APPENDIX A

Traffic Analysis

Parametrix
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MEMORANDUM

DATE:	November 11, 2020
TO:	HDR, Inc.
FROM:	Parametrix
SUBJECT:	Kimball Junction Area Study Existing and 2050 No Build Traffic and Safety Conditions Memo
PROJECT NUMBER:	PIN 17286; Project No. S-R299(308)
PROJECT NAME:	Kimball Junction and SR-224 Area Study

This memorandum documents the traffic and safety conditions for existing and 2050 no build scenarios to support the Kimball Junction and SR-224 Area Study. Results include a discussion of traffic conditions, active transportation and transit service in the study area.

STUDY AREA

The study area primarily consists of the I-80 / Kimball Junction interchange area, including the three signalized intersections along SR-224 (I-80 Single-Point Urban Interchange (SPUI), Ute Boulevard, Olympic Parkway) as well as the stop-controlled intersection of SR-224 / Rasmussen Road. Within the analysis model, the SR-224 corridor was extended approximately 4,500 feet to the south of the Olympic Parkway intersection near Bobcat Boulevard to allow for accurate representation of vehicle queueing. In addition to SR-224, traffic operations on I-80 were modeled from approximately milepost 141 to milepost 147. This allowed for inclusion of the Jeremy Ranch interchange with the currently under construction roundabouts on the western extent and the US-40 / SR-224 interchange on the eastern extent of the model. The model extents of I-80 also included the eastbound off-ramps to US-40 and the westbound on-ramps from US-40. The I-80 interchanges adjacent to the Kimball Junction interchange are not a focus of the study but are included in the model network to support any potential future coordination with the Federal Highway Administration (FHWA).

The design day for the study was coordinated with UDOT and Summit County staff to reflect typical conditions during the winter months. The design day chosen was a midweek, February day with typical recreation traffic (non-event, non-snow day). Consistent with typical weekday analyses, the weekday AM and PM peak hours were chosen as the analysis periods which reflect the highest traffic volumes in each direction over the course of the day.

EXISTING CONDITIONS

To support analysis, traffic data was collected within the study area to determine existing traffic volumes, traffic composition, and travel patterns. Traffic operations were evaluated using a microsimulation VISSIM model which was built and calibrated using the existing traffic data collected for the project.

Vehicle Traffic Data

Data was collected within the study area and used to evaluate existing conditions and traffic. The following sections describe the collection of data and how it was developed for use in the existing conditions analyses.

Traffic Volumes

The traffic volumes used for the project were developed using intersection turning movement counts, freeway detector volume data, and information from previous studies conducted in the study area.

Traffic counts were collected within the study area in 2019 and early 2020 at the following intersections:

1. SR-224 / Rasmussen Road
2. SR-224 / I-80 SPUI
3. SR-224 / Ute Boulevard
4. SR-224 / Olympic Parkway

Turning movement counts were collected for the *Olympic View Traffic Impact Study* (August 2019) in April 2019 were used as the base volumes in this study. These counts were conducted at the signalized intersections of Olympic Parkway, Ute Boulevard, and the I-80 interchange on SR-224 for the weekday AM and PM peak hours. To account for seasonal conversion from April to February, as well as background growth of traffic on the corridor, a growth factor of 10 percent was applied to each count. This growth factor was based upon traffic volumes observed with the UDOT detector sensors for January 2020 compared to April 2019 (when the intersection turning movement counts were conducted) at the SR 224 interchanges off-ramps and on-ramps with I-80.

At the Rasmussen Road / SR-224 intersection, located north of the I-80 interchange, turning movement counts were conducted during the weekday AM and PM peak hour in January 2020. These counts were conducted prior to the start of Sundance Film Festival, during days without snowfall or other inclement weather, and prior to any reductions in traffic due to the COVID-19 pandemic.

Within the traffic operations model, the Jeremy Ranch interchange ramps and intersections were also included. The Jeremy Ranch interchange was under construction at the time of the study to reconfigure the alignment and circulation of the interchange into roundabouts at each of the ramp termini; thus, no traffic counts were conducted. A planning study for the interchange was completed in July 2015 which included analysis of existing traffic conditions. The traffic volumes from this study were used as a basis for existing traffic volumes. A 10 percent total growth factor was added to each turning movement volume to account for background growth which may have occurred since the counts were conducted which accounts for approximately two percent annual growth.

Along I-80, detector data from UDOT was available along the corridor including on I-80 mainline segments, between off-ramps and on-ramps at interchanges, and at the US-40 and Kimball Junction interchange ramps. This data was used to determine traffic volumes along the I-80 mainline and at the three interchange ramps (Jeremy Ranch, SR-224, US-40). The location of the detector sensors within the study area is shown in Figure 1.

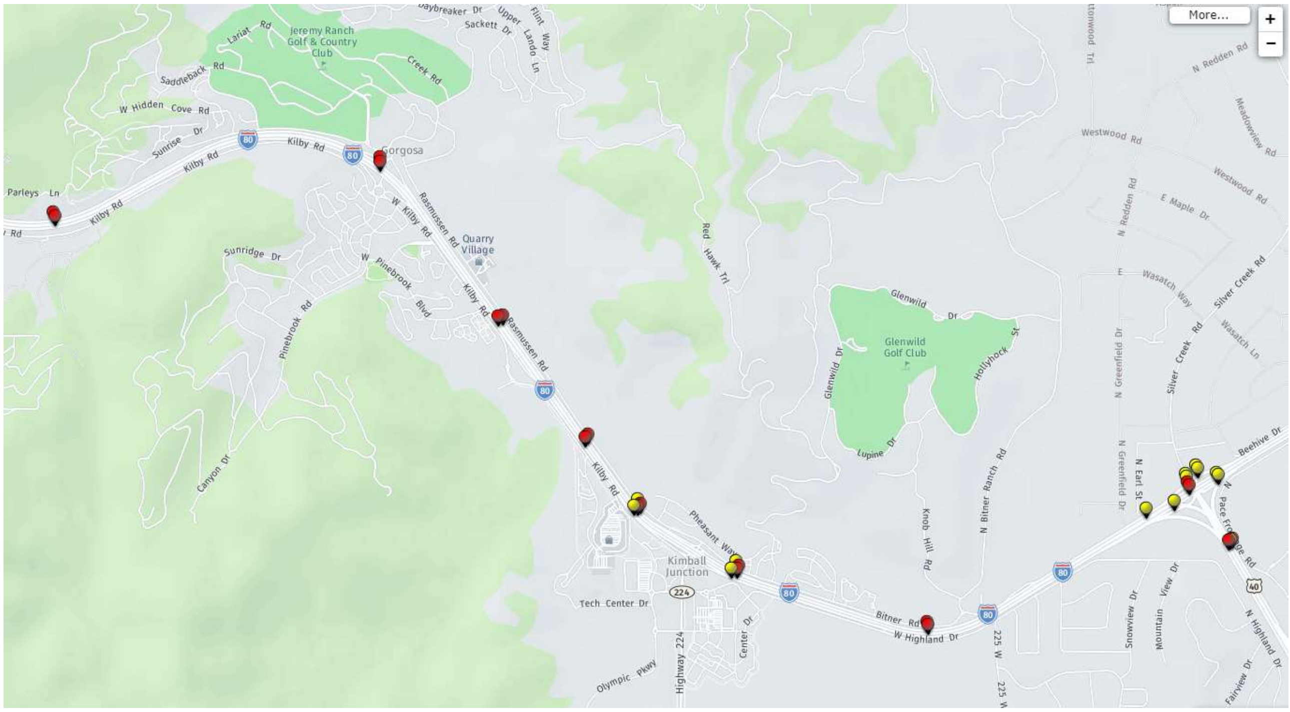


Figure 1: UDOT Detector Locations on I-80 Near Kimball Junction

Detector data from February 2019 showed limited reliability at several locations. Specifically, along I-80 Westbound west of Kimball Junction and on the I-80 Westbound off-ramp, only three weekdays during all of February and March 2019 had actual detector data recorded. As the detector data was being used to compare the ramp volumes to the collected turning movement counts, data from February 2018 from the detector system was used instead. The February 2018 data was screened for outliers which could represent inclement weather causing lower traffic volumes on the corridor and was balanced with the turning movement counts.

All traffic volumes were evaluated using 15-minute intervals in order to capture fluctuation that occurs within the peak hour. As the SR-224 interchange area is the primary focus of the analysis, peak hour traffic volumes at these intersections were used as the reference to balance traffic volumes along the I-80 corridor. Further, given the seasonal fluctuations of traffic volumes within the study area, the I-80 detector data for the Kimball Junction on- and off-ramps were also used to assist in volume balancing to ensure the accuracy of the seasonal factors. Weekday AM peak hour traffic volumes are shown in Figure 2 with weekday PM peak hour traffic volumes shown in Figure 3.

Figure 2: Weekday AM Peak Hour Traffic Volumes

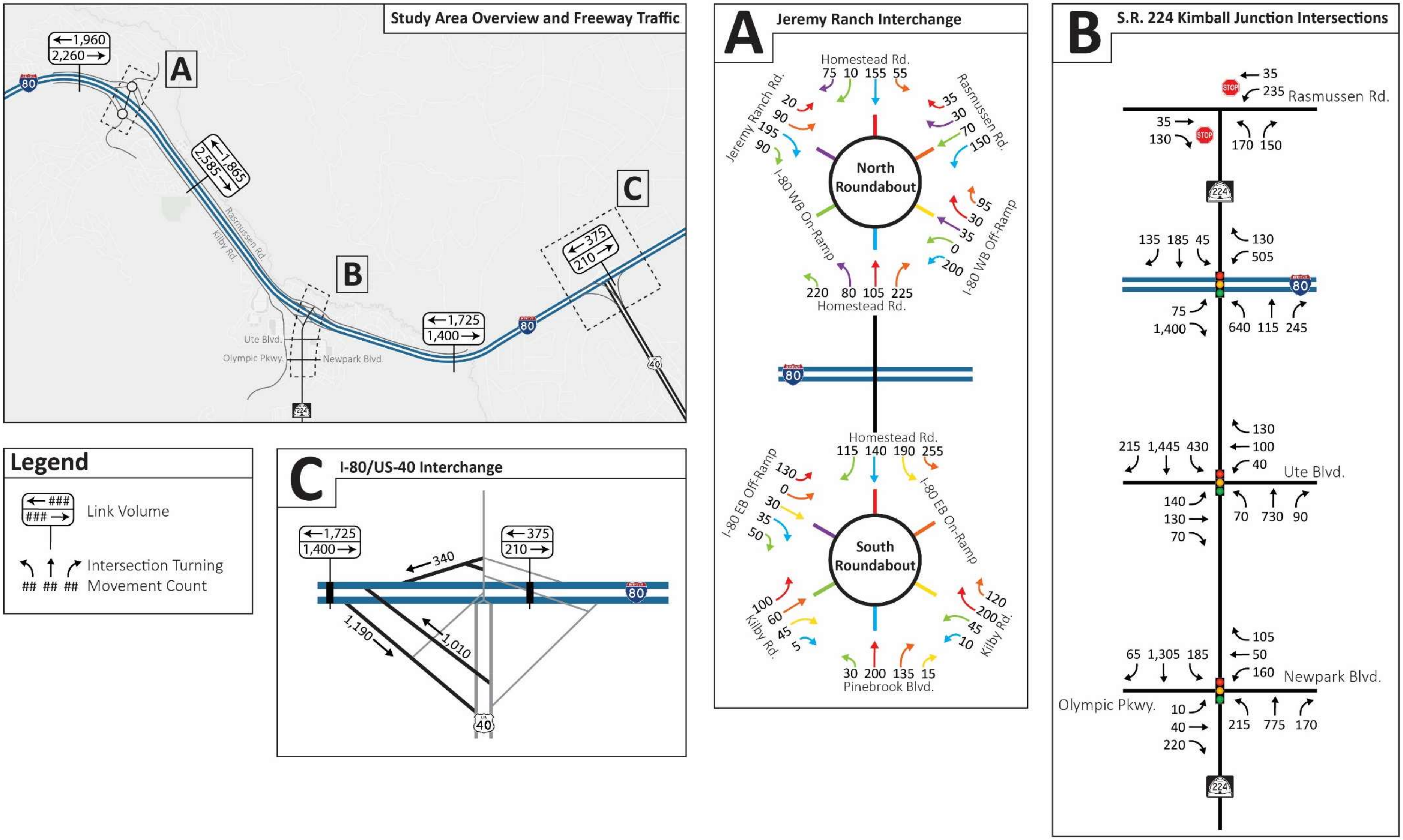
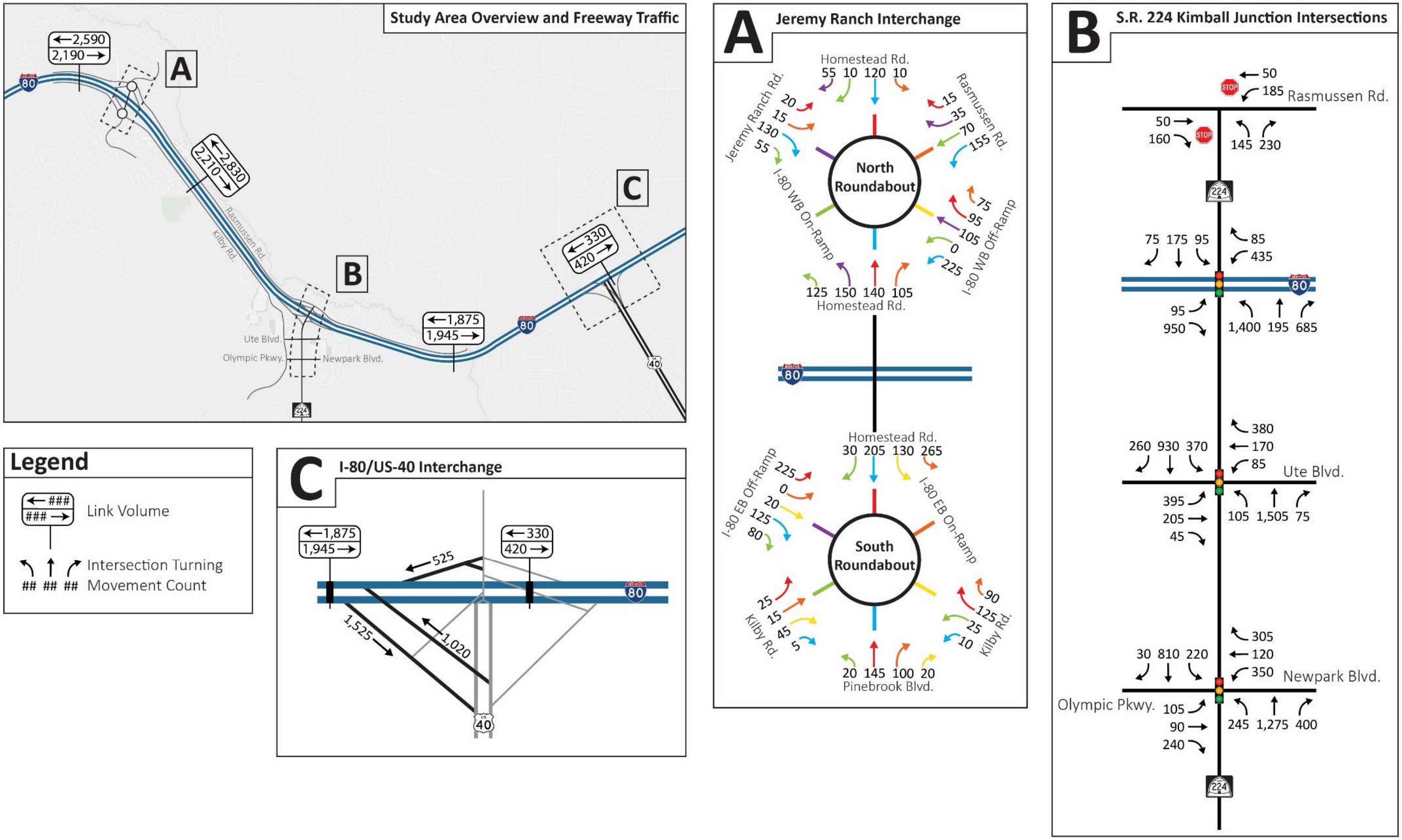


Figure 3: Weekday PM Peak Hour Traffic Volumes



Traffic Composition

Within the study area, I-80 is a major freight corridor and a higher percentage of heavy vehicles were added to the VISSIM network to properly account for the vehicle mix on the road. Heavy vehicle counts from UDOT's Powderwood Road traffic camera and UDOT detector data along I-80 at the Kimball Junction interchange were reviewed to determine the approximate mix of different vehicle classifications traveling on the corridor. Based on the peak hour, the vehicle inputs along I-80 were used as shown in Table 1 to allow for a higher percentage of heavy vehicles traveling through the model along I-80 than occur in the default VISSIM model.

Table 1: Existing VISSIM I-80 Vehicle Composition Percentages

Location	Weekday AM Peak Hour			Weekday PM Peak Hour		
	Cars	HGV Single	HGV Combo	Cars	HGV Single	HGV Combo
I-80 Eastbound	81%	11%	8%	88%	6%	6%
I-80 Westbound	76%	6%	20%	88%	4%	8%

The aerial drone video along SR-224 was also reviewed to determine if the default vehicle composition for arterials should be modified. Based on a review of the video, it was determined that during the weekday peak hours, the vehicles observed on the corridor were consistent with the default arterial composition with four percent single-unit trucks and two percent combination trucks and the remaining as passenger cars.

Vehicle Travel Times

Travel time data along the corridor was collected using Bluetooth sensors currently deployed by UDOT along I-80 and SR-224. These sensors collect and aggregate anonymized Bluetooth and Wi-Fi signals from passing vehicles to provide real-time vehicle travel times. To capture travel times along I-80 as well as though the SR-224 Kimball Junction area, data along 4 origin-destination pairs were used. These pairs and the approximate sensor locations are listed below and highlighted in Figure 4.

A. I-80 EB From Sensor 1 to Sensor 2
B. I-80 WB From Sensor 2 to Sensor 1
C. SR-224 NB to I-80 WB From Sensor 3 to Sensor 1
D. I-80 EB to SR-224 SB From Sensor 1 to Sensor 3
E. SR-224 NB to I-80 EB From Sensor 3 to Sensor 2
F. I-80 WB to SR-224 SB From Sensor 2 to Sensor 3
G. SR-224 NB, south of Kimball Junction: From Sensor 4 to Sensor 3
H. SR-224 SB, south of Kimball Junction: From Sensor 3 to Sensor 4

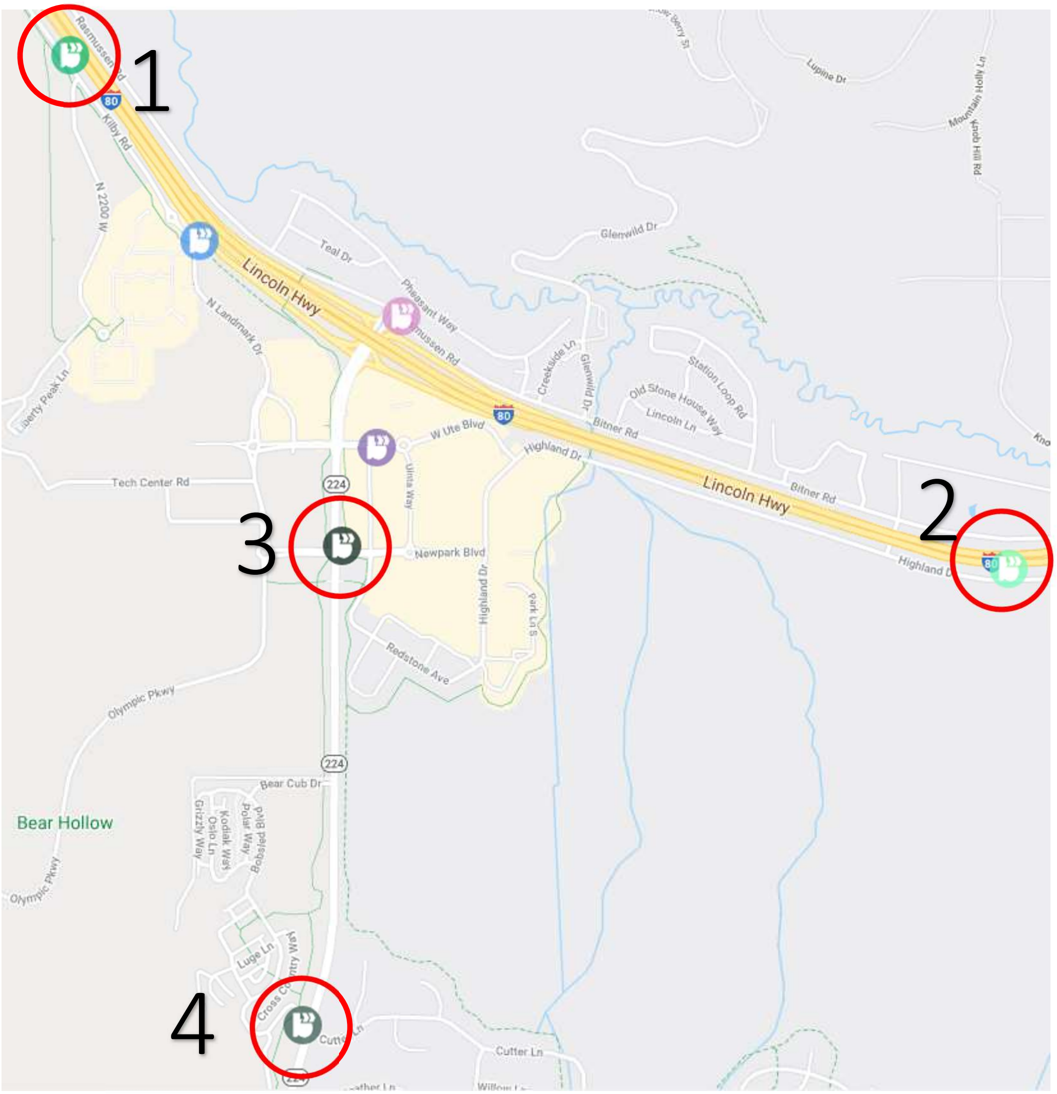


Figure 4: Bluetooth Sensor Locations on I-80 and SR-224

Data from the Bluetooth sensor were pulled for midweek days during the first two weeks of February 2020 (February 4-6 and February 11-13) for the weekday AM and PM peak hour. For each of the six weekdays analyzed, the Bluetooth data provider summarized the travel times of all vehicles passing between the Bluetooth pair into a single travel time for the peak hour. This allowed the travel times to be summarized on an hourly basis for each of the six sample days. By summarizing data over the full peak hour, variances that could be caused by traffic by signal cycle failures or by faster-than-normal travel conditions prior to or following the heaviest peak congestion periods are averaged out over the hour.

Table 2 shows the days with the fastest (minimum travel time) and slowest (maximum travel time) average peak hour travel time as well as the day with the median travel time. The median travel time which represents the typical midweek peak hour during the analysis period. Due to the large variance in average travel times observed over the six days along several of the travel time routes, the median travel time was used so as to have an average travel time that is not skewed by outlier days. These could include days with extremely heavy traffic and much higher travel times or days when the Bluetooth sensors are picking up incorrect readings which could result in much lower than realistic travel times.

Table 2: Existing Bluetooth Travel Times

Travel Time Route	Length (miles)	Weekday AM Peak Hour			Weekday PM Peak Hour		
		Minimum Travel Time	Median Travel Time	Maximum Travel Time	Minimum Travel Time	Median Travel Time	Maximum Travel Time
A. I-80 EB	1.9	1:39	1:42	2:23	1:39	1:41	1:44
B. I-80 WB	1.9	1:36	1:38	2:00	1:35	1:36	1:48
C. SR-224 NB to I-80 WB	1.1	1:57	2:09	2:27	2:35	2:42	2:45
D. I-80 EB to SR-224 SB	1.1	2:23	2:46	5:06	2:47	2:53	2:57
E. SR-224 NB to I-80 EB	1.5	1:23	1:40	2:12	3:06	4:46	7:54
F. I-80 WB to SR-224 SB	1.5	3:44	5:10	8:00	1:33	6:36	7:30
G. SR-224 NB	0.8	1:03	1:05	1:23	1:51	3:00	5:28
H. SR-224 SB	1.8	1:00	1:02	1:32	1:05	1:06	1:10

As shown in Table 2, travel times during the weekday AM and PM peak hours along the I-80 mainline (Route A and Route B) are relatively consistent during the weekdays studied with variations ranging from three to 41 seconds over the six days of data. The lack of variability indicates free flow traffic conditions along the I-80 mainline which was consistent with observations.

Of the remaining travel time pairs (Routes D-H), which involved vehicles traveling along SR-224, there was greater amounts of variability in the travel time. This can indicate unstable traffic conditions which results in fluctuations in travel times with changes in traffic conditions, volumes, and other environmental factors.

This travel time data was used to calibrate the VISSIM microsimulation traffic operations model. The travel times from the Bluetooth data were compared to existing travel times from the VISSIM model. Speeds and traffic behavior within the traffic model were adjusted to fall within the range of travel times observed during the weekday AM and PM peak hours with the Bluetooth data.

Traffic Operations

Traffic operations along the corridor were evaluated using a VISSIM microsimulation traffic model. This type of model was used due to the close proximity of intersections within the study area, queuing which spills back through multiple intersections in the existing condition, and the need to model and evaluate transit and active transportation operations. In addition, the microsimulation model allowed for evaluation of the I-80 mainline, on- and off-ramps and arterial street systems and the interactions between them. The microsimulation model used was VISSIM, version 10, Build 8. The following sections discuss the methods used to build the traffic operations model and the results from the existing weekday AM and PM peak hour analyses.

Signal Timing

Existing signal timing plans were obtained from the UDOT Signal Desk in February 2020 for the three signalized intersections along the SR-224 corridor.

- SR-224 / I-80 SPUI
- SR-224 / Ute Boulevard
- SR-224 / Olympic Parkway / Newpark Boulevard

An adaptive signal control system was instituted in December 2019 for the three signalized intersections within the project study area. This system monitors vehicle volumes on each approach within the corridor to dynamically adjust signal phases to maximize throughput of the intersections.

Queuing Data

Vehicle queuing data within the Kimball Junction interchange area was visually observed during the weekday AM and PM peak periods during January 2020. Vehicle queues were most notable in the northbound direction during the weekday PM peak period and along the I-80 eastbound off-ramp during the weekday AM peak hour. Aerial drone video of the corridor and I-80 ramps was captured by UDOT during March 2020 and was also used to visually calibrate queues and traffic operations in the area.

Traffic Volumes

The existing traffic volumes were used with the VISSIM model. These peak hour volumes were collected in 15-minute intervals for AM and PM peak periods.

Vehicle Routing

Vehicles routes were assigned on a corridor-wide basis for the entire network. Route beginnings and endings were located near vehicle input locations and on I-80 on- or off-ramps. This allowed for vehicles to navigate smaller areas and corridors on a single route which resulted in fewer last-minute lane changes. Additionally, the possibility of vehicles driving in circuitous directions is eliminated while avoiding the need for more complicated network-wide routing. Relative vehicle routing in the model is representative of the number of vehicles in the model along each route.

Model Calibration

All model data results were based on an average of 10 simulation runs. A seeding period of 30 minutes was used to allow the model to populate in addition to four 15-minute analysis periods for the peak hour. The model was calibrated to ensure study area traffic volumes, travel times, and queuing match existing weekday AM and PM peak hour conditions. A calibration memo as well as the electronic copies of the weekday AM and PM peak hour VISSIM models were reviewed and approved by UDOT's traffic performance engineers.

Intersection Level of Service

Vehicle level of service (LOS) was calculated for each of the intersections using the intersection node data. Node data was collected in 15-minute increments during the weekday AM and PM peak hours and averaged to determine average vehicle delay at each intersection throughout the peak hour period. Using the average vehicle delay, level of service was determined using the Highway Capacity Manual thresholds for unsignalized and signal-controlled intersections. The average weekday peak hour vehicle delay and level of service summary is shown in Table 3, for the SR-224 / Rasmussen Road intersection the movement with the worst delay is also noted in the table.

Table 3: Weekday Peak Hour Intersection Vehicle Delay and Level of Service

Location	Control Type	Vehicle Delay (sec / veh)	Level of Service (Worst Movement)
Weekday AM Peak Hour			
Rasmussen Rd / SR-224	Stop-Controlled	14	B (WBL)
I-80 SPUI / SR-224	Traffic Signal	27	C
Ute Blvd / SR-224	Traffic Signal	27	C
Olympic Pkwy / SR-224	Traffic Signal	38	D
Weekday PM Peak Hour			
Rasmussen Rd / SR-224	Stop-Controlled	16	C (WBL)
I-80 SPUI / SR-224	Traffic Signal	51	E
Ute Blvd / SR-224	Traffic Signal	84	F
Olympic Pkwy / SR-224	Traffic Signal	84	F

As shown in Table 6, during the weekday AM and PM peak hours, the three traffic signalized intersections are shown to operate at the LOS C and LOS D in the weekday AM peak hour and LOS E and LOS F during the weekday PM peak hour.

Vehicle Travel Times

Travel time collection points were placed in the model at the same location which the Bluetooth sensors are installed on the UDOT project. Travel times in the VISSIM model were measured along each of the pairs during the peak hour.

A summary of the comparison between the average (mean) VISSIM travel times and the Bluetooth travel times as well as the difference between the two is shown in Table 4 for the weekday AM peak hour and Table 5 for the weekday PM peak hour. The median Bluetooth travel time was shown in the table to give a representation of the average travel time on a typical February weekday whereas the minimum and maximum travel times show with the fastest and slowest average peak hour travel time.

Table 4: Weekday AM Peak Hour Travel Times

Travel Time Segment	Length (miles)	Bluetooth Minimum Travel Time	Bluetooth Median Travel Time	Bluetooth Maximum Travel Time	VISSIM Average Travel Time
A. I-80 EB	1.9	1:39	1:42	2:23	1:44
B. I-80 WB	1.9	1:36	1:38	2:00	1:43
C. SR-224 NB to I-80 WB	1.1	1:57	2:09	2:27	1:50
D. I-80 EB to SR-224 SB	1.1	2:23	2:46	5:06	2:58
E. SR-224 NB to I-80 EB	1.5	1:23	1:40	2:12	2:10
F. I-80 WB to SR-224 SB	1.5	3:44	5:10	8:00	3:40
G. SR-224 NB	0.8	1:03	1:05	1:23	1:18
H. SR-224 SB	1.8	1:00	1:02	1:32	1:02

Table 5: Weekday PM Peak Hour Travel Times

Travel Time Segment	Length (miles)	Bluetooth Minimum Travel Time	Bluetooth Median Travel Time	Bluetooth Maximum Travel Time	VISSIM Average Travel Time
A. I-80 EB	1.9	1:39	1:41	1:44	1:44
B. I-80 WB	1.9	1:35	1:36	1:48	1:44
C. SR-224 NB to I-80 WB	1.1	2:35	2:42	2:45	2:20
D. I-80 EB to SR-224 SB	1.1	2:47	2:53	2:57	2:09
E. SR-224 NB to I-80 EB	1.5	3:06	4:46	7:54	2:49
F. I-80 WB to SR-224 SB	1.5	1:33	6:36	7:30	5:16
G. SR-224 NB	0.8	1:51	3:00	5:28	3:46
H. SR-224 SB	1.8	1:05	1:06	1:10	1:00

As shown in Table 4 and Table 5, average vehicle travel times in VISSIM along travel time segments A and B on the I-80 mainline are within eight seconds of the median time measured with Bluetooth during the weekday AM and PM peak hours, respectively. On the six other travel time segments along SR-224, travel times within VISSIM generally fall within or near the range of travel times observed over a peak hour with the Bluetooth sensors. As the corridor is near capacity in the southbound direction during the weekday AM peak hour and the northbound direction during the weekday PM peak hour, it is likely there is a high variability in travel times along the corridor as volumes and other environmental factors change slightly on a day-to-day basis.

Queuing

Vehicle queuing was measured using queue counter data collected on every movement at each intersection in 90 second intervals. The queue data over the AM and PM peak hours were calculated for the average and 95th percentile queue lengths for each movement. This information is shown in Table 6.

Table 6: Weekday AM and PM Peak Hour Vehicle Queues

	Weekday AM Peak Hour		Weekday PM Peak Hour	
Intersection Approach	Average Queue (feet)	95th Percentile Queue (feet)	Average Queue (feet)	95th Percentile Queue (feet)
Rasmussen Road / SR-224				
EBT	15	25	20	25
EBR	35	45	55	100
WBL	55	75	85	160
WBT	15	25	20	25
NBL	0	0	0	0
NBT	0	0	0	5
I-80 SPUI / SR-224				
EBL	55	75	80	115
EBR	265	395	355	515
NBL	90	125	270	415
NBT	30	60	5	10
WBR	35	50	25	35
WBL	210	270	490	795
SBT	120	150	150	190
SBL	45	65	115	165
Ute Boulevard / SR-224				
EBL	70	85	795	925
EBT	55	75	410	590
EBR	20	35	15	35
WBL	30	45	50	70
WBT	80	110	195	285
WBR	20	40	135	195
NBL	30	55	40	65
NBT	140	165	630	900
NBR	20	30	15	30
SBL	180	325	735	860
SBT	350	485	75	125
SBR	35	65	35	60
Olympic Parkway / SR-224				
EBL	10	15	75	95
EBT	40	75	110	180
EBR	85	120	60	110
WBL	60	80	200	250
WBT	30	45	135	185
WBR	10	20	125	180
NBL	160	220	1565	3275
NBT	195	265	2760	4385
NBR	20	45	1665	3570
SBL	95	125	180	260
SBT	590	725	145	190
SBR	5	10	0	0

As shown in Table 6, during the weekday AM peak hour the longest queues are currently on the I-80 SPUI eastbound right-turn off-ramp movement to SR-224 and the southbound through movement on SR-224 at Ute Boulevard and Olympic Parkway. These movements have the highest traffic volumes and were observed in the field as well as the drone footage to have the longest queues as people travel inbound to Park City from the Salt Lake Valley to work and recreate during the weekday AM peak hour.

During the weekday PM peak hour, the longest queues were observed on the northbound approach of the Olympic Parkway intersection on SR-224, which is consistent with data shown in Table 6. The observed queuing from the weekday PM peak hour drone flyover is generally consistent with the queuing documented within the VISSIM model. One location where queuing within the model is greatly different is the SR-224 / Olympic Parkway intersection on the northbound approach. As observed in the drone video, vehicles turning left or right on the northbound approach will enter the turning area (either the two-way left-turn lane for left-turns or the shoulder / bus lane for right-turns) much earlier than is coded into the model to avoid the queue along the northbound through lane. Screenshots of queuing captured by the drone flights on SR-224 looking south of the Olympic Parkway intersection is shown in Figure 5. As shown in Figure 5, rolling vehicle queues extend past the Bear Cub Road intersection towards Bobcat Boulevard which is consistent with queuing observed in the model.

Figure 5: Northbound SR-224 Weekday PM Peak Hour Queues, Looking South from 850 Feet North of Bear Cub Road

In addition to the northbound vehicle queues on SR-224, the VISSIM model also has long vehicle queues identified on the I-80 westbound off-ramp for vehicles turning left. This queue is longer than observed during in-field visits and is caused in the model due to the spillover queue from the southbound left-turn movement at Ute Boulevard. In the model, this prevents vehicles on the westbound left-turn from completing their turning movement onto SR-224 without blocking the I-80 SPUI intersection. It is likely that this would occur in actual conditions as well; however, drivers are able to see when the long spillback queue is occurring and use the outside left-turn lane to complete the movement onto SR-224 or divert to the Olympic Parkway intersection at times when there is a long southbound left-turn queue on Ute Boulevard.

Transit

The Kimball Junction area is well served by regional and local transit. The Kimball Junction Transit Center is on the west side of SR-224 and accessed via Ute Boulevard and Landmark Drive. The transit center has a small park and ride area and is served by Park City Transit, Utah Transit Authority (UTA), and Summit County shuttles.

Park City Transit service and the Summit County shuttles are fare free which can incentivize shorter trips or chained trip to be taken via transit versus private vehicle. A description of the different transit routes serving the transit center are included in Table 7.

Table 7: Kimball Junction Transit Center Bus Service

Route (Agency)	Service Period	Vehicle Headways	Destinations
Route 6 (PC Transit)	6 a.m. to 10 p.m.	30 min	Ecker Hill / Park City Mountain
Route 7 (PC Transit)	5:45 a.m. to 9:45 p.m.	30 min	Summit Park / Canyons Village
Route 10 (PC Transit)	6 a.m. to 10 p.m.	30 min	Kimball Junction / Old Town
Trailside Loop (Summit Co.)	6:40 a.m. to 9:40 p.m.	10 min	Kimball Junction / Trailside Neighborhood
Kimball Junction Circulator (Summit Co.)	9 a.m. to 10 p.m.	Varies	Outlets / Newpark
PC-SLC Connect (UTA)	6 a.m. to 6 p.m.	4x daily	Downtown SLC / Kimball Junction

As shown, the Kimball Junction area is well-served by transit with service that accesses destinations on all sides. Frequent transit is available via Route 10 to Park City Old Town area with 10-minute headways throughout the day. People are also able to easily access the Kimball Junction Area via transit from the Ecker Hill Park and Ride with transit service operating on approximately 15-minute headways between the combined Route 6 and Route 7 service.

Active Transportation

The Kimball Junction area includes infrastructure to enable people to walk and bicycle within and to and from the area. Along SR-224, buffered multi-use trails, approximately eight feet wide, are included on the east side of the road from Ute Boulevard south through Kimball Junction area and extends nearly to Kearns Boulevard with multiple connections to the other regional trails. On the west side of SR-224, a similar multi-use trail buffered by landscaping from the roadway runs continuously throughout the Kimball Junction area. To the north, this trail provides connections to the active transportation bridge crossing I-80 as well as trails paralleling both sides of I-80 towards the east and west. South of Kimball Junction, the multi-use trail extends to Bear Hollow Drive and provides access to unpaved recreational trails on the west side of Kimball Junction.

Intersection crossings for the multi-use trails in the Kimball Junction area are typically provided via people-actuated crosswalks at existing traffic signals. However, several grade-separated crossings are also provided in the study area. As mentioned prior, a non-motorized bridge crosses I-80 approximately 800 feet west of the Kimball Junction SPUI. This bridge provides a connection from the retail and commercial space on the south side of I-80 to the neighborhoods on the north side of I-80 and Rasmussen Road. An undercrossing of I-80 also exists approximately one-half mile east of the SPUI. Along SR-224, an undercrossing of the highway is located approximately 200 feet south of the Olympic Parkway intersection which connected trails along Bitner Road to Highland Road adjacent to the Swaner Nature Preserve. This provides for a connection between the retail and residential uses on the south side of the Redstone Center to the trails and open space on the west side of SR-224. These crossings help facilitate safe movements for people bicycling and walking across the major highways within the study area. However, they can also require out of direction travel for people which could result in lower use compared to the at-grade crosswalks at Ute Boulevard or Olympic Parkway or along SR-224 crossing the SPUI.

Within the study area, Summit Bike Share provides short term bicycle rental at several stations in Kimball Junction along with others in the Canyons area, Park City, and other locations in the Basin. In Kimball Junction, bicycle rental stations are included by the Basin Recreation Field House and the Newpark Plaza on the east side of SR-224. On the westside of SR-224, bicycle rental stations are located at the Outlets, along Landmark Drive, and at the Kimball Junction Transit Center. All Summit Bike Share bikes are electric bikes with single-ride fares of $3 for a 30-minute ride and monthly and annual memberships available. Due to the amount of snowfall received in the

Park City area, bicycles are typically available from late spring to late fall and are removed during the winter months for safety and to preserve the equipment.

During winter months, snowfall can cause inaccessible conditions for the multi-use trails and sidewalks. Snow is typically plowed from the roads in the area onto the shoulders and adjacent landscaping. This can include onto sidewalks which can discourage use. Snow is typically cleared from sidewalks following the removal of snow from all streets in the area.

2050 NO BUILD TRAFFIC CONDITIONS

Travel Demand Modeling

The Summit travel demand model (v2 - 2020-01-08) was used for the purposes of generating 2050 no build traffic forecasts for use in the VISSIM traffic simulation model. The model is a traditional four-step travel demand model consisting of trip generation, trip distribution, model split, and trip assignment. The following sections document the modeling process, including model revisions, methods, and forecasts.

Model Refinements

Refinements were made to the Summit model to better represent existing travel patterns and improve forecasts. Revisions were made to socioeconomic (SE) inputs, and the highway network.

All model refinements discussed in this document were made in consultation with model developers from Mountainland Association of Governments (MAG), Wasatch Front Regional Council (WFRC) and UDOT and Summit County. The revised model is hereafter referred to as the "Kimball model" in this document. The following sub-sections document the refinements.

Socioeconomic (SE)

The geographical subdivisions within a travel demand model are called Traffic Analysis Zones (TAZ). Each TAZ is populated with SE data representative for its area. SE data includes household, population, and employment estimates. These estimates are originally derived from population projections developed by the Governor's Office of Management and Budget (GOMB) and the Kem C. Gardener Policy Institute at the University of Utah. These agencies also specify county population control totals which identify the projected population for a county for a given forecast year. State of the practice travel demand modeling techniques keep model SE data revisions within the population control totals. Figure 6 shows the TAZs relevant to the Kimball Junction area.

SE refinements were made in close coordination with Summit County. Revisions were made to two areas based upon approved development plans: the Canyons Village and Tech Center development areas (Figure 6). For the Canyons Village development area, employment totals were calculated from planned land uses and employees per square footage information derived from the Institute of Transportation Engineers (ITE) Trip Generation Manual version 10. Table 8 shows the employment inputs in the model and the employment calculated based on the development plan.

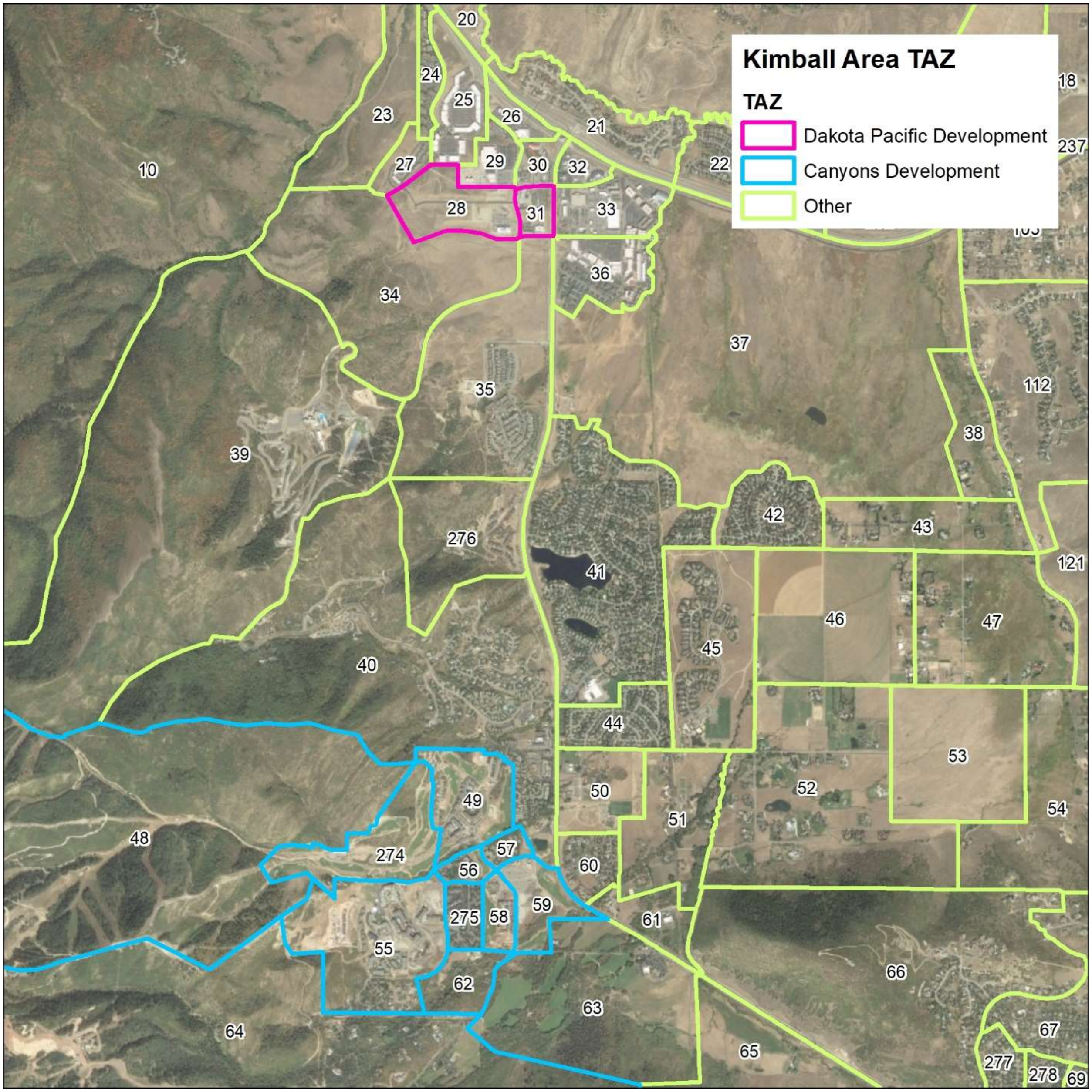


Figure 6: Kimball Area Traffic Analysis Zones

Table 8: Canyons Development Area Employment

	Existing (2020) Employment		Future (2050) Employment	
TAZ	Summit Model	Development Plan	Summit Model	Development Plan
48	0	0	0	1,581
49	320	215	438	392
55	1,213	1,597	3,043	3,068
59	119	0	271	118
64	66	0	154	79
274	1	0	272	602
TOTAL	1,719	1,812	4,179	5,839

The other set of SE revisions were made to the Tech Center development area (see Figure 6). Area totals for households and employment were bases on the Tech Center development plan. Table 9 shows the SE inputs from the original model and those based on the development plan.

Table 9: Tech Center Development Area Socioeconomics

	2050 Households		2050 Employment	
TAZ	Summit Model	Development Plan	Summit Model	Development Plan
28	251	1,100	1,059	457
31	0	0	413	661
Total	251	1,100	1,472	1,118

New totals for households and employment were then given to Summit County, who used them to inform new SE input sets for the Summit Model. The new inputs closely reflect the development area totals in Table 8 and Table 9, but do not match exactly as spreadsheet models were used and county-wide control totals had to be maintained. The new SE inputs were then implemented into the Kimball Junction model and are now a part of the official Summit Model.

Network

The model network was reviewed to ensure that that 2019 existing and future 2050 no build conditions were properly captured. Figure 7 and Figure 8 show the 2019 existing and 2050 no build modeled networks used for Kimball Junction. Ultimately, only one change was deemed necessary in the 2050 network, involving the addition of one centroid connector in the Tech Center area. Centroid connectors are responsible for transferring trips generated by SE assumptions in the model onto the roadway network and are represented in the network as low-impedance roadway links. The existing 2050 network was found to be loading a disproportionate share of trips north to Tech Center Drive and ultimately Ute Boulevard. Future development will be able to access the network directly to the Landmark Drive and Olympic Parkway roundabout with a planned fourth leg of the intersection. The new centroid connector, highlighted in Figure 8, allows this movement to occur and better distributes trips between Ute Boulevard and Olympic Parkway.

Another substantial assumption in the 2050 no build network is the configuration of interchanges along I-80. The network does not assume a new interchange between Kimball Junction and Jeremy Ranch. Though this interchange concept has been discussed for many years, it is not part of the most recent UDOT Long Range Plan. Thus, the assumption of no new interchange keeps the no build network consistent with current UDOT planning documents. This decision was made in consultation with UDOT, model developers and the project team.

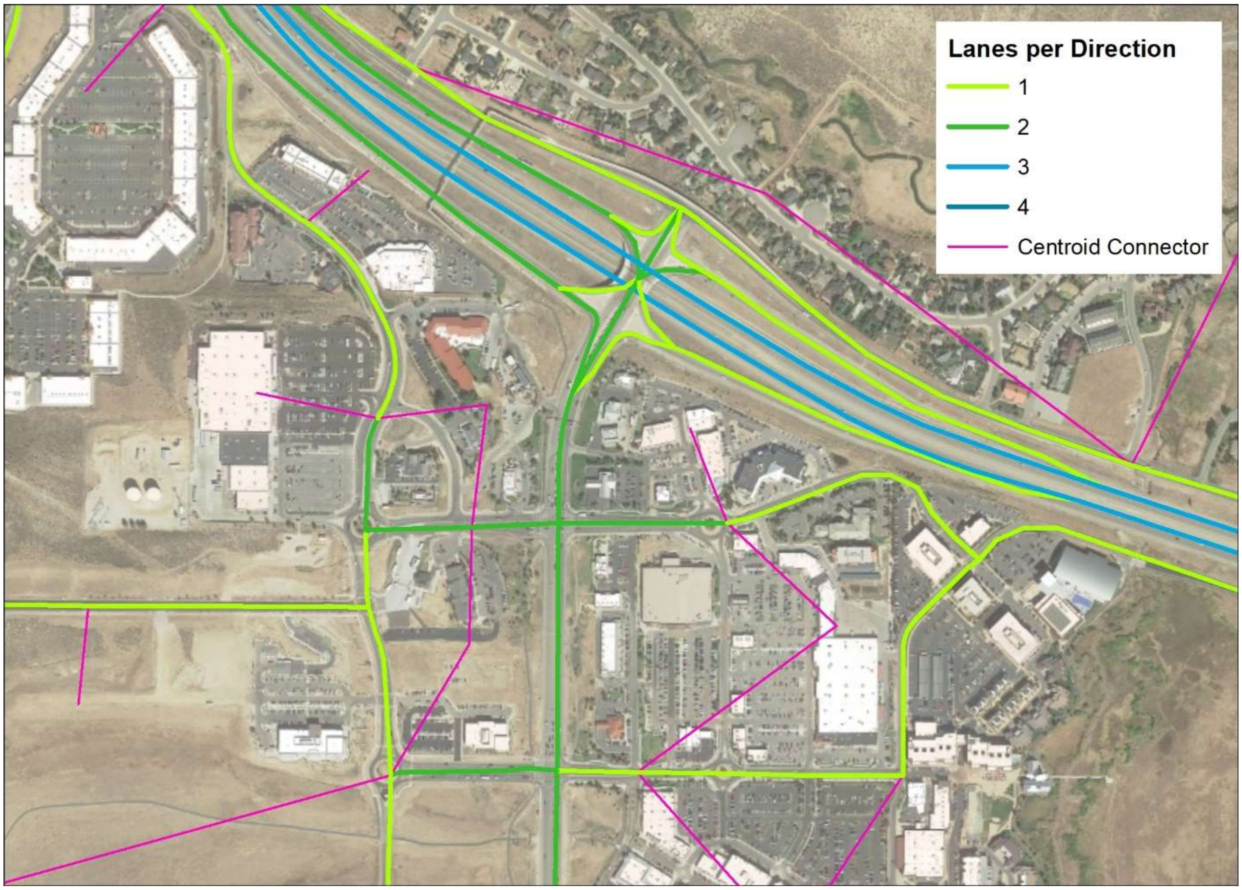


Figure 7: 2019 Modeled Network

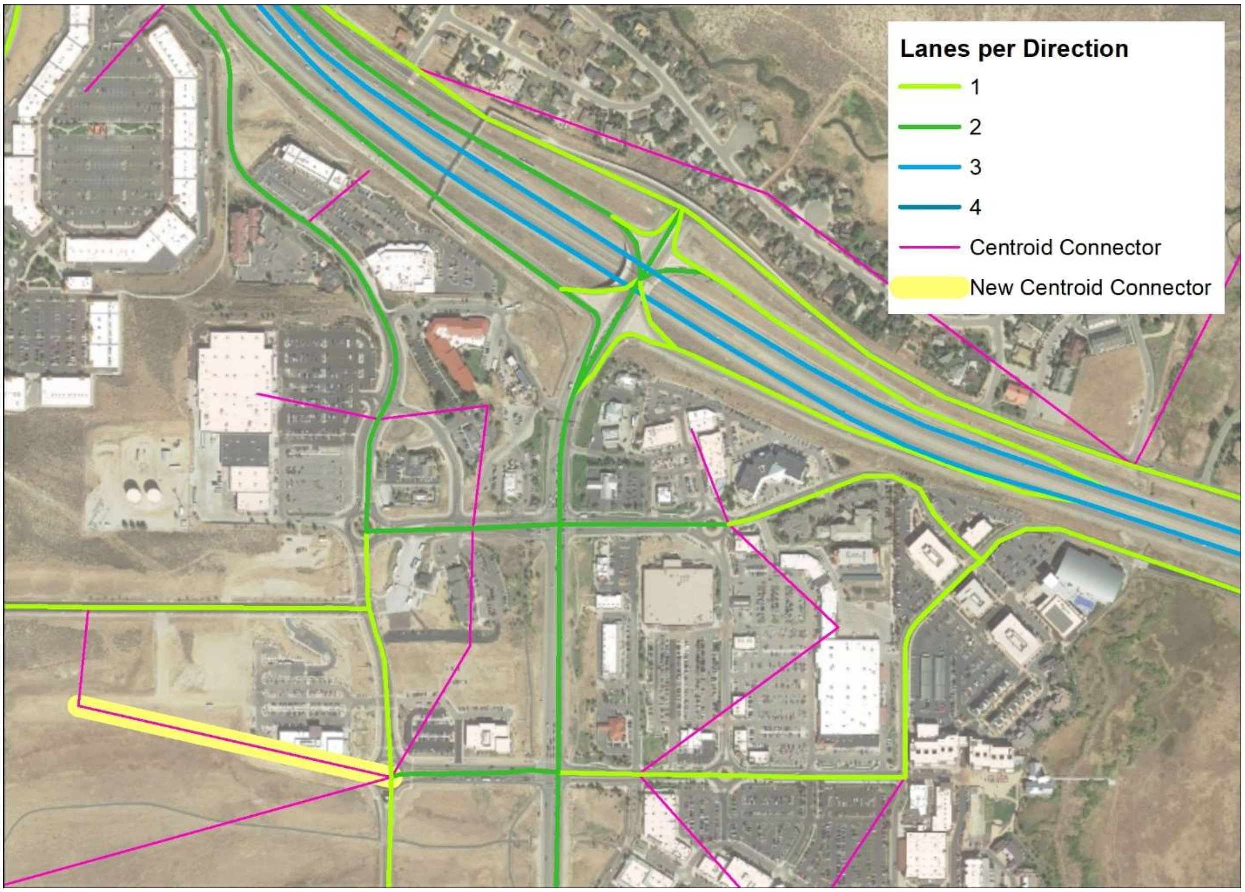


Figure 8: 2050 Modeled Network

Model Results

Base-Year Correction

A base-year correction was developed for model outputs to produce more accurate travel forecasts. The correction was created by comparing the difference between 2019 traffic counts and base year (2019) travel demand model volume outputs. The correction is then carried forward to the 2050 travel demand model outputs, with the assumption being that similar discrepancies will persist through forecast years of the model. Figure 9 shows the base-year corrections applied to generate the 2050 forecasts.

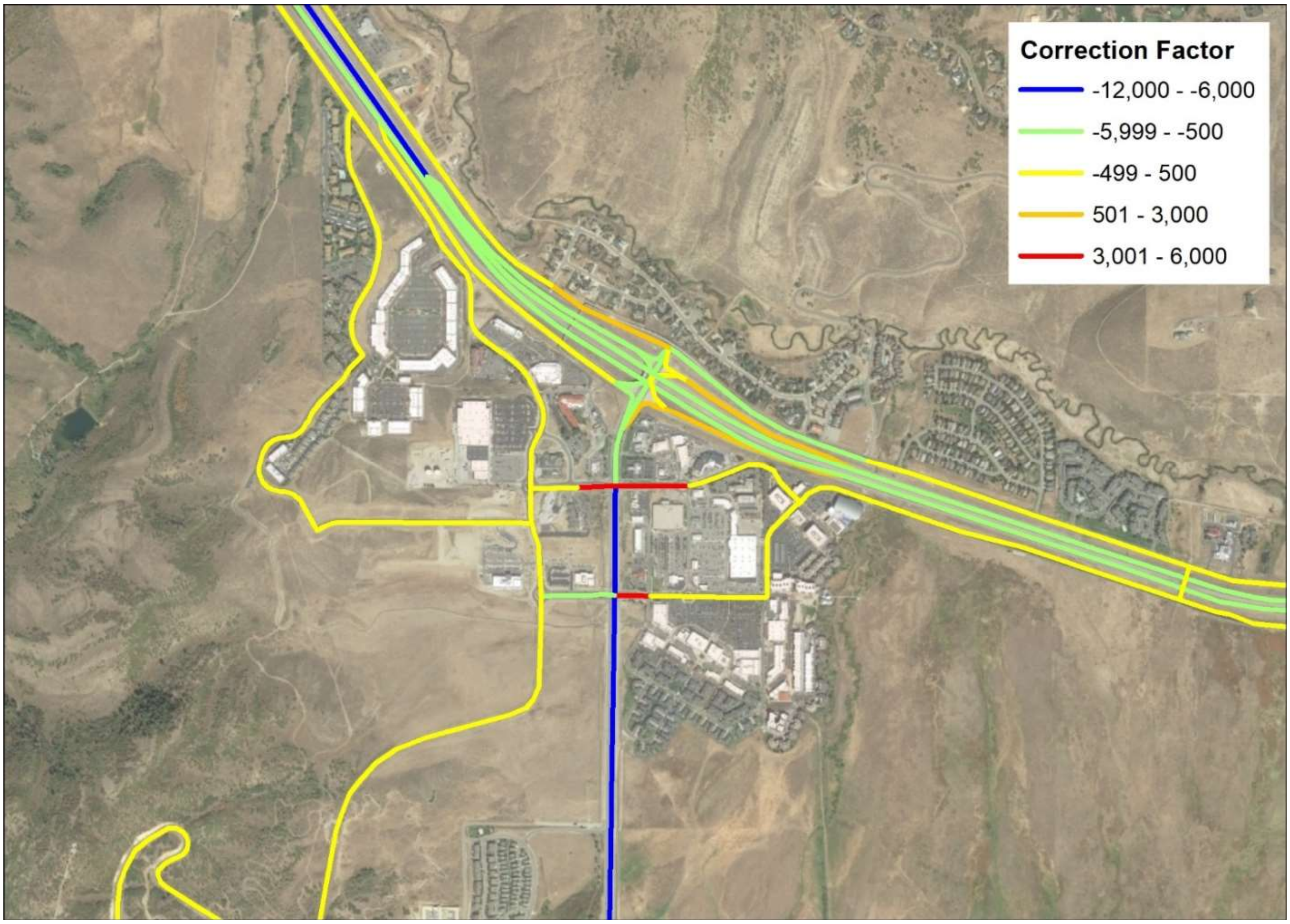


Figure 9: Model Correction Factor

2050 No Build Forecasts

2050 no build conditions were modeled using the revised Kimball Junction model and forecasts were produced using the correction factor. Figure 10 shows the 2050 Kimball Junction no build forecasts.

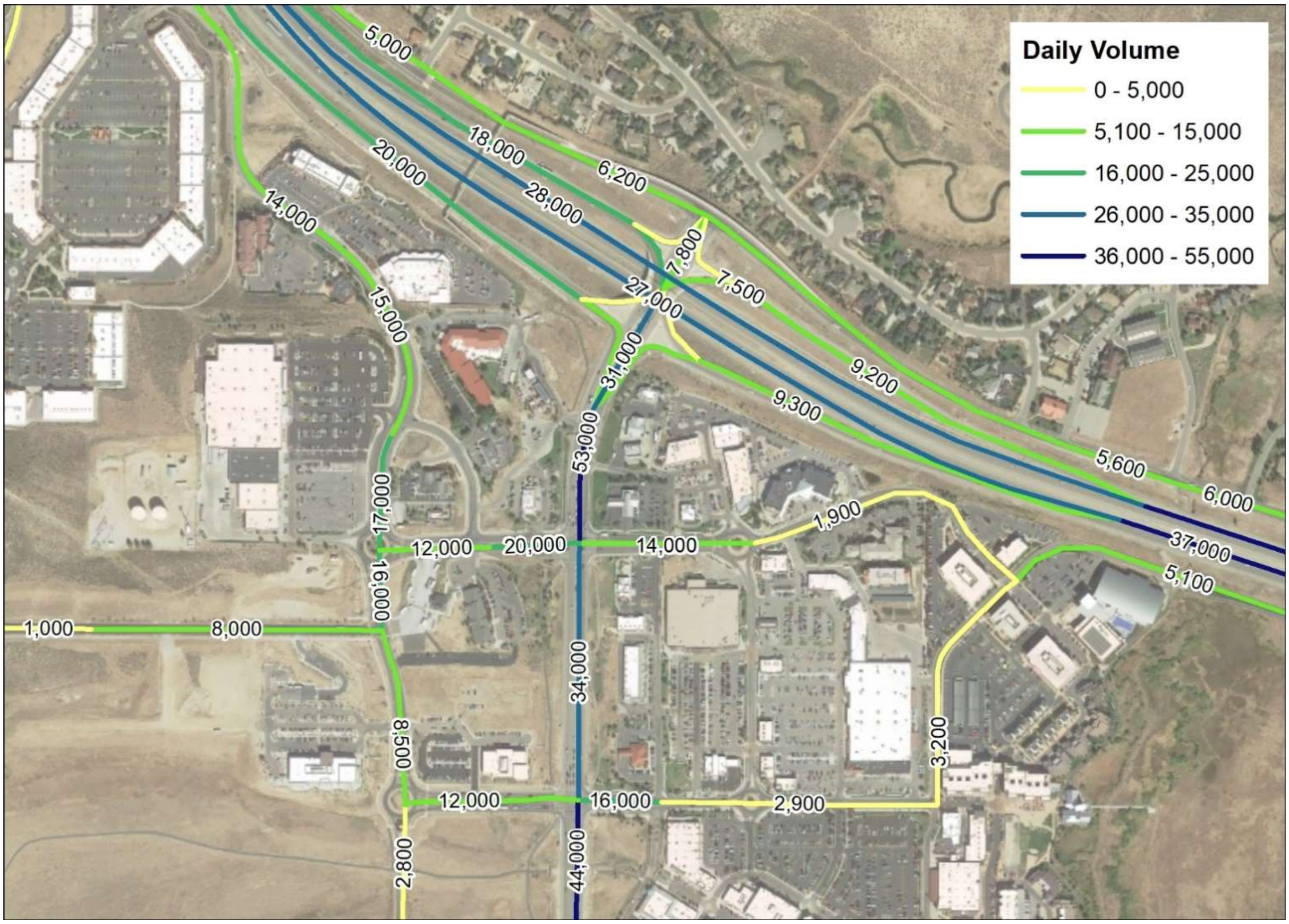
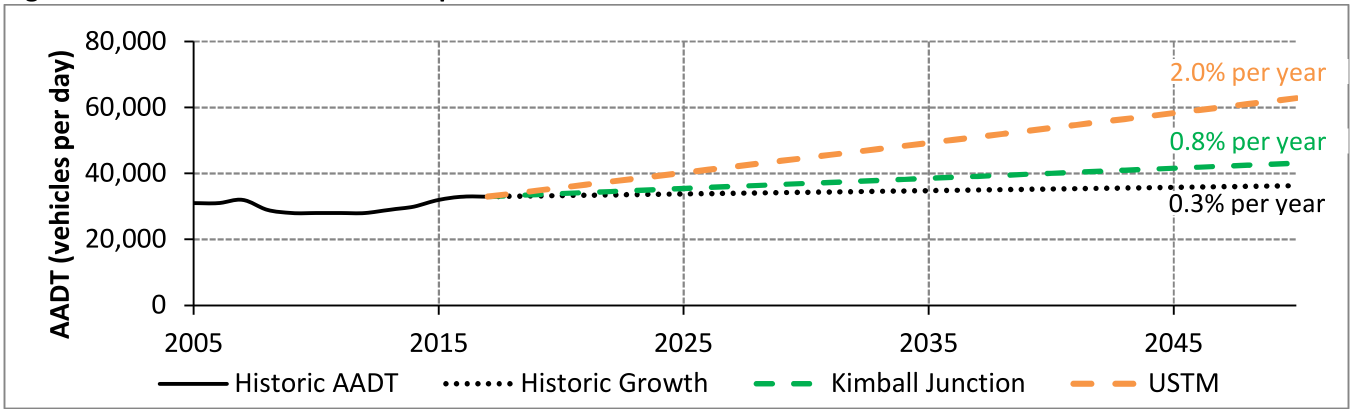


Figure 10: 2050 No Build Modeled Volumes

Figure 11 compares the forecasted growth on SR-224 from the revised Kimball Junction model with historic traffic volumes as well as forecasts produced by the Utah Statewide Travel Model (USTM). USTM is a travel demand model developed and maintained by UDOT and has been deployed for various planning purposes across the state for many years. Although USTM is not as refined in its representation of Kimball Junction, it offers a broader perspective on regional traffic flow through the Heber Valley.

As seen in Figure 11, the growth rate from the Heber Valley model is in between USTM and the historic growth rate, with a rate of 0.8% per year. This indicates that the forecasts produced for this study are reasonably in line with other available tools and historic trends.

Figure 11: SR-224 Growth Rate Comparison



SR-248 Sensitivity Test

A sensitivity test was performed in order to determine the impact of a widening project on SR-248, assumed in the 2050 no build network, on traffic patterns in the Kimball Junction area. The project provides widening to a five-lane section from approximately Bonanza Drive to Richardson Flat Road. A SR-248 no build network was developed without this widening based upon the Kimball Junction no build network shown in Figure 12. This network was then run through the model with all other inputs the same as the Kimball Junction no build model. The project was found to have minimal impacts to traffic patterns in the Kimball Junction area. Figure 12 illustrates the differences between the Kimball Junction no build model run and the SR-248 no build run. The no build scenario does increase volumes overall in the Kimball Junction area, with the biggest impact on SR-224 with an increase of daily volumes just over 1,300 (2 percent). Elsewhere the impacts to volumes are very minimal with volume changes ranging from -300 to 500 daily trips.

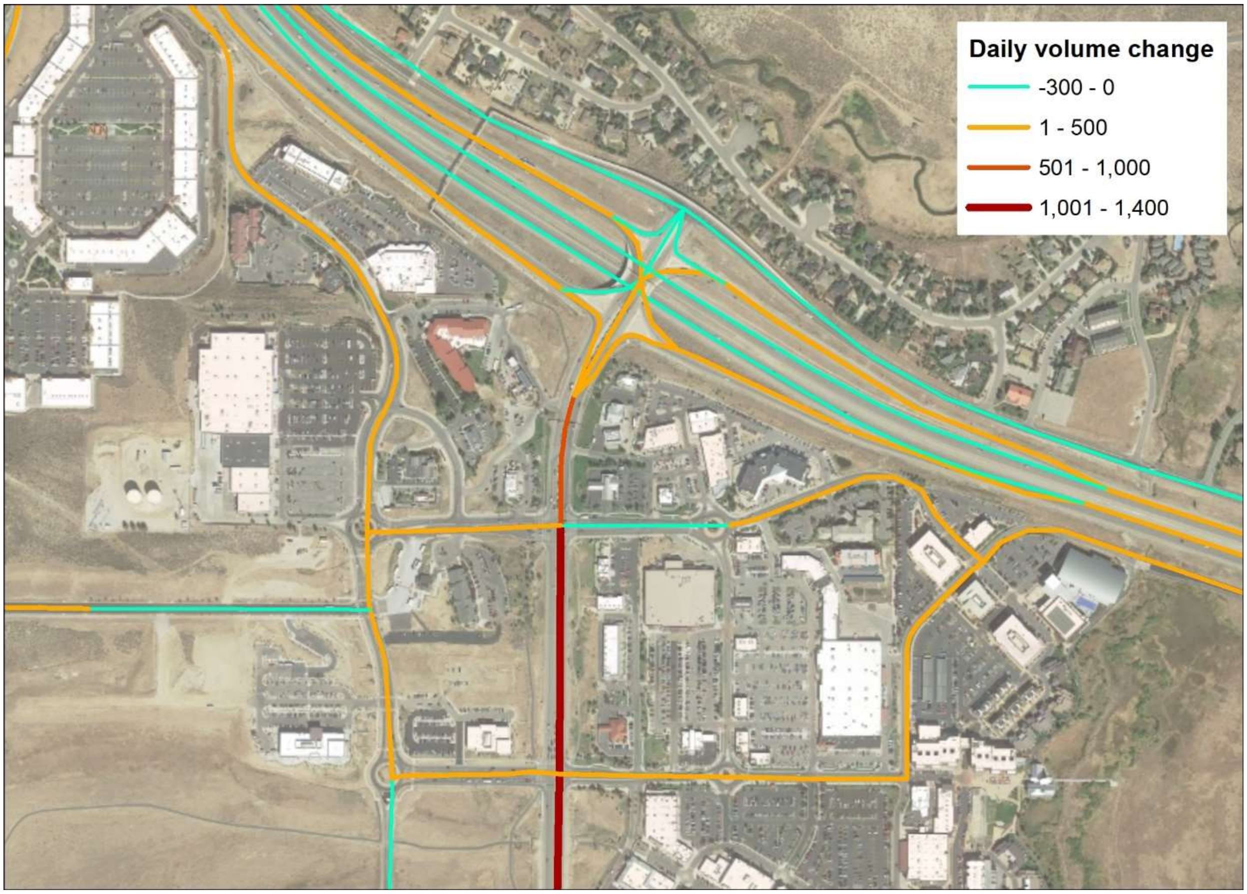


Figure 12: SR-248 Sensitivity Test Volume Change

Traffic Data

The results from the Summit County travel demand model were used to develop the 2050 no build traffic volume forecasts for the study area. As described previously, the travel demand model accounts for traffic volumes growth attributed to changes in both regional land uses as well as local land uses.

Within the Kimball Junction area, land uses from the proposed Tech Center development on the west side of SR-224 were also included in the travel demand model. Due to the location of this proposed project, manual adjustments were made to the traffic forecasts to balance entering and exiting volumes on Ute Boulevard and Olympic Parkway with the proposed project's access locations.

The future 2050 no build traffic volumes are shown in Figure 13 for the weekday AM peak hour and Figure 14 for the weekday PM peak hour and a comparison of turning movement count volumes at the intersections along SR-224 between existing and 2050 no build conditions is shown in Table 10.

Table 10: Intersection Turning Movement Count Volume Comparison

Intersection	Existing Volume	2050 No Build Volume	Percent Change
Weekday AM Peak Hour			
Rasmussen Rd / SR-224	755	950	26%
I-80 SPUI / SR-224	3,475	4,325	24%
Ute Blvd / SR-224	4,525	5,825	29%
Olympic Pkwy / SR-224	3,300	4,200	27%
Weekday PM Peak Hour			
Rasmussen Rd / SR-224	820	1,075	31%
I-80 SPUI / SR-224	4,190	5,300	26%
Ute Blvd / SR-224	3,590	4,500	25%
Olympic Pkwy / SR-224	4,190	5,400	29%

As shown in Table 10, traffic volumes during the weekday AM and PM peak hours are anticipated to increase by approximately 24 to 31 percent by the 2050 no build scenario. This includes growth both on the SR-224 mainline for vehicles traveling between I-80 and Park City as well as on the Ute Boulevard and Olympic Parkway side streets as more development occurs within the Kimball Junction area.

Figure 13: No Build (2050) Weekday AM Peak Hour Traffic Volumes

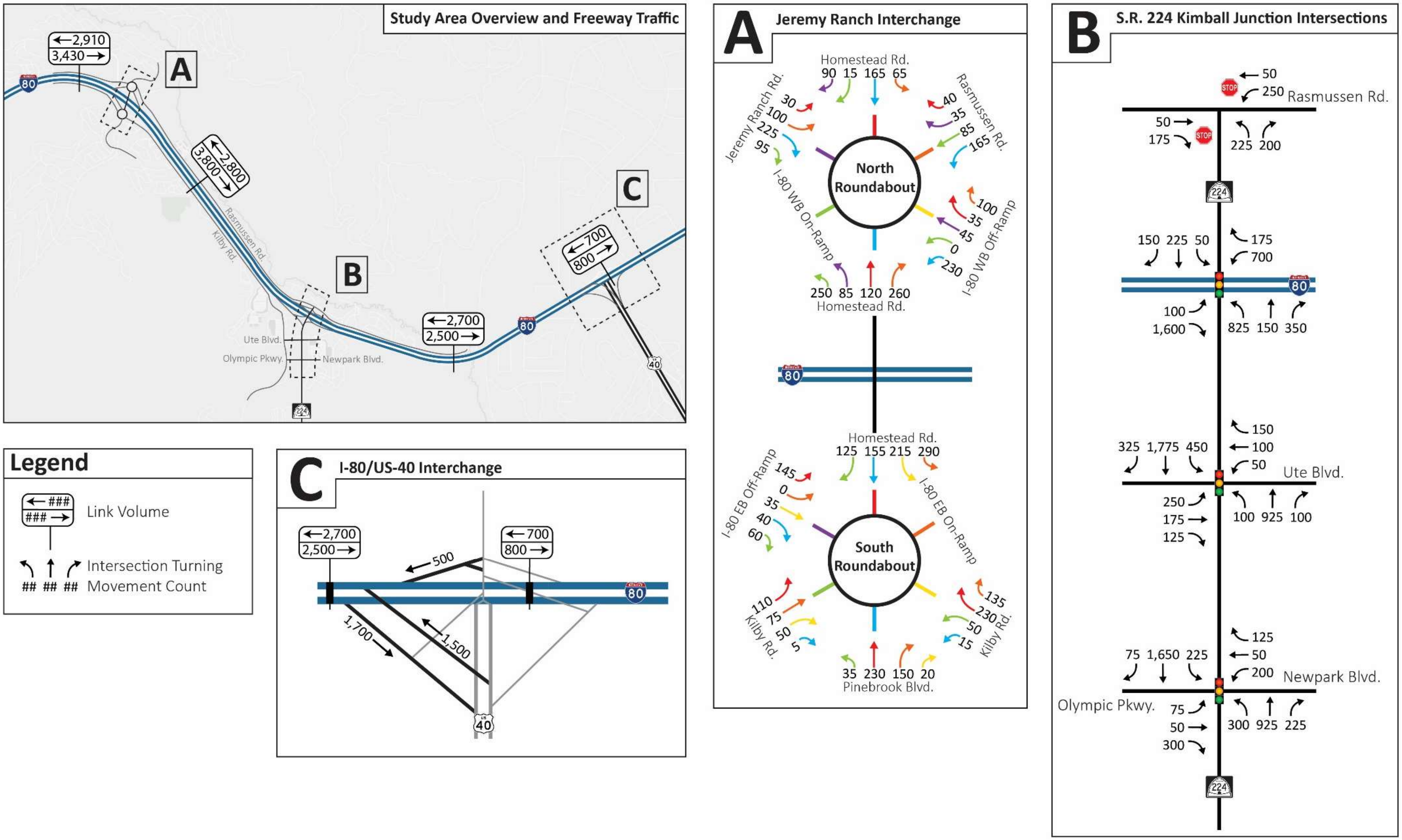
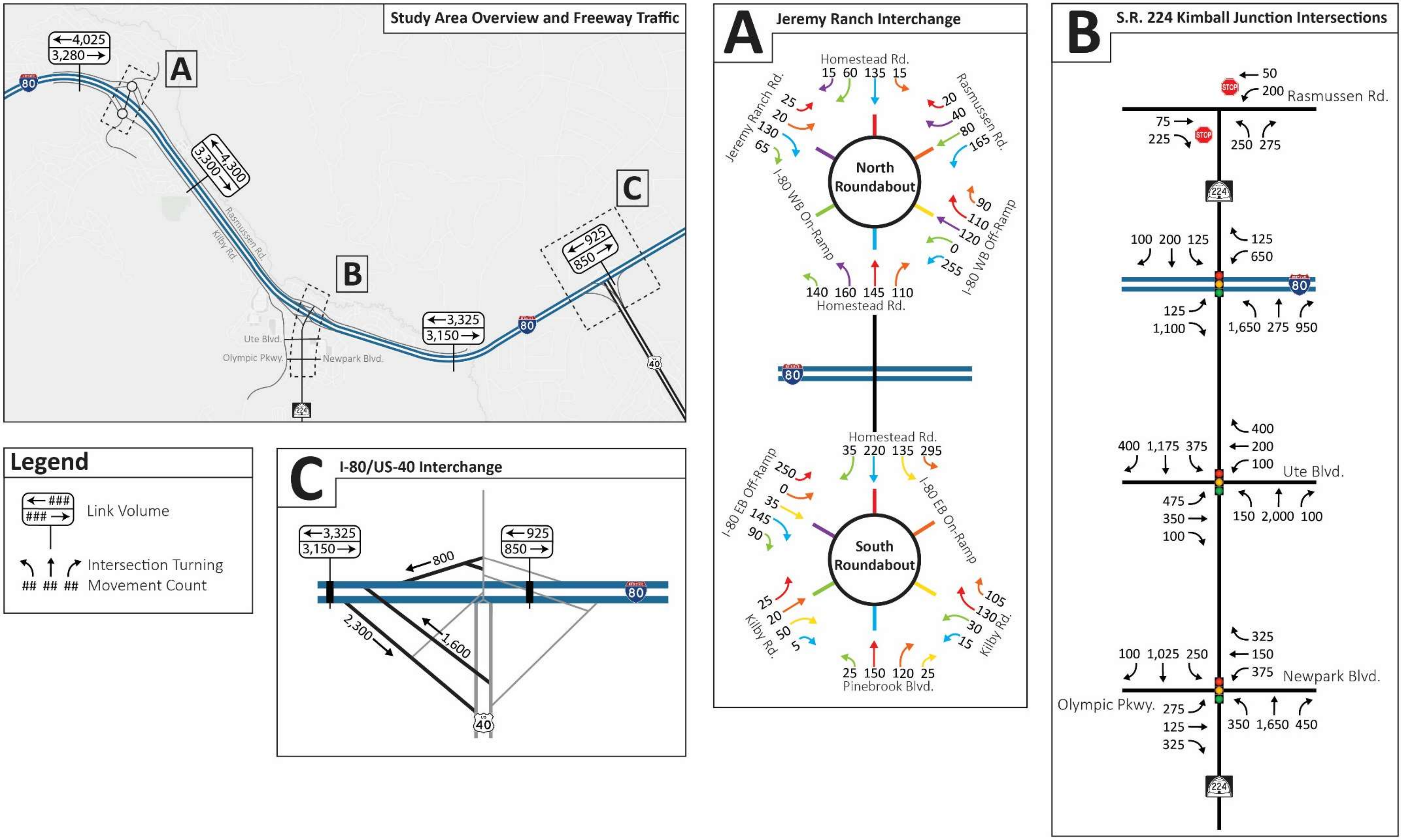


Figure 14: No Build (2050) Weekday PM Peak Hour Traffic Volumes



Traffic Operations

Traffic operations along the corridor were evaluated for the 2050 no build conditions using the same VISSIM microsimulation traffic model which was used for the existing condition. This allows for a comparison between the existing and 2050 no build conditions to determine relative changes in traffic operations. Future improvements within the Kimball Junction area, including the SR-224 Bus Rapid Transit, were included in the model to accurately represent 2050 conditions. Signal timing cycle length, phase length, and offsets along the corridor was optimized to most efficiently meet the changes in traffic demand during the weekday AM and PM peak hours.

Traffic Operations

Vehicle level of service (LOS) was calculated for each of the intersections using the intersection node data from the VISSIM model. Node data was collected in 15-minute increments during the weekday AM and PM peak hours and averaged to determine average vehicle delay at each intersection throughout the peak hour period. Using the average vehicle delay, level of service was determined using the Highway Capacity Manual thresholds for unsignalized and signal-controlled intersections. The average weekday peak hour vehicle delay and level of service summary is shown in Table 11, for the SR-224 / Rasmussen Road intersection the movement with the worst delay is also noted in the table. Results from the existing traffic operations analysis are also included for comparison.

Table 11: Weekday Peak Hour Intersection Vehicle Delay and Level of Service

		Existing Conditions		2050 No Build Conditions	
Location	Control Type	Vehicle Delay (sec / veh)	Level of Service (Worst Movement)	Vehicle Delay (sec / veh)	Level of Service (Worst Movement)
Weekday AM Peak Hour					
Rasmussen Rd / SR-224	Stop-Controlled	14	B (WBL)	16	C (WBL)
I-80 SPUI / SR-224	Traffic Signal	27	C	77	E
Ute Blvd / SR-224	Traffic Signal	27	C	32	C
Olympic Pkwy / SR-224	Traffic Signal	38	D	29	C
Weekday PM Peak Hour					
Rasmussen Rd / SR-224	Stop-Controlled	16	C (WBL)	20	C (WBL)
I-80 SPUI / SR-224	Traffic Signal	51	E	51	E
Ute Blvd / SR-224	Traffic Signal	84	F	94	F
Olympic Pkwy / SR-224	Traffic Signal	84	F	>100	F

As shown in Table 11, during the weekday AM and PM peak hours, the three traffic signalized intersections are shown to operate at the LOS D and LOS E in the weekday AM peak hour and LOS E and LOS F during the weekday PM peak hour. As shown during the weekday PM peak hour, the Olympic Parkway intersection sees the greatest increase in delay from existing to 2050 conditions. This intersection is overcapacity which prevents the Ute Boulevard and I-80 SPUI intersections from serving the full demand volume which likely results in better operations than would actually occur.

Travel Times

Using the same travel time segments and parameters in the existing peak hour VISSIM models, vehicular travel times for the 2050 no build were analyzed. The results of the weekday AM peak hour travel times analysis are shown in Table 12. The existing weekday AM travel times from the VISSIM model are also included for comparison to relative changes along each segment

Table 12: Weekday AM Peak Hour Travel Times

Travel Time Segment	Length (miles)	Existing VISSIM Average Travel Time	No Build VISSIM Average Travel Time	Change in Travel Time
A. I-80 EB	1.9	1:44	1:45	0:01
B. I-80 WB	1.9	1:43	1:44	0:01
C. SR-224 NB to I-80 WB	1.1	1:50	2:14	0:24
D. I-80 EB to SR-224 SB	1.1	2:58	4:56	1:58
E. SR-224 NB to I-80 EB	1.5	2:10	2:09	(0:01)
F. I-80 WB to SR-224 SB	1.5	3:40	4:00	0:20
G. SR-224 NB	0.8	1:18	1:15	(0:03)
H. SR-224 SB	1.8	1:02	1:00	(0:02)

As shown in Table 12, vehicle travel times are anticipated to stay relatively similar to existing conditions on the majority of the travel time segments. Along Segment D from I-80 Eastbound to SR-224 SB, an increase of 1:58 is anticipated. This is primarily caused due to queuing on the right-turn from the I-80 Eastbound off-ramp and congestion between the I-80 SPUI and the Ute Boulevard intersection. Minor increases in travel time were also observed along Segment C (SR-224 NB to I-80 WB) and Segment F (I-80 WB to SR-224 SB).

The results of the weekday PM peak hour travel times analysis are shown in Table 13, respectively. The existing weekday PM travel times from the VISSIM model are also included for comparison to relative changes along each segment

Table 13: Weekday PM Peak Hour Travel Times

Travel Time Segment	Length (miles)	Existing VISSIM Average Travel Time	No Build VISSIM Average Travel Time	Change in Travel Time
A. I-80 EB	1.9	1:44	1:45	0:01
B. I-80 WB	1.9	1:44	1:45	0:01
C. SR-224 NB to I-80 WB	1.1	2:20	2:41	0:21
D. I-80 EB to SR-224 SB	1.1	2:09	2:21	0:12
E. SR-224 NB to I-80 EB	1.5	2:49	3:02	0:13
F. I-80 WB to SR-224 SB	1.5	5:16	5:52	0:36
G. SR-224 NB	0.8	3:46	7:24	3:38
H. SR-224 SB	1.8	1:00	0:59	(0:01)

As shown in Table 13, the northbound SR-224 travel time segment which spans from Bobsled Boulevard to Olympic Parkway is anticipated to nearly double by the 2050 no build conditions. This is anticipated due to the large increase of vehicles on the northbound approach traveling from the Canyons and Park City to I-80 as well as increases anticipated on the east and west side of SR-224 at Kimball Junction. This causes the Olympic Parkway intersection to be overcapacity and unable to process all the vehicles during the weekday PM peak hour causing long delays and queues traveling northbound. The other travel times in the area are anticipated to see smaller increases between the existing and 2050 no build conditions. However, it should be noted that due to the overcapacity conditions occurring at Olympic Parkway, vehicles at the intersections to the north are being artificially metered and are not serving the actual demand volumes. By remediating the traffic issues solely at the Olympic Parkway intersection, it is likely that the congestion points would be moved to either the Ute Boulevard or I-80 SPUI and similar overall travel times would be observed to travel through the Kimball Junction area.

Queues

The weekday AM and PM peak hour vehicles queues were analyzed for each movement at each study intersection for the 2050 no build scenario. The queues were analyzed using the same methodology as was used for the existing weekday AM and PM peak hour conditions and average and 95th percentile vehicle queues are reported in Table 14. The existing weekday AM and PM peak hour queues are also included to provide a comparison of the relative change expected between existing and 2050 no build conditions.

Table 14: Weekday AM and PM Peak Hour Vehicle Queues

	Existing Weekday AM Peak Hour		No Build Weekday AM Peak Hour		Existing Weekday PM Peak Hour		No Build Weekday PM Peak Hour	
Intersection Approach	Average Queue (ft)	95th Percentile Queue (ft)	Average Queue (ft)	95th Percentile Queue (ft)	Average Queue (ft)	95th Percentile Queue (ft)	Average Queue (ft)	95th Percentile Queue (ft)
Rasmussen Road / SR-224								
EBT	15	25	20	30	20	25	25	40
EBR	35	45	40	60	55	100	55	70
WBL	55	75	85	175	85	160	55	95
WBT	15	25	15	25	20	25	15	30
NBL	0	0	0	5	0	0	5	40
NBT	0	0	0	0	0	5	0	5
I-80 SPUI / SR-224								
EBL	55	75	55	80	80	115	105	145
EBR	265	395	1520	2970	355	515	225	280
NBL	90	125	275	350	270	415	260	395
NBT	30	60	45	85	5	10	40	60
WBR	35	50	65	150	25	35	335	720
WBL	210	270	385	455	490	795	890	1410
SBT	120	150	135	165	150	190	165	245
SBL	45	65	45	85	115	165	165	240
Ute Boulevard / SR-224								
EBL	70	85	115	140	795	925	910	930
EBT	55	75	75	100	410	590	900	930
EBR	20	35	30	45	15	35	665	815
WBL	30	45	35	55	50	70	50	65
WBT	80	110	90	125	195	285	310	395
WBR	20	40	20	35	135	195	340	410
NBL	30	55	45	75	40	65	70	90
NBT	140	165	165	225	630	900	865	930
NBR	20	30	10	20	15	30	30	40
SBL	180	325	245	335	735	860	445	550
SBT	350	485	675	855	75	125	200	330
SBR	35	65	45	75	35	60	60	90
Olympic Parkway / SR-224								
EBL	10	15	45	60	75	95	340	470
EBT	40	75	50	90	110	180	235	315
EBR	85	120	80	110	60	110	205	295
WBL	60	80	95	110	200	250	250	340
WBT	30	45	40	55	135	185	265	355
WBR	10	20	10	20	125	180	435	505
NBL	160	220	250	335	1565	3275	205	270
NBT	195	265	210	265	2760	4385	5115	5185
NBR	20	45	30	50	1665	3570	3435	4490
SBL	95	125	70	105	180	260	335	465
SBT	590	725	350	485	145	190	315	415
SBR	5	10	5	20	0	0	10	20

As shown in Table 14, the greatest increase in queue from existing to 2050 no build conditions during the weekday AM is expected on the eastbound right movement at the I-80 SPUI. As noted in the travel time section, the increase of vehicles traveling from the Salt Lake Valley to Park City during the morning commute is anticipated to see large increases which would lead to congestion and added travel times to vehicles traveling through the I-80 SPUI. The average weekday AM peak hour queue for the eastbound right during the 2050 no build is anticipated to be 1,520 feet with a 95th percentile queue of nearly 3,000 feet. Based on the current alignment of the interchange, a 3,000 foot queue would extend to the off-ramp gore point which could cause issues with drivers not being able to decelerate quick enough from traveling on I-80 to the time they reach the back of the queue.

During the weekday PM peak hour, the greatest vehicle queue increases from existing to 2050 no build conditions is anticipated to occur on the northbound approach of SR-224 at the Olympic Parkway intersection. As previously discussed, this intersection is anticipated to operate overcapacity during the 2050 no build conditions and will not be able to serve the full vehicle demand during the weekday PM peak hour. As shown in Table 14, vehicle queues on each of the intersection's movements are anticipated to increase with the largest increases on the northbound movement. At the other study intersections, vehicle queue lengths are also anticipated to increase; however, these intersections are not likely processing the actual projected vehicle demand due to the bottleneck occurring at the Olympic Parkway intersection.

Transit

Within the Kimball Junction Area, transit service is expected to maintain an important role in moving people to and through the area. Existing levels of transit service in the Kimball Junction Area are anticipated to be maintained or expanded in order to provide frequent and reliable service connecting the surrounding area. Ongoing studies are being completed to determine how to best implement a bus rapid transit (BRT) line that would connect the Kimball Junction area with The Canyons and Park City. It is currently anticipated that the BRT line would follow a similar route and frequency as the current Route 10 (Electric Xpress) which runs with approximately 10-minute headways. The current studies are determining ways to make the current route a more reliable and attractive option by providing exclusive right-of-way, signal prioritization, and station and stop amenities along the alignment. Successful implementation of this project could lead to a higher percentage of users choosing transit as an option to navigate throughout the SR-224 corridor, including the Kimball Junction Area.

Active Transportation

With the planned development of vacant land uses in the Kimball Junction Area, it is likely that the area could become more walkable as potential destinations will be located closer together and there will be a higher density of complementary land uses. Similar to existing conditions, it will be important to determine where the desire paths are for people walking and to make sure these are constructed and maintained throughout the year to create a well-connected network for people walking and bicycling in the neighborhood on both sides of SR-224.

CONCLUSIONS

This memorandum documents traffic conditions for existing and the 2050 no build scenario to support the Kimball Junction Area Study. The conclusions of the analysis are:

Traffic

Existing traffic conditions do not exhibit significant traffic operational concerns during the weekday AM peak hour. However, during the weekday PM peak hour, several of the study intersections operate at LOS E or LOS F which indicates heavy vehicle delays with long queues and extended travel times. Traffic volume growth is expected along the SR-224 corridor and on both sides of the Kimball Junction neighborhood by 2050. In the 2050 no build conditions, severe congestion is anticipated to occur, particularly in the southbound direction of SR-224 during the AM peak hour and the northbound direction of SR-224 during the weekday PM peak hour. Average vehicle delay, vehicle travel times, and queue lengths are all anticipated to grow from existing to 2050 no build conditions. Travel times during the PM peak hour are anticipated to double from existing conditions for vehicles traveling northbound on SR-224 to I-80.

Transit

Transit service within the Kimball Junction area is concentrated around the Kimball Junction Transit Center on the west side of SR-224. This center is served by four Park City Transit bus routes, one local circulator shuttle for Kimball Junction, and the UTA PC-SLC connection. Plans are currently underway to determine the best options of a BRT line connecting the Kimball Junction area with the Canyons and Park City. This would replace the existing Route 10 with a line that includes similar headways but infrastructure improvements that allow for fast and reliable service. As vehicle volumes and travel times within the Kimball Junction area and along the SR-224 corridor are anticipated to increase by the 2050 horizon year, it is important to find alternative ways to move people more efficiently using less space throughout the basin.

Active Transportation

The Kimball Junction area currently has a robust network of multiuse paths on both sides of SR-224 providing access throughout the basin as well as to multiple recreational opportunities. Within the Kimball Junction area, there are two grade separated crossings of I-80 as well as one grade-separated crossing of SR-224 and two signalized at-grade pedestrian crosswalks. As the Kimball Junction area continues to develop and densify, it is likely that walking and bicycling to different uses could become a more attractive transportation option.

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MEMORANDUM

DATE:	April 9, 2021
TO:	HDR, Inc.
FROM:	Parametrix
SUBJECT:	Kimball Junction Area Study Traffic Screening Methods and Assumptions Memo
PROJECT NUMBER:	PIN 17286; Project No. S-R299(308)
PROJECT NAME:	Kimball Junction and SR-224 Area Study

This memorandum documents the traffic analysis to conduct Level 2 alternative screening for the Kimball Junction Area Study. Level 2 screening was divided into two steps, Level 2A and Level 2B with some refinements to alternatives being implemented as a results of Level 2A screening results.

LEVEL 2A SCREENING

The purpose of Level 2A screening was to analyze alternatives at a high level to help determine whether any alternatives should not advance to more detailed traffic analysis (Level 2B). Level 2A screening was primarily conducted using outputs from the Summit travel demand model (v2 - 2020-01-08).

Travel demand model outputs generally do not provide a level of detail that applies directly to traffic-related screening criteria. However, the project team identified travel demand outputs that could serve as surrogates to screening criteria. Then, because detailed traffic analysis results are available for the 2050 No Build scenario, comparing the surrogates between 2050 No Build and the build alternatives can indicate the relative change expected for detailed screening criteria between 2050 No Build and each build alternative. Table 1 lists the travel demand model surrogates developed for the screening criteria.

To develop surrogate measures, the Summit travel demand model was customized to represent Alternatives 1, 2 and 3. Additional roadway links were coded to represent the new interchange ramps and bridges in Alternative 1 and Alternative 2. New links were also coded to represent the bypass road in Alternative 2 as well as the tunnels in Alternative 3. The travel demand model does not currently support the ability to directly model HOV vehicles. As a result, special HOV ramps and lanes in alternatives were not represented in the model. The HOV bypass road in Alternative 2 was included in the model, but it was coded as being available for all vehicles. Finally, Alternative 4 was not analyzed for Level 2A screening because it is almost entirely composed of intersection lane improvements which are too small for a travel demand model to measure and are more suited to VISSIM analysis. Thus, Alternative 4 automatically advanced to Level 2B screening.

Table 1: Level 2A Traffic Screening Surrogates

Criteria	Measure	Travel Demand Model Surrogate Measure	Reasoning
Prevent off-ramp queues from I-80 to SR-224 from affecting operations and safety of the I-80 mainline	Measure peak-hour queue lengths at the westbound and eastbound off ramps	EB and WB I-80 off ramp daily volumes (vehicles per day)	Off ramp traffic volumes typically correlate with off ramp queue lengths
Reduce person delay of private vehicles navigating through Kimball Junction	Qualitatively assess the alternative's ability to reduce travel time pairs on SR-224 south Kimball Junction to and from eastbound and westbound I-80	Volume-to-capacity (V/C) ratio of SR-224 model links between I-80 and Ute Boulevard	Congestion on SR-224 between I-80 and Ute Boulevard is one of the most significant contributors to Kimball Junction through traffic
Improve vehicle mobility to/from I-80 and to/from SR-224 through Kimball Junction	Improve vehicle or person throughput at intersections during future (2050) peak hours measuring overall intersection LOS	Entering intersection volume at Ute Boulevard and Olympic Parkway (vehicles per day)	Total intersection volume typically correlates with intersection delay
Improve vehicle mobility to and from the Kimball Junction area	Qualitatively assess vehicle delay for movement into and out of Kimball Junction land uses via SR-224 and I-80	V/C ratio of entering east/west links at Ute Boulevard and Olympic Parkwy intersections	Congestion for east/west approaches is one of the most significant contributors to delay for Kimball Junction access traffic

Results

Table 2 summarizes the detailed traffic analysis results as well as the corresponding surrogates from the travel demand model. For example, the eastbound I-80 off ramp is predicted to have queues that spill onto the I-80 mainline for 2050 No Build conditions. This correlates with a daily ramp volume of 20,600 vehicles per day.

Table 2: Level 2A 2050 No Build Detailed Traffic Analysis and Corresponding Surrogate Results

Screening Criteria Measure	2050 No Build Detailed Traffic Analysis		2050 No Build Travel Demand Model Surrogates	
	Measure	Result	Measure	Result
Measure peak-hour queue lengths at the westbound and eastbound off ramps	EB AM off ramp queue	2,970 ft (Backs onto mainline)	EB I-80 off ramp daily volume	20,600 veh/day
	WB AM off ramp queue	455 ft (No backing onto mainline)	WB I-80 off ramp daily volume	8,400 veh/day
Qualitatively assess the alternative's ability to reduce travel time pairs on SR-224 south Kimball Junction to and from eastbound and westbound I-80	SR-2240 NB PM Travel Time	10:05 (Very slow travel)	PM NB V/C btwn Ute Blvd & I-80	1.25
	SR-2240 NB PM Travel Time	6:00 (Slow travel)	PM SB V/C btwn Ute Blvd & I-80	1.24
Improve vehicle or person throughput at intersections during future (2050) peak hours measuring overall intersection LOS	Ute Boulevard PM Intersection LOS	LOS F	Entering intersection volumes	62,000 veh/day
	Ute Boulevard PM Intersection LOS	LOS F	Entering intersection volumes	61,700 veh/day
Qualitatively assess vehicle delay for movement into and out of Kimball Junction land uses via SR-224 and I-80	Ute Boulevard EB/WB PM LOS	LOS F / LOS F	Ute Blvd EB/WB PM V/C	0.49 / 0.25
	Olympic Pkwy EB/WB PM LOS	LOS F/ LOS F	Olympic Pkwy EB/WB PM V/C	0.49 / 0.66

Table 3 compares the surrogates from the 2050 No Build conditions with the surrogates from Alternatives 1, 2 and 3. Table 3 describes the change in surrogate value and offers an assessment as to how the base screening measure is likely to change from 2050 No Build conditions.

As seen in Table 3, most surrogates from Alternative 2 travel demand model outputs change very little compared to 2050 No Build model outputs. Thus, the screening criteria measures are likely to offer little to no improvement over 2050 No Build conditions. For example, eastbound I-80 off ramp volumes only decrease slightly from 2050 No Build which suggests eastbound backing onto the I-80 mainline is likely to continue to occur. Furthermore, because the bypass road in Alternative 2 was coded as being available to all vehicles, results are likely overstating any reduction of traffic on SR-224 near the interchange. If only general purpose vehicles were not allowed to use the bypass road, traffic volumes on SR-224 would be greater and the surrogates would likely perform even worse. Due to the poor performance during Level 2A screening, including non-traffic related concerns documented in the full study report, Alternative 2 was not advanced to Level 2B screening.

Alternative 1 has mixed results. Some surrogates improve over 2050 No Build conditions and others worsen. However, as mentioned previously, the travel demand model is unable represent intersection lane improvements and the optional D-series improvements packaged with Alternative 1 during the alternative development process are not accounted for in Level 2A screening. Some of these D-series improvements, such as intersection turn lane widening, have the potential to address areas where Alternative 1 surrogates are worse than 2050 No Build. Thus, it was determined Alternative 1 would move forward to Level 2B screening with D-series improvements included.

Alternative 3 demonstrates several surrogates with significant improvement. Additionally, the surrogates that worsen are not directly considering the effect of the reduction of traffic on SR-224 due to the tunnels. Thus, it was determined that Alternative 3 showcased enough potential benefit to move forward to Level 2B screening.

Table 3: Level 2A Surrogate Comparison

Surrogate Measure	2050 No Build	Alternative 1			Alternative 2			Alternative 3		
	Surrogate Results	Surrogate Results	Change from No Build	Expected Effect on Measure	Surrogate Results	Change from No Build	Expected Effect on Measure	Surrogate Results	Change from No Build	Expected Effect on Measure
EB I-80 off ramp daily volume	20,600 veh/day	13,100 veh/day	Significant decrease	Backing likely eliminated	19,000 veh/day	Slight decrease	Backing likely persists	21,200 veh/day	Slight increase	Backing could be eliminated b/c of volume drop on SR-224
WB I-80 off ramp daily volume	8,400 veh/day	8,500 veh/day	Slight increase	Likely still no backing	8.400 veh/day	No change	Likely still no backing	8,600 veh/day	Slight increase	Likely still no backing
PM NB V/C btwn Ute Blvd & I-80	1.25	0.90	Marginal decrease	Likely somewhat slow travel	1.14	Slight decrease	Likely slow travel	0.59	Significant decrease	Travel much improved
PM SB V/C btwn Ute Blvd & I-80	1.24	0.87	Marginal decrease	Likely somewhat slow travel	1.15	Slight decrease	Likely slow travel	0.45	Significant decrease	Travel much improved
Entering intersection volumes	62,000 veh/day	53,600 veh/day	Marginal decrease	Likely LOSE E or F	56,400 veh/day	Marginal decrease	Likely LOSE E or F	37,900 veh/day	Significant decrease	Likely improved LOS
Entering intersection volumes	61,700 veh/day	61,100 veh/day	Slight decrease	Still LOS F	58,000 veh/day	Slight decrease	Still LOS F	29,400 veh/day	Significant decrease	Likely improved LOS
Ute Blvd EB/WB PM V/C	0.49 / 0.25	0.46 / 0.21	Slight decrease	Still LOS F	0.36 / 0.24	Marginal decrease	Still LOS F	0.64 / 0.27	Increase	May have improved LOS b/c of volume drop on SR-224
Olympic Pkwy EB/WB PM V/C	0.49 / 0.66	0.49 / 0.61	Slight decrease	Still LOS F	0.33 / 0.62	Slight decrease	Still LOS F	0.34 / 0.59	Marginal decrease	May have improved LOS b/c of volume drop on SR-224

ALTERNATIVE REFINEMENT

During Level 2A screening, travel demand model outputs indicated Alternatives 1 and 3 had underutilized or redundant elements. After discussions with the project team, it was determined that Alternatives 1 and 3 would be refined to eliminate or consolidate underutilized and redundant elements. It is expected that these refinements will offer similar mobility benefits with less cost and impacts to the community. Table 4 details the refinements. The cumulative effects of the Alternative 1 refinements convert the alternative into a split diamond interchange with one-way frontage roads in between SR-224 and the new bridge over I-80 to the west.

Table 4: Level 2A Alternative Refinement

	Refinement	Reasoning
Alternative 1	Remove new east half diamond interchange and ramps.	Ramps experience very little use because they are largely a redundant and slower alternative to existing SR-224 on/off ramps and because there are no access points on the north side one-way frontage road.
	Remove the west SR-224 on/off ramps. Consolidate movements to the new ramps at the west half diamond interchange.	The combined ramps simplify freeway access eliminating the closely-spaced entry and exit gores. Combined ramps should be able to accommodate traffic volumes since local access is split between the new bridge and SR-224.
	Remove both Texas U-turns	There are no access points on the proposed one-way frontage roads to generate traffic for the Texas U-turns.
Alternative 3	Remove the tunnel branching off to the EB I-80 on-ramp.	This tunnel attracts only 200 daily trips in the travel demand model. Most travel to east I-80 appears to be generated at Kimball Junction itself and these drivers would be using the SR-224 frontage road rather than the tunnel. The frontage road system can absorb the low volume of drivers wanting to make a right-turn onto the ramp from the tunnel.

LEVEL 2B SCREENING

The purpose of Level 2B screening was to provide sufficient data to support the traffic-related measures identified for overall alternative screening. Analysis for Level 2B screening was conducted by creating VISSIM traffic simulation models for each advanced alternative like existing and 2050 No Build conditions. The development and results of those models is documented in the *Kimball Junction Area Study Existing and 2050 No Build Traffic and Safety Conditions Memo*.

Alternative analysis was performed with 2050 volumes developed similarly to the 2050 No Build traffic volumes. Base year travel demand model volumes were compared to existing traffic counts to develop model correction factors. These factors were applied to 2050 travel demand model outputs. Then the growth experienced between base year and 2050 was applied to existing AM and PM peak hour intersection turning movement counts to develop forecast 2050 AM and PM intersection volumes.

For all alternatives, the overall traffic volume totals within the Kimball Junction area remained similar to 2050 No Build conditions, though Alternatives 1 and 3 demonstrated a shift in travel patterns. For example, in Alternative 1, SR-224 volumes near I-80 decrease by 20 to 30 percent. This is due to the presence of the half interchange west of SR-224 which provides an alternate way for local land uses to access I-80. Additionally, approximately 40 to 60 percent of SR-224 traffic uses the new tunnel in Alternative 3 which reduces volumes at the Ute Boulevard and Olympic Parkway intersections. These travel pattern shifts were incorporated into the VISSIM model analysis volumes. For Alternative 4, because the travel demand model would not be sensitive to any of the alternative changes, no separate travel demand model was configured. The AM and PM 2050 No Build intersection volumes were used directly for Alternative 4.

Results

The VISSIM traffic simulation models were used to develop results for quantitative traffic-related screening criteria. Tables 5 through 8 document the results of quantitative traffic-related screening criteria for the 2050 No Build and Alternatives 1, 3, and 4.

Table 5: Level 2B: Peak Hour Queue Lengths

Measure peak-hour queue lengths at the westbound and eastbound off ramps		95th Percentile Queues (ft)	
		EB	WB
No Build	AM	2,350	450
	PM	300	1,250
Alt 1	AM	1,300	400
	PM	175	250
Alt 3	AM	150	425
	PM	75	425
Alt 4	AM	1,000	400
	PM	450	725

Table 6: Level 2B: Through Travel Time Savings

Qualitatively assess the alternative's ability to reduce travel time pairs on SR-224 south Kimball Junction to and from eastbound and westbound I-80		Average Travel Time (m:ss)			Peak Direction Only Travel Time Savings from No Build
		SR-224 to East/West I-80 (NB)	SR-224 from East/West I-80 (SB)	Peak Direction Only	
No Build	AM	3:30	5:10	5:10	--
	PM	10:10	4:50	10:10	--
Alt 1	AM	3:30	5:00	5:00	0:10
	PM	5:00	4:00	5:00	5:10
Alt 3	AM	3:00	3:10	3:10	2:00
	PM	3:50	3:00	3:50	6:20
Alt 4	AM	3:50	4:00	4:00	1:10
	PM	4:00	5:10	4:00	6:10

Table 7: Level 2B: Overall Intersection LOS

Improve vehicle or person throughput at intersections during future (2050) peak hours measuring overall intersection LOS		Intersection LOS		
		Olympic Pkwy	Ute Blvd	I-80
No Build	AM	LOS C	LOS C	LOS E
	PM	LOS F	LOS F	LOS D
Alt 1	AM	LOS C	LOS C	LOS E
	PM	LOS E	LOS D	LOS C
Alt 3	AM	LOS C	LOS C	LOS C
	PM	LOS D	LOS E	LOS C
Alt 4	AM	LOS D	LOS C	LOS D
	PM	LOS D	LOS D	LOS D

Table 8: Level 2B: Vehicle Delay Into and Out of Kimball Junction Land Uses

Qualitatively assess vehicle delay for movement into and out of Kimball Junction land uses via SR-224 and I-80		Approach Delay (sec/veh)										
		Olympic Pkwy Approach or Movement					Ute Blvd Approach or Movement					Average In/Out of Kimball Junction (sec/veh)
		EB	WB	NBL/R	SBL/R	Overall	EB	WB	NBL/R	SBL/R	Overall	
No Build	AM	48	34	48	21	39	39	50	31	33	40	**40**
	PM	121	131	212	114	147	107	303	43	51	143	**145**
Alt 1	AM	39	28	38	33	34	29	35	30	38	35	**35**
	PM	79	37	67	56	66	72	55	31	90	62	**65**
Alt 3	AM	36	26	33	53	31	30	37	30	27	35	**35**
	PM	56	47	53	77	63	54	74	99	40	55	**60**
Alt 4	AM	49	50	42	36	36	42	50	35	23	45	**40**
	PM	64	63	50	170	60	56	74	59	45	72	**65**

Table 9 provides an aggregated summary of how 2050 No Build and individual alternatives compare against the screening criteria. As shown in Table 9, all alternatives offer considerable improvement over 2050 No Build conditions. Ramp queues onto I-80 mainline are abated, peak-direction SR-224 travel times for through traffic decrease, intersection LOS improves, and delay for movements in and out of Kimball Junction land uses decreases. Relative to each other, no alternative provides a consistent and distinct advantage over the others. Alternative 4 offers LOS D or better at all intersections. Alternative 3 has the greatest through traffic travel time savings. All alternatives have comparable delay for local access traffic.

Table 9: Aggregated Comparison of Level 2B Traffic-related Screening Criteria

		Measure peak-hour queue lengths at the westbound and eastbound off ramps	*Qualitatively assess the alternative's ability to reduce travel time pairs on SR-224 south Kimball Junction to and from eastbound and westbound I-80*	*Improve vehicle or person throughput at intersections during future (2050) peak hours measuring overall intersection LOS*			*Qualitatively assess vehicle delay for movement into and out of Kimball Junction land uses via SR-224 and I-80*
		I-80 Ramp queues Backing to Mainline (Yes/No)	Peak Direction Through Traffic Travel Time Savings from No Build (m:ss)	Intersection LOS			Average Vehicle Delay In/Out of Kimball Junction (sec/veh)
				Olympic Pkwy	Ute Blvd	I-80	
AM	No Build	Yes - EB I-80	--	C	C	E	40
	Alt 1	No	0:10	C	C	E	35
	Alt 3	No	2:00	C	C	C	35
	Alt 4	No	1:10	D	C	D	40
PM	No Build	No	--	F	F	D	145
	Alt 1	No	5:10	E	D	C	65
	Alt 3	No	6:20	D	E	C	60
	Alt 4	No	6:10	D	D	D	65

SUMMARY

Traffic analysis was conducted on study alternatives for Level 2 screening – split into Level 2A and Level 2B. Level 2A screening consisted of a high-level approximation of performance using travel demand model outputs. Alternative 2 did not advance past Level 2A screening. Geometric refinements for Alternatives 1 and 3 were identified based on insights from travel demand model results and carried into Level 2B screening. Level 2B screening was conducted with the VISSIM traffic simulation program. All remaining alternatives (1, 3 & 4) offer considerable improvement over 2050 No Build conditions. While there are slight differences between results, no alternative provides a consistent and distinct advantage relative to the others.

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MEMORANDUM

DATE: April 27, 2021

TO: HDR, Inc.

FROM: Parametrix

SUBJECT: Kimball Junction Area Study Traffic Volumes Memo

PROJECT NUMBER: PIN 17286; Project No. S-R299(308)

PROJECT NAME: Kimball Junction and SR-224 Area Study

This memorandum documents minor adjustments to existing conditions traffic volumes made as a result of a comparison of historical traffic count data and discussions with UDOT staff.

EXISTING CONDITIONS TRAFFIC VOLUMES

Traffic volumes for use in the Kimball Junction Area Study were developed using intersection turning movement counts, freeway detector volume data, and information from previous studies conducted in the study area.

Following the initial compilation of traffic data for study analysis, the study team and UDOT staff developed comparisons to historic counts data spanning several years as well as newly available count data. Based on the comparison, it was determined that adjustments would be made to the southbound left turn movement and the southbound through movement volumes at Ute Boulevard. Figures 1 and 2 summarize the count data for these two movements as well as the original Kimball Junction Study volume and the adjusted volume used for all subsequent study analysis.

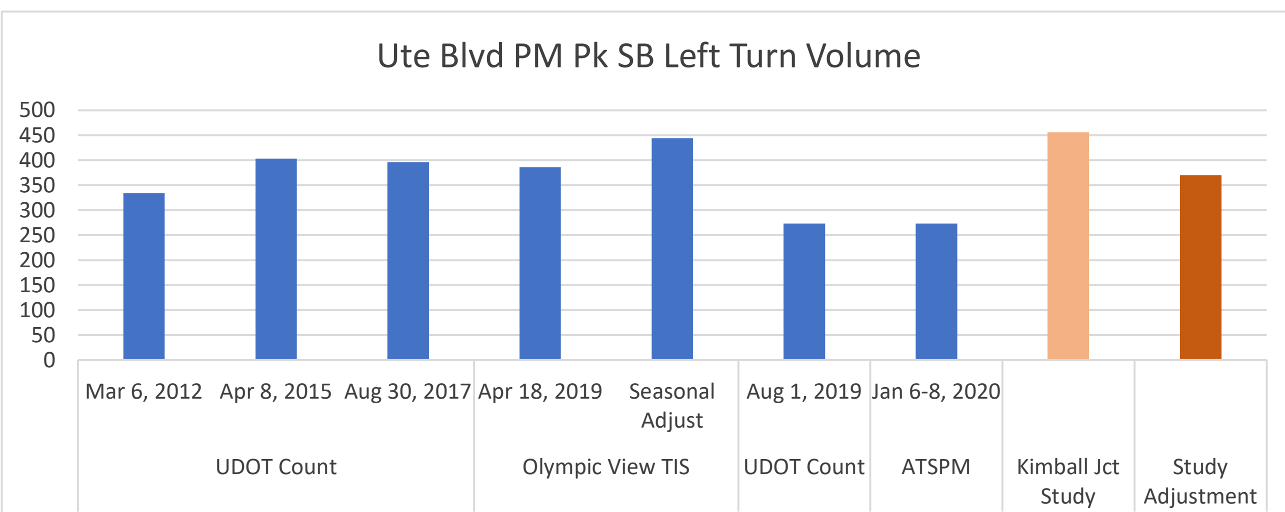

Figure 1: Ute Boulevard PM Peak Hour Southbound Left-turn Volume Comparison

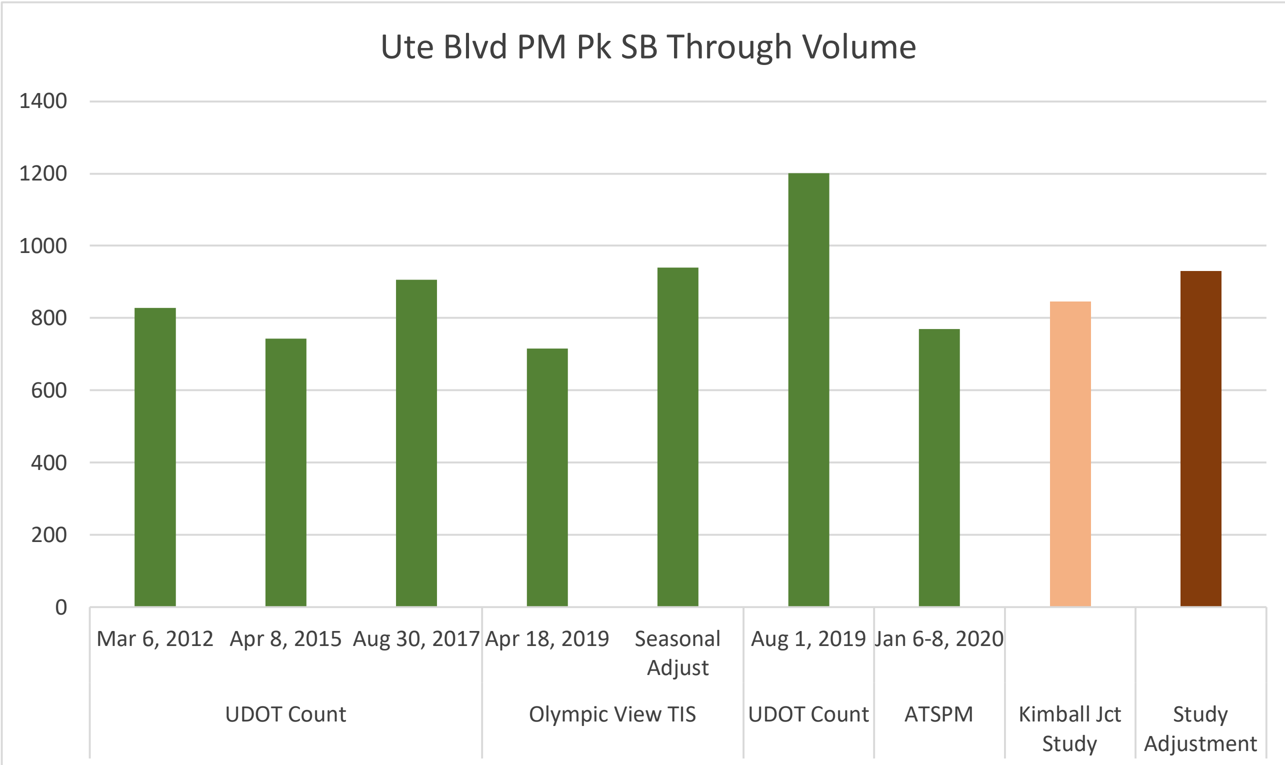

Figure 2: Ute Boulevard PM Peak Hour Southbound Through Volume Comparison