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US 50 OPERATIONAL STUDY

LYON COUNTY, PINE CONE ROAD TO NEIGH ROAD

Prepared For:

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NEVADA DOT
SAFE AND CONNECTED

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1. Study Background

The following US 50 Operational Study within East Dayton was initiated by the Nevada Department of Transportation (NDOT) to develop a long-term corridor vision that could be utilized to ensure continuity of future improvements to the US 50 corridor by NDOT, local agencies, and private developments. NDOT has also received concerns from residents, businesses, and other local agencies about the rapid development of the corridor and its ability to handle increased congestion. Other concerns relayed to NDOT also include access, safety, operation and wild horses. This operational study identifies existing conditions, corridor vision concepts, and recommendations on a corridor vision that should be considered to align with future improvements.

1.1 Study Limits and Description

Northern Nevada has been continuously developing and its population increasing since the end of the Great Recession. This has been especially noticeable on the US 50 corridor between Carson City and Silver Springs, Nevada (Figure 1). Recently, there have been multiple commercial and residential developments along and nearby the US 50 corridor. Development is well underway for the Tahoe Reno Industrial Center (TRIC), which at 107,000 acres and a planned employment of 35,000 to 50,000 people, is reportedly the largest industrial park in the world. Adjacent roadways in the area have been impacted by the development of TRIC.

Figure 1: Vicinity Map

Accordingly, NDOT has been making improvements to US 50 between Dayton and Silver Springs and has completed several projects, including widening most of US 50 to a four lane divided highway from Neigh

Road to Silver Springs, roundabout construction at US 50 and USA Parkway and at US 50 and US 95A, as well as horse fencing projects. NDOT has also recently completed the construction of a new four lane roadway, USA Parkway, which connects I-80 and TRIC to US 50, approximately 12 miles east of the limits of this study.

This study focuses on US 50 between Pine Cone Road at the north end of Dayton, for approximately eight miles east to Neigh Road. Figure 2 shows the north end of the study limit.

Figure 2: Location Map

In 2013, this segment of US 50 was improved to a four-lane urban arterial (two lanes each direction) with a two-way left-turn lane. All intersections in the project limits are currently two-way STOP controlled, with the exception of Fortune Drive, where a signalized High-T was recently constructed, controlling westbound US 50 traffic (Figure 3). Eastbound US 50 traffic through the study limits is a free flow movement with STOP controlled on the intersecting streets.

Figure 3. US 50 Near Fortune Drive Looking East

Figure 4 shows the intersection of US 50 and Six Mile Canyon Road/Fort Churchill Road located towards the east end of the project limit.

Figure 4. US 50 Near Six Mile Canyon Rd Looking East

US 50 has a posted speed limit of 60 miles per hour (mph) east of Fortune Drive and 45 mph west of Fortune Drive.

As development and congestion have increased, so have public concern and complaints. Some recurring complaints are:

- there have been many crashes, including with wild horses in the area;
- that motorists are driving too fast;
- sight distance at some intersections is lacking; and
- congestion on US 50 for westbound traffic at Fortune Drive is excessive

NDOT has initiated this study to evaluate the corridor and potential improvements to develop a plan that can be used to establish a vision for the corridor. Some of the major goals of the study are to:

- Incorporate Stakeholder and Public Input
- Evaluate/Improve Operations - Travel time, Level-of-Service (LOS)
- Evaluate/Improve Safety
- Compare Safety Benefit-Cost (B/C) and Lifecycle B/C
- Select a roadway concept/vision for the corridor

1.2 Project Stakeholders/Stakeholder Information

Project meetings were held with affected local public agencies and groups to gather input regarding what developments are currently being considered, known issues or problems in the corridor, and what future improvements stakeholders would like to see included. Input has been solicited from the following groups:

- Lyon County
- Storey County
- Carson City
- Carson City Metropolitan Planning Organization (CAMPO)
- Nevada Department of Public Safety/Nevada Highway Patrol (DPS/NHP)
- Lyon County Sherriff
- Lyon County Fire Protection District
- Lyon County Schools Transportation
- Stagecoach Silver Springs Hospital District
- Northern Nevada Development Authority

Numerous private developments are in the planning and development process and more are expected. Figure 5 shows a compilation of developments that are currently in the Lyon County planning process or are anticipated to continue. Most of the development adjacent to the corridor consists of single-family residential homes, with some commercial development adjacent to US 50 and at the major intersections.

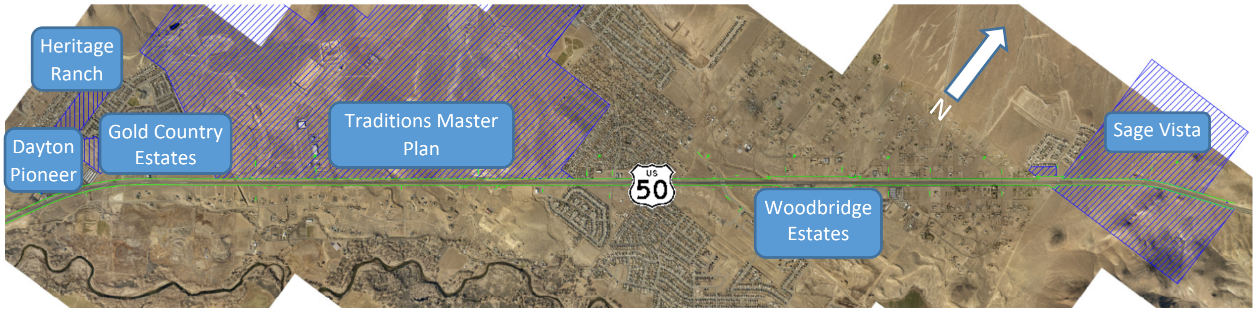


Figure 5: Planned Developments

Figure 6 shows a copy of Lyon County Land Use Map. The Land Use Map and potential developments were used as a starting point to determine a local roadway circulation concept that is needed for the proposed US 50 alternatives. Figure 6 can be viewed in greater detail and higher resolution at https://www.lyon-county.org/DocumentCenter/View/1510/Appendix-A-LandUseMaps-12-23-2010?bidId

The official master plan of the Storey County (McCarran and Mark Twain) in also included in Appendix K.

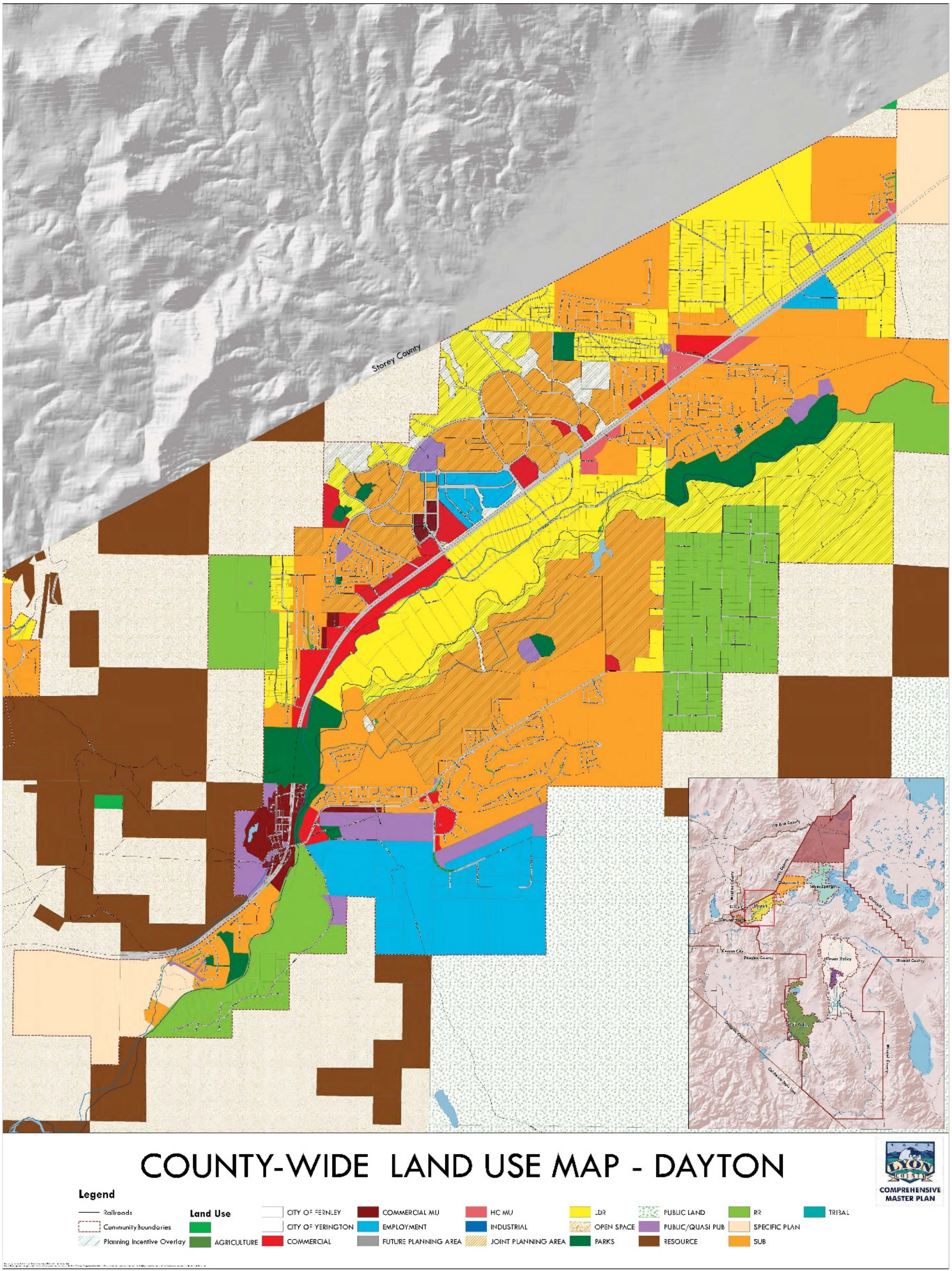


Figure 6: Lyon County Land Use Map

A major restriction in the Dayton Valley transportation network is the Carson River and access across the river to the southeast area of the valley. A second river crossing has been considered by Lyon County to improve access and a preferred location has been identified near the eastern end of the developed area of the valley. This would provide a connection from southeast Dayton to US 50 near Chaves Road as shown in Figure 7.

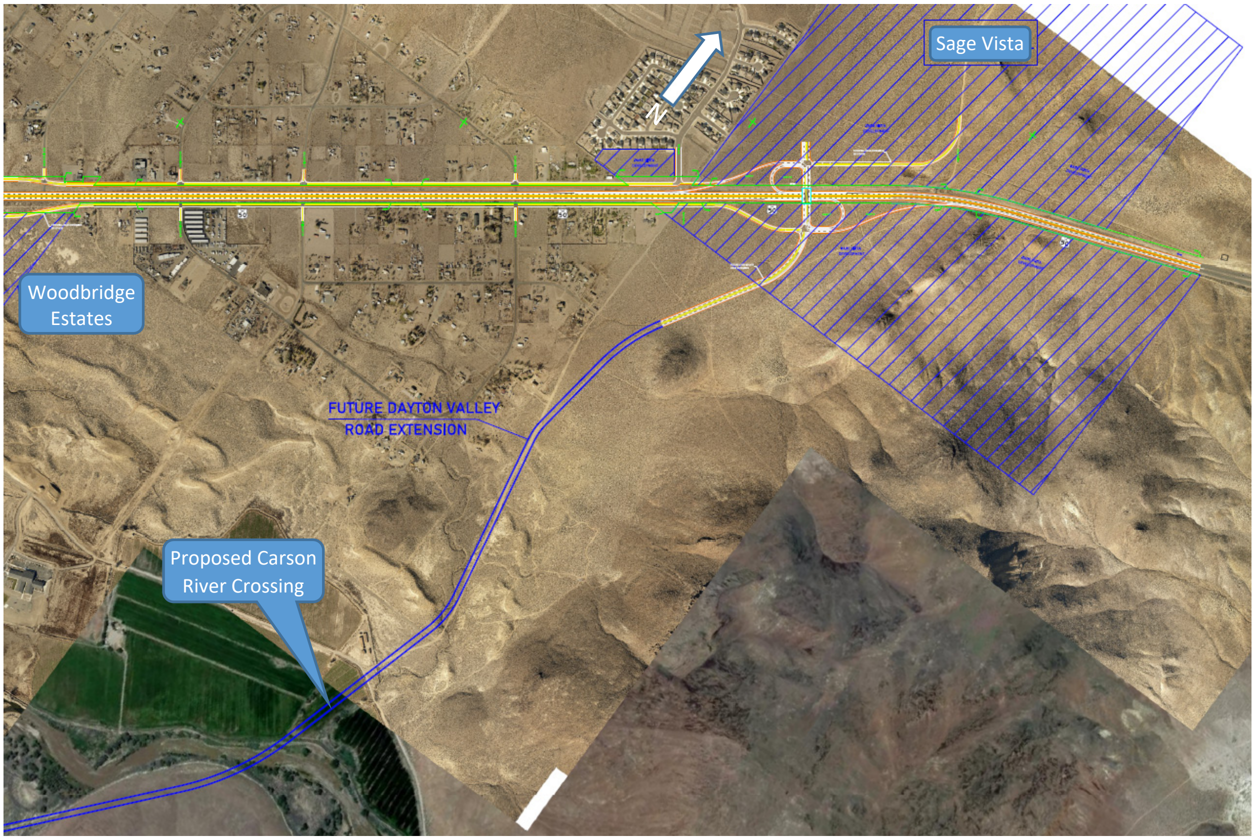


Figure 7: Potential Carson River Crossing

1.3 Existing Conditions Data Collection/Analysis

1.3.1 Traffic Volumes

Existing Average Annual Daily Traffic (AADT) volumes were available through NDOT's Traffic Information Access (TRINA) application. As can be seen in Figure 8, traffic volumes have increased significantly along US 50 in the past five years. From west to east along the corridor, there is a reduction in traffic volumes as local residents turn off to their respective developments.

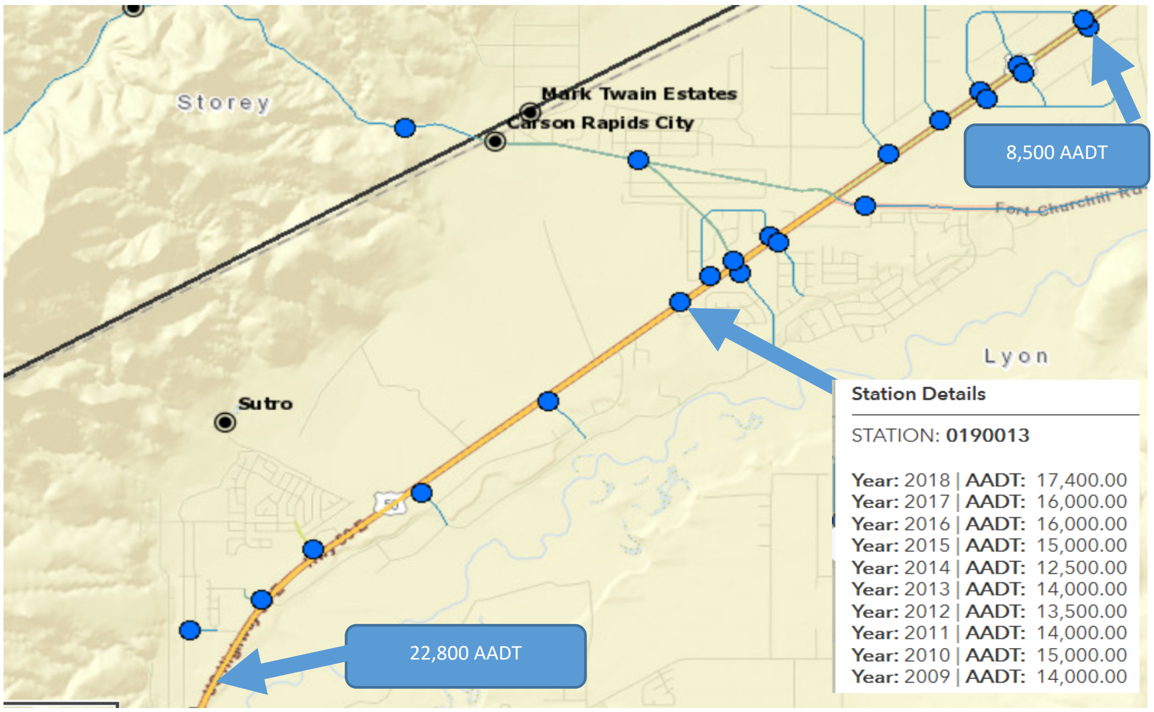


Figure 8: NDOT TRINA Existing Traffic Volumes

Since 2014, the US 50 corridor has seen an average growth of approximately 8% per year. Even during the second half of the Great Recession, traffic volumes remained fairly consistent throughout the corridor.

In an effort to obtain more detailed traffic information, traffic counts at key study intersections were collected as part of this study. In addition, the study team reviewed traffic data, including existing and future forecasts, truck percentage, and freight information along with various proposed development traffic studies. More detailed information of the existing and forecasted traffic information can be found in Traffic Report (Appendix A).

1.3.2 Safety Information

The study team obtained crash data from NDOT for the study limits from July 1, 2013 to July 1, 2018. A corridor and intersection crash analysis was performed on the crash data provided. The corridor crash analysis included crashes along the corridor, while the intersection crash analysis included crashes 425 feet along the major legs of the intersections and 200 feet along the minor legs of the intersection, within the same five-year crash data period. After Traffic/Safety commented on the distances used for the intersection crash data, they were evaluated. The 60 mph mainline section should have been increased to 570 feet along mainline at the intersections. After further review of the corridor crash data this 150-foot change in distance along the mainline for the intersection analysis would have provided six additional crashes at four different intersections, all but one of these crashes were non-collision and were not intersection related. All of these crashes have been captured in the analysis as segment crashes and not intersection crashes. Detailed crash data along the US 50 corridor and existing intersections is included in Appendix B (Crash Data & Crash Charts). The crash data was analyzed to determine any trends or patterns which would indicate specific areas where safety could be enhanced. Based on the safety analysis, crashes are more concentrated in the developed areas of the corridor, especially the retail area between Pine Cone Road and Fortune Drive, and near the Riverboat Road and Six Mile Canyon Road. Prior to this study, there were safety improvements constructed at Retail Road and Fortune Drive that were completed during the crash data analysis period. The crash data was closely evaluated at these locations and there were only two crashes at Fortune Drive and one crash at Retail Road. These crashes were evaluated and determined to be not misleading or an impact to the existing crash analysis. The charts on the following pages identify the predominant crash severities and crash types that occurred at the intersections and along the corridor.

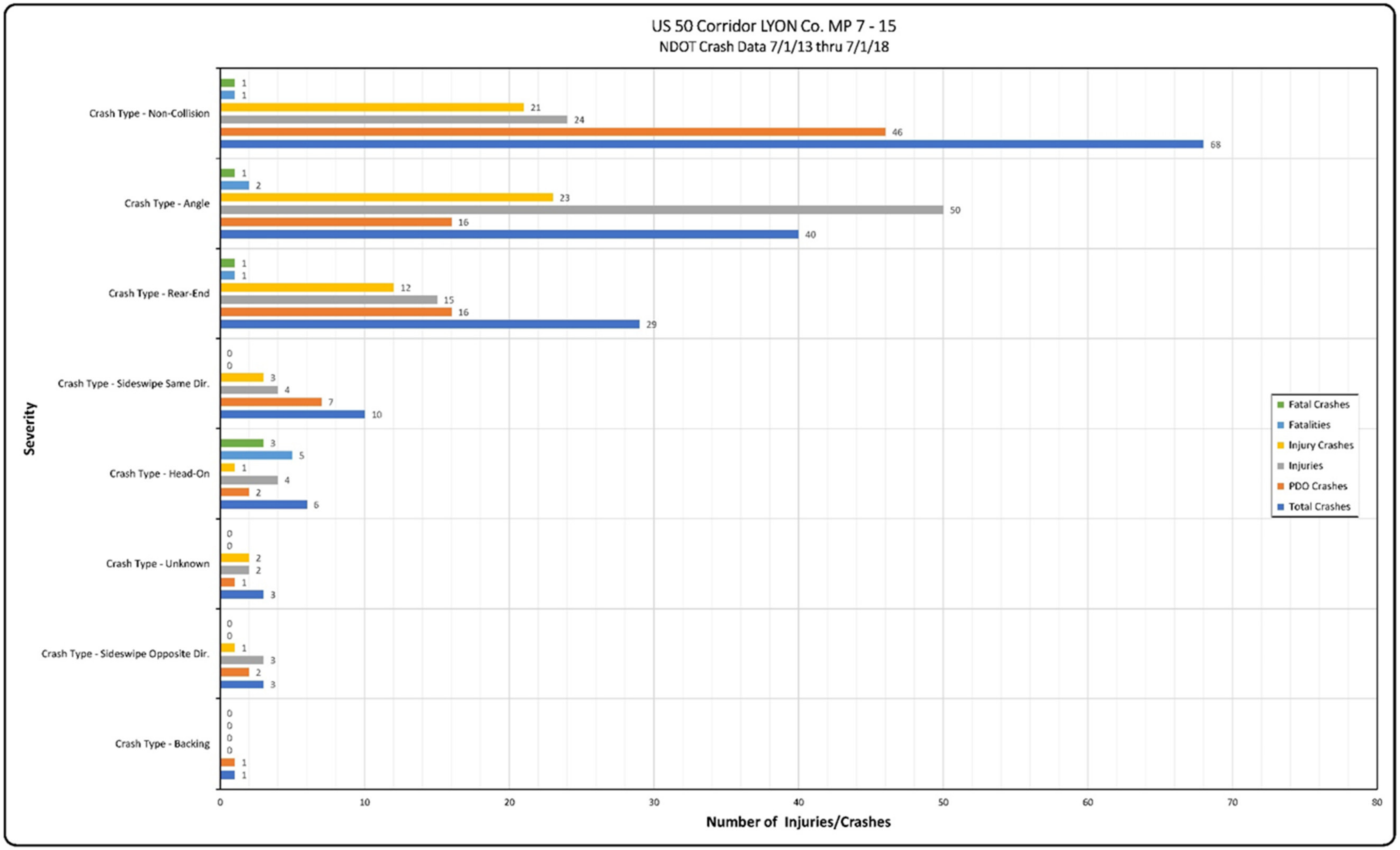
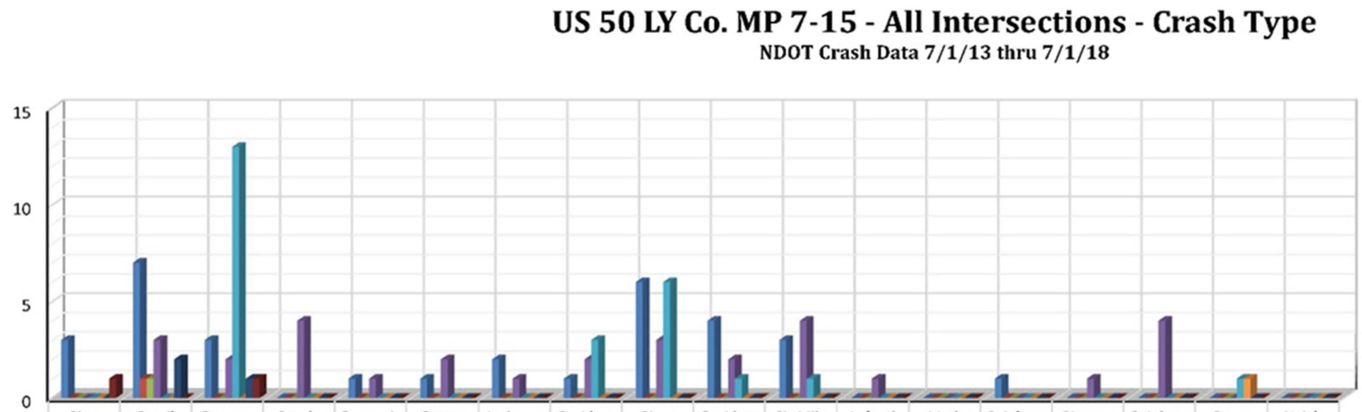
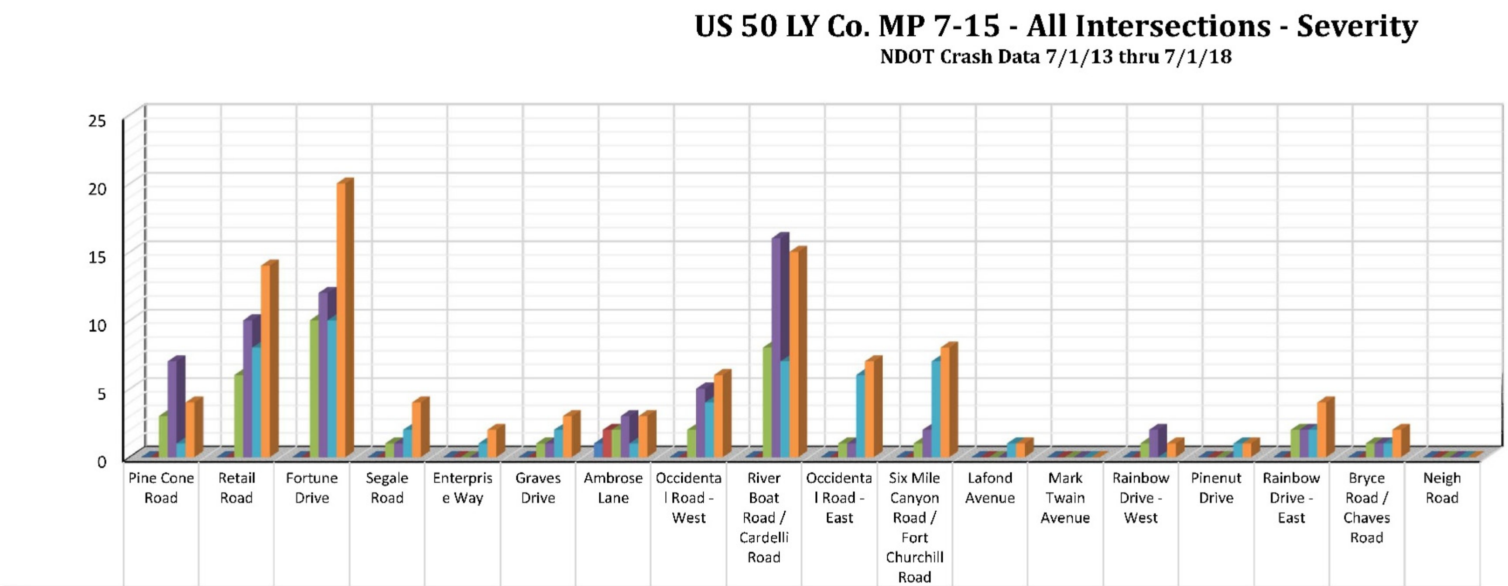


Figure 9: Summary of Crash Types and Severity



	Pine Cone Road	Retail Road	Fortune Drive	Segale Road	Enterprise Way	Graves Drive	Ambrose Lane	Occidental Road - West	River Boat Road / Cardelli Road	Occidental Road - East	Six Mile Canyon Road / Fort Churchill Road	Lafond Avenue	Mark Twain Avenue	Rainbow Drive - West	Pinenut Drive	Rainbow Drive - East	Bryce Road / Chaves Road	Neigh Road
Angle	3	7	3	0	1	1	2	1	6	4	3	0	0	1	0	0	0	0
Backing	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Head On	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-Collision	0	3	2	4	1	2	1	2	3	2	4	1	0	0	1	4	0	0
Rear-End	0	0	13	0	0	0	0	3	6	1	1	0	0	0	0	0	1	0
Sideswipe Opposite Dir.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Sideswipe Same Dir.	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 10: Summary of Crash Types at Intersections



	Pine Cone Road	Retail Road	Fortune Drive	Segale Road	Enterprise Way	Graves Drive	Ambrose Lane	Occidental Road - West	River Boat Road / Cardelli Road	Occidental Road - East	Six Mile Canyon Road / Fort Churchill Road	Lafond Avenue	Mark Twain Avenue	Rainbow Drive - West	Pinenut Drive	Rainbow Drive - East	Bryce Road / Chaves Road	Neigh Road
Fatal Crashes	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Fatalities	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Injury Crashes	3	6	10	1	0	1	2	2	8	1	1	0	0	1	0	2	1	0
Injuries	7	10	12	1	0	1	3	5	16	1	2	0	0	2	0	2	1	0
PDO Crashes	1	8	10	2	1	2	1	4	7	6	7	1	0	0	1	2	1	0
Total Crashes	4	14	20	4	2	3	3	6	15	7	8	1	0	1	1	4	2	0

Figure 11: Summary of the Crash severity at the intersections

US 50, in the study time period of five years (July 1, 2013 to July 1, 2018), had a total of 160 crashes within the corridor limits. Of these crashes, there were six fatal crashes with nine fatalities, five serious injury crashes with seven serious injuries, and 63 injury crashes with 102 injuries. The predominant crash types, descending by the number of crashes are Non-Collision crashes (68), Angle crashes (40), Rear-End crashes (29), Sideswipe Same Direction crashes (10), and Head-on Crashes (6). Table 1 provides the Corridor Crash Analysis and further break down of these crashes.

Table 1: Corridor Crash Analysis

Corridor Crash Analysis	
Overall Crash Data	• 160 total crashes during 07/01/2013 through 07/01/2018 ➢ 6 fatal crashes with 9 fatalities • 63 injury crashes with 102 injuries ➢ 5 A injury crashes with 7 A injuries
Predominant Crash Types	• 68 Non-Collision crashes ➢ 1 fatal crash with 1 fatality • 40 Angle crashes ➢ 1 fatal crash with 2 fatalities • 29 Rear-End crashes ➢ 1 fatal crash with 1 fatality • 10 Sideswipe Same Direction crashes • 6 Head-On crashes ➢ 3 fatal crashes with 5 fatalities
Motorcycle Crashes	• 1 Motorcycle crash
Bus Crashes	• 1 Crash involving a bus
Weather Conditions	• 121 Clear ➢ 5 fatal crashes with 8 fatalities • 30 Cloudy ➢ 1 fatal crash with 3 fatalities • 5 Snow • 4 Rain
Lighting Conditions	• 97 Daylight ➢ 5 fatal crashes with 8 fatalities • 31 Dark – No Lighting ➢ 1 fatal crash with 1 fatality • 25 Dark – Spot Lighting • 4 Dusk • 3 Dawn
Animal Crashes	• 19 Crashes involving horses • 3 Crashes involving dogs/coyotes • 1 Crash involving a bear

2. Alternative Development

As development continues to occur along US 50, it is important to develop a corridor vision that addresses long-term needs and can be followed as development continues to expand and construct transportation infrastructure. The vision will provide a basis for which the affected agencies and adjacent developments can use as the backbone for transportation planning. The number and type of access points along the highway will determine the overall characteristics of the roadway. Three different alternatives were developed to illustrate the type of roadways that could be adopted for the vision of the corridor as well as the impacts associated with each one.

Potential alternatives were discussed for consideration following the Institute of Transportation Engineers (ITE) Unsignalized Intersection Improvement Guide (UIIG). This guide was developed to assist practitioners in selecting design, operation, maintenance, enforcement, and other types of treatments to improve safety, mobility, and accessibility at unsignalized intersections.

Project constraints, as described below, were also considered in the selection of alternatives developed.

Right-of-Way: Approximate right-of-way limits provided by NDOT are shown in the alternative figures. Any alternatives requiring additional right-of-way for roadway, drainage, or utility purposes will impact costs and potentially impact the alternative schedule by approximately two to three years (for the acquisition process).

Topography: The vertical grades on US 50 and approaching roadways are very mild, typically less than one percent.

Drainage: There are several roadside ditches and cross culverts within the study area. Drainage design will be an important factor in design, but it does appear that any of the alternatives can be designed to accommodate drainage with reasonable efforts.

Environmental Areas: There are no known biological or threatened and endangered species issues in the vicinity of the project.

2.1 Alternative 1: Arterial

The Arterial alternative consists of widening US 50 to three lanes in each direction from Pine Cone Road to Chaves Road with a speed limit of 45 mph. Figure 12 shows the typical cross section through the whole corridor. From Chaves Road to Neigh Road, US 50 will maintain two lanes in each direction with a speed limit of 60 mph. This alternative will reduce the speed limit for a majority of the corridor segments within the study limits. The Arterial alternative will essentially provide full access at most existing intersections, for example, full movements for each direction would be accommodated. Access to US 50 will be modified throughout the corridor by adding traffic signals at ten intersections that are currently stop controlled along the minor street. At six other locations the left turns from minor streets are restricted by converting those intersections to a T-intersection, or partial T-intersection, with right-in and right-out only to and from the minor streets. The Arterial alternative is included in Appendix C.

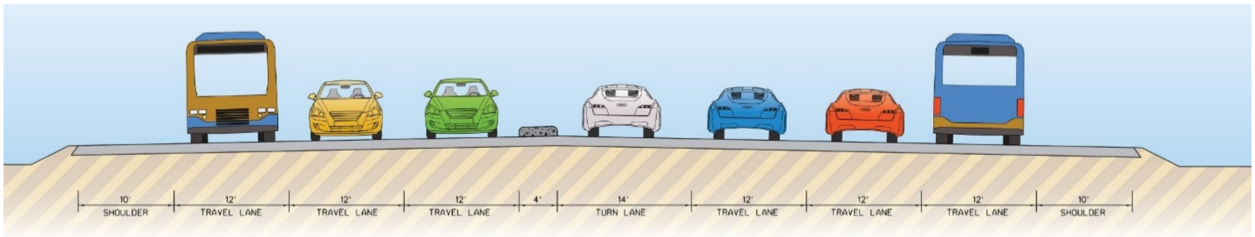


Figure 12: Typical Cross Section for Arterial Alternative

2.2 Alternative 2: Parkway

The Parkway alternative limits more movements than the Arterial alternative, providing better mainline operations. The Parkway alternative consists of widening US 50 to three lanes in each direction from Pine Cone Road to east of Six Mile Canyon Road/Fort Churchill Road with a speed limit of 45 mph (Figure 12). East of Fort Churchill Road to Neigh Road, US 50 will maintain two lanes in each direction with a speed limit of 60 mph (Figure 13). This alternative will reduce the speed limit for majority of the corridor segments within the study limits. Access to US 50 will be modified throughout the corridor by adding traffic signals at five intersections with higher volumes and turning movements. At eleven other locations, the left turns from minor street are restricted by converting those intersections to a T-intersection, or partial T-intersection, with right-in and right-out only to and from the minor streets. The Parkway alternative is included in Appendix C.

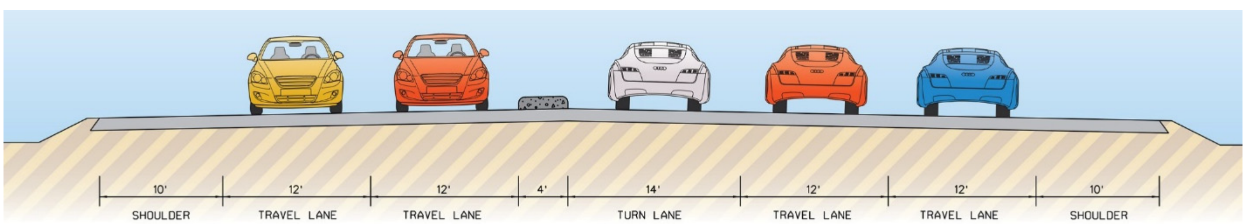


Figure 13: Typical Cross Section for Parkway Alternative (East of Six Mile Canyon Road)

2.3 Alternative 3: Controlled Access (Freeway)

The Controlled Access alternative would limit local access and provide a full freeway for the majority of the corridor. This alternative consists of widening US 50 to three lanes in each direction from Pine Cone Road to east of Fortune Drive with a speed limit of 45 mph. From east of Fortune Drive to Neigh Road, US 50 would transition to a freeway configuration and maintain two lanes in each direction with a speed limit of 65 mph (Figure 14). Interchanges at Traditions Parkway/Segale Road, Six Mile Canyon Road/Fort Churchill Road and Chaves Road were added to provide a Controlled Access facility. Frontage roads are used to tie the minor street network together providing traffic circulation to and from the proposed interchanges. The Controlled Access alternative is included in Appendix C.

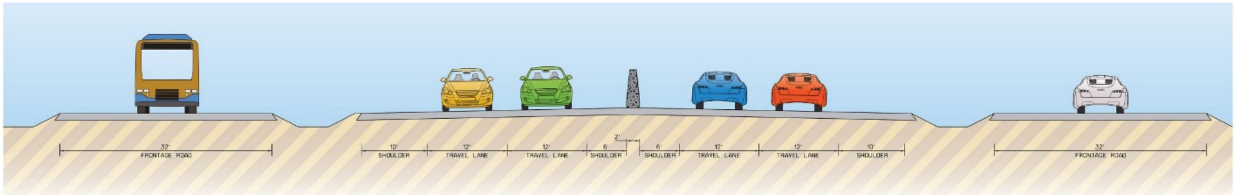


Figure 14: Typical Cross Section for Controlled Access Alternative

Table 2 compares the intersection access for each alternative.

Table 2: Intersection Access Comparison

No.	US 50 Intersections	Scenario			
		Existing	Arterial	Parkway	Controlled Access
1	Pine Cone Rd	TWSC	Signal	TWSC Right-in/Right-out	TWSC
2	Retail Rd/River Rd	TWSC Right-in/Right-out	Signal	Signal	Signal
3	Fortune Dr	Signalized High-T	Signalized High-T	Signalized High-T	Signalized High-T
4	Traditions Pkwy/Segale Rd	TWSC	Signal	Signalized High-T	Signals at Interchange
5	Enterprise Way West	TWSC	TWSC Right-in/Right-out	TWSC Right-in/Right-out	No Access
6	Occidental Dr West	TWSC	TWSC Right-in/Right-out	TWSC Right-in/Right-out	
7	Riverboat Rd/Cardelli Rd	TWSC	Signal	Signal	
8	Occidental Dr East	TWSC	Signal	TWSC Right-in/Right-out	
9	Six Mile Canyon Rd/Fort Churchill Rd	TWSC	Signal	Signal	Signals at Interchange
10	Lafond Ave	TWSC	Signal	TWSC Right-in/Right-out	No Access
11	Mark Twain Rd	TWSC	TWSC Right-in/Right-out	TWSC Right-in/Right-out	
12	Rainbow Dr West	TWSC	TWSC Right-in/Right-out	TWSC Right-in/Right-out	
13	Pinenut Dr	TWSC	Signal	TWSC	
14	Rainbow Dr East	TWSC	TWSC	TWSC Right-in/Right-out	
15	Bryce St	TWSC	Signal	Signal	Signals at Interchange

3. Traffic Operational Analysis

Each alternative was evaluated for performance of major categories; namely Travel Delay, LOS, Vehicle Miles Travelled (VMT), Vehicle Hours Travelled (VHT) and Total Network Delay. All backup data, assumptions, and calculations for each of these criteria are included in the Traffic Report (Appendix A).

Traffic analysis was performed using Synchro 11 using methodologies per Highway Capacity Manual (6th Edition). 2020 Existing Conditions were analyzed to evaluate the current performance measures at the intersections and for the corridor. The 2040 No-Action condition was also evaluated to determine its traffic operations. For 2020 Existing conditions, all intersections along the project network are Two-Way Stop-Controlled (TWSC) except the intersection at US 50 and Fortune Drive, which is signal controlled. For the TWSC intersections, the worst of the minor street delay and LOS is reported. For the signalized intersection, the overall intersection delay and LOS is reported. Table 3 compares the 2020 Existing Conditions and 2040 No-Action delay and LOS for the intersection/movement for both AM and PM peak hours. Detailed information from the traffic analysis is described in the Traffic Report (Appendix A).

Table 3: Comparison for Delay and LOS

Intersection /Scenario	2020 Existing		2040 No-Action	
	AM	PM	AM	PM
US 50 and Pine Cone Road	26.8 (D)	25.4 (D)	F	F
US 50 and Retail/River Road	15.3 (C)	13.2 (B)	F	F
US 50 and Fortune Drive*	16.2 (B)	13.8 (B)	151.8 (F)	66.3 (E)
US 50 and Enterprise Way	25.9 (D)	16.9 (C)	F	F
US 50 and Occidental Drive West	13.6 (B)	11.4 (B)	F	F
US 50 and River Boat Road/Cardelli Road	25.7 (D)	67.5 (F)	F	F
US 50 and Occidental Drive East	25.9 (D)	48.9 (E)	F	F
US 50 and Six Mile Canyon Road/Fort Churchill Road	16.1 (C)	25.5 (D)	F	F
US 50 and Lafond Avenue	10.5 (B)	11.5 (B)	F	F
US 50 and Mark Twain Avenue	11.1 (B)	9.9 (A)	F	F
US 50 and Rainbow Drive West	12.8 (B)	17.2 (C)	F	F
US 50 and S Pinenut Drive	12.1 (B)	15.1 (C)	F	F
US 50 and Rainbow Drive East	11.7 (B)	18.1 (C)	F	F
US 50 and Bryce Street/Chaves Road	10.0 (B)	17.2 (C)	F	F

* Signalized Intersection

In 2020 Existing Conditions, most minor streets are operating with LOS D or better, but in the 2040 No-Action, all the minor streets show considerably higher delay and will be operating at LOS F. The network wide results are shown in Table 4. A considerable increase in all measures of effectiveness are observed in 2040 No-Action indicating major congestion.

Table 4: Comparison of Network Wide Results for Existing and No-Action

Measure of effectiveness	2020 Existing		2040 No-Action	
	AM	PM	AM	PM
Total Distance Traveled-VMT (miles)	7,613	9,293	22,239	27,390
Total Travel Time-VHT (Hours)	167	255	6,280	7,605
Total Network Delay (Hours)	20	74	5,863	7,091

As mentioned in the previous sections, three alternatives were developed to improve traffic operations at the project intersections and along the overall corridor. The comparison of delay and LOS for the three alternatives is shown in Table 5. The cells highlighted in blue have the worst minor street delay and LOS. At the intersection of US 50 and Enterprise Way, the minor street operated at LOS E in the AM peak-hour in both the Arterial and Parkway alternative. In addition, in the Arterial alternative, at the intersection of US 50 and Rainbow Drive East, the minor street operated at LOS F. In the Parkway alternative, the minor street at the intersection of US 50 at Pine Cone Road and at S Pinenut Drive operated at LOS F. The intersection of US 50 and Pine Cone Road also operated at F in the Controlled Access alternative. All of the other project intersections operated at LOS D or better. Traffic operations outside the AM and PM peak-hour would be operating better, as the traffic volumes are typically lower compared to peak hours (AM and PM peak-hour volumes are much higher than non-peak hours). Detailed delay and LOS results are discussed in the Traffic Report (Appendix A).

Table 5: Comparison of Delay and (LOS) of Alternatives

<table>
<tr><th rowspan="2">Intersection/Scenario</th><th colspan="2">Arterial</th><th colspan="2">Parkway</th><th colspan="2">Controlled Access</th></tr>
<tr><th>AM</th><th>PM</th><th>AM</th><th>PM</th><th>AM</th><th>PM</th></tr>
<tr><td>US 50 and Pine Cone Road</td><td>20.8 (C)</td><td>15.4 (B)</td><td>217.3 (F)</td><td>27.9 (D)</td><td>217.3 (F)</td><td>28.7 (D)</td></tr>
<tr><td>US 50 and Retail/River Road</td><td>22.7 (C)</td><td>21.4 (C)</td><td>24.5 (C)</td><td>36.9 (D)</td><td>36.4 (D)</td><td>36.4 (D)</td></tr>
<tr><td>US 50 and Fortune Drive</td><td>40.3 (D)</td><td>30.1 (C)</td><td>41.4(D)</td><td>30.1 (C)</td><td>39.3 (D)</td><td>30.1 (C)</td></tr>
<tr><td rowspan="2">US 50 and Segale Rd/Transitions Pkwy</td><td rowspan="2">22.6 (C)</td><td rowspan="2">24.4 (C)</td><td rowspan="2">29.0 (C)</td><td rowspan="2">24.5 (C)</td><td>26.3 (C)</td><td>16.9 (B)</td></tr>
<tr><td>17.7 (B)</td><td>9.0 (A)</td></tr>
<tr><td>US 50 and Enterprise Way</td><td>39.5 (E)</td><td>21.3 (C)</td><td>39.5 (E)</td><td>21.3 (C)</td><td rowspan="4" colspan="2">–</td></tr>
<tr><td>US 50 and Occidental Drive West</td><td>11.0 (B)</td><td>9.4 (A)</td><td>10.7 (B)</td><td>9.3 (A)</td></tr>
<tr><td>US 50 and River Boat Road/Cardelli Road</td><td>26.4 (C)</td><td>22.5 (C)</td><td>27.5 (C)</td><td>22.9 (C)</td></tr>
<tr><td>US 50 and Occidental Drive East</td><td>20.7 (C)</td><td>8.7 (A)</td><td>34.5 (D)</td><td>31.1 (D)</td></tr>
<tr><td rowspan="2">US 50 and Six Mile Canyon Road/Fort Churchill Road</td><td rowspan="2">9.0 (A)</td><td rowspan="2">25.8 (C)</td><td rowspan="2">35.4 (D)</td><td rowspan="2">33.3 (C)</td><td>26.7 (C)</td><td>34.4 (C)</td></tr>
<tr><td>37.4 (D)</td><td>36.3 (D)</td></tr>
<tr><td>US 50 and Lafond Avenue</td><td>12.1 (B)</td><td>7.6 (A)</td><td>20.6 (C)</td><td>16.6 (C)</td><td rowspan="5" colspan="2">–</td></tr>
<tr><td>US 50 and Mark Twain Avenue</td><td>20.8 (C)</td><td>18.1 (C)</td><td>18.2 (C)</td><td>15.8 (C)</td></tr>
<tr><td>US 50 and Rainbow Drive West</td><td>22.2 (C)</td><td>18.5 (C)</td><td>19.1 (C)</td><td>16.1 (C)</td></tr>
<tr><td>US 50 and S Pinenut Drive</td><td>19.2 (B)</td><td>20.1 (C)</td><td>(F)</td><td>(F)</td></tr>
<tr><td>US 50 and Rainbow Drive East</td><td>(F)</td><td>(F)</td><td>19.0 (C)</td><td>16.5 (C)</td></tr>
<tr><td rowspan="2">US 50 and Bryce Street/Chaves Road</td><td rowspan="2">29.2 (C)</td><td rowspan="2">27.1 (C)</td><td rowspan="2">33.7 (C)</td><td rowspan="2">29.4 (C)</td><td>35.6 (D)</td><td>25.0 (C)</td></tr>
<tr><td>39.0 (D)</td><td>31.2 (C)</td></tr>
</table>

Cells filled in blue are the worst of the minor street delay and LOS since the intersections are unsignalized

The network wide results for the three alternatives are compared in Table 6. The 2040 Build Alternatives have higher VMT during both AM and PM, except for the AM peak for Parkway Alternative, which is slightly less than the 2040 No-Action. The Controlled Access alternative has highest VMT among the three alternatives. Comparing the VHT, all of the three alternatives have lower VHT compared to the 2040 No-Action indicating less congestion in the network. The Controlled Access alternative had the lowest VHT among the three alternatives. The total network delay for all three Build Alternatives was considerably lower than the 2040 No-Action. Similar to VHT, the lowest delay was observed for the Controlled Access alternative.

Table 6: Comparison of Network Wide Results of Alternatives

Measure of effectiveness	Arterial		Parkway		Controlled Access	
	AM	PM	AM	PM	AM	PM
Total Distance Traveled-VMT (miles)	22,241	27,495	22,155	27,421	22,980	29,079
Total Travel Time-VHT (Hours)	642	774	730	907	535	658
Total Network Delay (Hours)	140	156	252	304	119	131

4. Safety Analysis

4.1 IHSDM Analysis

The Interactive Highway Safety Design Model (IHSDM) Crash Prediction Model (CPM) was used to predict the number of crashes for the existing condition and for the 2040 No-Action and Build alternatives. The IHSDM requires the same data needed for the predictive models in Part C of the HSM, and these models differ for each facility and intersection type, that is, Urban and Suburban Arterials and Freeway facilities, and three- or four-legged stop or signal controlled intersection that ties into the facility type. Using the IHSDM requires the user to break each facility into homogenous segments, by evaluating the following roadway elements, geometric data, area type, AADT, and speed. The segments are clearly defined by one or more of these data items. Once the segments identified there are additional data elements need to complete the evaluation of the segment. These data elements are discussed below in the alternatives analysis sections. Figure 15 shows the typical roadway segments used in the IHSDM and Figure 16 shows the typical freeway data identified by the IHSDM.

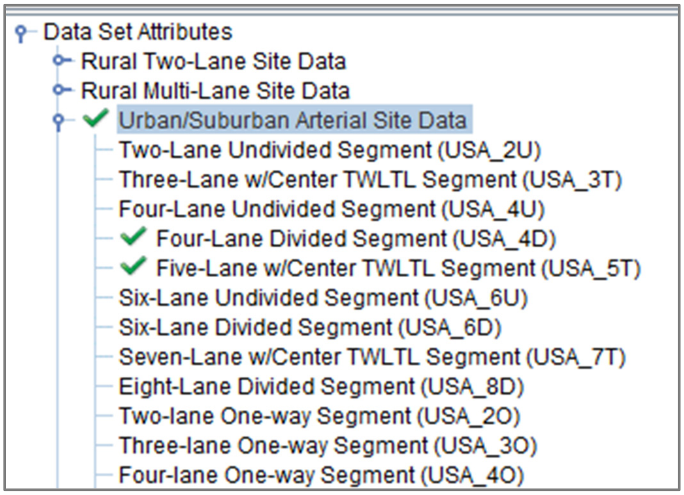


Figure 15: Example of IHSDM Segments

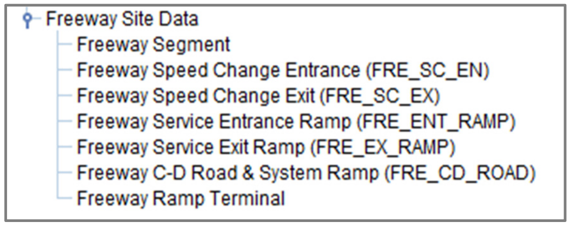
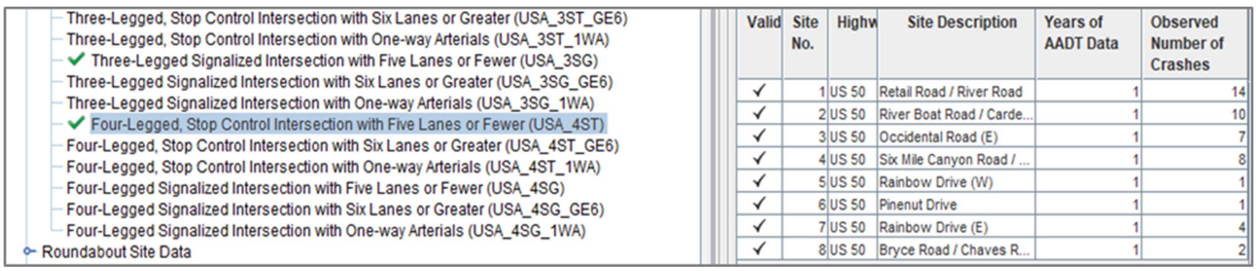


Figure 16: Example of IHSDM Freeway Segments

The intersection analysis used in the IHSDM (CPM) follows similar methods when evaluating each intersection. As with breaking the facility into segments, the intersections have to be defined and built by the criteria defined by the IHSDM. The intersections also need additional data elements to complete the analysis, these data elements are discussed below in the alternative's analysis section. Figure 17 shows the typical intersection types used in the IHSDM.



Valid	Site No.	Highw	Site Description	Years of AADT Data	Observed Number of Crashes
✓	1	US 50	Retail Road / River Road	1	14
✓	2	US 50	River Boat Road / Carde...	1	10
✓	3	US 50	Occidental Road (E)	1	7
✓	4	US 50	Six Mile Canyon Road / ...	1	8
✓	5	US 50	Rainbow Drive (W)	1	1
✓	6	US 50	Pinenut Drive	1	1
✓	7	US 50	Rainbow Drive (E)	1	4
✓	8	US 50	Bryce Road / Chaves R...	1	2

Figure 17: Example of IHSDM Intersections

4.2 Existing Condition

The existing conditions of US 50 between Pine Cone Road and Neigh Road (Figure 2), as stated above in the study limits were segmented into 18 segments. Using the existing intersections as the key segment break points this corridor was divided into homogeneous segments. The first two segments, between Pine Cone Road and Fortune Drive, were identified as Urban/Suburban Arterial four-lane divided segments and the next sixteen segments, between Fortune Drive and Neigh Road were identified as Urban/Suburban Arterial, five-lane with a two-way left-turn lane segments. The IHSDM analysis of the existing condition intersections was also conducted and included seventeen intersections. One intersection was identified as a three-legged, signalized intersection with five lanes or fewer; eight intersections were identified as three-legged, stop controlled intersections with five lanes or fewer; and eight intersections were identified as four-legged, stop controlled intersections with five lanes or fewer. Data requirements for the IHSDM to run the Crash Prediction Model for segments and intersection are listed in Figures 18, 19, and 20, and they cover the data requirements for the existing conditions and all alternatives. The combined results for this analysis are shown in Table 7, and included in Appendix IHSDM Combined Results. All of the IHSDM analysis reports are listed in Appendix F IHSDM Safety Analysis.

IHSDM Required Data for Crash Prediction Models	
Segment Type	
5 Lanes or fewer and 6 Lanes or more	
	Data Elements
General	Speed Category; AADT; Functional Classification; Area type; Posted Speed
Cross Section	Thru Lane; Two-way Left-turn lane (TWLTL) (if present); Lane Width; Median; Median Barrier; Auxillary Lanes(Left/Right Turn Lanes); Shoulder Section; Lane Offset
Roadside	Roadside fixed object density; Railroad Crossing; Driveway locations and types; Automated Speed Enforcement

Figure 18

IHSDM Required Data for Crash Prediction Models
Intersections
Intersections with 5 Lanes or fewer
Data Elements
Number of Legs (only 3 and 4-legged intersections of the urban and suburban arterials would be evaluated by these models)
Traffic Control (signal-control and minor-stop-control for 3 and 4-leg intersections)
Average daily traffic for both major and minor roads
Sum of daily pedestrian volume (pedestrian/day) crossing all intersection legs
Maximum number of traffic lanes crossed by a pedestrian in any cross maneuver at the intersection considering the presence of refuge island
Number of approaches on which right turn on red is allowed (prohibited)
Proportion of total crashes for unlighted intersections that occur at night (default values are provided)
Number of bus stops within 300 meter (1000 ft) of the center of the intersection (0; 1 or 2; 3 or more)
School presence within 300 meter (1000 ft) of the center of the intersection (Yes/No)
Number of Alcohol Sales Establishments within 300 meter (1000 ft) of the intersection (0; 1-8; and 9 or more)
Presence of Red Light Camera
Presence of Lighting
Left-Turn signal phasing (permissive; protected/permissive or permissive/protected; protected)

Figure 19

IHSDM Required Data for Crash Prediction Models
Intersections
Intersections with 6 or more lanes
Data Elements
Number of Legs (only 3 and 4-legged intersections of the urban and suburban arterials would be evaluated by these models)
Traffic Control (signal-control and minor-stop-control for 3 and 4-leg intersections)
Average daily traffic for both major and minor roads
Number of Lanes on each intersecting road
Sum of daily pedestrian volume (pedestrian/day) crossing all intersection legs
Maximum number of traffic lanes crossed by a pedestrian in any cross maneuver at the intersection considering the presence of refuge island
Number of approaches on which right turn on red is allowed (prohibited)
Number of major-road approaches with channelized right turn lane
Number of approaches on which U turn is prohibited
Proportion of total crashes for unlighted intersections that occur at night (default values are provided)
Number of bus stops within 300 meter (1000 ft) of the center of the intersection (0; 1 or 2; 3 or more)
School presence within 300 meter (1000 ft) of the center of the intersection (Yes/No)
Number of Alcohol Sales Establishments within 300 meter (1000 ft) of the intersection (0; 1-8; and 9 or more)
Presence of Red Light Camera
Presence of Lighting
Left-Turn signal phasing (permissive; protected/permissive or permissive/protected; protected)

Figure 20

4.3 Alternative 1 – Arterial

Using the intersections identified in the Arterial alternative as the key segment break points, this corridor was divided into 18 homogeneous segments. The first two segments (between Pine Cone Road and Fortune Drive) were identified as six lane Urban/Suburban Arterial divided segments, the next fifteen segments (between Fortune Drive and Bryce Street/Chaves Road) were identified as six lane Urban/Suburban Arterial undivided segments, and the last segment was identified as five-lane with a two way left turn lane segment. The IHSDM analysis of the Arterial Alternative intersections was also conducted and included twenty intersections. Two intersections were identified as a three-legged, signalized intersection with six lanes or greater; one intersection was identified as three-legged, stop controlled intersection with five lanes or fewer; four intersections were identified as three-legged, stop controlled intersection with six lanes or greater; one intersection was identified as four-legged, stop controlled intersection with five lanes or fewer; four intersections were identified as four-legged, stop controlled intersections with six lanes or greater; one intersection was identified as four-legged, signalized intersection with five lanes or fewer; and eight intersections were identified as four-legged, signalized intersection with six lanes or greater. Six of these intersections had median islands to control access and required further analysis. The intersections were calculated as a one-way T-intersections, to simulate not permitting left turns from the minor road, which result was than averaged with the number of crashes at the intersection in the existing condition. There were two intersections where a High-T intersection was identified. A Crash Modification Factor was utilized in the ISHDM to calculate the crash reductions for the intersection. The combined results for this analysis are shown in Table 7, and included in Appendix E IHSDM Combined Results. All of the IHSDM analysis reports are listed in Appendix F IHSDM Safety Analysis.

4.4 Alternative 2 – Parkway

Using the intersections identified in the Parkway alternative as the key segment break points, this corridor was divided into 18 homogeneous segments. The first two segments (between Pine Cone Road and Fortune Drive) were identified as six lane Urban/Suburban Arterial divided segments, the next nine segments (between Fortune Drive and Six Mile Canyon Road/Fort Churchill Road) were identified as six lane Urban/Suburban Arterial undivided segments, and the next seven segments (between Six Mile Canyon Road/Fort Churchill Road and Neigh Road) were identified as Urban/Suburban Arterial, five-lane with a two way left turn lane segments. The IHSDM analysis of the Arterial Alternative intersections was also conducted and included twenty intersections. One intersection was identified as a three-legged, signalized intersection with six lanes or greater; one intersection was identified as three-legged, stop controlled intersection with five lanes or fewer; four intersections were identified as three-legged, stop controlled intersection with six lanes or greater; four intersections were identified as four-legged, stop controlled intersection with five lanes or fewer; three intersections were identified as four-legged, stop controlled intersections with six lanes or greater; one intersection was identified as four-legged, signalized intersection with five lanes or fewer; and four intersections were identified as four-legged, signalized intersection with six lanes or greater. Six of these intersections had median islands to control access and required further analysis. The intersections were calculated as a one-way T-intersections, to simulate not permitting left turns from the minor road that result was than averaged with the number of crashes at the intersection in the existing condition. There were five intersections where a High-T intersection was identified. A Crash Modification Factor was utilized in the ISHDM to calculate the crash reductions for the intersection. The combined results for this analysis are shown in Table 7, and included in Appendix E IHSDM Combined Results. All of the IHSDM analysis reports are listed in Appendix F IHSDM Safety Analysis.

4.5 Alternative 3 – Controlled Access (Freeway)

Using the intersections and interchanges identified in the Controlled Access alternative as the key segment break points, this corridor was divided into three homogeneous segments and five freeway segments. The first three segments (between Pine Cone Road and the beginning of the freeway) were identified as six lane Urban/Suburban Arterial divided segments, the next five segments (between the beginning of the freeway and just past Neigh Road) were identified as freeway segments. Figure 21 shows a small portion of the data entry for the freeway segments. Along with the freeway segments there were seven freeway speed change lanes, entrance, and six freeway speed change lanes, exit. These define the acceleration and deceleration lanes enter or exit on to the freeway. Along with the freeway segments and speed change lanes there were nine freeway service entrance ramps and seven freeway exit ramps.

	Highway	Site Description	Area Type	Rightside Number Thru Lanes	Leftside Number Thru Lanes	Length (mi)	Effective Segment Length (mi)	Average Lane Width (ft)	Effective Median Width (ft)	Proportion Segment Length With Median Barrier	Average Median Barrier Offset from Inside Shoulder	Proportion Segment Length With Outside Barrier	Average Outside Barrie Offset from Outside
1	US 50	Segment 1	Suburban	2	2	0.9700	0.9700	12.00	16.00	1.000	6.00	0.000	10.(
2	US 50	Segment 2	Suburban	2	2	1.7400	1.7400	12.00	16.00	1.000	6.00	0.370	10.(
3	US 50	Segment 3	Suburban	2	2	1.0100	1.0100	12.00	16.00	1.000	6.00	0.870	10.(
4	US 50	Segment 4	Suburban	2	2	1.3400	1.3400	12.00	16.00	1.000	6.00	0.000	10.(
5	US 50	Segment 5	Suburban	2	2	1.3900	1.3900	12.00	16.00	1.000	6.00	0.000	10.(

Figure 21: Example of Freeway Segment Data Entered in the IHSDM

The IHSDM analysis of the Controlled Access Alternative intersections was also conducted and included three intersections. One intersection was identified as a three-legged, signalized intersection with six lanes or greater; one intersection was identified as three-legged, stop controlled intersection with six lanes or greater; and one intersection was identified as four-legged, signalized intersection with six lanes or greater. One intersection had median islands to control access and required further analysis. The intersection was calculated as a one-way T-intersection, to simulate not permitting left turns from the minor road that result was than averaged with the number of crashes at the intersection in the existing condition. The data requirements to run the IHSDM Crash Prediction Model for freeway segments and ramps are listed in Figure 22 and the detailed data is listed in Appendix D IHSDM Controlled Access Data. The combined results for this analysis are shown in Table 7, and included in Appendix E IHSDM Combined Results. All of the IHSDM analysis reports are listed in Appendix F IHSDM Safety Analysis.

IHSDM Required Data for Crash Prediction Models	
Freeway Segments and Speed Change Lanes	
Data Elements	
General	Functional Class; AADT; Area Type
Horizontal	length of section; presence of curve
Vertical	used for system purpose only, take the default as a level tangent
Cross Section	Lane; Median[1]; Ramp Connection; Shoulder Section[2]; Cross Slope (used for system purpose only, take the default value)
Crash Prediction Specific	High Volume Section; Weaving Section; Median Barrier; Outside Barrier; Clear Zone; Crash History Data
Freeway Ramps and C-D Roads	
Data Elements	
General	Area Type; Functional Class; AADT
Horizontal	Complete, including: Length of curve if present prior/in the segment; Radius of curve if present prior/in the segment; Average Entering Speed (of vehicles entering ramp)
Vertical	used for system purpose only, take the default as a level tangent
Ramp Type	Not Set; Entrance; Exit (for Service Ramps only not for C-D roads & System Ramps)
Cross Section	Lane; Ramp Connetor; Shoulder Section
Crash Prediction Specific	Weaving Section; Left side Barrier; Right side Barrier; Crash History Data

Figure 22

Table 7: IHSDM Analysis Results

Combined Roadway Sections and Intersections Crash Totals (NO Build)

Site No.	Type	Highway	Site Description	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)	Predicted Intersection Travel Crash Rate (crashes/million veh)	Intersection Crash Rate (crashes/yr)
			Total	7.62	2679.53	125.67	39.64	86.03	21.40	1.85	0.61	33.49

Predicted Severity Total for Evaluation Period

Fatal	A	B	C	PDO
21.23	94.23	359.62	780.98	1423.50

Predicted Severity per year

		Fatal	A	B	C	PDO
2020	57.67	0.46	2.03	7.74	16.81	30.64
2040	198.14	1.57	6.97	26.59	57.75	105.26

Combined Roadway Sections and Intersections Crash Totals (Arterial)

Site No.	Type	Highway	Site Description	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)	Predicted Intersection Travel Crash Rate (crashes/million veh)	Intersection Crash Rate (crashes/yr)
			Total	7.62	2579.02	122.81	54.03	68.78	28.67	2.79	1.77	56.11

Predicted Severity Total for Evaluation Period

Fatal	A	B	C	PDO
20.44	90.69	346.13	751.68	1370.11

Predicted Severity per year

		Fatal	A	B	C	PDO
2020	59.04	0.47	2.08	7.92	17.21	31.37
2040	192.15	1.52	6.76	25.79	56.00	102.08

Combined Roadway Sections and Intersections Crash Totals (Parkway)

Site No.	Type	Highway	Site Description	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)	Predicted Intersection Travel Crash Rate (crashes/million veh)	Intersection Crash Rate (crashes/yr)
			Total	7.62	2566.51	121.67	49.68	72.10	31.43	2.84	5.50	41.64

Predicted Severity Total for Evaluation Period

Fatal	A	B	C	PDO
19.95	90.66	347.98	724.21	1383.69

Predicted Severity per year

		Fatal	A	B	C	PDO
2020	55.73	0.43	1.97	7.56	15.73	30.05
2040	193.64	1.50	6.84	26.25	54.64	104.39

Combined Roadway Sections, Intersections, Freeway Sections, Speed Change Lanes and Freeway Ramps Crash Totals (Controlled Access)

Site No.	Type	Highway	Site Description	Length (mi)	Total Predicted Crashes for Evaluation Period	Predicted Total Crash Frequency (crashes/yr)	Predicted FI Crash Frequency (crashes/yr)	Predicted PDO Crash Frequency (crashes/yr)	Predicted Crash Rate (crashes/mi/yr)	Predicted Travel Crash Rate (crashes/million veh-mi)	Predicted Intersection Travel Crash Rate (crashes/million veh)	Intersection Crash Rate (crashes/yr)
			Total	13.15	2100.22	100.01	36.12	63.89	40.59	7.55	0.75	10.50

Predicted Severity Total for Evaluation Period

Fatal	A	B	C	PDO
14.40	54.63	270.06	592.45	1171.90

Predicted Severity per year

		Fatal	A	B	C	PDO
2020	92.46	0.64	1.97	10.51	20.31	59.03
2040	107.55	0.73	2.43	12.53	24.78	67.06

Construction Cost: Quantities were summarized in a spreadsheet using calculated quantities of materials for each type of construction per location. Construction items included removals, base and surfacing, concrete structures, striping, and lighting. Unit prices for each of the quantified items were selected in 2019 dollars based on historical bid tabulation data and NDOT cost data. Once compiled, the cost estimates were checked, and contingency factors were applied for traffic control, drainage, landscaping, mobilization, preliminary design, utilities, right-of-way, and construction engineering for total improvement costs (Appendix G).

Safety Benefit-Cost: Safety benefits were estimated using a reduction in predicted crashes between existing conditions and the alternatives from IHSDM Safety Analysis and are included in Appendix H Safety BC Analysis. Societal costs for crashes in 2020 dollars were from NDOT 2020 Performance Management Report, Table E-5 Crash Cost Assumptions. Reduction in crashes multiplied by societal costs provides an annual safety benefit. Construction Costs from Appendix G were utilized to calculate the safety B/C ratio.

5. Benefit-Cost Analysis

The benefit-cost analysis (BCA) quantified the project's estimated user benefits and costs over a specified period. User benefits were quantified and compared to project costs using a 20-year life-cycle analysis utilizing the Cal-BC v7.2 Corridor spreadsheet tool. Benefits and costs were estimated using the existing year 2020, project opening year 2021, and design (horizon) year 2040 AADT. Travel time savings, safety cost savings, vehicle emissions reductions, residual value, and vehicle operating cost (VOC) savings comprised the quantified benefits. VOC costs savings are cost savings that vary with vehicle miles traveled such as fuel, maintenance and repair, tires, depreciation, leases, insurance, permits, and licenses. Project costs were estimated from initial capital costs, subsequent maintenance, and rehabilitation costs, and are provided in Appendix G.

Savings in travel time, VOC, and emission reductions were estimated using the difference between the No-Action and each of the Build alternatives. Generally, VMT and VHT from Synchro analysis are converted to benefits using the travel cost, VOC, vehicle occupancy, and proportion of trucks parameters listed in Appendix I (as discussed below). These are obtained from the NDOT 2020 Performance Management Report, which provides recommended statewide average values to monetize typical benefits of transportation projects. The residual value was estimated from the Controlled Access only as discussed below. Table 8 provides a summary of the value of benefits.

Alternative 1: Arterial

Using the Cal-BC v7.2 Corridor spreadsheet tool, the analyzed model was divided into three model groups by time, AM peak-hour, PM peak-hour, and the rest-of-the-day. 2020 and 2040 VMT and VHT were used to quantify travel time savings, VOC, and emissions. To obtain average daily VHT and VMT estimates, an annualization factor of 365 was used with the Synchro VHT and VMT output, which assumed a straight-line interpolation over the 20-year period.

Alternative 2: Parkway

Similar to the Arterial alternative, the Parkway alternative model structure was divided into three model groups by time: AM peak-hour, PM peak-hour, and the rest-of-the-day. Travel time savings, VOC, and emissions reduction were obtained using VMT and VHT. Average daily VHT and VMT were interpolated over the 20-year period after being annualized (annualization factor of 365).

Alternative 3: Controlled Access (Freeway)

The Controlled Access alternative was divided into model groups for AM peak-hour, PM peak-hour, and the rest-of-the-day for mainline and ramp segments. This resulted in a total of 84 model groups with speed limits of 65 mph and 35 mph on the mainline and ramp segments respectively. 2040 volumes for this alternative and the proposed speed limit were used to determine the annualized VMT and VHT. The VHT and VMT were used to perform a consistent comparison between the 2020 and 2040 No-Action, and the 2040 Controlled Access alternative.

The Controlled Access alternative required three bridge structures at the respective interchanges. The useful service life for bridge structures typically spans 75 years. The analysis was for 20 years leaving 55 years of useful service life at the end of the study period. The remaining years of useful service life were used to estimate total residual and discounted values as a benefit.

Initial Capital Costs were obtained from Appendix G. Each alternative was evaluated for operation and maintenance costs over a 20-year life cycle period. Routine maintenance includes pavement, bridge structures, lighting, and landscaping. Pavement rehabilitation was based on a 2-inch mill and overlay over a ten-year period. Bridge structures typically require approximately $7,000 each year in maintenance cost. Lighting fixtures typically require approximately $100 each, per year in operation and maintenance costs. Landscaping can vary based on specific features. A lump sum of $6,000 was used for annual landscaping labor and supplies. The signal maintenance was estimated to cost $2,500 per year which includes retiming costs and power. Table 9 provides a summary of the project costs.

Table 8: Total Discounted Benefits (2019$)

Benefit Categories	Arterial	Parkway	Controlled Access
Travel Time Savings	$1,311,173,149	$1,237,269,128	$1,306,184,566
Vehicle Operation Savings	$74,170,434	$73,609,761	$77,342,508
Crash Reduction Savings	$1,839,402	$4,785,630	$36,355,511
Vehicle Emission Reductions	$2,566,974	$2,532,810	$2,378,379
Residual Value	-	-	$5,066,600
Total Benefits	**$1,389,749,959**	**$1,318,197,077**	**$1,427,327,564**

Table 9: Total Discounted Costs (2019$)

Cost Items	Arterial	Parkway	Controlled Access
Capital Costs	$58,706,000	$45,950,991	$88,617,993
Operation and Maintenance	$9,804,728	$9,129,296	$9,708,143
Total Costs	**$68,510,728**	**$55,080,287**	**$98,326,136**

Present Value of discounted life-cycle costs (in 2019 dollars) was estimated from the years 2021 to 2040 using a 7% real discount rate to quantify annual costs. 2019 dollars were used to be consistent with the 2019 dollars for the safety society costs, travel costs, VOC costs and vehicle emissions costs reported in the 2020 NDOT Performance Management Report. Life-Cycle B/C ratio was calculated from the benefits and costs that were estimated for each of the alternatives compared to existing conditions as summarized in Table 10 on the following page. Details of the BCA are included in Appendix J.

Table 10: Alternatives Summary Table

Parameter	Existing Condition	Alt. 1 Arterial	Alt. 2 Parkway	Alt. 3 Controlled Access
Safety Analysis				
Existing Crashes per year (Avg)	32	N/A	N/A	N/A
Safety Analysis, predicted crashes per year (Avg)	125.67	122.81	121.67	100.01
Cost Analysis				
Right-of-Way Area [Yes/No]	N/A	None		Yes
Right-of-Way Utility Conflicts [Yes/No]	N/A	No	No	Yes
Retaining Walls/Structures [Yes/No]	N/A	No	No	No
Need for Environmental Evaluation [Yes/No]	N/A	No	No	No
Project Cost, initial (2019 dollars)	N/A			
Total Project and Life Cycle Costs (2019 dollars)	N/A	$68.5 M	$55.1 M	$98.3 M
Benefit-Cost Method				
Safety Performance Benefit-Cost Ratio	N/A	0.12	0.20	0.60
Life-Cycle Benefit-Cost Ratio	N/A	20.29	23.93	14.52
Life-Cycle Benefit-Cost Ratio with Sensitivity	N/A	19.69 - 20.91	23.24 - 24.67	14.09 – 14.97

6. Public Outreach

A virtual public meeting was conducted on May 11, 2021, from 5:30 PM to 7:00 PM. A presentation over the study's goals, objectives, existing condition, and potential alternative was provided. After the presentation, a question-and-answer session was conducted for attendees to type in questions and the study team to provide responses. A 30-day comment period was provided after the public meeting for comments to be provided via a project email identified on the study's website.

During this comment period, the public also had access via the website to a survey requesting feedback on the following three questions:

1. Please select your first choice of the three long-term visions identified (Arterial Concept, Parkway Concept, or Controlled Access Concept);
2. Please select your second choice of the three long-term visions identified (Arterial Concept, Parkway Concept, or Controlled Access Concept);
3. Please select your last choice of the three long-term visions identified (Arterial Concept, Parkway Concept, or Controlled Access Concept);
4. What is your biggest priority that you feel the long-term vision should address (Safety, Multi-Modal, Mobility, Access); and
5. Do you have any additional comment or feedback regarding the US 50 Operational Study?

Table 11 provides a summary of the result for questions 1-3 of the survey.

Table 11: Survey Results Summary Question 1 to 3

Concept	Question 1: First Choice	Question 2: Second Choice	Question 3: Last Choice
Arterial	20	20	31
Parkway	24	35	7
Controlled Access	24	13	30

Table 12 provides a summary of the results of question 4.

Table 12: Survey Results Summary Question 4

Safety	Multi-Modal (Bikes, Peds, etc.)	Mobility (minimizing delay on US 50)	Access (providing access to US 50)
39	2	14	13

Question 5 received forty-six typed response which can be found in Appendix L. Appendix M also provides a summary of the thirty-nine email comments received during the 30-day comment period.

7. Final Comparison and Recommendation

As a result of continuous development, US 50 from Pine Cone Road to Neigh Road is rapidly changing from a rural corridor. This change requires the Department and other local agencies to be proactive in the development of US 50 and the adjacent roadway network to ensure a balance between operations and access, while also providing a safe corridor for local residents and pass-through traffic. This study has identified three potential long-term visions for the corridor and conducted an extensive analysis on each alternative's long-term traffic operations, safety, costs, and overall benefits. Table 13 provides a comparison summary between the various proposed alternatives.

Table 13: Comparison of Alternatives

Alternative	Benefits	Risks
1 Arterial	• Most access to US 50 • Improves pedestrian access	• Reduced mainline efficiency • Highest predicted crashes • High intersection crash rates • High crash severities • Higher costs • Lower Safety B/C
2 Parkway	• Provides access to US 50 • Provides pedestrian access • Highest Life-cycle B/C • Lowest Cost	• Reduced mainline efficiency • High intersection crash rates • High crash severities • Lower Safety B/C
3 Controlled Access	• Improved mainline efficiency • Lowest predicted crashes • Low crash severities • Low intersection crash rates • Proven Safety Countermeasure • Highest Safety B/C	• Limited access to US 50 • Pedestrian access limited to at interchanges • Higher costs • Lowest Life-cycle B/C

Based on discussions with technical staff, local agency feedback, and public comments, a two-tier approach is recommended for the US 50 East Dayton corridor vision. Ultimately, Alternative 3 – Controlled Access is recommended to provide a priority on US 50 mainline traffic and east-west regional movement. A frontage road system will need to be developed to provide local access to US 50 with enhanced safety over existing access.

However, the study team recognizes that full implementation of an ultimate Alternative 3 vision will require significant effort and costs to achieve. In the near term, it is recommended that Alternative 2 - Parkway Concept be utilized for corridor improvements to address immediate needs and concerns of the corridor. Achieving near-term and long-term vision will require extensive effort by NDOT and Lyon County. Both planning and engineering groups must incorporate these visions into entitlement documents; right-of-way dedication and acquisition; and final design approvals. Success of the Alternative

3 configuration relies on frontage roads established and developed by Lyon County and local development.

Through the public and local agency comment process, NDOT received numerous comments on all potential visions. As improvements are planned and move towards final design, the project team should review current conditions and how they may have changed since the development of this study and recommendations. In addition, project improvement outreach to local agencies and the general public should be solicited to identify location specific concerns as the objective of this study was to identify a planning level corridor vision.

Local projects such as Lyon County's Chaves Road connection over the Carson River to south need to remain a priority to assist in relieving local traffic impacts to US 50. In addition, intersections and interchanges shown are conceptual in nature. Actual details and layouts of these designs will need to be modified to accommodate the existing street network as final design begins. Additional discussions with local agencies and developers will also be required to refine the layouts to provide the most efficient final design and construction layout.