seven intersections are operating at LOS A during both AM and PM peak-hours. Lamb Boulevard and WB CC-215 intersection is operating at LOS A for both peak-hours. The interchange of I-15 at Lamb Boulevard is operating at LOS C, and Speedway Boulevard is operating at LOS A for both peak-hours. The following two intersections were operating at LOS E or worse:

- Lamb Boulevard and Tropical Parkway – LOS F(E) for AM(PM)
- Range Road and El Campo Grande – LOS E for AM

At the intersection of Lamb Boulevard and Tropical Parkway, the volume for eastbound to southbound is 961(581) for AM(PM) peak-hours. Eastbound has one through lane approaching the intersection with a single left-turn (100' storage) and a single right-turn lane (100' storage). The average delay is approximately 206 sec/veh and 72 sec/veh during AM and PM peak-hours, respectively. All the movements at the intersection are operating at a desired LOS with the only exception being the eastbound right-turn which is operating at LOS F with an average delay of over 500 sec/veh. These are the factors affecting the overall operations at the intersection along with a high-volume on the southbound Lamb Boulevard through movement.

Range Road and El Campo Grande is a 4-way stop controlled intersection. The southbound through and left-turn movement total over 650 veh/hr during the AM peak-hour which makes the intersection operate at its capacity (LOS E). Figure 11 shows the LOS for various intersections for AM and PM peak-hours. Table 7 shows the delay and LOS for both AM and PM peak-hours. Appendix A includes *Synchro* output that shows the detailed results for each approach and movement.

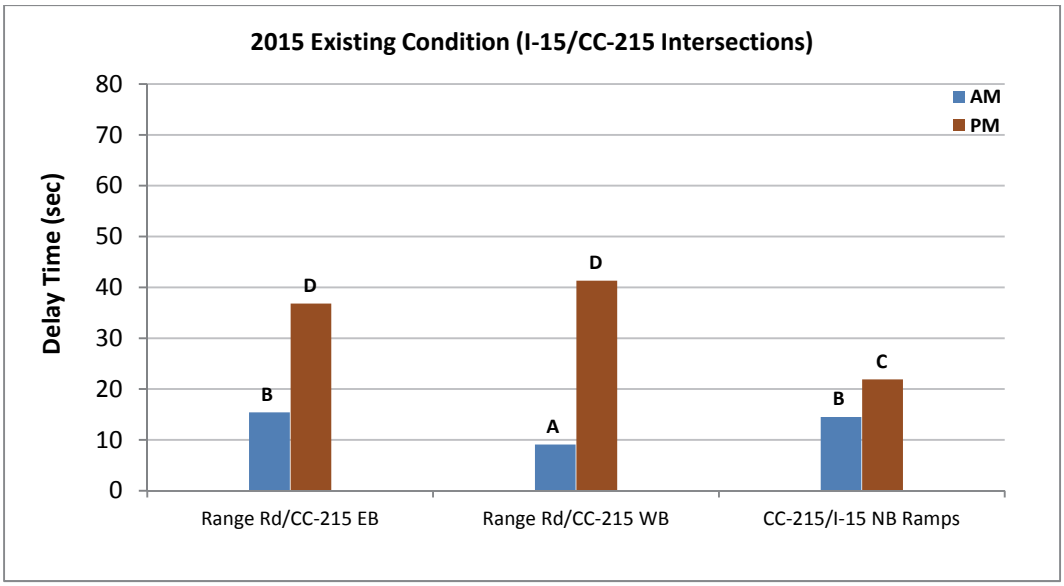


Figure 10: LOS for I-15/CC-215 Intersections (2015 Existing Conditions)

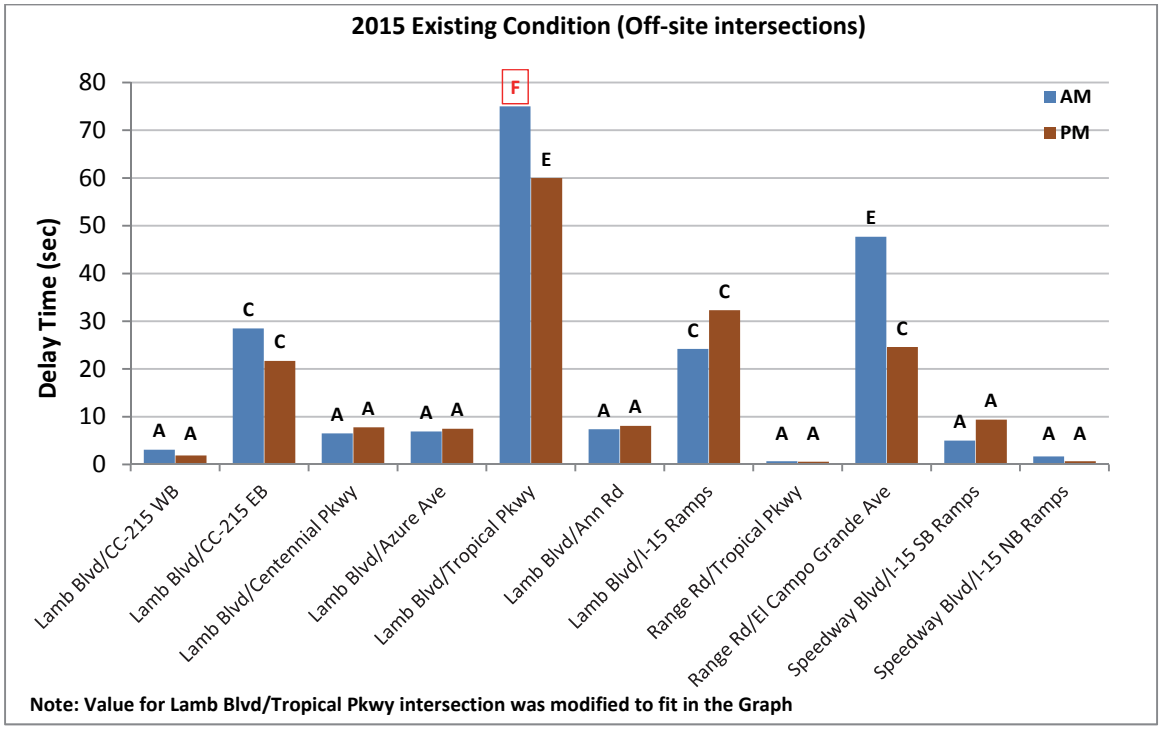


Figure 11: LOS for Off-Site Intersections (2015 Existing Conditions)

Table 7: Intersection Traffic Analysis Summary for 2015 Existing Conditions

INTERSECTION	DELAY (sec/veh)	LOS
I-15/CC-215 INTERSECTIONS		
Range Rd/CC-215 EB	15.4 (36.8)	B (D)
Range Rd/CC-215 WB	9.1 (41.3)	A (D)
CC-215/I-15 NB Ramps	14.5 (21.9)	B (C)
OFF-SITE INTERSECTIONS		
Lamb Blvd/CC-215 WB	3.1 (1.9)	A (A)
Lamb Blvd/CC-215 EB	28.5 (21.7)	C (C)
Lamb Blvd/Centennial Pkwy	6.5 (7.8)	A (A)
Lamb Blvd/Azure Ave	6.9 (7.5)	A (A)
Lamb Blvd/Tropical Pkwy	205.8 (72.1)	F (E)
Lamb Blvd/Ann Rd	7.4 (8.1)	A (A)
Lamb Blvd/I-15 Ramps	24.2 (32.3)	C (C)
Range Rd/Tropical Pkwy	0.7 (0.6)	A (A)
Range Rd/El Campo Grande Ave	47.4 (24.6)	E (C)
Speedway Blvd/I-15 SB Ramps	5.0 (9.4)	A (A)
Speedway Blvd/ I-15 NB Ramps	1.7 (0.7)	A (A)

4.1.2 2035 Results

Summary of the traffic analysis for 2035 No-Action, Alternative 1 and Alternative 2 are shown in Figure 12 through Figure 17. In the 2035 no-action analysis, *CC-215/I-15 NB ramps* intersection is operating at LOS D during AM and PM peak-hours. Centennial Parkway at CC-215 EB and CC-215 WB intersections is operating at LOS D or better for both peak-hours. S Range Road at Centennial Parkway intersection is operating at LOS C during AM and PM peak-hours, while the N Range Road at Centennial Parkway is operating at LOS D during both peak-hours. Even though the intersection of *CC-215/I-15 NB ramps* is operating at LOS D, the intersection queue length is an issue which is described in detail in the later part of this section.

Off-site Intersections: All the intersections along Lamb Boulevard are operating at desired LOS D or better except at the I-15 interchange which is operating at LOS F during both peak-hours. Range Road and Tropical Parkway intersection is operating at LOS A. Range Road at El Campo Grande is operating at its capacity (LOS E) during the PM peak-hour and LOS C during the AM peak-hour. No other improvements apart from the ones mentioned in the previous section were made to the 2035 no-action to affect the performance. The intersection of Lamb Boulevard/Tropical Parkway is operating at LOS D with the included improvements from the RTP. The interchange of I-15/Lamb Boulevard is operating at LOS F during both peak-hours because of the substantial increase in the volumes in 2035 and no planned improvements per the RTP. Detailed results for each intersection are included in Appendix B.

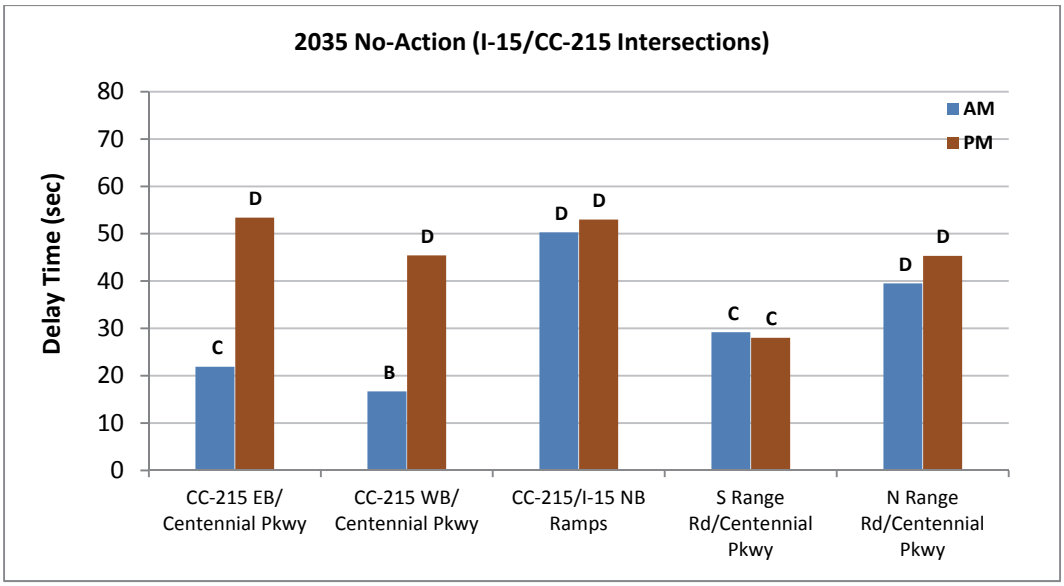


Figure 12: LOS for I-15/CC-215 Intersections (2035 No-Action)

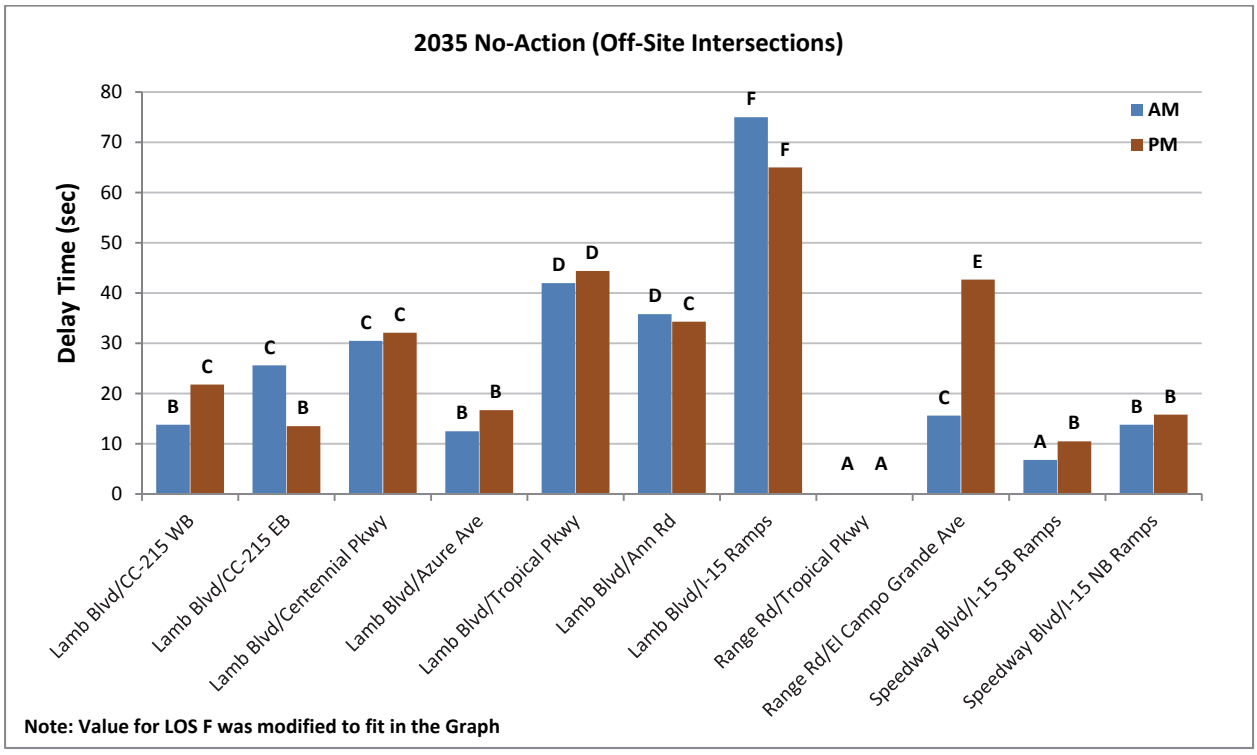


Figure 13: LOS for Off-Site Intersections (2035 No-Action)

The LOS at various intersections for Alternatives 1 and 2 shows all the intersections are operating at the desired LOS D or better except the interchange at I-15/Lamb Boulevard. Even though the I-15/Lamb Boulevard interchange is operating at LOS F in all three scenarios, the intersection delays are significantly reduced in Alternatives 1 & 2 compared to no-action during both peak-hours. A savings of approximately 31.5 sec/veh is achieved in Alternative 1 while Alternative 2 has over 55 sec/veh savings in the AM peak-hour. Table 8 compares the delay and LOS for all three scenarios. As shown in Figure 12 and 14, the Tropical Parkway/I-15 NB ramps (*CC-215/I-15 NB ramps*) intersection has improved performance resulting in a LOS B during both peak-hours. The new intersection of I-15 southbound ramps and Tropical Parkway is operating at LOS A with delays less than 7 sec/veh during both peak-hours in Alternatives 1 and 2. Lamb Boulevard intersections at westbound CC-215, eastbound CC-215, Centennial Parkway, Azure Road and Ann Road operate at LOS C or better during both AM and PM peak-hours. The intersection of Lamb Boulevard and Tropical Parkway is operating at LOS D in both Alternatives similar to the no-action scenario with a slight savings in delay during the PM peak-hour.

In Alternative 1, the two new intersections of Range Road at E Centennial Parkway/W Centennial Parkway are operating at the desired LOS C or better, and the movements are operating at LOS D or better. I-15/Speedway interchange is operating similar to no-action with no major savings in the delays. Appendix C includes the detailed *Synchro* output for Alternative 1 that shows the delay and LOS for all the movements.

In Alternative 2, the new intersection of I-15 ramps at Tropical Parkway is operating at LOS B during both peak-hours similar to Alternative 1. The new intersection of Tropical Parkway/Centennial Parkway is operating at LOS B during both peak-hours. The two intersections of S Range Road/N Range Road at Centennial Parkway are operating at a better LOS B compared to no-action with major savings in delays as shown in Table 8. Range Road at Tropical Parkway is operating at LOS A. Lamb Boulevard/CC-215 intersections are operating at the same LOS as Alternative 1. No improvement was observed in the LOS at the interchange of I-15/Lamb Boulevard but with savings in the delays as mentioned earlier. Appendix D includes detailed *Synchro* results for Alternative 2.

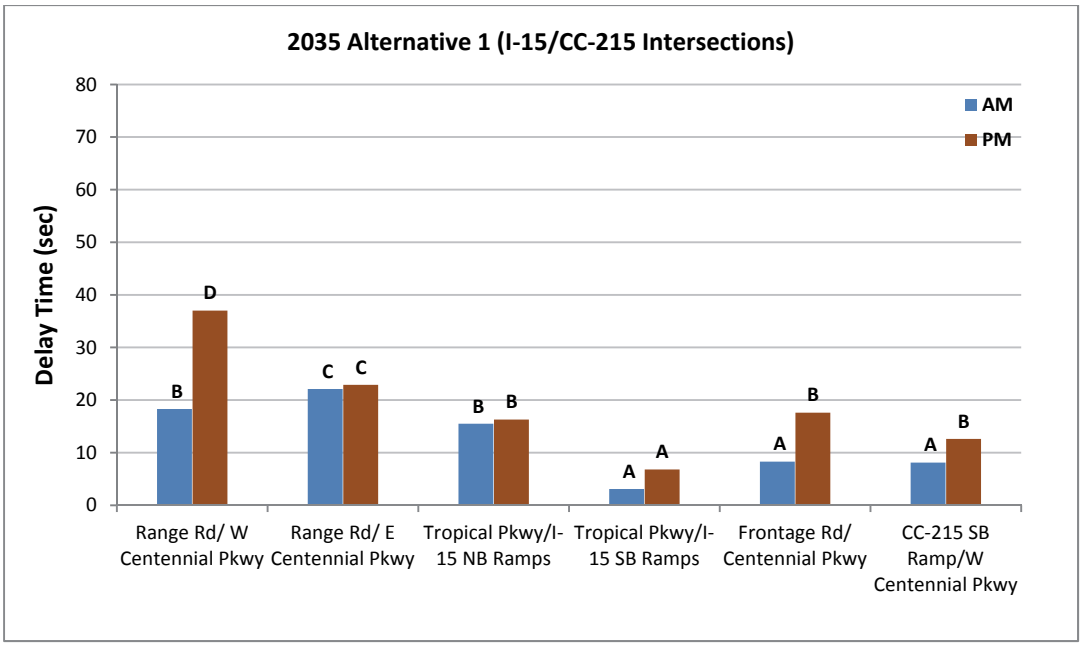
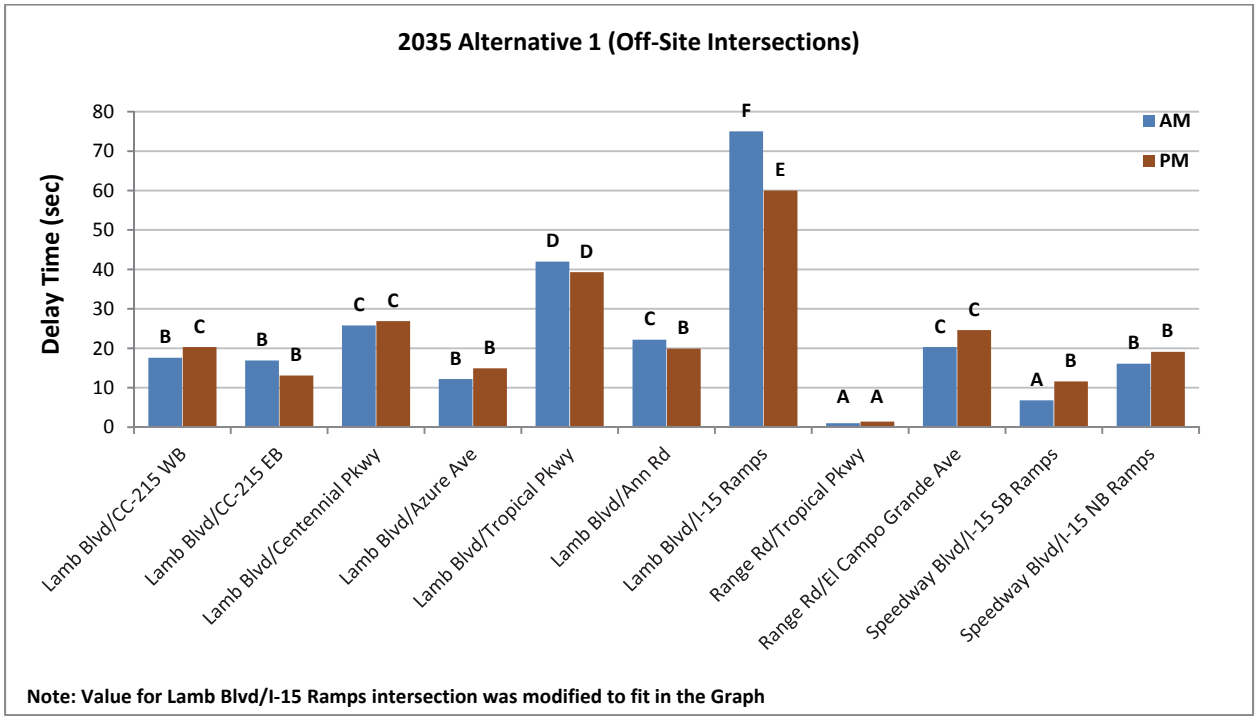


Figure 14: LOS for I-15/CC-215 Intersections (2035 Alternative 1)



Note: Value for Lamb Blvd/I-15 Ramps intersection was modified to fit in the Graph

Figure 15: LOS for Off-Site Intersections (2035 Alternative 1)

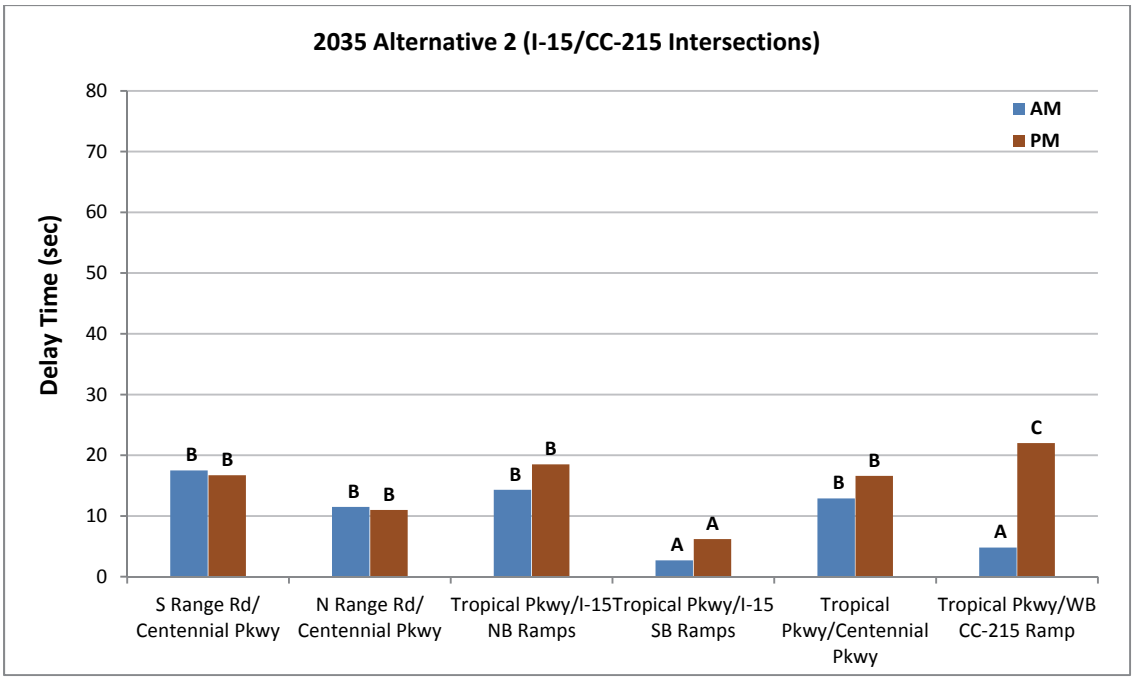


Figure 16: LOS for I-15/CC-215 Intersections (2035 Alternative 2)

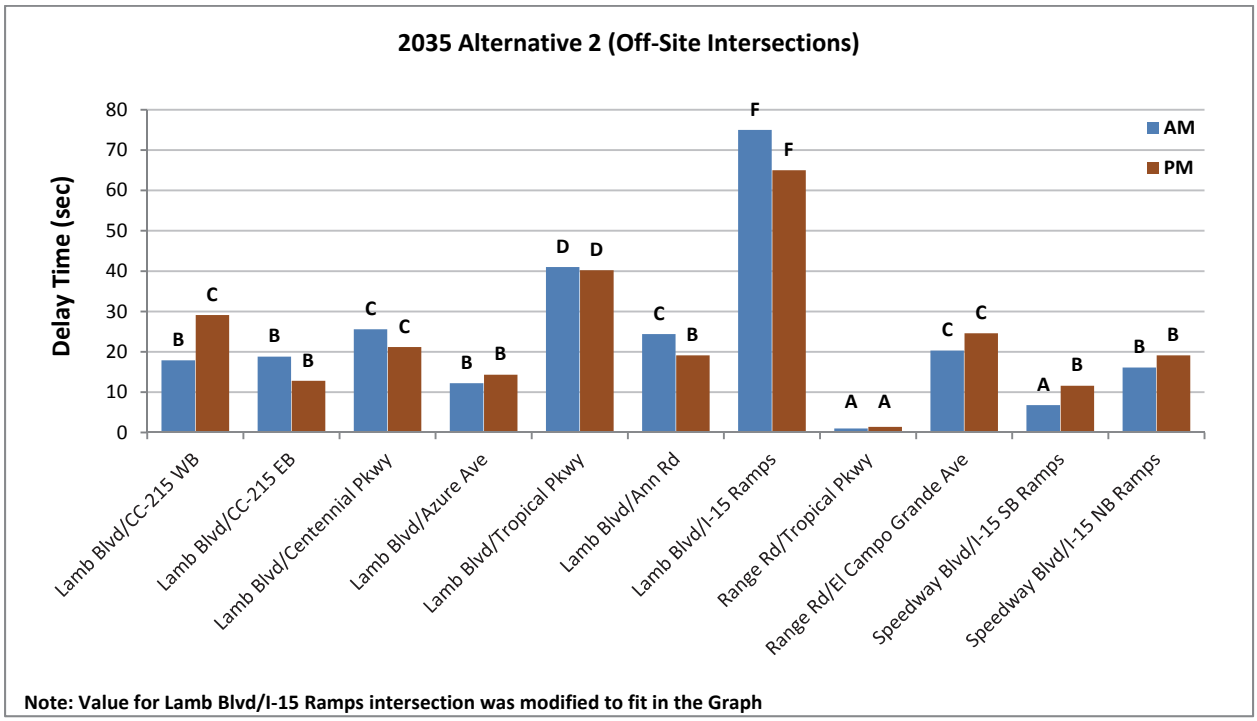


Figure 17: LOS for Off-site Intersections (2035 Alternative 2)

Table 8: Comparison of Intersection Traffic Analysis Summary for various 2035 Scenarios

INTERSECTION	2035 NO-ACTION		2035 ALTERNATIVE 1		2035 ALTERNATIVE 2	
	DELAY (sec/veh)	LOS	DELAY (sec/veh)	LOS	DELAY (sec/veh)	LOS
I-15/CC-215 INTERSECTIONS						
CC-215 EB/Centennial Pkwy	21.9 (53.4)	C (D)	-	-	-	-
CC-215 WB/Centennial Pkwy	16.7 (45.4)	B (D)	-	-	-	-
CC-215/I-15 NB Ramps	50.3 (53.0)	D (D)	-	-	-	-
S Range Rd/Centennial Pkwy	29.2 (28.0)	C (C)	-	-	17.5 (16.7)	B (B)
N Range Rd/Centennial Pkwy	39.5 (45.3)	D (D)	-	-	11.5 (11.0)	B (B)
Range Rd/ W Centennial Pkwy	-	-	18.3 (37.0)	B (D)	-	-
Range Rd/ E Centennial Pkwy	-	-	22.1 (22.9)	C (C)	-	-
Tropical Pkwy/ I-15 SB Ramps	-	-	3.1 (6.8)	A (A)	2.7 (6.2)	A (A)
Frontage Rd/ Centennial Pkwy	-	-	8.3 (17.6)	A (B)	-	-
CC-215 Ramp/W Centennial Pkwy	-	-	8.1 (12.6)	A (B)	-	-
Tropical Pkwy/Centennial Pkwy	-	-	-	-	12.9 (16.6)	B (B)
Tropical Pkwy/I-15 NB Ramps	-	-	15.5 (16.3)	B (B)	14.3 (18.5)	B (B)
Tropical Pkwy/CC-215 WB Ramp	-	-	-	-	4.8 (22.0)	A (C)
OFF-SITE INTERSECTIONS						
Lamb Blvd/CC-215 WB	13.8 (21.8)	B (C)	17.6 (20.3)	B (C)	17.9 (29.1)	B (C)
Lamb Blvd/CC-215 EB	25.6 (13.5)	C (B)	16.9 (13.1)	B (B)	18.8 (12.8)	B (B)
Lamb Blvd/Centennial Pkwy	30.5 (32.1)	C (C)	25.8 (26.9)	C (C)	25.6 (21.2)	C (C)
Lamb Blvd/Azure Ave	12.5 (16.7)	B (B)	12.2 (14.9)	B (B)	12.2 (14.3)	B (B)
Lamb Blvd/Tropical Pkwy	42.0 (44.4)	D (D)	42.0 (39.3)	D (D)	41.0 (40.2)	D (D)
Lamb Blvd/Ann Rd	35.8 (34.3)	D (C)	22.2 (19.9)	C (B)	24.2 (19.1)	C (B)
Lamb Blvd/I-15 Ramps*	160.6 (115.1)	F (F)	129.1 (79.1)	F (E)	105.0 (82.6)	F (F)
Range Rd/Tropical Pkwy	0.0 (0.0)	A (A)	1.0 (1.4)	A (A)	1.0 (1.4)	A (A)
Range Rd/El Campo Grande Ave	15.6 (42.7)	C (E)	20.3 (24.6)	C (C)	20.3 (24.6)	C (C)
Speedway Blvd/I-15 SB Ramps	6.8 (10.5)	A (B)	6.8 (11.6)	A (B)	6.8 (11.6)	A (B)
Speedway Blvd/ I-15 NB Ramps	13.8 (15.8)	B (B)	16.1 (19.1)	B (B)	16.1 (19.1)	B (B)

Note: Dashes denote the intersections not existing in that alternative. * HCM 2000 was used to calculate delay

Intersection Turn Queue Lengths are summarized in Table 9 for turn bays at various locations when the queue overspills beyond the available storage. The worst case queue lengths of AM/PM (Synchro 50th percentile queues) are presented in the table.

For *No-Action*, the intersections of Centennial Parkway at CC-215 EB and CC-215 WB have queues extending beyond the capacity. At the intersection of Lamb Boulevard/CC-215, the eastbound queue extends over 300' while the available storage is 250'. It is noted that eastbound has two right-turn lanes with one right-turn bay of 250' and the other one is the forced right-turn lane from the off-ramp gore area. The interchange of Lamb Boulevard/I-15 has queues over 1000' for the I-15 northbound off-ramp left-turn movement. *Alternatives 1* and *2* show no major queues apart from I-15/Lamb Boulevard which is similar to no-action. Alternative 2 has only one overflowing intersection (Tropical Parkway/CC-215 WB) with a right-turn queue of approximately 400'.

Table 9: Intersection Queue Lengths (2035 Peak-Hour)

CROSS STREETS	EASTBOUND						WESTBOUND						NORTHBOUND						SOUTHBOUND					
	LEFT-TURN BAYS			RIGHT-TURN BAYS			LEFT-TURN BAYS			RIGHT-TURN BAYS			LEFT-TURN BAYS			RIGHT-TURN BAYS			LEFT-TURN BAYS			RIGHT-TURN BAYS		
	No. of Lanes	Queue Storage (ft)	Queue Length (ft)	No. of Lanes	Queue Storage (ft)	Queue Length (ft)	No. of Lanes	Queue Storage (ft)	Queue Length (ft)	No. of Lanes	Queue Storage (ft)	Queue Length (ft)	No. of Lanes	Queue Storage (ft)	Queue Length (ft)	No. of Lanes	Queue Storage (ft)	Queue Length (ft)	No. of Lanes	Queue Storage (ft)	Queue Length (ft)	No. of Lanes	Queue Storage (ft)	Queue Length (ft)
NO-ACTION																								
I-15/CC-215 INTERSECTIONS																								
CC-215 EB/Centennial Pkwy							2	150	406										1	250	476			
CC-215 WB/Centennial Pkwy	2	150	258										1	250	372									
CC-215/I-15 NB Ramp	1	350	435																					
OFF-SITE INTERSECTIONS																								
Lamb Blvd/CC-215 EB				2	*250*	311																		
Lamb Blvd/Ann Rd							1	200	301															
Lamb Blvd/I-15 Ramp*													2	*450*	1027							1	450	2754
Speedway Blvd/ I-15 SB							2	*250*	273															
ALTERNATIVE-1																								
OFF-SITE INTERSECTIONS																								
Lamb Blvd/I-15 Ramp*													2	*450*	935							1	450	1977
Speedway Blvd/ I-15 SB Ramp							2	*250*	297															
ALTERNATIVE-2																								
I-15/CC-215 INTERSECTION																								
Tropical Pkwy/ CC-215 WB Ramp																						1	150	396
OFF-SITE INTERSECTIONS																								
Lamb Blvd/I-15 Ramp*													2	*450*	939							1	450	1994
Speedway Blvd/ I-15 SB Ramp							2	*250*	297															

Note: *Italicized* denotes the entire segment is left/right-turn lane (no through lane)

* denotes left-turn bays for I-15 NB off-ramp to northbound Lamb Boulevard

4.1 HCS 2010 Results (Freeway & Ramps)

The *HCS* analyses of freeway (I-15) and various ramps were performed for the 2015 existing conditions, 2035 no-action and 2035 Alternatives 1 and 2. Since both Alternatives 1 and 2 have on- and off-ramps at the same locations with the same volumes, no separate analysis was required. I-15 was analyzed in both northbound and southbound directions from north of Craig Road interchange past Speedway Boulevard interchange.

I-15 was analyzed as basic segments (between ramps), merge (on-ramp) and diverge (off-ramp). There were no weaving segments in the study area since the interchanges are spaced far apart. A heavy vehicle percent of 17% (AM) and 15% (PM) was used for mainline analysis. The following percent of heavy vehicles were used for the various ramps for both AM & PM analysis. These percentages are consistent with I-15 North Corridor Phase-2 project (RTP Project #4353).

- I-15/Lamb Boulevard (NB): 10%
- I-15/Lamb Boulevard (SB): 5%
- I-15/CC-215 (NB & SB): 5%
- I-15/Speedway Boulevard (NB & SB): 15%

Figure 18 shows the LOS for various basic freeway segments and ramps along I-15 for 2015 existing conditions, 2035 no-action and 2035 Alternatives 1 and 2. The 2015 existing condition has two lanes on I-15 in each direction while the 2035 configuration includes the programmed improvements from the RTP mentioned earlier. All the basic freeway segments and ramps are operating at LOS C or better in the 2015 existing condition. At the interchange of I-15/CC-215, all the ramps are operating at LOS B or better. Similar to *Synchro* analysis no improvements were assumed for *HCS* analysis in order to evaluate the current performance. Appendices E and F show the detailed *HCS* results for the 2015 existing conditions for basic freeway segments and ramps.

In the 2035 No-Action scenario, all the basic freeway segments are operating at LOS B or better. The northbound ramps at the interchange of I-15/CC-215 are operating at LOS A during both peak-hours. The southbound ramps are operating at LOS A during AM and LOS B during PM peak-hours. Also, none of the basic freeway segments are operating at speed less than 50 mph. The *HCS* output showing the detailed results are included in Appendix G and Appendix H.

In Alternatives 1 and 2, the northbound basic freeway segments are operating at LOS B or better during AM and LOS C or better during PM peak-hours. The decline in LOS during the PM peak-hour is because of the increase in the PM volumes for the alternatives. All the basic freeway segments and ramps north of CC-215 operate at a similar LOS to that of the no-action scenario. Similar to no-action, all the basic freeway segments are operating at speeds more than 50 mph. At the I-15/CC-215 interchange, the northbound and southbound ramps are operating at LOS B or better during both peak-hours.

Appendix I show the detailed *HCS* results for all basic freeway segments and Appendix J includes the *HCS* output for ramps.

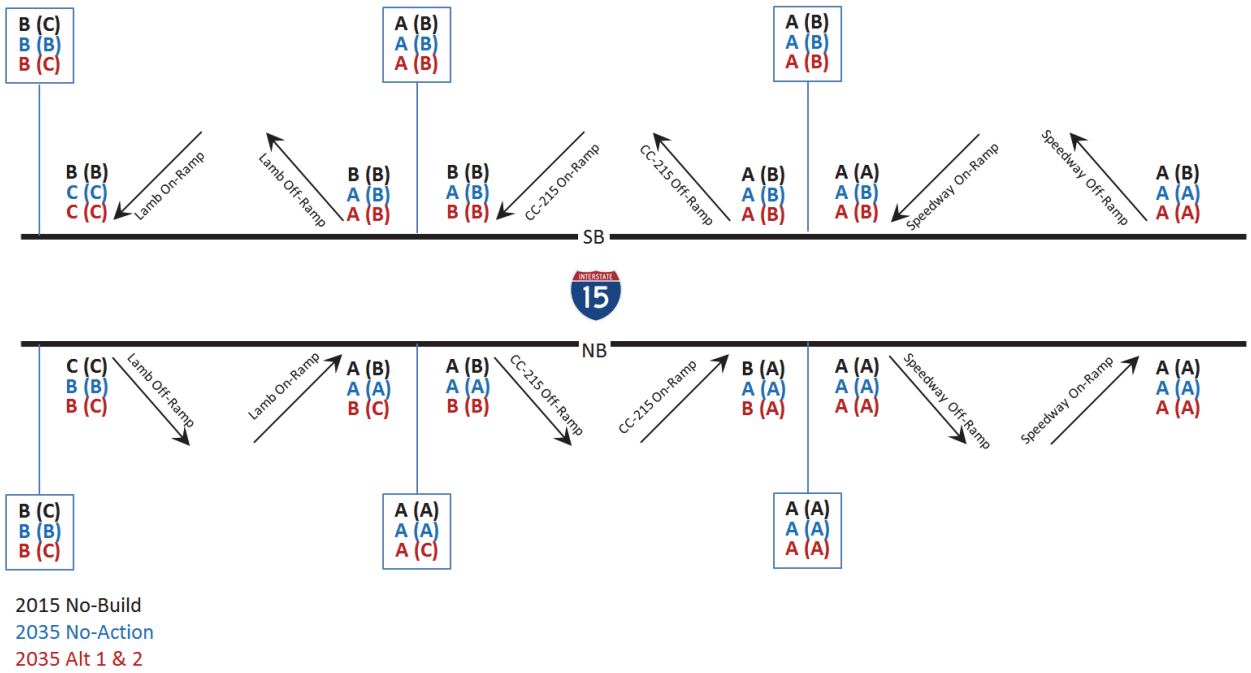


Figure 18: Comparison of LOS for Various Options

At the interchange of I-15/CC-215, *Ramp roadway* capacities for all the direct connectors were calculated using the worst case scenario. The entire ramp volume was assumed to be on the flyover ramp to determine the capacity of the roadway. Table 10 shows the capacity check for all the movements at the interchange of I-15/CC-215. The Alternatives 1 and 2 preliminary designs showing two-lane direct connectors for all the movements meet or exceed the demand.

Table 10: Evaluation of Ramp Lane Capacity

DIRECTION	2035 VOLUME	HCM 2010 Ramp Capacity (FFS >40-50 mph)		MINIMUM LANES REQUIRED	LANES IN ALTERNATIVES
		Single-Lane	Two-Lane		
ALTERNATIVES					
I-15 NB to CC-215 WB	3,832	2,100	4,200	2	2
I-15 SB to CC-215 WB	1,040			1	2
CC-215 EB to I-15 NB	888			1	2
CC-215 EB to I-15 SB	1,866			1	2

Note: Volumes are assumed to be the worst case scenario

5. Summary & Conclusions

Synchro analysis showed that three on-site intersections at the *I-15/CC-215* interchange are currently operating at LOS D or better. The rest of the I-15 Interchanges in the study limits are performing at a desired LOS. All the *off-site* intersections are operating at the desired LOS except Lamb Boulevard at Tropical Parkway (Table 7). The eastbound right-turn volume is significantly impacting the overall performance of the intersection with an average delay of over 200 sec/veh. The existing single-lane right-turn storage (100') is not sufficient to meet the demand of 961 veh/hr. Also, the existing single through lane in the eastbound direction approaching the intersection is an added drawback for the intersection operation.

Traffic analysis for all 2035 options revealed that Alternatives 1 and 2 perform better than no-action as shown in Table 8. The Tropical Parkway/I-15 ramps (*CC-215/I-15 NB Ramps*) intersection operates at LOS B or better in both alternatives compared to LOS D in no-action. The new intersection at Tropical Parkway/I-15 SB Ramps has LOS A for both alternatives during AM and PM peak-hours.

For *off-site* intersections, including the RTP improvements to all the 2035 models improved the performance of the Lamb Boulevard and Tropical Parkway. The I-15/Lamb Boulevard interchange fails (LOS F) in no-action and Alternative 2. The interchange is operating at its capacity (LOS E) in Alternative 1 for the PM peak-hour and fails (LOS F) in the AM peak-hour. Intersection delay savings were observed in both alternatives even though performing at LOS F. Addition of new intersections in both alternatives did not degrade the overall performance of the network. All the new intersections were operating better than the acceptable LOS.

There were a total of seven intersections with queue lengths extending beyond the capacity for no-action (Table 9). There was no queue backup at *I-15/CC-215* northbound off-ramp. In the no-action scenario, the Centennial Parkway intersections at CC-215 EB and CC-215 WB have limited capacity at the turn-lanes resulting in queues that extend the available storage lengths. I-15/Lamb Boulevard has significant queue backup in no-action and somewhat reduced in both alternatives but far exceeds storage per Table 9.

HCS analysis of the basic freeway segments and ramps indicated that the 2015 existing conditions and all 2035 alternatives operate better than the desired LOS D (Figure 18) including the I-15 northbound off-ramp to CC-215 which is operating at LOS B. It was noted that 2035 no-action has issues regarding the queue lengths even though performing at the desired LOS. It was observed that none of the basic freeway segments were operating worse than LOS C. The increase in volume for 2035 alternatives did not adversely affect the operation due to the programmed RTP improvements on I-15. All the ramp roadways have capacities more than required to meet the demand.

6. Recommendations for Intersection & Freeway/Ramp Improvements

I-15/CC-215 Interchange: Based on the 2015 existing conditions analysis, no immediate improvements are recommended at the intersections of I-15/CC-215 interchange. Based on HCS analysis, no improvements are recommended on I-15 or ramps as they are operating at desired LOS.

Off-Site Intersections: Although improvements to off-site intersections are not within the scope of the I-15 North Phase 4 project, certain needs were identified in this analysis.

The intersection of Tropical Parkway and CC-215 WB in Alternative 2 has right-turn queue extending beyond the storage shown in the preliminary design. The capacity of the right-turn bay needs to be increased by extending the storage length if this design is advanced.

At the *off-site* intersections, the only immediate recommended improvement would be to widen Tropical Parkway to six lanes as shown in the RTC travel-demand model. This will improve the intersection of Lamb Boulevard and Tropical Parkway. At the Interchange of I-15/Lamb Boulevard, the northbound off-ramp left-turn capacity needs to be increased by providing a dual-lane exit from I-15 as proposed by the I-15 North Phase 2 project. This will separate the right-turn traffic and provide a separate lane including enough storage for left-turn traffic.

Other locations where the turn-bay capacities need to be increased are shown in Table 9. Potential mitigation to reduce the turn queue overspill are extending the turn bays or adding a turn lane where possible. Adjacent land uses, driveways and available right-of-way should be considered when implementing the turn-bay improvements.

Scoping Report

I-15 North Phase 4
I-15/CC215 Interchange

December 29, 2015

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I-15 North Phase 4

Scoping Report

EXECUTIVE SUMMARY

The purpose of this scoping effort is to identify the most desirable interchange layout that will provide a fully developed system interchange connecting Interstate 15 (I-15) to the northern terminus of the Bruce Woodbury Beltway (CC215), with local service connections to Range Road, Tropical Parkway, and Centennial Parkway. The project is one in a series of improvements (Phase 1 – Phase 4) being undertaken by Nevada Department of Transportation (NDOT) to relieve congestion and improve the operational characteristics of the I-15 corridor in response to continued development and the resultant traffic growth in the Las Vegas Valley.

The study area includes the adjacent freeway segments and interchanges at I-15/Lamb Boulevard, I-15/ Speedway Boulevard, and CC215/Lamb Boulevard. In addition to the freeway components, the study area includes the segment of Lamb Boulevard between CC215 and I-15. A review of traffic patterns in the area suggests that Lamb Boulevard is currently used as a parallel alternate route to the I-15/CC215 interchange connection.

The scoping process was initiated with the development of a series of analyses to define the project needs, constraints, and potential alternative solutions. These included a Problem and Needs Report, Conceptual Plans for Alternatives, Landscape Aesthetics Site Analysis, Traffic Forecasting Memorandum, Utility Locations Plans and Conflict Matrix, Conceptual Drainage Report, Traffic Operations Analysis, Cost Risk Assessment, and Benefit-Cost Analysis.

Two alternative configurations for the proposed interchange were developed which are very similar in function but differ in the layout of the components. The two alternatives were compared on a number of factors as summarized in the following table and notes:

	Evaluation Factors											
	Cost	Traffic Operations	Drainage	Right-of-Way	Utilities	Environmental	Risk Assessment	Benefit-Cost Ratio	Preliminary Phasing	Future Adaptability	Stakeholder Preference	**Consensus**
Alternative 1					X							
Alternative 2	X	X		X		X		X			X	**X**
No Significant Difference			X				X		X	X		

- Cost. Right-of-way and construction costs are about 10% less for Alternative 2 ($127 million) than for Alternative 1 ($140 million).
- Traffic Operations. Both alternatives provide satisfactory levels of service within the study area, but the total peak hour delay at intersections is less for Alternative 2 (667 hrs/day) than for Alternative 1 (722 hrs/day).
- Drainage. There is no significant difference between the alternatives with respect to drainage requirements.
- Right-of-Way. Both alternatives require right-of-way acquisitions from BLM, state, and private owners. The area of acquisitions is less for Alternative 2 (1.6 acres) than for Alternative 1 (3.7 acres). Also, there is a possibility that the small BLM acquisition could be eliminated for Alternative 2.
- Utilities. The number of utility relocations is less for Alternative 1 (8 relocations) than for Alternative 2 (14 relocations).
- Environmental. Both alternatives will require some form of environmental re-evaluation. Alternative 2 offers a slight advantage due to its lower right-of-way acquisition requirements outside of the footprint cleared by the 2007 Environmental Assessment/FONSI.
- Risk Assessment. There is no significant difference between the alternatives in regard to risks to cost or schedule.
- Benefit-Cost Ratio. Alternative 2 provides a better benefit-cost ratio (1.66) than Alternative 1 (1.37).
- Preliminary Phasing. Phasing plans are expected to be similar for both alternatives. There is no significant difference between the alternatives in regard to phasing.
- Future Adaptability. Both alternatives offer similar adaptability to accommodate future traffic growth and/or redistribution. Conceptual designs include accommodation of future HOV lanes. The widths of major ramps will accommodate two lanes even if the current traffic forecast requires only one.
- Stakeholder Preference. Of the six major stakeholders participating throughout the scoping effort, four expressed a preference for Alternative 2 and two indicated no preference. None of the major stakeholders expressed a preference for Alternative 1.

Based on the scoping analysis, Alternative 2 is the recommended interchange configuration.

1. INTRODUCTION

1.1. Scoping Objective

NDOT proposes to upgrade the existing interchange connecting I-15 to the northern terminus of the Bruce Woodbury Beltway (CC215) to provide a fully developed system interchange. In addition to the freeway-to-freeway connections, the proposed interchange configuration will include local service connections to Range Road, Tropical Parkway, and Centennial Parkway. The objective of this scoping effort is to identify the most desirable interchange layout serving these needs.

1.2. Project Location and Study Area

The project site is located in the northeast area of the Las Vegas Valley, about 9 miles northeast of the I-15/US 95 "Spaghetti Bowl" Interchange. The project is designated Phase 4, one of a series of planned improvements defined by NDOT's I-15 North Corridor project.

The study area, shown in Figure 1, encompasses the I-15/CC215 interchange and the adjacent freeway segments and interchanges at I-15/Lamb Boulevard, I-15/Speedway Boulevard, and CC215/Lamb Boulevard. In addition to the freeway components, the study area includes the Lamb Boulevard segment between CC215 and I-15. A review of traffic patterns in the area suggests that Lamb Boulevard is used by some motorists as a parallel alternate route to the I-15/CC215 interchange connection.

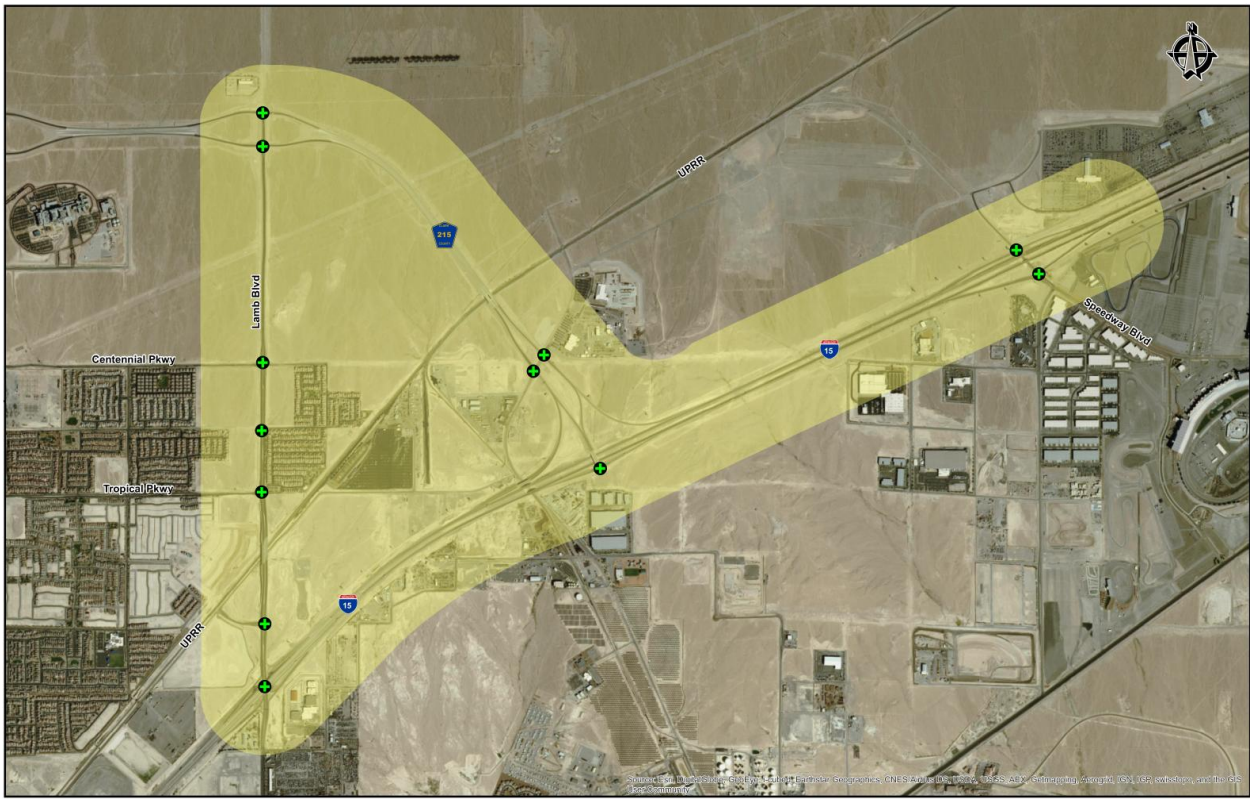

Figure 1. Study Area and Intersection Locations

1.3. Scoping Process

The scoping process was initiated with the development of a series of analyses to define the project needs, constraints, and potential alternative solutions. The results of these analyses are provided in the following I-15 North Phase 4 project documents:

- Problem and Needs Report, July 10, 2015
- Conceptual Plans, Alternative 1 and Alternative 2, dated August 7, 2015
- Landscape Aesthetics and Site Analysis, dated August 7, 2015
- Traffic Forecasting Memorandum, dated August 21, 2015
- Utility Location Plans, Utility Conflict Matrix, and Menu of Utility and Right-of-Way Alternatives, dated August 31, 2015
- Conceptual Drainage Report, dated December 2015
- Traffic Operations Analysis, dated December 28, 2015
- Cost Risk Assessment, dated October 2015
- Benefit Cost Analysis, dated December 29, 2015

This report includes summary information on these topics, and provides a comparison of proposed alternatives leading to a recommended interchange configuration.

2. BACKGROUND

2.1. Existing and Future Conditions

2.1.1. Characteristics

2.2.1.4 Roadway/Pavement

The existing interchange, illustrated in Figure 2, connects the I-15 freeway with the initial CC215 limited access expressway. The existing configuration is a modified diamond, with conventional diamond entrance and exit ramps serving northbound I-15, and free-flowing directional on and off-ramps serving southbound I-15. The CC215 intersection with Range Road is traffic signal controlled, typical of interim Beltway facilities.

Upgrading the I-15/CC215 interchange to a system interchange is one in a series of improvements identified in NDOT's I-15 North Corridor plan covering the 15-mile freeway segment from the US 95 "Spaghetti Bowl" interchange to the Apex interchange. The Phase 1 improvements, from US 95 to Craig Road, were completed in 2010. Phase 2, currently in design, will widen I-15 from four (4) to six (6) thru lanes and provide auxiliary lanes between interchanges from Craig Road to Speedway Boulevard. The Phase 2 project is scheduled to start construction in 2016. The Phase 2 widening of I-15 through the I-15/CC215 interchange is independent of the interchange configuration. Phase 3 will widen I-15 from Speedway Boulevard to Apex interchange. Upgrading of the I-15/CC215 interchange to a system interchange is designated as Phase 4.

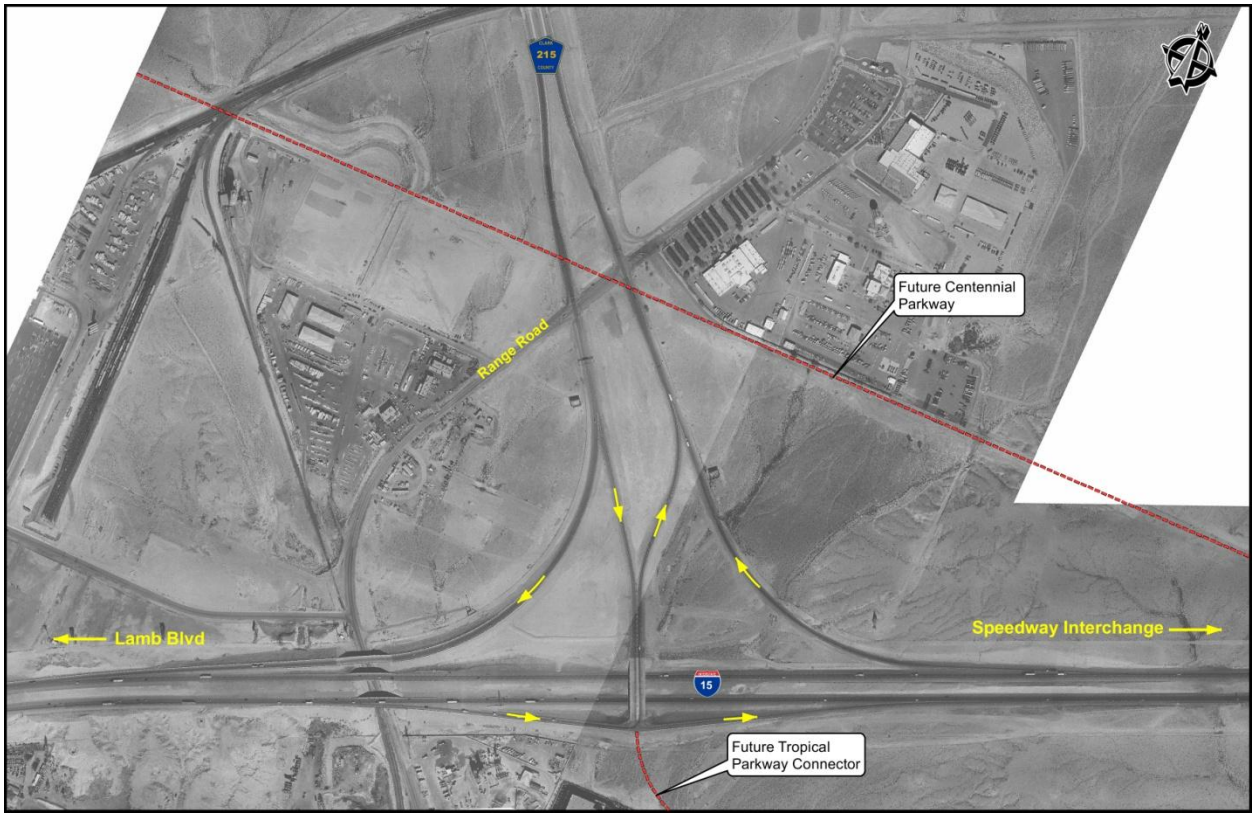

Figure 2. Existing I-15/CC215 Interchange

From its inception, the 53-mile-long CC215 Bruce Woodbury Beltway was planned to ultimately meet freeway design standards, but was initially constructed as a limited access expressway. Clark County has been continually upgrading the Beltway to freeway standards, such that now only 6 miles of the northern Beltway remain in the initial configuration. Currently, two miles between Hualapai Parkway and North 5th Street are under construction, and Clark County intends to complete the remaining four miles as funding becomes available.

Two alternatives have been developed for evaluation in this scoping report. Both of the proposed I-15/CC215 system interchanges will provide free flow, direct connection ramps for all freeway-to-freeway movements, and will be designed to accommodate 2035 traffic volumes. Although not included in the Phase 4 improvements, the interchange planning has included the accommodation of future HOV lanes connecting CC215 with the southwest leg of I-15. Refer to section 3.1.2 for further information on the interchange alternatives.

Existing and future local access is an important aspect of the interchange configuration. Currently, access to Range Road is provided by signalized intersections with the CC215 initial facilities. Range Road is a public facility to the south of the Centennial Parkway alignment, with restricted access to the military facilities to north of the Centennial Parkway alignment.

Proposed City of North Las Vegas (CNLV) street improvements in the project area include the Tropical Parkway Connector to the south and the extension of Centennial Parkway in the east-west direction.

The Tropical Parkway Connector is currently in design by CNLV, and the alignment of Centennial Parkway is defined by the City's Master Plan of Streets and Highways.

The I-15 pavement in the project area will be widened and resurfaced by NDOT's Phase 2 project. However, most of the existing CC215 pavement in the project area will be removed and replaced due to horizontal and vertical realignment of the Beltway and the interchange ramps.

The Beltway mainline was constructed with 11-inch PCC pavement. The existing PCCP pavement begins approximately 150 feet east of the UPRR overcrossing and continues to the west. The use of PCC pavement will be considered on the Beltway mainline and for the north-to-west and east-to-south directional "flyover" ramps within the interchange. Plantmix bituminous surfacing will be considered on Range Road, Centennial Parkway, service interchange ramps and the at-grade directional ramps.

2.1.1.1. Structures

There are six existing bridges in the project area which will be retained and/or modified to suit the system interchange configuration. The locations of the existing bridges are shown in Figure 3.

Figure 3. Existing Bridges

Information on each of the existing bridges is summarized in Table 1.

Structure No.	Description	Built	Type	Notes
G-961S	I-15 SB over Range Rd/UPRR	1963	3-Span CIP Box Girder	Widening by Phase 2 project
G-961N	I-15 NB over Range Rd/UPRR	1963	3-Span CIP Box Girder	Widening by Phase 2 project
G-961R	CC215 to I-15 Direct Connector	2001	3-Span CIP PT Box Girder	Potential Widening by Phase 4 project
I-2499	CC215 over I-15	2002	2-Span CIP PT Box Girder	Potential Widening by Phase 4
G-2568E	CC215 EB over UPRR	2001	Single Span PT Box Girder	Potential Widening by Phase 4
G-2568W	CC215 WB over UPRR	2001	Single Span PT Box Girder	Potential Widening by Phase 4

Table 1. Existing Bridge Summary

All six of the existing bridges have been evaluated and rated by NDOT within the last 10 years. No bridge scored less than a 7 in evaluating the condition of the deck, superstructure and substructure. Each bridge has substantial remaining service life and would potentially be widened with a cast-in-place, post-tensioned box girder structure type.

The I-15 North Phase 4 project will require construction of several new bridge structures to complete the system interchange. Construction of two large flyover ramp structures is anticipated to complete the north-to-west and east-to-north direct connections. Due to the required geometric curvature, it is assumed these structures will be constructed with steel plate girders. Other new bridges are proposed to carry CC215 traffic over either Range Road or Centennial Parkway, depending on the alternative configuration. At these and other bridge locations, it is assumed the structures will be post-tensioned, cast-in-place concrete box girder bridges. Refer to Section 3 for a description of the interchange configuration alternatives and proposed bridges evaluated for this scoping effort.

2.1.1.2. Drainage

Existing Drainage Conditions. The existing interchange area is subject to storm runoff developed in areas north of the project site and conveyed south, passing through culverts under the UPRR railroad. Four major offsite conveyances cross the project site. These are conveyed below existing roadway improvements via culvert crossings and within the interchange area via earthen ditches. Figure 4 shows the existing flow path of each of these major conveyances, along with existing culvert locations and 100-year flow rates.

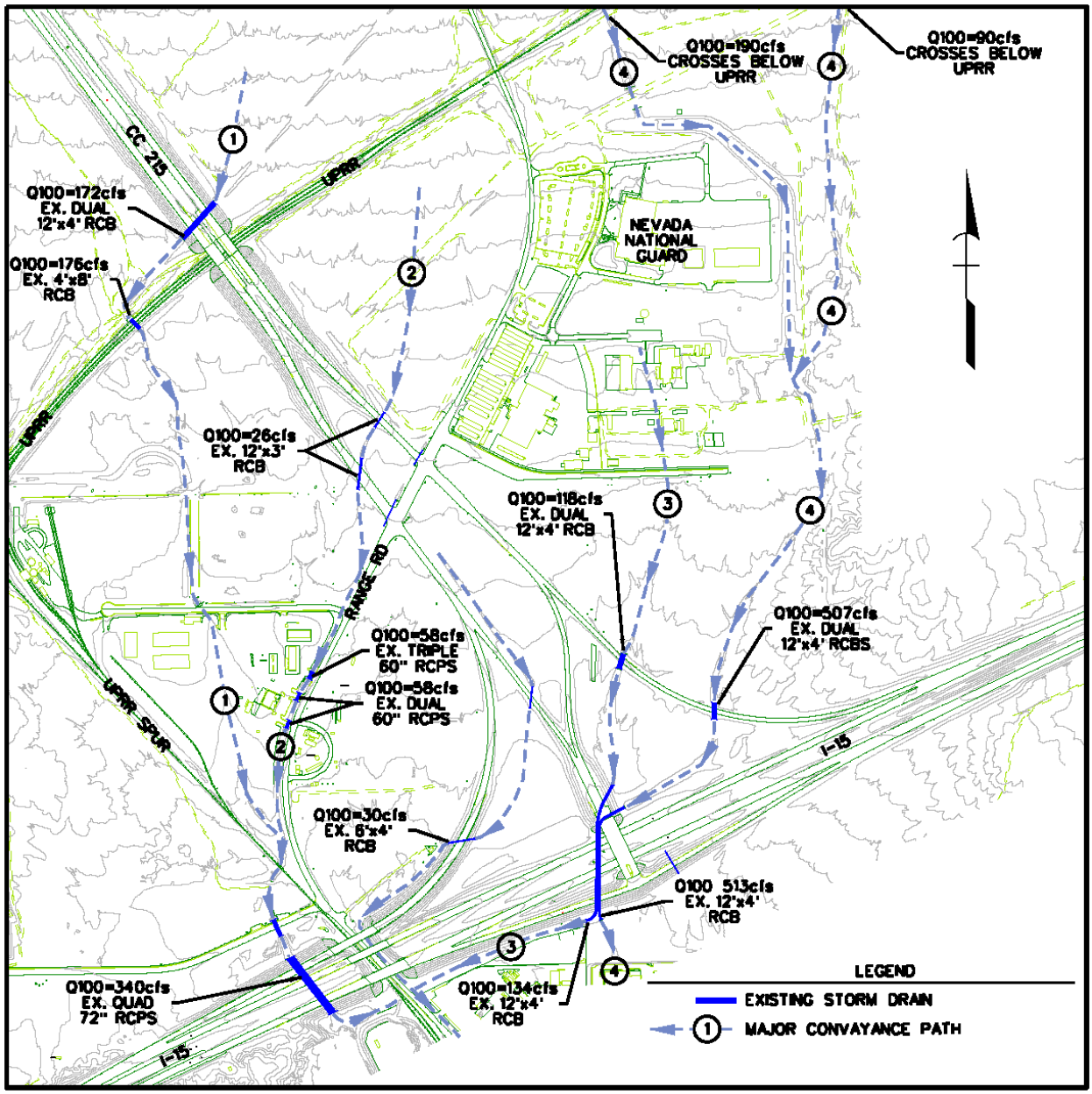

Figure 4. Existing Drainage Conditions

As shown in Figure 4, runoff following conveyance path 1 is initially developed in sub-basin areas north of the UPRR. The path is routed west along the UPRR, crossing CC215 via a dual 12'x4' RCB. West of CC215, the flow crosses beneath the UPRR and travels south, overland, to a quad 72" RCP under I-15, west of the UPRR Spur.

Runoff along conveyance path 2 is developed south of the UPRR and crosses the existing CC215 frontage roads via two 6'x3' RCBs. This runoff continues along the west side of Range Road in an earthen ditch, and ultimately combines with the flow from path 1 prior to crossing under I-15 through the quad 72" RCP culvert.

Runoff along conveyance path 3 is developed south of the UPRR, in the vicinity of the existing Nevada National Guard facility. This flow crosses the southbound I-15 to eastbound CC215 ramp via dual 12'x4' RCBs. The runoff is then conveyed across the interchange infield area via an earthen ditch to a 12'x4' RCB. This RCB crosses I-15, and discharges to a ditch on the south side of I-15, which conveys the runoff to the west and discharges at Range Road. Runoff from the tributary area north of the UPRR, upstream of the Nevada National Guard, crosses the UPRR, but is diverted to the east by an existing riprap lined channel. These flows combine with runoff in conveyance path 4.

Runoff in Conveyance path 4 is developed in areas north of the UPRR and is conveyed below the railroad via an existing culvert. This flow combines with runoff from the channel upstream of the Nevada National Guard and crosses the southbound I-15 to eastbound CC215 connecting ramp via a dual 12'x4' RCB. The flow is conveyed across the interchange infield area to a separate 12'x4' RCB, which crosses I-15 and discharges to the south. It is important to note that, while conveyance paths 3 and 4 are in parallel and cross I-15 in adjacent parallel culverts, each is a separate conveyance path, collecting flows from separate sub-basin areas and discharging flows to separate discharge points.

Smaller cross culverts and earthen ditches convey localized flows developed within the interchange area.

Future Drainage Conditions. The proposed Clark County Regional Flood Control District (CCRFCD) Range Wash Railroad (RWRR) channel and detention basin improvements are currently in design and scheduled for completion within the timeframes anticipated for interchange construction. Completion of these facilities will reduce the offsite flows reaching the interchange area by diverting upland runoff to the detention basin.

Within the project area, the major flow conveyance paths will be unchanged. Completion of the CCRFCD facilities will reduce runoff in conveyance paths 1 and 4. Future condition flows in conveyance paths 2 and 3 will remain largely unaltered, since the existing condition tributary areas lie downstream of the UPRR.

Proposed drainage facilities for both Alternative 1 and 2 utilize similar drainage facility sizes and alignments. With both, offsite flows will be collected in existing flowlines at the project boundaries. It is proposed to eliminate the existing cross culverts below the northbound CC215 frontage road and tie collection channels directly to the established wash flowlines. Earthen and riprap lined channels will be

used for conveyance of offsite flows within infield areas. These channels will also be used for collection of smaller, localized flows developed within the system interchange, and as discharge points for onsite storm drain systems. Cross culverts, sized for the future condition 100-year storm will be constructed below embankment fills. Alignments of these culverts will be set to avoid conflict with bridge abutments and structural elements associated with viaduct structures. The two existing 12'x4' box culverts below I-15 will continue to be used. Storm flows within the westerly box (Path 3) will remain the same as existing, however a reduction of flows will be seen in the easterly box (Path 4.)

The quad 72" RCP under I-15 will be extended to accommodate the widened roadway footprint. In addition, discharge from the westerly 12'X4' RCB below I-15 will be directed along the southerly right-of-way boundary in a concrete lined channel, discharging to Range Road.

Differences between the two alternatives are a result of routing drainage systems to conform to roadway embankments and structural elements. Both alternatives discharge offsite flows in locations consistent with existing conditions, and a reduction of flows will be seen at the quad 72" RCP and the easterly 12'X4' RCB below I-15.

Future Drainage Conditions for Alternatives 1 and 2 are shown in Figures 5 and 6, respectively.

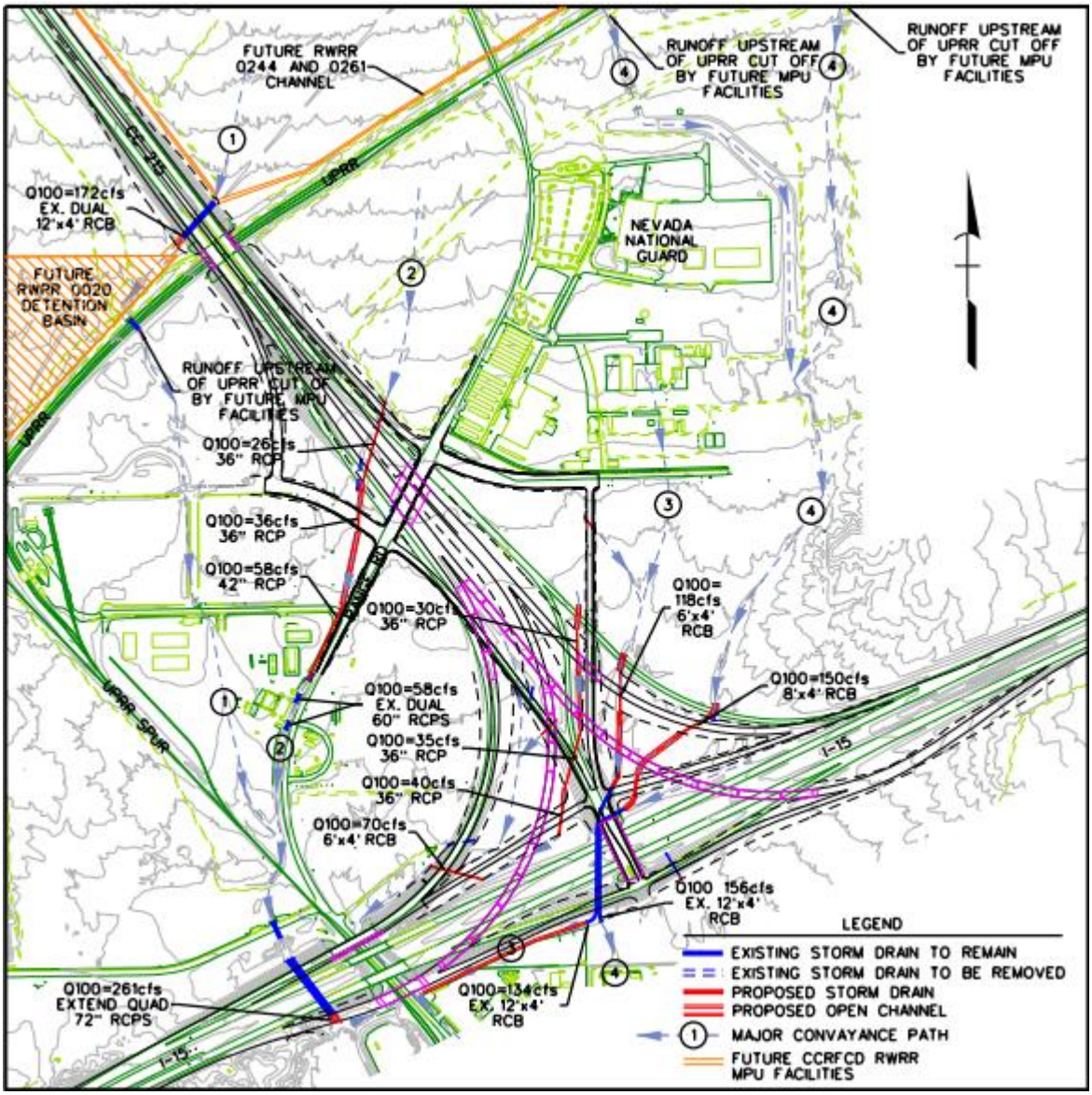

Figure 5. Future Drainage Conditions, Alternative 1

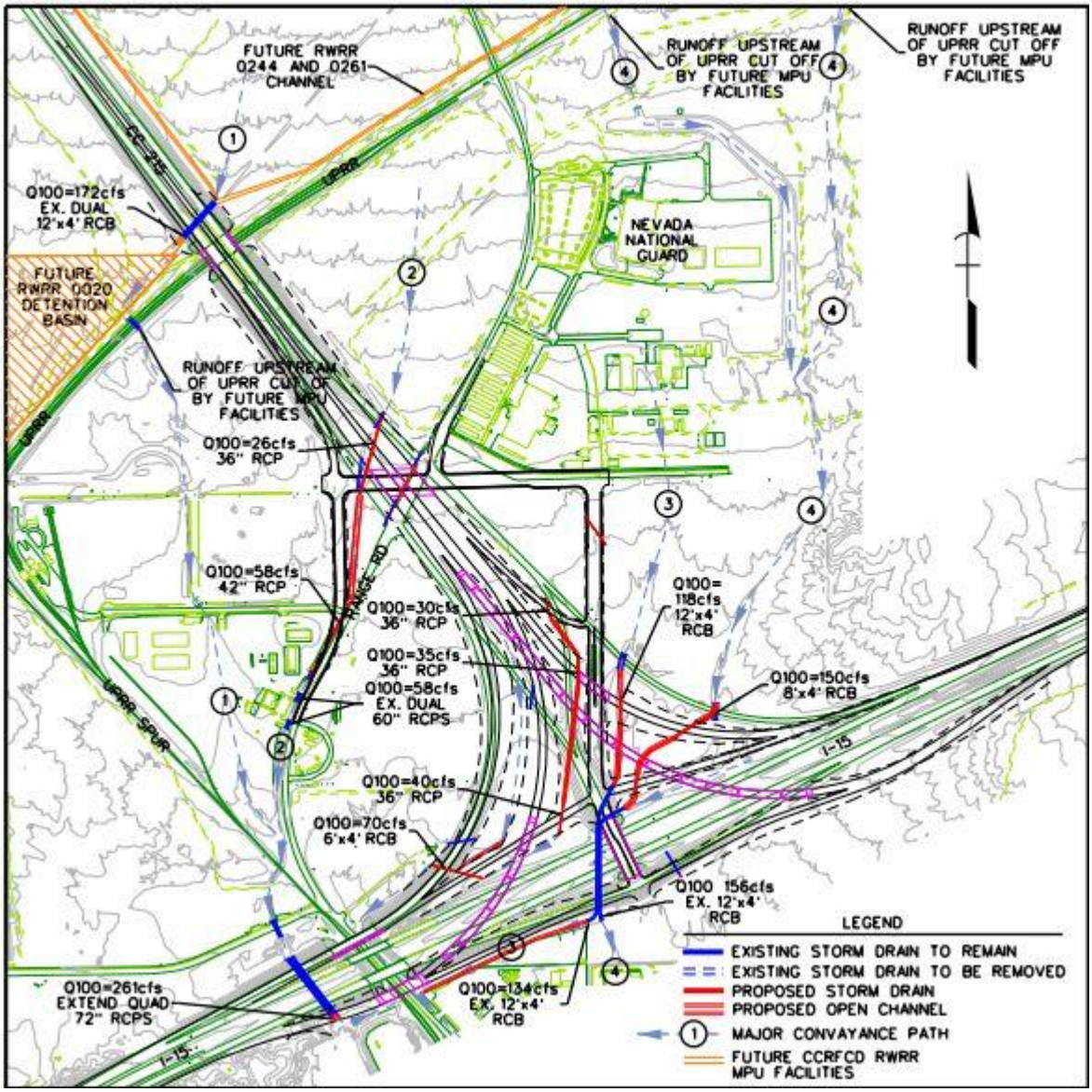

Figure 6. Future Drainage Conditions, Alternative 2

2.1.1.3. Utilities

The majority of existing utilities in the project area are located within the Range Road alignment, and include petroleum, gas, electric, telephone, fiber optic, water, and sewer lines. In addition, an existing water line is located within the future alignment of Centennial Parkway and an existing sewer line crosses CC215 at the existing ramp connections. Existing utility locations are illustrated in Figure 7.

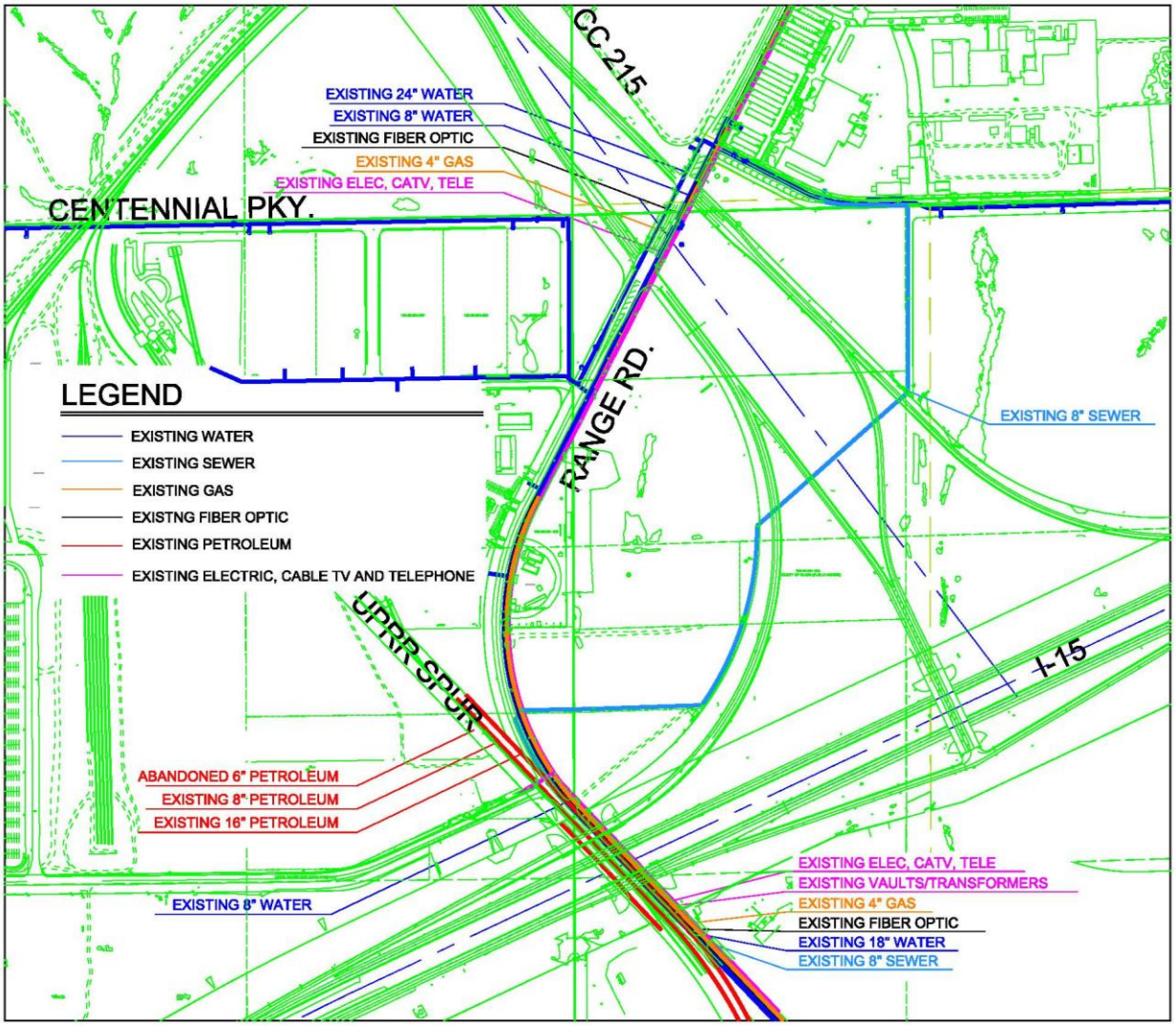

Figure 7. Existing Utilities

A summary of the existing utilities and potential conflicts associated with each of the two interchange configuration alternatives is provided in Table 2. Utilities in conflict with the proposed project are highlighted.

I-15 North Phase 4 Utility Conflict Matrix				
Location	Utility	Utility Owner	Conflict	
			Alternative 1	Alternative 2
I-15/Range Rd	8" Petroleum	Kinder Morgan	None: Protect in place	None: Protect in place
	14" Petroleum	Kinder Morgan	None: Protect in place	None: Protect in place
	6" Petroleum (Abandoned)	Kinder Morgan	None: Protect in place	None: Protect in place
	8" Water Line	City of North Las Vegas	None: Protect in place	None: Protect in place
	18" Water Line	City of North Las Vegas	None: Protect in place	None: Protect in place
	8" Sanitary Sewer Line	Clark County Water Reclamation District	None: Protect in place	None: Protect in place
	Fiber Optic	Zayo	None: Protect in place	None: Protect in place
	4" Gas	Southwest Gas	Conflict with proposed bridge piers (I-15/CC215 Ramps over Range Rd)	Conflict with proposed bridge piers (I-15/CC215 Ramps over Range Rd)
	4" Electric	NV Energy	Conflict with proposed bridge piers (I-15/CC215 Ramps over Range Rd)	Conflict with proposed bridge piers (I-15/CC215 Ramps over Range Rd)
	(2) 4" Telephone	Century Link	Conflict with proposed bridge piers (I-15/CC215 Ramps over Range Rd)	Conflict with proposed bridge piers (I-15/CC215 Ramps over Range Rd)
CC215/Range Rd	8" Water Line	City of North Las Vegas	None: Protect in place	Conflict with proposed bridge foundation (CC215 over Centennial Pkwy)
	(2) 4" Electric	NV Energy	None: Protect in place	Conflict with proposed bridge foundation (CC215 over Centennial Pkwy)
	(2) 4" Telephone	Century Link	None: Protect in place	Conflict with proposed bridge foundation (CC215 over Centennial Pkwy)
	4" Gas	Southwest Gas	None: Protect in place	Conflict with proposed bridge foundation (CC215 over Centennial Pkwy)
	24" Water Line	City of North Las Vegas	None: Protect in place	Conflict with proposed bridge foundation (CC215 over Centennial Pkwy)
	Fire Hydrant	City of North Las Vegas	Conflict with proposed bridge foundation (CC215 over Range Rd)	Conflict with future HOV Ramp
	Fiber Optic	Zayo	None: Protect in place	Conflict with proposed bridge foundation (CC215 over Centennial Pkwy)
I-15/CC215 Ramp Crossovers	8" Sanitary Sewer Line	Clark County Water Reclamation District	Ramp embankments SW, NW, ES to be constructed over sewer line	Ramp embankments SW, NW, ES to be constructed over sewer line and Ramp R5 excavation over sewer line
Military Rd	8" Sanitary Sewer Line	Clark County Water Reclamation District	Proposed one way frontage road to be constructed over sewer line	Proposed Tropical Pkwy Extension to be constructed over sewer line
	48" SSMH	Clark County Water Reclamation District	Proposed one way frontage road to be constructed over sewer line	Proposed Tropical Pkwy Extension to be constructed over sewer line
Centennial Pkwy/ Military Rd	48" SSMH	Clark County Water Reclamation District	Proposed Centennial Pkwy to be constructed over manhole	Proposed Centennial Pkwy to be constructed over manhole

Table 2. Utility Conflict Matrix

2.1.2 Traffic Volumes

Peak hour traffic forecasts were developed for the project using the latest version of the Regional Transportation Commission (RTC) of Southern Nevada's travel demand model that reflects the Regional Transportation Plan (RTP) 2013-2035. Forecasts were developed for the existing scenario (year 2015), future no-action scenario (year 2035), and two alternative build scenarios (year 2035).

A review of traffic patterns in the study area found that Lamb Boulevard acts as an alternate route to the eastern end of CC-215. Therefore, intersections along Lamb Boulevard were included to account for traffic distribution between two parallel routes. The intersection termini at the I-15/Speedway interchange were also included to forecast freeway segments.

The approved traffic forecasts at the interchange are shown graphically in Appendix 6.1. Refer to the Traffic Forecasting Memorandum for the off-site intersection and freeway forecasts.

2.1.3 Traffic Operations Analysis

Micro-level traffic modeling and analysis was performed using Synchro 9 to evaluate the performance of signalized and unsignalized intersections, and Highway Capacity Software 2010 (HCS 2010) to analyze freeway segments and ramps. The operations analysis addressed the existing conditions (2015) and three future scenarios: 2035 No Action, 2035 Alternative 1, and 2035 Alternative 2. The future scenarios assumed completion of programmed improvements in the Regional Transportation Plan 2013-2035, and other improvements programmed into the RTC travel-demand model.

Results of the HCS analysis of freeway segments and ramps are shown graphically in Figure 8. In the existing condition and the three 2035 scenarios, all of the freeway segments and ramps to the north of Lamb Boulevard operate at LOS B or better.

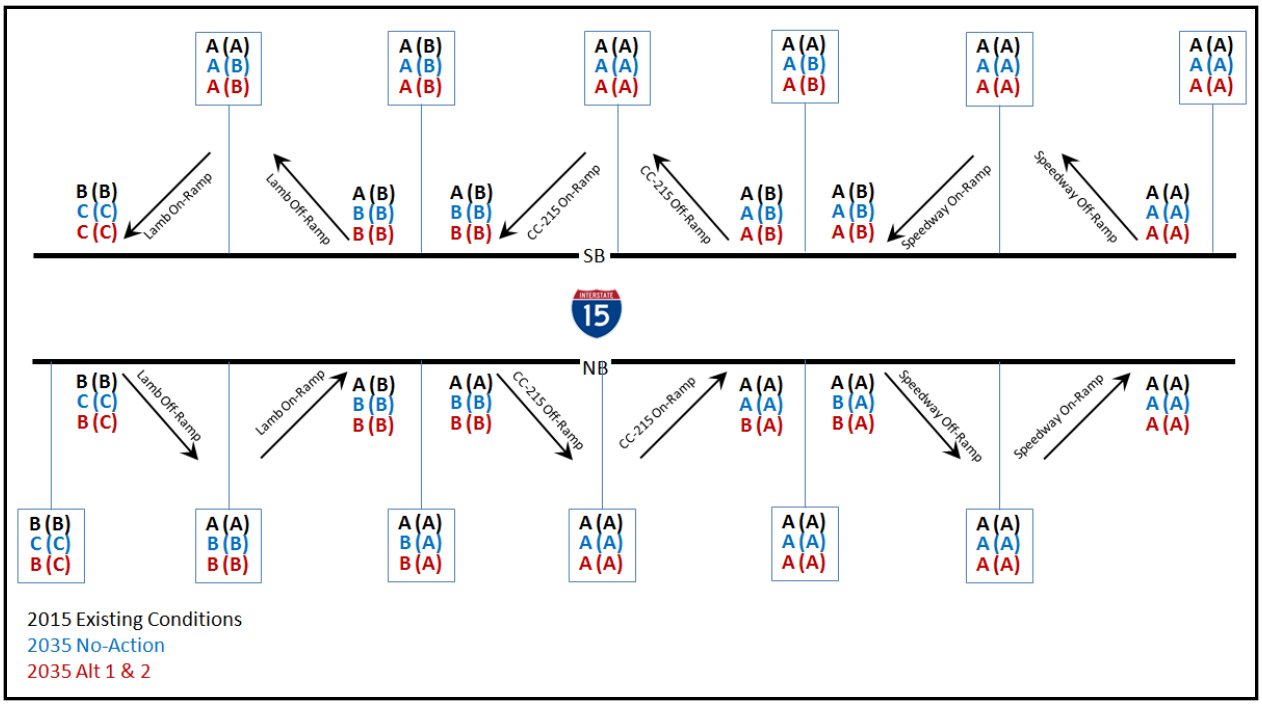

Figure 8. Summary of HCS Analysis of Freeway Segments and Ramps

The Synchro analysis of existing conditions showed most of the intersections performing at LOS D or better, with two off-site exceptions: Lamb Boulevard/Tropical Parkway - LOS F(E) for AM(PM), and Range Road/El Campo Grande – LOS E for AM (4-way stop control).

Intersection performance of the three future year 2035 scenarios is summarized in Table 3. In the No Action scenario, all of the intersections at the interchange site are operating at LOS D or better. However, with signalized intersections remaining in place on CC215, the No Action scenario does not achieve the primary goal of completing the system interchange. Alternatives 1 and 2 will provide the direct connector ramps. With these alternatives, most of the signalized intersections at ramp terminals and local roadway connections operate at LOS B or better. The Alternative 1 summary shows one intersection operating at LOS D (PM only) and one intersection operating at LOS C (AM/PM). The Alternative 2 summary shows one intersection operating at LOS C (PM only).

INTERSECTION	2035 NO-ACTION		2035 ALTERNATIVE 1		2035 ALTERNATIVE 2	
	DELAY (sec/veh)	LOS	DELAY (sec/veh)	LOS	DELAY (sec/veh)	LOS
I-15/CC215 INTERSECTIONS						
CC215 EB/Centennial Pkwy	21.9 (53.4)	C (D)	-	-	-	-
CC215 WB/Centennial Pkwy	16.7 (45.4)	B (D)	-	-	-	-
CC-215/I-15 NB Ramps	50.3 (53.0)	D (D)	-	-	-	-
S Range Rd/ Centennial Pkwy	29.2 (28.0)	C (C)	-	-	17.5 (16.7)	B (B)
N Range Rd/ Centennial Pkwy	39.5 (45.3)	D (D)	-	-	11.5 (11.0)	A (A)
Range Rd/ W Centennial Pkwy	-	-	18.3 (37.0)	B (D)	-	-
Range Rd/ E Centennial Pkwy	-	-	22.1 (22.9)	C (C)	-	-
Tropical Pkwy/ SB I-15 Ramps	-	-	3.1 (6.8)	A (A)	2.7 (6.2)	A (A)
Frontage Rd/ Centennial Pkwy	-	-	8.3 (17.6)	A (B)	-	-
CC215 Ramp/W Centennial Pkwy	-	-	8.1 (12.6)	A (B)	-	-
Tropical Pkwy/Centennial Pkwy	-	-	-	-	12.9 (16.6)	B (B)
Tropical Pkwy/ I-15 NB Ramps	-	-	15.5 (16.3)	B (B)	14.3 (18.5)	B (B)
Tropical Pkwy/CC215 WB Ramp	-	-	-	-	4.8 (22.0)	A (C)
OFF-SITE INTERSECTIONS						
Lamb Blvd/CC215 WB	13.8 (21.8)	B (C)	17.6 (20.3)	B (C)	17.9 (29.1)	B (C)
Lamb Blvd/CC215 EB	25.6 (13.5)	C (B)	16.9 (13.1)	B (B)	18.8 (12.8)	B (B)
Lamb Blvd/Centennial Pkwy	30.5 (32.1)	C (C)	25.8 (26.0)	C (C)	25.6 (21.2)	C (C)
Lamb Blvd/Azure Ave	12.5 (16.7)	B (B)	12.2 (14.9)	B (B)	12.2 (14.3)	B (B)
Lamb Blvd/Tropical Pkwy	42.0 (44.4)	D (D)	42.0 (39.3)	D (D)	41.0 (40.2)	D (D)
Lamb Blvd/Ann Rd	35.8 (34.3)	D (C)	22.2 (19.9)	C (B)	24.2 (19.1)	C (B)
Lamb Blvd/I-15 Ramps	160.6 (115.1)	F (F)	129.1 (79.1)	F (E)	105.0 (82.6)	F (F)
Speedway Blvd/SB I-15 Ramps	6.8 (10.5)	A (B)	6.8 (11.6)	A (B)	6.8 (11.6)	A (B)
Speedway Blvd/ NB I-15 Ramps	13.8 (15.8)	B (B)	16.1 (19.1)	B (B)	16.1 (19.1)	B (B)

Note: Dashes denote the intersections not existing in that alternative

Table 3. Intersection Traffic Analysis Summary – 2035 Scenarios

2.1.4. Crash Analysis

Crash history within the existing interchange was reviewed for the five year period from July 2009 to July 2014. A total of 17 crashes were recorded, an average of 3.4 per year. The relatively low number of crashes is consistent with the existing low traffic volumes and good levels of service. Most of the crashes can be attributed to driver behavior, with 13 of the 17 crashes classified as non-collision. The various crash categories are discussed below and summarized in Table 4.

Fatal: There were no fatal crashes during the study period.

Injury: There were seven injury crashes with ten people injured. There were five non-collision crashes with six people injured, one rear-end collision with two people injured and one angle collision with two people injured.

Property Damage Only (PDO): There were ten PDO crashes with eight classified as non-collision. The other two crashes included one rear-end and one angle collision.

CRASH SUMMARY @ I-15/CC215 INTERCHANGE								
	Rear-End		Angle		Non-Collision		Total	Total
	Crashes	People	Crashes	People	Crashes	People	Crashes	People
Fatality	0	0	0	0	0	0	0	0
Injury	1	2	1	2	5	6	7	10
PDO	1	0	1	0	8	0	10	0
Totals	2	2	2	2	13	6	17	10
Total Crashes	17							
Total People Injured	10							

Table 4. I-15/CC215 Interchange Crash Summary

2.1.5 Multimodal Facilities – Pedestrian, Bicycle, and Transit

In 2013 the Regional Transportation Commission of Southern Nevada adopted "Complete Streets" design guidelines for Southern Nevada government entities to assist with the planning of streets to better accommodate all modes of transportation, including cars, bicycles, transit and pedestrians.

Both the RTC and the City of North Las Vegas (CNLV) have bikeway plans that cover the project limits. The CNLV plan (2006) shows Range Road as an adopted bike route and a planned off-street bike facility along CC215. The RTC plan (2008) depicts a proposed on-street bike lane on Centennial Parkway. The local roadway network within the project limits is incomplete at this time. However, it is anticipated that as the roadway network is improved, complete street standards and bikeway planning will be incorporated into the design of these roadways.

Bicycle and pedestrian facilities will not be included on the freeways and ramps. Adequate width for bicycle lanes and sidewalks will be provided on roadways and bridges connecting local streets.

There are no plans for dedicated transit facilities on the project nor is there existing transit service within the project limits.

Although not included in the proposed I-15 Phase 4 improvements, planning for the interchange has included the future accommodation of HOV lanes connecting CC215 with the southwest leg of I-15. The HOV lanes would be developed in the median areas of both freeways, and be carried through the interchange area primarily on elated bridge structures, similar to the proposed direct connector ramps. Conceptual plans, profiles, and typical sections for the HOV lanes are included in the Conceptual Plans for the interchange alternatives.

2.1.6. Environment

FHWA/NDOT completed an Environmental Assessment (EA) in May 2007 for I-15 Improvements, US-95 to Apex (FHWA-NV-EA 06-01), that concluded with a Finding of No Significant Impact (FONSI). The scope of the EA included new, upgraded ramps at the CC215 beltway interchange and a connection to Tropical Parkway on the southeast side of I-15, as shown in Figure 9.

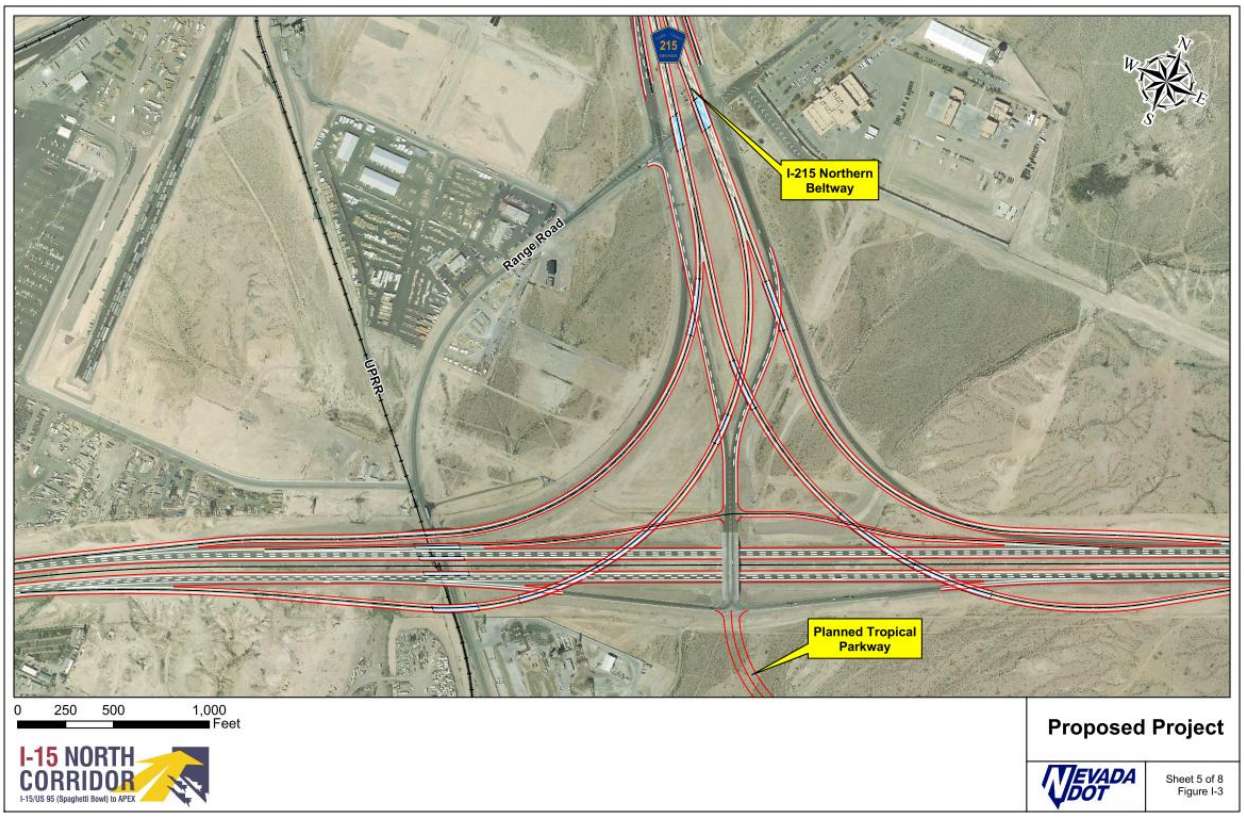

Figure 9. Proposed Project, FHWA-NV-EA 06-01

FHWA regulations on National Environmental Policy Act (NEPA) procedures address the reevaluation of a NEPA document prior to requesting approvals or grants from FHWA (23 CFR 771.129). A reevaluation establishes if the NEPA document (EA) or final project decision (FONSI) remains valid for the subsequent federal action. A reevaluation is generally required when there has been a time lag or changes have occurred between the FONSI and the request for action.

The 2007 EA study covered only project improvements to the I-15/CC215 interchange depicted in Figure 9 and located within the then existing right-of-way. Design alternatives resulting in improvements to areas outside the 2007 right-of-way or that may result in impacts not studied in the 2007 EA may require a written reevaluation. This reevaluation may result in additional mitigation measures and environmental commitments not identified in the 2007 EA and FONSI.

The 2007 EA/FONSI listed mitigation measures and commitments the project contractor would be responsible for following and implementing. The measures and commitments listed below will continue to be applicable to this phase of the project, unless a reevaluation of the 2007 EA deems otherwise:

- Air Quality: Contract specifications will require the contractor to obtain and comply with a Dust Control Permit for Construction Activities issued by the Clark County Department of Air Quality Management. In addition, the contractor must comply with all Federal, State, and local laws, ordinances, and regulations governing air pollution control.
- Noise: Contract specifications will require the contractor to implement noise mitigation measures during construction.
- Surface Water Quality: Contractor will develop, implement and maintain a Storm Water Pollution Prevention Plan in compliance with NDOT's construction site Best Management Practices Manual.
- Plant Species: In accordance with the Clark County Multiple Species Habitat Conservation Plan, construction activities will avoid Las Vegas bearpoppy plants in proposed construction areas. Any unavoidable loss of plants will be documented. The removal or destruction of Las Vegas bearpoppy will be performed under the "Conditional Permit for Disturbance or Destruction of Critically Endangered Species in Clark County: Las Vegas Bearpoppy", issued by the Nevada Division of Forestry. The proposed project right-of-way and staging areas will be surveyed for the presence of Las Vegas Bearpoppy and Las Vegas Buckwheat plants prior to the start of construction. Any cacti or yuccas that may be impacted with the proposed project will be moved and utilized as drought-tolerant landscaping within the proposed project area. These activities will be monitored by a biologist familiar with the care and handling of these unique plants.
- Noxious Weeds: A weed management plan will be implemented to keep the spread of exotic invasive species to a minimum. The plan will include minimizing the spread of seeds and plant parts with contaminated equipment.
- Wildlife Species: A qualified biologist will relocate any Desert Tortoise found within the limits of construction activities. Where Desert Tortoises may be present, use of the USFWS standard approved fencing along the right-of-way will prevent entry to the Desert Tortoise. Fencing the right-of-way will be completed as the first order of construction. NDOW Gila Monster protocols will be followed.
- Migratory Birds: Removal of vegetation will be scheduled to occur outside breeding season (active breeding season is March 15 - July 30). Should the breeding season be unavoidable, the area to be disturbed will be surveyed for nests prior to implementation. If active nests with eggs

or chicks are found, the area around the nest will be avoided. These nests will remain protected until such time as the birds have fledged the nest.

2.2. Identified Problems, Deficiencies and Needs

2.2.1. Existing

The existing I-15/CC215 interchange provides acceptable operations for 2015 traffic volumes. The two traffic signal controlled intersections at CC-215 EB/Range Road and CC215 WB/Range Road currently operate at level-of-service (LOS) B (D) during the AM (PM) peak hours. The stop controlled intersection at the CC215/I-15 NB Ramps currently operates at LOS B (C) during the AM (PM) peak hours. The five-year crash history at the interchange recorded only 17 total crashes, an average of 3.4 per year.

There are no current problems, deficiencies, or needs with the existing facility. However, upgrading of the existing CC215 interim facility to full freeway standards and providing direct ramp connections to I-15 are essential components to complete the ongoing development of the two freeway systems.

2.2.2. Future/Projected No-Build

Capacity improvements to the I-15 freeway are ongoing as envisioned in NDOT's I-15 North Corridor project. Phase 1 improvements from US 95 to Craig Road were completed in 2010. Phase 2 improvements from Craig Road to Speedway Boulevard are currently in design with a planned construction start in 2016. Phase 2 will widen I-15 from two lanes in each direction to three lanes in each direction plus auxiliary lanes through the I-15/CC215 project area. Phase 3 improvements from Speedway Boulevard to Apex interchange are scheduled to start design in 2016. Phase 4 is the subject of this Scoping Report.

Concurrently, Clark County is continuing upgrading of the Beltway to full freeway standards. Construction is currently underway on the segment between Aliante Parkway and North 5th Street, with upgrading of the remaining four-mile segment from North 5th Street to Range Road scheduled for completion in 2020 per the Regional Transportation Plan 2013-2035. Figure 10 illustrates the multi-phased I-15 North Corridor improvements and the ongoing improvements of the CC215 Beltway to full freeway standards.

Of similar importance is the projected development in areas adjacent to the interchange, and the construction of local connections serving these areas. Figure 11 shows the areas of anticipated development as identified to RTC for inclusion in the regional travel demand model. Tropical Parkway, currently in design by the City of North Las Vegas, will serve the industrial zone to the south of I-15. The extension of Centennial Parkway will serve the area zoned for community retail to the north of I-15. The existing Range Road intersects with CC215, and is recognized as an important commuter link to Nellis Air Force Base facilities to the south, and also provides access to military facilities to the north.

2.2.3. Location Maps

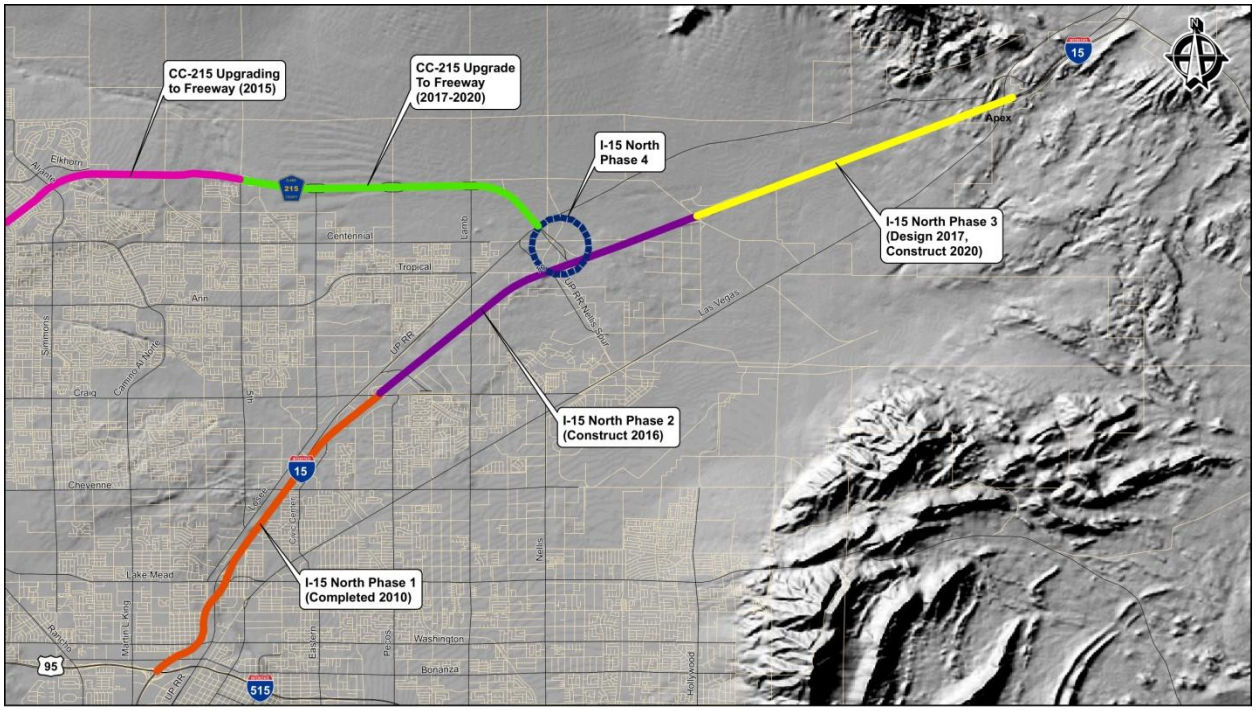

Figure 10. I-15/CC215 Freeway Development Overview

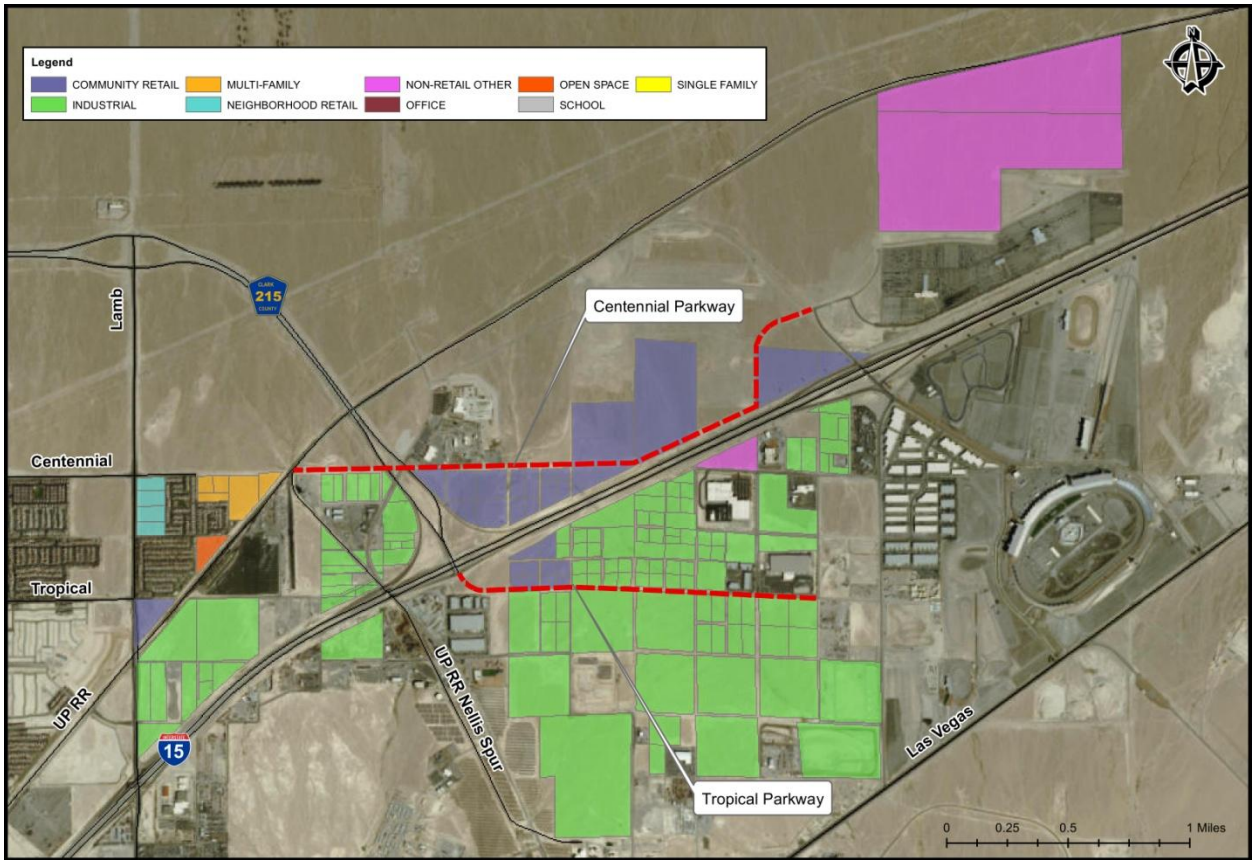

Figure 11. CNLV Future Land Use and Local Access

2.3. Preliminary Purpose & Need

Upgrading of the I-15/CC215 interchange to a full system interchange is needed to accommodate future traffic volumes, and to provide local access and mobility. The existing traffic signal and stop controlled intersections are inadequate for this purpose. As noted in sections 2.2.1 and 2.2.2, upgrading of the existing CC215 interim facility to full freeway standards and providing system-to-system ramp connections to I-15 are essential components to complete the ongoing development of the two freeway systems.

Although growth of the Las Vegas economy has slowed by the current recession, the Regional Transportation Commission of Southern Nevada reports that growth in both population and employment is expected to continue in the Las Vegas Valley for the foreseeable future. However, in recognition of future economic uncertainty and conservation of funding resources, upgrading of the current facility to a system interchange will be undertaken in a series of sub-projects or phases that respond to travel demand within the constraints of available funding.

3. ALTERNATIVES DEVELOPMENT

3.1 Preliminary Alternatives

3.1.1. No-Action

The existing interchange, illustrated in Figure 12, connects the I-15 freeway with the initial CC215 limited access expressway. The existing configuration is a modified diamond, with conventional diamond entrance and exit ramps serving northbound I-15, and free-flowing directional on and off-ramps serving southbound I-15. The CC215 intersection with Range Road is traffic signal controlled, typical of the interim Beltway facilities. The No Action alternative assumes that the Tropical Parkway Connector (currently in design by the City of North Las Vegas) and the extension of Centennial Parkway (City of North Las Vegas Master Plan of Streets and Highways) will be completed within the interchange area prior to the year 2035 traffic planning horizon.

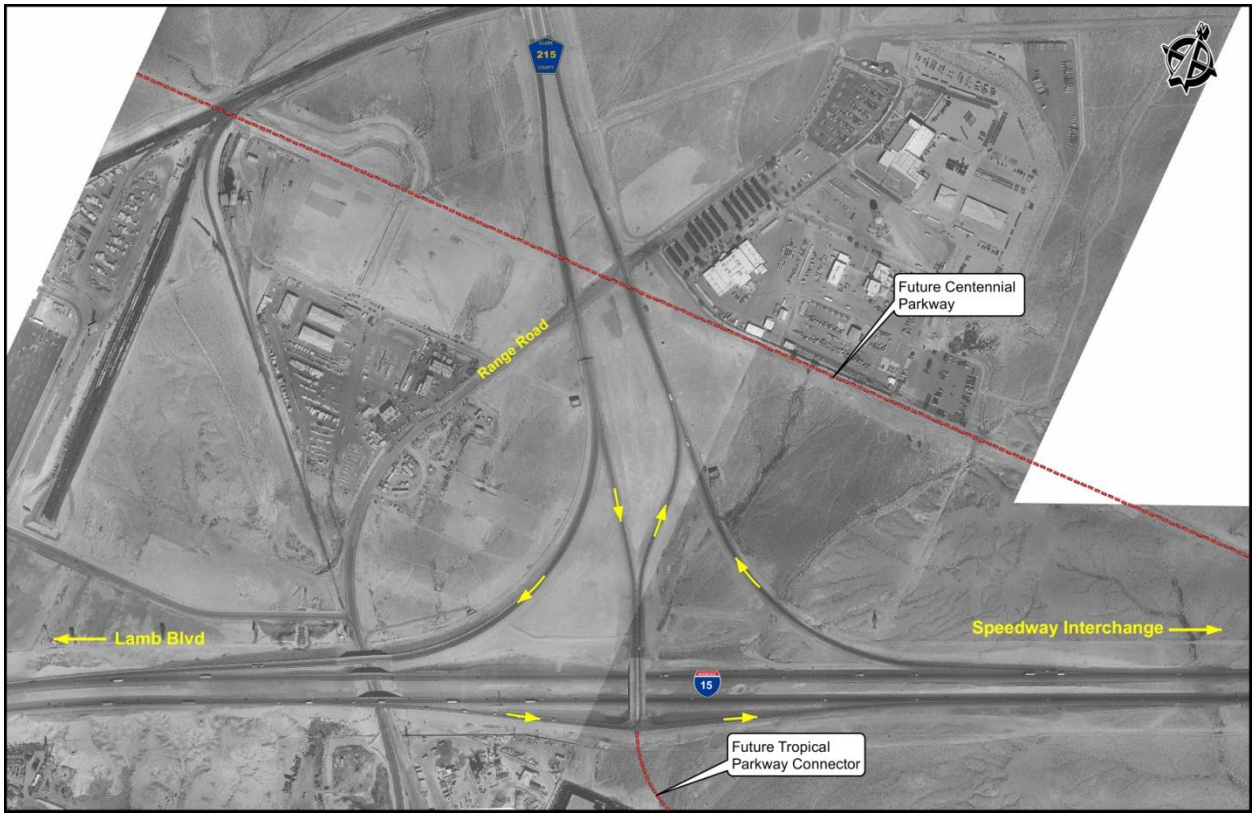

Figure 12. No Action Alternative

3.1.2. Build Alternatives

Two build alternatives have been developed for the interchange, each incorporating the following common requirements:

- Direct connector ramps for all freeway-to-freeway movements
- Local service connections to Range Road, the Tropical Parkway Connector (currently in design), and the future extension of Centennial Parkway through the interchange area
- Horizontal and vertical layout that will accommodate future HOV lanes within the median areas linking CC215 to the southwest leg of I-15

A challenge in developing both alternatives was the accommodation of Range Road and Centennial Parkway in conjunction with access to CC215, given the intersection of all three alignments at the same location. The two alternatives illustrate different solutions for this problem.

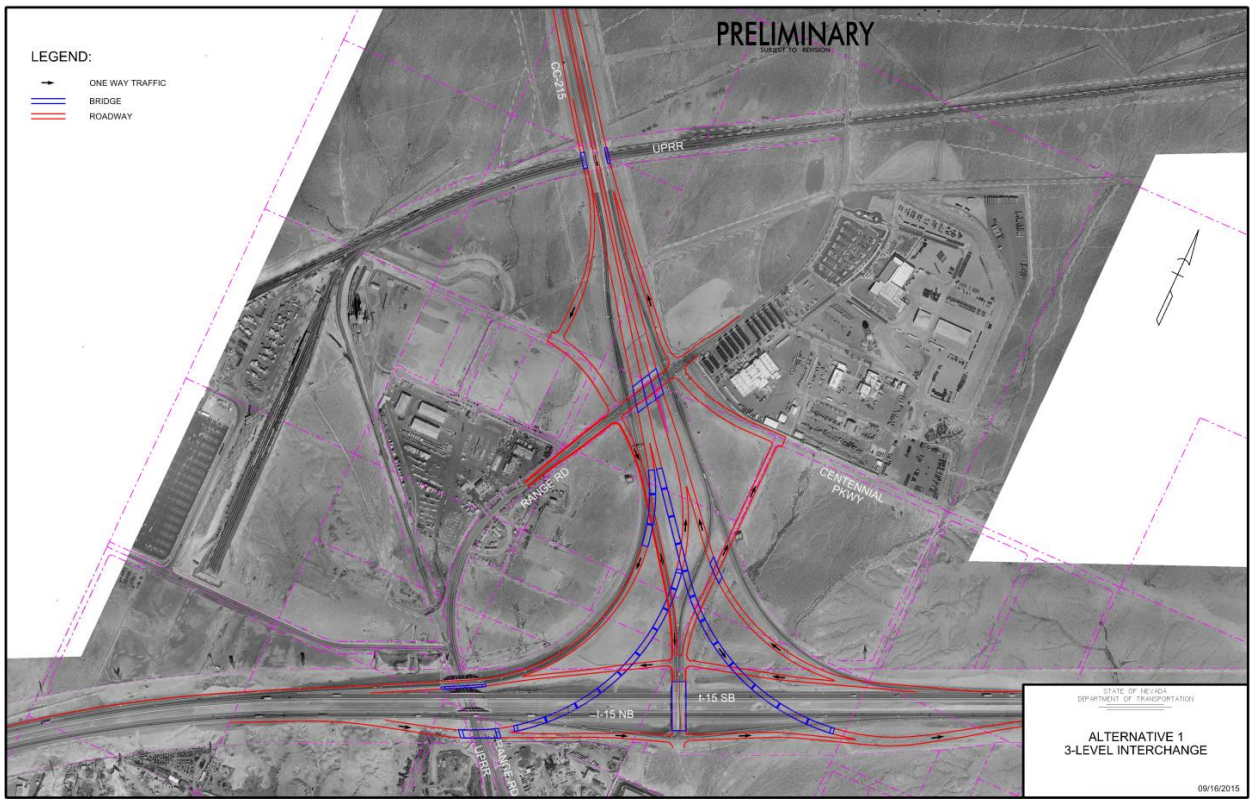

Figure 13. Alternative 1

Alternative 1, shown in Figure 13, is described as a 3-level interchange based on the vertical stacking of the ramps. Access to/from I-15 to the service connections is via a diamond interchange configuration within the system ramps, consistent with previous planning for the interchange (see Figure 8). The diamond connection to the south is the Tropical Parkway Connector (two-way arterial), and to the north the alignment is split into one-way frontage roads similar to the existing CC215 connections.

Range Road remains on its current alignment as does the existing Centennial Parkway connector on the east side of CC215. On the west side of CC215, Centennial Parkway meets Range Road at a new intersection that mirrors the east side intersection. The existing one-way frontage roads and ramps are realigned to avoid interference with the new Range Road/Centennial Parkway intersections.

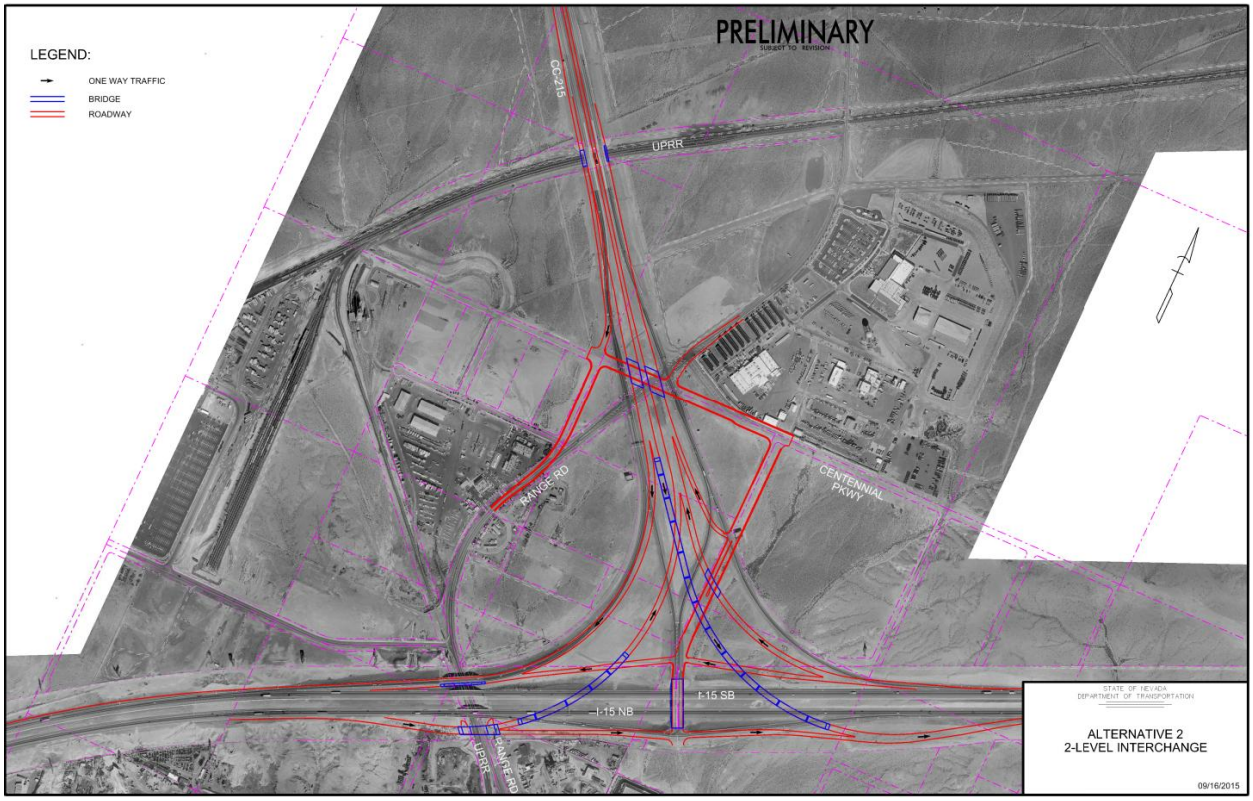

Figure 14. Alternative 2

Alternative 2, shown in Figure 14, is described as a 2-level interchange based on the vertical stacking of the ramps. As with Alternative 1, access to/from I-15 to the service connections is via a diamond interchange configuration within the system ramps. The diamond connection to the south is the Tropical Parkway Connector, and to the north the two-way arterial configuration is extended on a north-south alignment to an intersection with Centennial Parkway. Local access to westbound CC215 will be provided from this roadway. The existing one-way frontage roads are eliminated.

For this alternative, Centennial Parkway is provided a straight east-west alignment. Range Road is realigned, creating intersections with Centennial Parkway, one on each side of CC215. The west side intersection will be the end of the public roadway section of Range Road, and the east side intersection will begin the controlled access section of Range Road as it enters the military facilities.

4. ALTERNATIVES EVALUATION

4.1. Methodology

The two alternatives developed for this scoping analysis are very similar in function. They provide the system-to-system direct connections as well as the local service connections. However, significant differences are seen in the layout of the interchange components. These differences have been evaluated on the basis of a number of key elements including cost, traffic operations, drainage, right-of-way, utilities, environmental, risk assessment, benefit-cost analysis, preliminary phasing concepts, adaptability for future traffic growth and redistribution, and the preferences of project stakeholders.

A comparison of the two alternatives on the basis of these elements was done to facilitate the selection of a preferred alternative.

4.2 Initial Screening

4.1.1 Valid Alternatives

Two alternatives were developed and evaluated. Both are deemed reasonable and feasible, and address the project needs.

4.1.2 Dismissed Alternatives

No additional alternatives were developed. The basic layout for the interchange was conceived during preliminary engineering for the Northern Las Vegas Beltway (now known as a part of the Bruce Woodbury Beltway). The interchange right-of-way was acquired and the existing initial facilities were constructed with the ultimate facility in mind. In the years since, the most significant change has been the continuing growth and development of the Las Vegas Valley, highlighting the need and importance of local access in the interchange vicinity. The two alternatives developed for study have provided the opportunity to address these needs in creative ways.

4.3. Alternatives Analysis

4.3.1. Alternative Key Elements/Scope

4.3.1.1. Cost

Conceptual level cost estimates for construction and right-of-way are summarized in Table 5.

Description	Alternative 1	Alternative 2
Roadway	$22,008,300	$22,226,595
Structures	$69,896,655	$59,463,600
Traffic	$9,491,000	$9,435,000
Utilities	$175,400	$585,650
Drainage	$2,669,405	$2,968,380
Landscaping & Aesthetics (3%)	$3,127,223	$2,840,377
Erosion Control (0.5%)	$521,204	$473,397
Mobilization (7%)	$7,552,244	$6,859,510
Contingency (20%)	$21,577,837	$19,598,600
Total Construction Cost	**$137,020,000**	**$124,452,000**
Right-of-Way	$2,683,280	$2,132,960
Total Cost (Construction + Right-of-Way)	**$139,703,280**	**$126,584,960**

Table 5. Cost Estimates (Construction + Right-of-Way)

The cost estimate for Alternative 2 is $13 million, or about 10%, less than Alternative 1. The most significant difference is $10 million in the cost of structures, which can be attributed to the longer bridges required to achieve the three-level configuration in Alternative 1. Other cost differences are

noticeable in the areas of utilities, drainage and right-of-way, but these differences are relatively small and tend to offset between the two alternatives.

4.3.1.2. Traffic Operations Analysis

Traffic operations analysis performed for the project is described in Section 2.1.3 of this report, and the calculated intersection delays throughout the study area in year 2035 are summarized in Table 3. To further evaluate and compare the performance of Alternatives 1 and 2, the peak hour volumes were applied to the average peak hour delays to calculate total peak hour delay within the study area. The results are summarized in Tables 6 and 7.

This comparison of at-grade intersection delay in the study area is independent of traffic moving on the I-15 and CC215 freeways and direct connector ramps. Travel times and levels of service on the freeways and ramps are identical for Alternatives 1 and 2.

Alternative 1									
	AM Peak Hour				PM Peak Hour				AM + PM
Intersection	Volume (vph)	Delay (sec/veh)	Peak Hr Delay (sec)	Peak Hr Delay (hr)	Volume (vph)	Delay (sec/veh)	Peak Hr Delay (sec)	Peak Hr Delay (hr)	Peak Hour Delay
I-15/CC215 Intersections									
Range Rd/W Centennial Pkwy	1,751	18.3	32,043	9	2,371	37	87,727	24	33
Range Rd/E Centennial Pkwy	966	22.1	21,349	6	3,052	22.9	69,891	19	25
CC-215/I-15 NB Ramps	1,800	15.5	27,900	8	2,010	16.3	32,763	9	17
Tropical Pkwy/I-15 SB Ramps	1,540	3.1	4,774	1	2,310	6.8	15,708	4	6
Frontage Road/Centennial Pkwy	1,265	8.3	10,500	3	2,945	17.6	51,832	14	17
CC-215 EB Off-Ramp/W Centennial Pkwy	1,490	8.1	12,069	3	1,280	12.6	16,128	4	8
Subtotals, I-15/CC215 Intersections				30				76	106
Off-Site Intersections									
Lamb Blvd/WB CC-215	310	17.6	5,456	2	660	20.3	13,398	4	5
Lamb Blvd/EB CC-215	1,580	16.9	26,702	7	990	13.1	12,969	4	11
Lamb Blvd/Centennial Pkwy	3,450	25.8	89,010	25	3,170	26.9	85,273	24	48
Lamb Blvd/Azure Ave	3,500	12.2	42,700	12	3,070	14.9	45,743	13	25
Lamb Blvd/Tropical Pkwy	5,040	42	211,680	59	5,185	39.3	203,771	57	115
Lamb Blvd/Ann Rd	4,902	22.2	108,824	30	4,722	19.9	93,968	26	56
Lamb Blvd/I-15 Ramps	5,470	129.1	706,177	196	5,860	79.1	463,526	129	325
Speedway Blvd/SB I-15 Ramps	1,595	6.8	10,846	3	2,840	11.6	32,944	9	12
Speedway Blvd/NB I-15 Ramps	1,800	16.1	28,980	8	1,820	19.1	34,762	10	18
Subtotals, Off-Site Intersections				342				274	616
Peak Hour Delay - All Intersections (hr)				372				350	
AM + PM Peak Hour Delay - All Intersections per a single day (hr)									722

Table 6. Peak Hour Delay, Alternative 1

Alternative 2									
	AM Peak Hour				PM Peak Hour				AM + PM
Intersection	Volume (vph)	Delay (sec/veh)	Peak Hr Delay (sec)	Peak Hr Delay (hr)	Volume (vph)	Delay (sec/veh)	Peak Hr Delay (sec)	Peak Hr Delay (hr)	Peak Hour Delay
I-15/CC215 Intersections									
S Range Rd/Centennial Pkwy	1,540	17.5	26,950	7	1,770	16.7	29,559	8	16
N Range Rd/Centennial Pkwy	1,070	11.5	12,305	3	1,491	11	16,401	5	8
Tropical Pkwy/I-15 NB Ramps	1,800	14.3	25,740	7	2,010	18.5	37,185	10	17
Tropical Pkwy Ext/I-15 SB Ramps	1,540	2.7	4,158	1	2,310	6.2	14,322	4	5
Tropical Pkwy Ext/Centennial Pkwy	1,690	12.9	21,801	6	2,860	16.6	47,476	13	19
Tropical Pkwy/CC-215 WB Ramp	1,430	4.8	6,864	2	2,650	22	58,300	16	18
Subtotals, I-15/CC215 Intersections				27				56	84
Off-Site Intersections									
Lamb Blvd/WB CC-215	310	17.9	5,549	2	660	29.1	19,206	5	7
Lamb Blvd/EB CC-215	1,580	18.8	29,704	8	990	12.8	12,672	4	12
Lamb Blvd/Centennial Pkwy	3,450	25.6	88,320	25	3,170	21.2	67,204	19	43
Lamb Blvd/Azure Ave	3,500	12.2	42,700	12	3,070	14.3	43,901	12	24
Lamb Blvd/Tropical Pkwy	5,040	41	206,640	57	5,185	40.2	208,437	58	115
Lamb Blvd/Ann Rd	4,902	24.2	118,628	33	4,722	19.1	90,190	25	58
Lamb Blvd/I-15 Ramps	5,470	105	574,350	160	5,860	82.6	484,036	134	294
Speedway Blvd/SB I-15 Ramps	1,595	6.8	10,846	3	2,840	11.6	32,944	9	12
Speedway Blvd/NB I-15 Ramps	1,800	16.1	28,980	8	1,820	19.1	34,762	10	18
				307				276	583
Peak Hour Delay - All Intersections (hr)				334				332	
AM + PM Peak Hour Delay - All Intersections per a single day (hr)									667

Table 7. Peak Hour Delay, Alternative 2

When compared on the basis of total peak hour delay within the study area, the Alternative 2 total of 667 hr/day is lower than the to the Alternative 1 total of 722 hr/day. However, it is noted that both alternatives will provide acceptable levels of service for all intersections within the interchange project area.

4.3.1.3. Drainage

Existing and future drainage conditions are described in Section 2.1.1.3 of this report. Proposed drainage facilities for both Alternatives 1 and 2 will have similar sizes and alignments, with some differences as a result of routing the systems to conform to the roadway embankments and structures. There is no significant difference favoring one alternative over the other.

4.3.1.4. Right-of-Way

Right-of-way for the I-15/CC215 interchange was defined during preliminary engineering for the Northern Las Vegas Beltway segment, and was subsequently acquired by Clark County. That original right-of-way footprint remains adequate for the direct freeway connector ramps, but is not sufficient for the currently proposed service connections to Range Road and Centennial Parkway. Each of the two alternatives provides a different layout for these connections, with different right-of-way requirements, as shown in Figure 15 and summarized in Table 8.

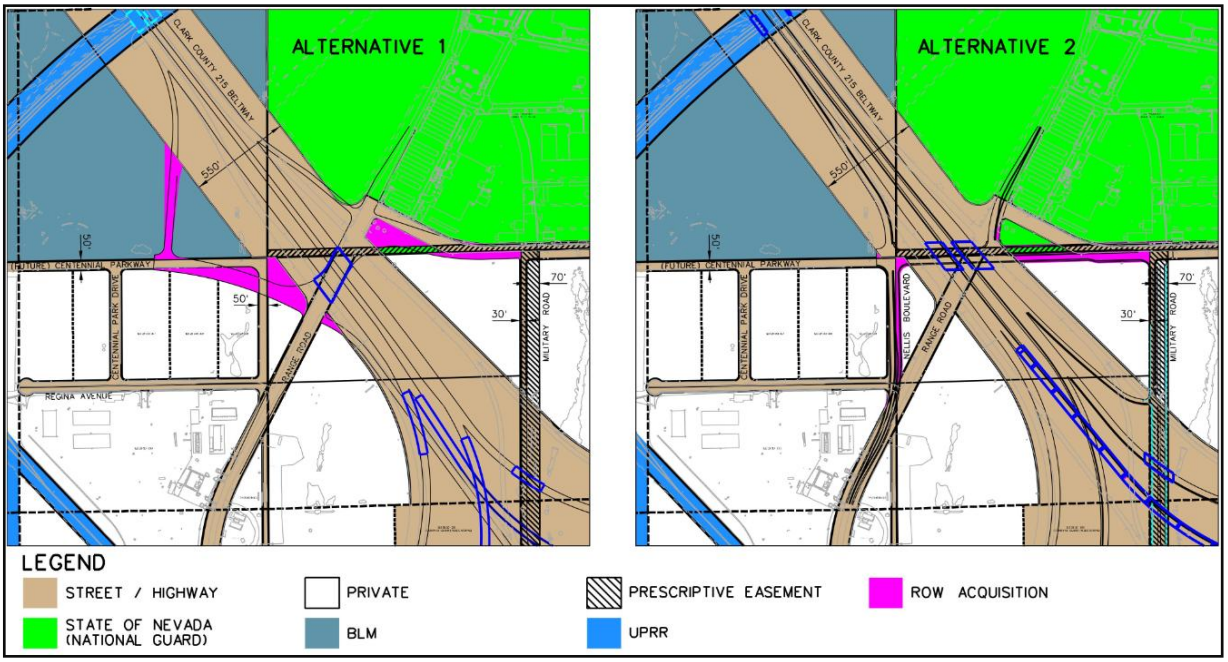

Figure 15. Right-of-Way Acquisition Requirements

Current Ownership	Alternative 1	Alternative 2
Bureau of Land Management	40,017 SF	444 SF
State of Nevada (National Guard)	31,993 SF	8,881 SF
Private	90,889 SF	60,378 SF
TOTALS	**162,889 SF (3.7 acres)**	**69,703 SF (1.6 acres)**

Table 8. Right-of-Way Acquisition Requirements

The right-of-way requirements are substantially less for Alternative 2 compared to Alternative 1, primarily due to the alignment of proposed local connections on existing street alignments. Of further advantage to Alternative 2 is the possibility of eliminating the small BLM acquisition. There is also the possibility vacating portions of the existing right-of-way at Range Road and the existing Centennial Parkway segment, potential trade-offs that might help to facilitate the needed acquisitions.

4.3.1.5. Utilities

Utilities in the project area are discussed in Section 2.1.1.4, and are illustrated in Figure 7. Table 2 provides a comparative summary of the utility conflicts associated with Alternatives 1 and 2. Most of the existing utility lines are embedded in the Range Road alignment. Construction and widening of ramp bridges on I-15 are expected to require relocation of four utility lines regardless of which alternative is selected. However, the proposed realignment of Range Road to accommodate Centennial Parkway associated with Alternative 2 is expected to require relocation six utility lines currently embedded in Range Road. The Alternative 1 layout retains the existing Range Road alignment in this area, so the existing utilities can remain in place. Therefore, Alternative 1 would provide a lower cost and less coordination effort for utilities relocation compared to Alternative 2.

4.3.1.6. Environmental Considerations

The interchange project was cleared environmentally in conjunction with other improvements to I-15 via Environmental Assessment/FONSI in 2007. As noted in Section 2.1.6, the 2007 EA covered only project improvements to the I-15/CC215 interchange depicted in Figure 9 and located within the then-existing right-of-way. Figure 15 in Section 4.3.1.4 shows that both Alternatives 1 and 2 require work outside of the 2007 project footprint to accommodate connections to Centennial Parkway, and would therefore require some form of environmental re-evaluation.

Also in reference to Figure 15, the BLM acquisition for Alternative 1 would create an isolated triangular parcel of about 88,000 square feet that might be difficult for BLM to utilize or manage in the future. If this parcel were to be added to the right-of-way acquisition, the possibility of encountering sensitive resources would be greater for Alternative 1. Accordingly, Alternative 2 would provide a significantly lower impact to the BLM property compared to Alternative 2.

4.3.1.7. Risk Assessment

Alternatives 1 and 2 were evaluated in a risk assessment workshop conducted in September 2015. The two alternatives were reviewed for specific threats and opportunities that could affect the project cost and schedule. Cost estimates for both alternatives were evaluated for uncertainty in the unit costs and quantities, and the impacts of potential risk factors. Examples of the most significant cost threats for both alternatives are minor change orders, bridge deck cracking, additional ITS components, and deep foundation requirements. Potential opportunities for cost reduction included reduction in retaining wall heights, reduced requirement for bridge widening, and foundation design opportunities. The greatest risks to schedule included availability of funding and right-of-way.

The results of the cost risk assessment converted the base cost estimates to cost ranges based on probability. As with the base cost estimates, the cost range for Alternative 2 is lower than the cost range for Alternative 1. Apart from the difference in cost range, no significant risks were identified that would favor one alternative over the other.

4.3.1.8. Benefit-Cost Analysis

A comparative benefit-cost analysis was performed for Alternatives 1 and 2. The analysis estimates that the present value benefits for each alternative exceed the present value costs. However, Alternative 2 provides a higher benefit-cost ratio of 1.66 compared to 1.37 for Alternative 1. The results are summarized in Table 9.

Alternative 2 returned a higher benefit-cost ratio as a result of its lower capital and O&M cost, and higher benefits in the form of travel time savings and safety benefits.

	Alternative 1	Alternative 2
Discount Rate	**7%**	**7%**
Benefit-Cost Ratio	1.37	1.66
Total Benefits (Present Value 2015 $)	$172,285,839	$189,703,410
Total Costs (Present Value 2015 $)	$125,841,278	$114,197,177
Net Present Value (Present Value 2015 $)	$46,444,562	$75,506,232

Table 9. Benefit-Cost Ratio

4.3.1.9. Preliminary Phasing Concepts

Phased construction concepts are expected to be very similar for each of the two alternatives. The primary feature of the first phase would be construction of a bridge carrying CC215 traffic over Range Road / Centennial Parkway, essential to upgrading the existing CC215 facility to freeway standards. Re-alignment of the existing at-grade roadways and intersections would also be included in the first phase. The following two phases would each provide a direct connector flyover ramp, with the I-15 northbound to CC215 westbound ramp in the second phase and the CC215 eastbound to I-15 northbound ramp following in the third phase. There is no significant difference favoring one alternative over the other in regard to construction phasing.

4.3.1.10. Future Adaptability

Both alternatives are similar in their ability to accommodate future traffic growth and/or redistribution not reflected in the current RTC travel demand model. Potential future traffic generators could include:

Feature	Location	Notes
Apex Industrial Park	6 miles northeast on I-15	7,000 acres; 116,000 jobs
Coyote Springs MPC	47 miles northeast on I-15, US 93	43,000 acres; 159,000 homes
Park Highlands MPC	3 miles west on CC215	2,700 acres; 15,000 homes
UNLV North Campus	1 mile northwest on CC215	761 acres
Sheep Mountain Parkway	Eastern terminus on CC215 or I-15	Multiple alternative routings
Interstate 11	To be determined	Three alternative routings

In consideration of future traffic growth, the conceptual designs of both alternatives provide for future HOV lanes connecting CC215 and the southwest leg of I-15. In addition, the major system-to-system ramp structures are designed to accommodate two lanes of traffic even if one lane would be sufficient for the 2035 forecast traffic volumes. The reserve capacity was included in the conceptual plans in consideration of the difficulty of widening the structures in the future.

4.3.1.11. Stakeholder Preference

Major project stakeholders participated in the scoping process through attendance at the monthly progress meetings and by providing periodic feedback on the project. At the progress meeting on

November 3, 2015, features and analysis of the two alternatives were reviewed, and comments and preferences were requested of each of the stakeholders. The stakeholder's preferences and comments are summarized in Table 10.

Stakeholder (Representative)	Preference/Comments
City of North Las Vegas* (Tom Brady)	Alternative 2 is preferred due to lower cost and operational benefits that best reflect the City's objectives with regard to the Tropical Parkway Connector and development in the area.
Clark County (Spring Dineen)	Alternative 2 is preferred considering the Centennial Parkway alignment.
RTC of Southern Nevada (John Penuelas)	RTC would prefer the alternative that has the least impact during construction. Note: This aspect was not studied, but similar traffic impacts are expected with both alternatives.
Nellis Air Force Base* (Victor Rodriguez)	No objection to either alternative.
Nevada National Guard (Major Douglas McEldowney)	Alternative 2 is preferred because it best serves the Guard's mobility needs. A traffic signal at the entrance to the Guard's facility is important. The Guard also supports extension of Centennial Parkway to the east as a primary access between its existing and future facilities.
Las Vegas Motor Speedway* (Dave Stetzer)	Alternative 2 is preferred based solely on the cost savings.
* Not present at meeting on November 3, 2015, but provided comments	

Table 10. Stakeholder Preferences and Comments

4.4. Summary Table

A summary of the evaluation factors discussed above is provided in Table 11.

	Evaluation Factors											
	Cost	Traffic Operations	Drainage	Right-of-Way	Utilities	Environmental	Risk Assessment	Benefit-Cost Ratio	Preliminary Phasing	Future Adaptability	Stakeholder Preference	**Consensus**
Alternative 1					X							
Alternative 2	X	X		X		X		X			X	**X**
No Significant Difference			X				X		X	X		

Table 11. Evaluation Summary

5. RECOMMENDATION

5.1 Final Alternative(s) Comparison

The two alternatives considered in this scoping analysis are very similar, and either one would achieve the project objectives of completing the I-15/CC215 system interchange and providing local access to serve the needs of planned development in the area. The key differences are seen in the layout of the facilities. Alternative 2 provides a 2-level arrangement of the ramps resulting in shorter bridge lengths with a correspondingly lower cost compared to the 3-level arrangement of the Alternative 1 ramps. Similarly, the arrangement of Range Road and Centennial Parkway connections provided by Alternative 2 offers a lesser right-of-way acquisition scenario that offsets its higher utility relocation requirements compared to Alternative 1. The Alternative 2 arrangement also delivers somewhat better traffic operations results and a smaller area for environmental consideration.

5.2 Recommended Alternative w/ Justification Overview

Based on the foregoing analysis, Alternative 2 is the recommended interchange configuration based on its lower cost and the layout of local service connections that best serves the access and mobility needs in the project area. Alternative 2 is also preferred by key stakeholders, the City of North Las Vegas, the Nevada National Guard, and Clark County.

5.3 Action Plan

5.3.1 Phasing

Following approval of the preferred alternative, a Value Engineering Analysis will be performed in accordance with the SAVE Value Standard and the SAVE 6-step process.

Concurrently, a Phasing Plan will be developed to break the project into a series of stand-alone but operationally independent projects with a construction value of $40-60 million. A benefit-cost analysis will be performed for each phase to determine the life-cycle benefits and costs, the benefit-cost ratios, and net present values. In addition, the Project Delivery Selection Approach (PDSA) tool will be used to recommend an appropriate project delivery method for each phase of the project.

30% design of the first phase will conclude the current scoping effort. It is anticipated that final design of the first phase will be initiated in 2016, and construction could commence as early as 2018. The estimated delivery time frames for the subsequent phases will be determined during development of the Phasing Plan in consideration of benefits to the travelling public.

5.3.2 Funding

In anticipation of the first phase of construction, the RTC Transportation Improvement Plan 2015-2019 includes $40 million in FY 2018 from the following sources: National Highway Performance Program (NHPP) ($28.5 million), State Matching Funds (NDOT) ($2.0 million), and STP Statewide $9.5 million).

Another potential source of project funding is the Fuel Revenue Indexing program. In the event that authorizing legislation is passed to extend the program beyond its current expiration on December 31, 2016, there is a possibility that additional funding would be available which could reduce construction phasing requirements and related inflationary costs.

6. APPENDICES

6.1 Traffic Volume Forecasts