SANTA FE & MINERAL INTERSECTION STUDY

Littleton
Colorado

Santa Fe & Mineral Intersection Study

Prepared for:

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1 Executive Summary

The intersection of Santa Fe Drive (US 85) and Mineral Avenue in Littleton, Colorado is the most congested intersection in the City during peak periods. The intersection is situated along a major north-south regional route that carries up to 60,000 vehicles per day (Santa Fe Drive), while Mineral Avenue carries more than 30,000 vehicles per day. Delays at this intersection cost people time and the congestion causes crashes—the intersection saw 59 crashes in 2017 alone. Queue lengths routinely exceed one mile in length approaching this intersection, and delays can be as long as 15-20 minutes in extreme cases.

In response to the severe congestion and safety issues at the intersection, the City of Littleton (the City) is conducting an evaluation to identify and analyze potential solutions, aiming to mitigate congestion and improve safety both at the intersection and along the study corridors. Recognizing that the long-term solution may involve a grade-separated interchange that has a steep price tag, the City has endeavored to identify solutions that can be implemented for a lower cost and in a shorter timeframe.

The intersection is in a relatively constrained location, with Regional Transportation District (RTD) and Consolidated Main Line (CML) freight rail tracks immediately adjacent to Santa Fe Drive on the east, the RTD Mineral Park-n-Ride in the northwest corner, and RTD Mineral Light Rail Station in the northeast corner. Figure ES-1 shows the context of the intersection.

Alternatives Evaluation

To address the capacity and safety deficiencies at the study intersection, multiple conceptual alternatives were developed. In total, twelve—six at-grade and six grade-separated—potential designs were chosen for a high-level analysis:

At-Grade Alternatives

- Existing Intersection
- Expanded Traditional Intersection
- Continuous Flow Intersection (CFI)
- Quadrant Intersection(s)
- Median U-Turn Intersection (MUT)
- Restricted Crossing U-Turn Intersection (RCUT)

Grade-Separated Alternatives

- Traditional Diamond Interchange
- Diverging Diamond Interchange (DDI)
- Displaced Left Turn Interchange (DLT)
- Single Point Urban Interchange (SPUI)
- Partial Cloverleaf Interchange
- "Split Diamond" Interchange

Figure ES-1: Study Context

After accounting for future growth in traffic volumes of between 1.0% and 2.5% per year that is driven mostly by new developments south and west of the intersection, four at-grade alternatives were carried forward for a detailed traffic analysis. These alternatives were the CFI, the northwest quadrant roadway, the southwest quadrant roadway, and dual quadrant roadways.

All four alternatives can be expected to address the capacity issues at the study intersection—under “normal” conditions, or an average day’s conditions as represented by the field data collected, each alternative operates similarly. While some intersections in the CFI and dual quadrants alternatives operate at LOS E in the 2030 horizon year, this level is still significantly better than operations at the existing intersection today. Notably, the northwest quadrant, including a fourth (south) leg at the Mineral Avenue/Platte River Parkway intersection, is the only alternative for which all intersections operate at LOS D or better in the 2030 horizon year for an average day. These results are driven by how left turns are distributed around each quadrant roadway; for example, the dual quadrant alternative results in significant opposing left turn volumes at the Mineral Avenue/Platte River Parkway intersection, requiring green time to be shifted from the through movements to the left turn movements along all approaches, whereas the single-quadrant alternatives only add left-turning volume to some movements, impacting fewer high-volume through movements. Note that dual quadrant roadway operations may be optimized through active traffic management techniques, such as dynamic message signing directing drivers to use a specific quadrant roadway to complete their left-turn movement based on live traffic conditions.

Under “incident” conditions, or a high-volume day’s conditions due to incidents/crashes on parallel corridors, the CFI fails when faced with volumes beyond those of an average day. The dual quadrants alternative also begins to fail when faced with additional left-turn demand at the Mineral Avenue/Platte River Parkway intersection, while the single-quadrant alternatives continue to operate at LOS E or better at all intersections in the system.

When considering additional criteria (driver safety, bicycle/pedestrian safety, ROW impacts, stakeholder impacts, cost, constructability, and adaptability for potential future phases), the quadrant roadway(s) alternatives are significantly more desirable than the CFI. While the ROW and stakeholder impacts of the quadrant roadway(s) are greater than those of the CFI, the safety benefits are also greater, the cost is lower, and the improvements are much more easily constructed. When considering the adaptability of each alternative for future improvements, the additional capacity provided by the quadrant roadway(s) configuration away from the main intersection would make future construction (i.e. grade-separation) significantly easier, less expensive, and less impactful to traffic flow along US 85 and Mineral Avenue compared to the CFI, which would construct infrastructure that both cannot be adapted for future use and offers no alternative route to accommodate traffic around the study intersection during construction. Based on this, the CFI alternative may not be desirable or a proper use of current resources.

Based on these findings, the single-quadrant alternatives should be pursued first; however, selection of the CFI or dual quadrants alternatives based on other factors (e.g. stakeholder coordination, public input, constructability) will still result in significantly improved operations in the 2030 horizon year compared to those in the field today.

Next steps for the project include, but are not limited to:

- Coordination with CDOT for input when selecting the final alternative and concurrence when completing construction and installing of new traffic signals along US 85.
- Stakeholder partnerships, including RTD and the southwest quadrant developers, for right-of-way needs and potential quadrant roadways through one or both properties.
- A detailed VISSIM traffic operations analysis of the final proposed alternative(s), with refinements to signal timings and geometry. The final model(s) should be thoroughly reviewed by CDOT prior to selecting and constructing the preferred alternative.

2 Introduction

The intersection of Santa Fe Drive (US 85) and Mineral Avenue in Littleton, Colorado is the most congested intersection in the City during peak periods. The intersection is situated along a major north-south regional route that carries up to 60,000 vehicles per day (Santa Fe Drive), while Mineral Avenue carries more than 30,000 vehicles per day. Delays at this intersection cost people time and the congestion causes crashes—the intersection saw 59 crashes in 2017 alone. Queue lengths routinely exceed one mile in length approaching this intersection, and delays can be as long as 15-20 minutes in extreme cases.

Due to these operational issues and the high volume of traffic passing through the intersection, safety issues such as crashes and red-light running are prevalent. In response to the severe congestion and safety issues at the intersection, the City of Littleton (the City) is conducting an evaluation to identify and analyze potential solutions, aiming to mitigate congestion and improve safety both at the intersection and along the study corridors. Recognizing that the long-term solution may involve a grade-separated interchange that has a steep price tag, the City has endeavored to identify solutions that can be implemented for a lower cost and in a shorter timeframe.

This report has been developed to document evaluation efforts to date, to identify the potential short- and long-term solutions, and to identify the next steps for the project. The **Existing Conditions** section details the study area and adjacent land uses, the data collection process, and existing traffic operations. The **Future Conditions** section details a preliminary evaluation of many potential solutions, the process by which final options were selected, and provides traffic analyses, cost estimates, and preliminary designs for each. The **Engagement Activities** section discusses the public and stakeholder involvement activities to date. Finally, the **Conclusions and Next Steps** section identifies action items for the project moving forward.

3 Existing Conditions

Study Area

The project study area encompasses approximately 1.4 miles of Santa Fe Drive (US 85) and approximately 0.65 miles of Mineral Avenue. Along US 85, the study area extends from Aspen Grove Way on the north to County Line Road/C-470 on the south; along Mineral Avenue, the study area extends from the South Platte River Bridge on the west to Jackass Hill Road/Long Avenue on the east (Figure 1). Within the study area, both US 85 and Mineral Avenue are four-lane (two per direction) roadways with additional turn lanes at each study intersection. Posted speeds in the study area are 45 mph along US 85 approaching the intersection, 45 mph along Mineral Avenue to the west, and 40 mph along Mineral Avenue to the east.

Based on the data provided in the Colorado Department of Transportation (CDOT) Online Transportation Information System (OTIS), the study segment of US 85 has been identified as a "Principal Arterial - Freeway or Expressway" in access control category "E-X: Expressway, Major Bypass." As Mineral Avenue is not owned/managed by CDOT, it is not included in OTIS. Land use in and surrounding the study area is variable, with a number of notable destinations (Figure 2) adjacent to the study intersection:

- Aspen Grove, a mixed-use development including residential and commercial land uses, located west of US 85 at the north end of the study area;
- The RTD C/D and Consolidated Main Line (Burlington Northern Santa Fe and Union Pacific Railroad) rail corridors located just east of US 85, with the CML corridor running the full length of the study area;
- The RTD Littleton-Mineral LRT station, a terminal station for the RTD C/D lines located in the northeast quadrant of the study intersection;
- The 1,227-parking space RTD Littleton-Mineral Station Park-and-Ride, located in the northwest quadrant of the study intersection;
- 7-Eleven, a retail store and gas station located just west of Platte River Parkway; and
- South Platte Park and the Carson Nature Center, including the Mary Carter Greenway Trailhead, located northwest of the RTD Park-and-Ride.

Figure 1: Study Area

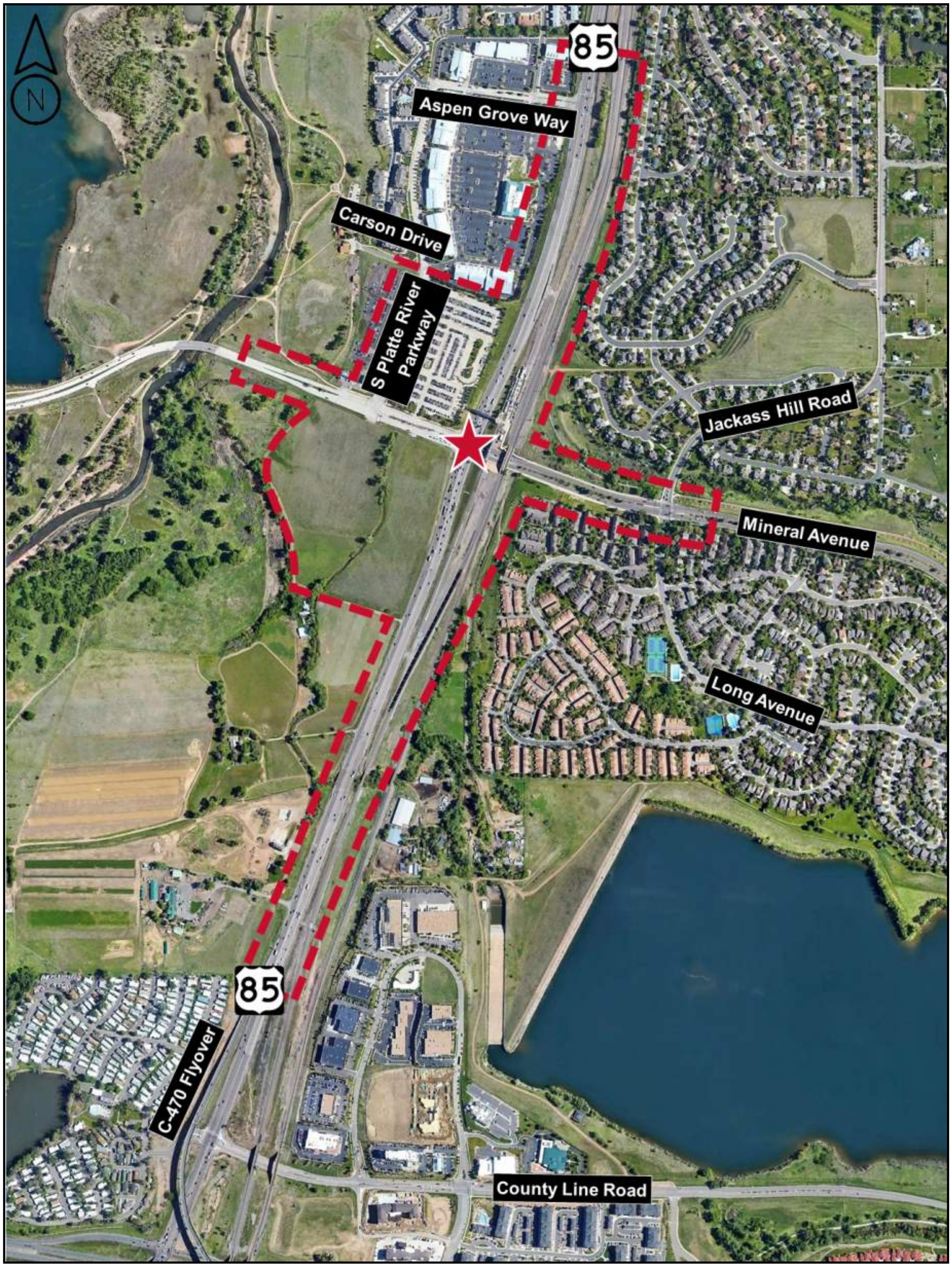
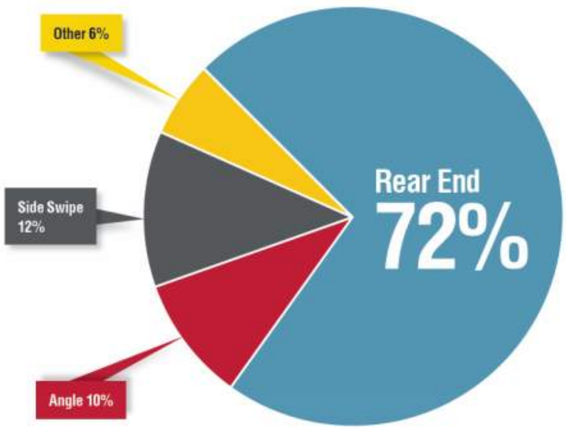


Figure 2: Notable Destinations

Crash Data

Crash data collected indicates that the congestion at the US 85/Mineral Avenue intersection is resulting in a large number of crashes. Rear end crashes, which can typically be attributed to congestion, near the US 85/Mineral Avenue intersection between 2013 and 2017 were six times more likely than any other crash types. Of the 59 total crashes at this intersection in 2017, 72 percent were rear-ends (Figure 3).

Figure 3: Crashes by Type (2017)



Observed Operations

Existing traffic data was collected from INRIX, a Big Data aggregation company that compiles GPS and cell phone data worldwide to determine typical free-flow traffic conditions on major roadways and, subsequently, when and where delay is occurring, as well as from prior traffic studies conducted at the study intersection. These included:

- The Conceptual Design of Traffic Capacity Improvements Study (2014)
- The US 85 Planning and Environmental Linkages Study (2015)
- The Santa Fe Park Development Traffic Impact Study (2017)

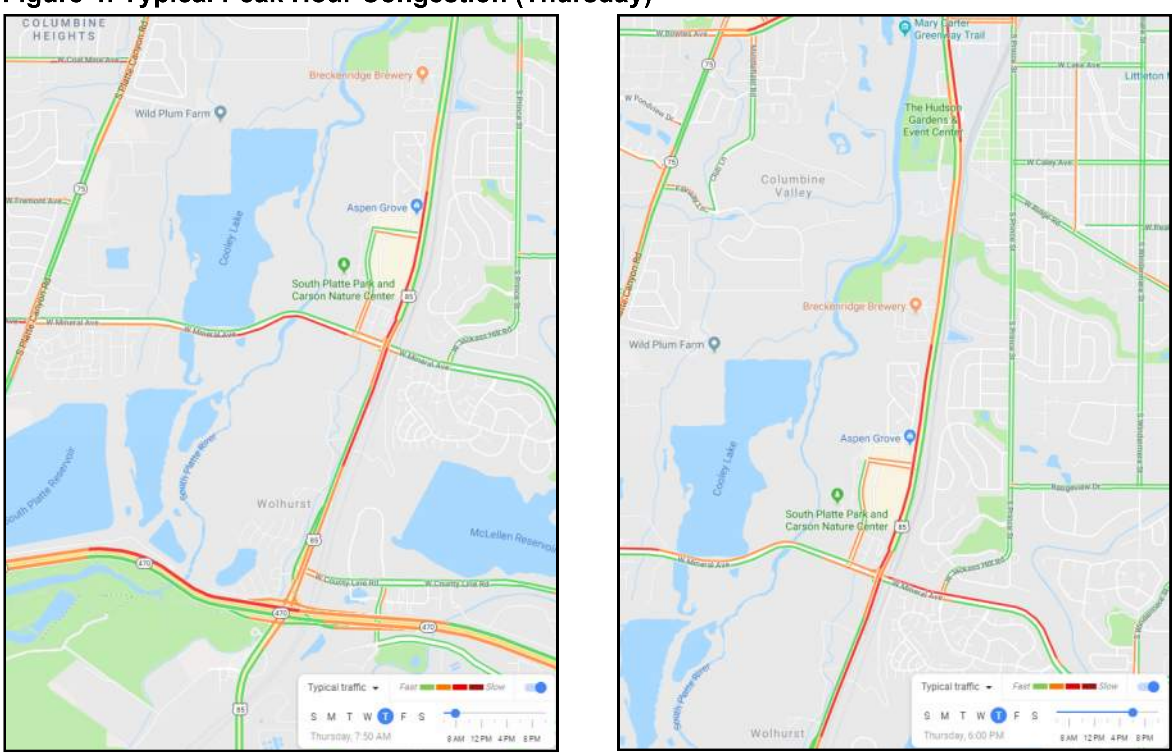
Queues over a mile long were routinely documented along both directions of both US 85 and Mineral Avenue. In particular, northbound US 85 and eastbound Mineral Avenue experience significant congestion during the AM peak period, while southbound US 85 and westbound Mineral Avenue experience significant congestion during the PM peak period; however, during peak periods in particular, congestion is prevalent along all approaches. While signal timings have been updated frequently in the past three years, with some improvement to show, the intersection still fails to process the full demand daily during the peak periods. Severe queuing and delays along each approach indicate that the demand volume, or the actual volume attempting to pass through the intersection, is significantly higher than the counted (i.e. processed) volumes gathered from the previous studies.

INRIX data indicates that speeds along US 85 through this area—northbound from C-470 and southbound from Bowles Avenue to the study intersection—slow significantly during peak hours and cost the traveling public severely:

- In the morning, northbound speeds are as low as 29 miles per hour (mph) on average and as low as 13 mph on a typical "poor" day (i.e. the bottom 5th percentile).
- In the afternoon, southbound speeds are as low as 26 mph on average and as low as 15 mph on a typical "poor" day (i.e. the bottom 5th percentile). When collecting travel time data, for example, southbound speeds were approximately 16 mph, indicating significantly worse operations than the INRIX-reported average. This suggests that the data collected represents a typical "poor" day, and that the analysis conducted using the data will provide more conservative results than if data had been collected during a period with less congestion and delay.
- Delays just along Santa Fe Drive are estimated to have cost the traveling public as much as $5.2 million in user costs in 2017 alone. This accounts for travelers' vehicle operation costs and the value of their time, according to INRIX's methodology.

The screenshots below, from Google Maps, indicate the typical congestion on the US 85 and Mineral Avenue corridors (**Figure 4**). This congestion routinely extends along US 85 beyond Bowles Avenue to the north and beyond County Line Road/C-470 to the south.

Figure 4: Typical Peak Hour Congestion (Thursday)



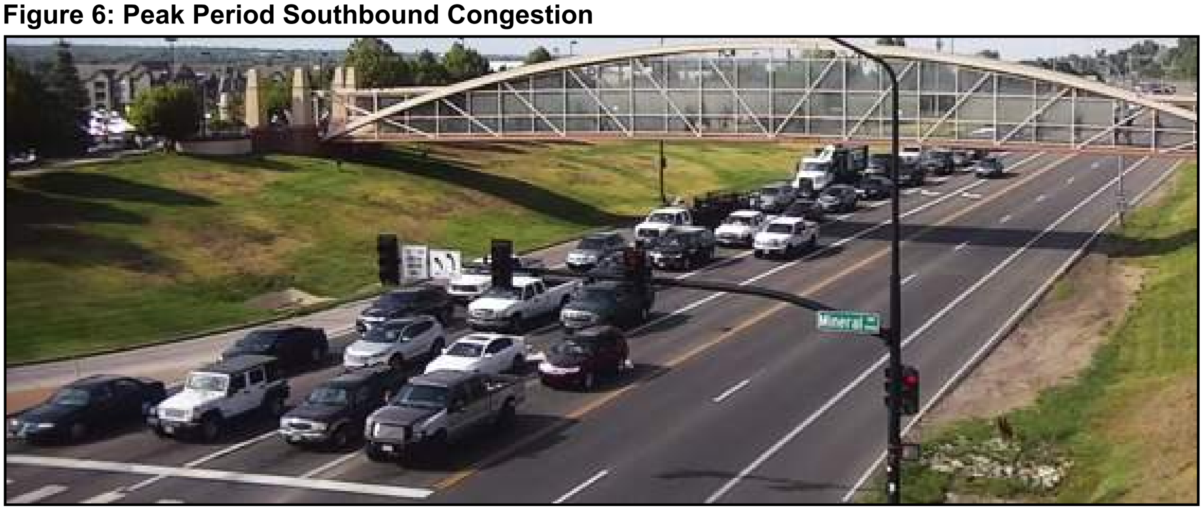
AM Peak Hour ***PM Peak Hour***

Photographs from permanent cameras installed at the US 85/Mineral Avenue intersection show the peak period congestion along US 85 (Figure 5 and Figure 6). Due to the extensive delay experienced by motorists during these periods, it is challenging to fully capture the maximum queues along any approach.

In addition to the severe delays and queuing experienced along US 85, queues along Mineral Avenue routinely stretch over one mile in each direction. These queues often extend beyond the next upstream signal, impacting corridor-wide operations and resulting in significant delay.

Figure 5: Peak Period Northbound Congestion

Figure 6: Peak Period Southbound Congestion



Traffic Analysis

Data Collection

To support the traffic analysis effort, four types of data were collected: intersection turning movement counts (TMCs), corridor average daily traffic (ADT) volumes, maximum queue lengths, and corridor travel times. Each data set was collected concurrently, starting during the PM peak period on Wednesday, February 13 and ending after the AM peak period on Friday, February 15. The data collected is summarized below.

Turning Movement Counts

Turning movement counts were conducted at four signalized intersections in the study area:

- US 85 at Mineral Avenue
- US 85 at Aspen Grove
- Mineral Avenue at Platte River Parkway
- Mineral Avenue at Jackass Hill Road/Long Avenue

At the US 85/Mineral Avenue intersection, TMCs were collected continuously from Sunday, February 10 to Sunday, February 17. The remaining three count locations were counted four times—two AM and two PM peaks—over the data collection period. These times were:

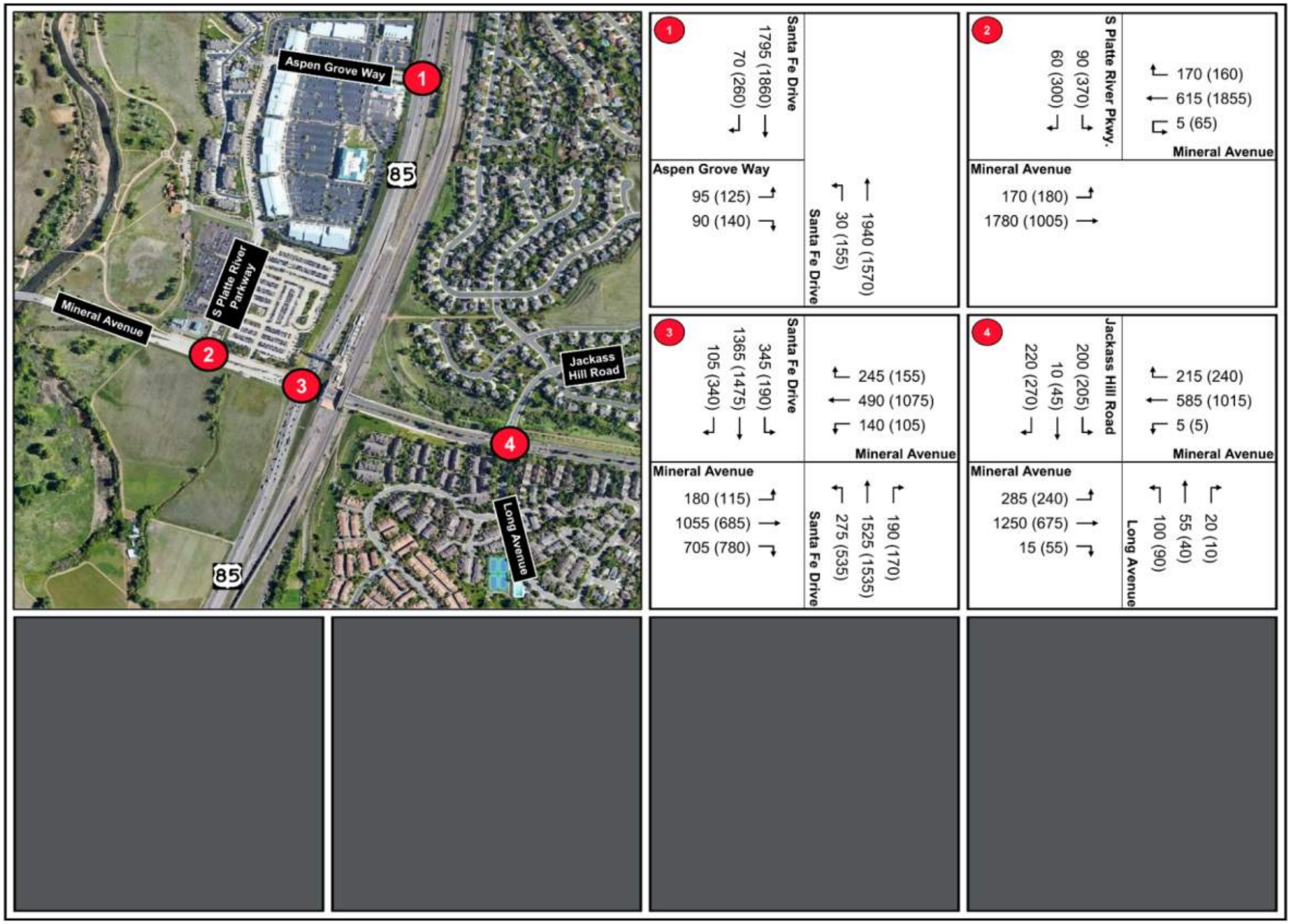
- The PM peak period (3:45PM - 6:15PM) on Wednesday, February 13;
- The AM peak period (6:30AM - 8:30AM) on Thursday, February 14;
- The PM peak period (3:45PM - 6:15PM) on Thursday, February 14; and
- The AM peak period (6:30AM - 8:30AM) on Friday, February 15.

To accurately represent real-world traffic conditions on a specific day with supporting data, it was decided that one AM and one PM peak hour would be modeled rather than an average of two days' data. After processing the data, it was determined that the highest-volume peak hours were from 7:15AM - 8:15AM and from 4:45PM - 5:45PM on Thursday, February 14. The turning movement volumes counted during the two peak hours are shown in Figure 7.

Average Daily Traffic Counts

Continuous ADT counts were collected along Mineral Avenue east of US 85 and west of Platte River Parkway. These were conducted concurrently with the TMCs, running from 3PM on Wednesday, February 13 through 11AM on Friday, February 15. ADT volumes along US 85 north and south of Mineral Avenue were not counted explicitly; rather, the continuous TMCs at the study intersection were used to calculate the daily volumes at each of these locations. A summary of the 2019 existing daily and average weekday ADT volumes at each of the four locations is provided in Table 1.

Figure 7: 2019 Existing Unbalanced Turning Movement Volumes



***XX (XX) =** AM (PM) Peak Hour Turning Movement Volume*

Table 1: Existing 2019 Average Daily Traffic Volumes

Location	Average Daily Traffic (ADT) Volume by Weekday					Typical Weekday Average (Tues-Thurs)	Overall Weekly Average (Mon-Fri)
	Monday 2/11/2019	Tuesday 2/12/2019	Wednesday 2/13/2019	Thursday 2/14/2019	Friday 2/15/2019		
Santa Fe Drive north of Mineral Avenue	53,300	54,900	52,600	54,300	51,700	53,900	53,400
Santa Fe Drive south of Mineral Avenue	52,500	51,700	56,200	53,800	55,900	53,900	54,000
Mineral Avenue west of Santa Fe Drive	32,000	33,600	34,100	34,100	34,100	33,900	33,600
Mineral Avenue east of Santa Fe Drive	25,900	27,400	27,600	27,300	26,600	27,400	27,000

As shown in Table 1, ADT volumes at each location are relatively consistent throughout the week, with minor fluctuations. Based on a typical weekday (e.g. Tuesday, Wednesday, or Thursday), the volumes are approximately 54,000 vehicles along US 85 and approximately 33,900 and 27,400 vehicles west of Platte River Parkway and east of US 85, respectively, with total ADT volumes passing through the intersection exceeding 90,000 vehicles per day.

Travel Times and Maximum Queues

Corridor travel times and maximum queue lengths were recorded in tandem, with each travel time run starting at the back of the approach queue and ending when the recorder crossed the stop bar at the US 85/Mineral Avenue intersection. As some approach queues reached beyond one or more upstream intersections and others did not, upstream intersections that were never reached were chosen from which to measure total travel times. These points were:

- US 85 at Church Avenue to the north;
- US 85 at County Line Road to the south;
- Mineral Avenue at Polo Ridge Drive to the west; and
- Mineral Avenue at Southpark Lane/Windermere Street to the east.

To calculate the total travel time from these points to the stop bar at the study intersection, the remaining distance was divided by the posted speed (45 mph along US 85 approaching the intersection, 45 mph along Mineral Avenue to the west, and 40 mph along Mineral Avenue to the east) and added to the time spent in the queue. A summary of the average travel times from ten travel time runs per peak period, as measured from the points noted above, and the maximum queue lengths recorded on each approach is provided in Table 2.

Table 2: Existing 2019 Average Travel Times & Maximum Queues

Intersection	Movement	Distance Traveled (ft)	Travel Time (mm:ss)		Average Speed (mph)		Maximum Queue Length (ft)	
			AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Santa Fe Drive at Mineral Avenue	NBT	4,700	01:44	02:28	30.9	21.7	1,950	1,400
	SBT	11,450	04:07	08:03	31.6	16.2	1,075	10,325
	EBT	4,550	02:54	02:45	17.8	18.8	2,650	225
	WBT	6,000	02:17	04:00	29.9	17.1	250	2,150

Volume Development

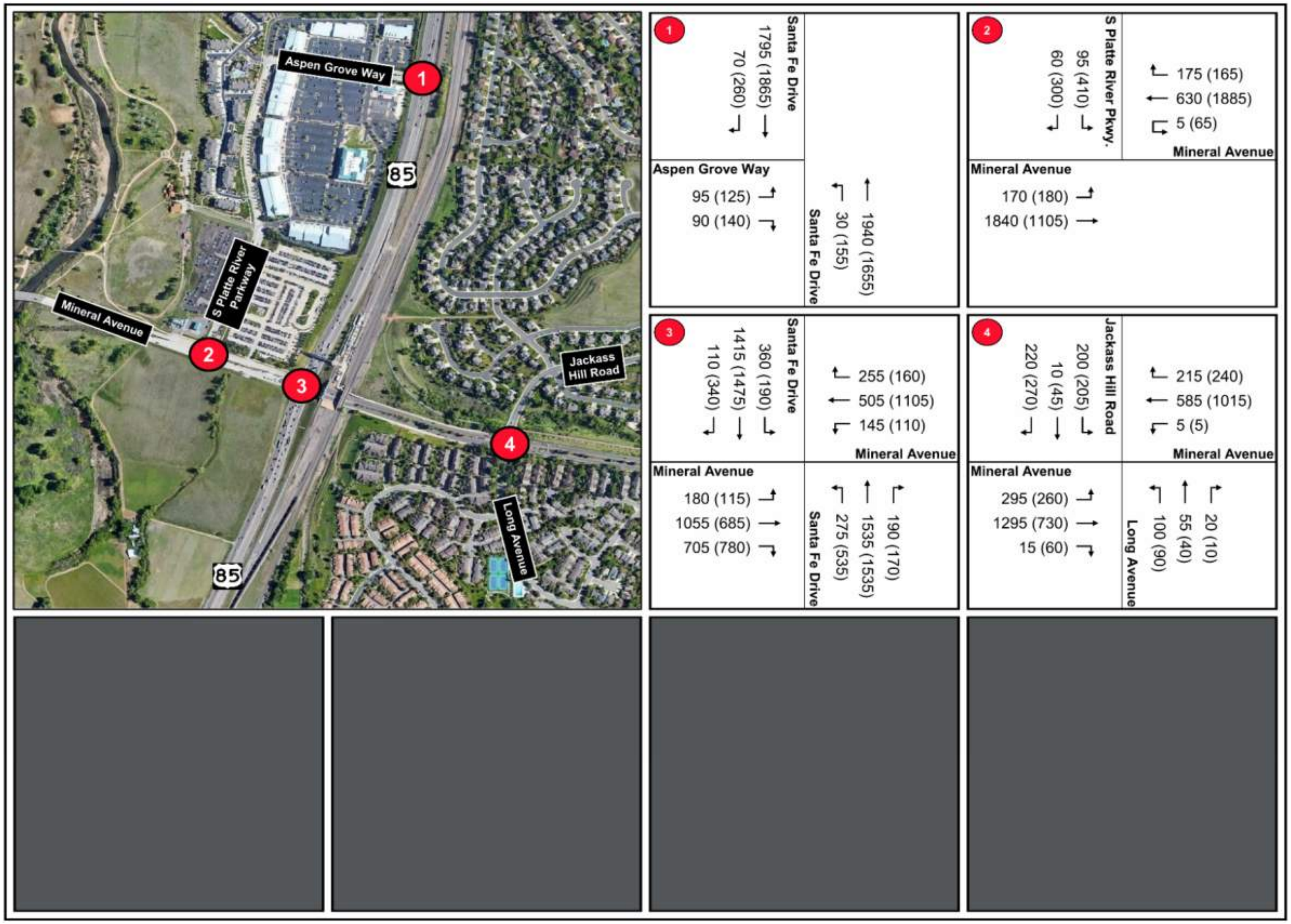
The unbalanced turning movement volumes shown in Figure 7 were balanced according to the methodology provided in NCHRP *Report 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design*. The NCHRP methodology applies each imbalance to the downstream approach, based on the existing turning movement proportions. Where the NCHRP methodology would result in subtracting volume from a downstream approach, that imbalance was applied to the upstream movements instead to provide a conservative analysis. The balanced turning movement volumes are provided in Figure 8.

Due to the severe queuing along multiple approaches at the study intersection, significant unserved demand is not being processed by the intersection and therefore was not included in the counted volumes. To account for this demand, the queue lengths along approaches that were noted to not process all demand every cycle were divided by an assumed vehicle spacing of 50 feet to determine the number of vehicles waiting to be served by the signal. The additional demand was applied to all movements along the following approaches, which were observed to experience significant queuing during the noted peak period:

- Northbound US 85 during the AM peak period;
- Southbound US 85 during the PM peak period;
- Eastbound Mineral Avenue during the AM peak period; and
- Westbound Mineral Avenue during the PM peak period.

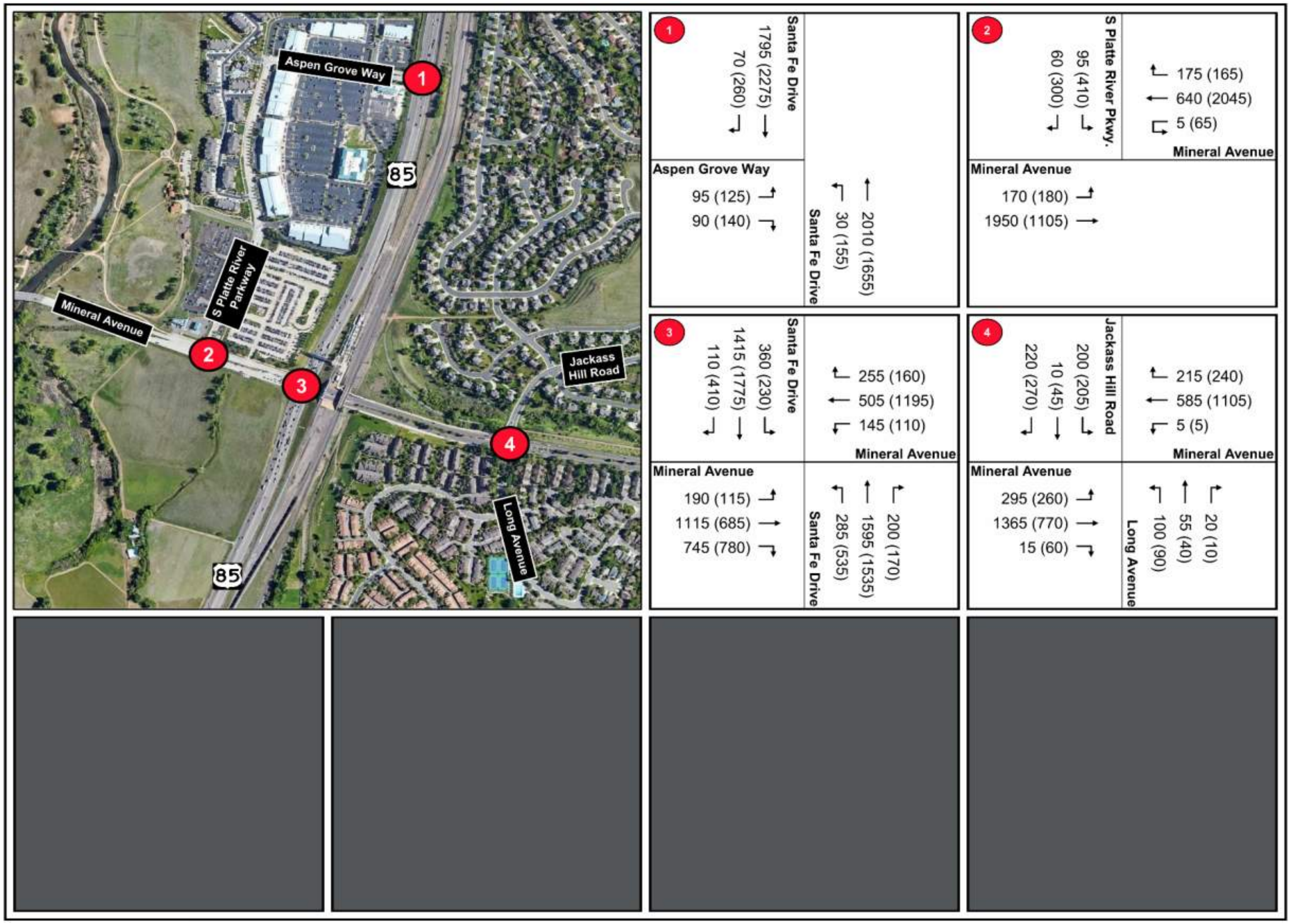
The final 2019 Existing Conditions turning movement volumes are provided in Figure 9.

Figure 8: 2019 Base Balanced Turning Movement Volumes



***XX (XX) =** AM (PM) Peak Hour Turning Movement Volume*

Figure 9: 2019 Final Balanced Turning Movement Volumes



***XX (XX) =** AM (PM) Peak Hour Turning Movement Volume*

Synchro Analysis

Synchro models based on the adjusted traffic volumes and existing signal timings (provided by the City) were developed to document existing operations in the study area. A summary of this analysis is provided in Table 3; full HCM outputs are provided in Attachment A.

Table 3: Existing 2019 Synchro Analysis Summary

Intersection	Existing Conditions			
	AM Peak		PM Peak	
	Delay (s)	LOS	Delay (s)	LOS
Mineral Avenue at S Platte River Parkway[1]	5.2	A	25.6	C
Santa Fe Drive at Mineral Avenue	92.5	F	99.6	F
Santa Fe Drive at Aspen Grove Way	10.8	B	22.5	C
Mineral Avenue at Jackass Hill Road/Long Avenue	18.7	B	33.8	C

[1]Actual delay experienced in the field is greater due to spillback from the Santa Fe / Mineral intersection.

The models confirm that the US 85/Mineral Avenue intersection is currently over capacity, operating at LOS F during both peak hours. The adjacent Mineral Avenue/Platte River Parkway intersection appears to operate at acceptable levels; however, it should be noted that these results do not account for spillback from the main intersection greatly impacting operations at this location as seen in the field

VISSIM Analysis

VISSIM models were created to reflect existing peak hour operations in the study area and support the eventual alternatives analysis process. Based on the guidance found in CDOT's *Traffic Analysis and Forecasting Guidelines* document, the models were calibrated to reflect the volume, travel time, and queuing data collected in the field. The *Guidelines* document outlines the microsimulation parameters which may be changed, as well as ranges within which the parameters should fall. A summary of the suggested ranges, the final parameters used, and the reason for each change is provided in Table 4.

Table 4: VISSIM Calibration Parameter Summary

Parameter		Existing AM Peak				Existing PM Peak			
		Default	Recomm. Range	Adjusted	Reason?	Default	Recomm. Range	Adjusted	Reason?
Lookback Distance (ft)		16.4	n/a	Varies	Provide for smooth merging and lane changes.	16.4	n/a	Varies	Provide for smooth merging and lane changes.
Emergency Stop Distance (ft)		656.2	n/a	Varies	Provide for smooth merging and lane changes.	656.2	n/a	Varies	Provide for smooth merging and lane changes.
Input Volumes (veh)		Counted Volume	n/a	Demand Volume	Account for unserved demand (e.g. vehicles in a 10,000-foot queue).	Counted Volume	n/a	Demand Volume	Account for unserved demand (e.g. vehicles in a 10,000-foot queue).
Wiedemann 74 Car Following Model	Average Standstill Distance (ft)	6.56	3.28 - 6.56	4.92	Reduce queue lengths along relevant approaches.	6.56	3.28 - 6.56	3.28	Reduce queue lengths along approaches, as needed.
	Additive Part of Safety Distance	2.0	2.0 - 2.2	2.0	n/a	2.0	2.0 - 2.2	2.0	n/a
	Multiplicative Part of Safety Distance	3.0	2.8 - 3.3	2.8	Lower variation in safety distance (e.g. more cars adhere to average value above).	3.0	2.8 - 3.3	2.8	Lower variation in safety distance (e.g. more cars adhere to average value above).
Reduced Safety Distance Close to a Stop Line		0.6	n/a	0.6	n/a	0.6	n/a	0.3	Increase number of vehicles able to stack in storage bays, as needed.

The Guidelines document also identifies a number of calibration targets which must be met by at least 85 percent of relevant links (volumes and queues) and/or routes (travel times) to consider a model calibrated to field conditions. For volumes, these targets are:

- For movements below 700 vehicles per hour (vph), the modeled volume should be within 100 vph of the observed traffic volume;
- For movements above 700 vph and below 2,700 vph, the modeled volume should be within ± 15 percent of the observed traffic volume; and
- For movements above 2,700 vph, the modeled volume should be within 400 vph of the observed traffic volume.

For travel times, these targets are:

- For routes below seven minutes in length, the modeled travel time should be within ± 60 seconds of the observed travel time; and
- For routes above seven minutes in length, the modeled travel time should be within ± 15 percent of the observed travel time.

Finally, the modeled queue lengths should fall within ± 20 percent of the observed maximum queue length. Summaries of the calibration results for each measure of effectiveness (MOE) are provided in Table 5, Table 6, Table 7, and Table 8.

Table 5: VISSIM Volume Calibration Summary—US 85 at Mineral Avenue

Intersection	Approach	Movement	AM Peak			PM Peak		
			# of Vehicles		Meets Target?[1]	# of Vehicles		Meets Target?[1]
			Input	Model		Input	Model	
Santa Fe Drive at Mineral Avenue	Northbound	Left	285	276	Y	535	530	Y
		Through	1,595	1,605	Y	1,535	1,538	Y
		Right	200	192	Y	170	166	Y
		Overall	**2,080**	**2,073**	-	**2,240**	**2,234**	-
	Southbound	Left	360	359	Y	230	204	Y
		Through	1,415	1,411	Y	1,775	1,535	Y
		Right	110	111	Y	410	366	Y
		Overall	**1,885**	**1,881**	-	**2,415**	**2,105**	-
	Eastbound	Left	190	180	Y	115	114	Y
		Through	1,115	1,069	Y	685	680	Y
		Right	745	723	Y	780	794	Y
		Overall	**2,050**	**1,972**	-	**1,580**	**1,588**	-
	Westbound	Left	145	143	Y	110	109	Y
		Through	505	494	Y	1,195	1,189	Y
		Right	255	265	Y	160	164	Y
		Overall	**905**	**902**	-	**1,465**	**1,462**	-
	Overall Intersection		**6,920**	**6,828**	-	**7,700**	**7,389**	-

[1] **Per the CDOT *Traffic Analysis and Forecasting Guidelines*, simulated volume calibration targets are:**
For < 700 vph, within ± 100 vph of observed traffic volumes;
For 700 to 2,700 vph, within ± 15 percent of observed traffic volumes; or
For > 2,700 vph, within ± 400 vph of observed traffic volumes.

Table 6: VISSIM Volume Calibration Summary—Mineral Avenue at Platte River Parkway

Intersection	Approach	Movement	AM Peak # of Vehicles		AM Peak Meets Target?[1]	PM Peak # of Vehicles		PM Peak Meets Target?[1]
			Input	Model		Input	Model	
Mineral Avenue at S Platte River Parkway	Southbound	Left	95	98	Y	410	414	Y
		Right	60	61	Y	300	303	Y
		Overall	**155**	**159**	-	**710**	**717**	-
	Eastbound	Left	170	162	Y	180	178	Y
		Through	1,950	1,866	Y	1,105	1,107	Y
		Overall	**2,120**	**2,028**	-	**1,285**	**1,285**	-
	Westbound	U-Turn	5	5	Y	65	65	Y
		Through	640	628	Y	2,045	1,979	Y
		Right	175	177	Y	165	167	Y
		Overall	**820**	**810**	-	**2,275**	**2,211**	-
	Overall Intersection		**3,095**	**2,997**	-	**4,270**	**4,213**	-

[1] **Per the CDOT *Traffic Analysis and Forecasting Guidelines*, simulated volume calibration targets are:**
For < 700 vph, within ± 100 vph of observed traffic volumes;
For 700 to 2,700 vph, within ± 15 percent of observed traffic volumes; or
For > 2,700 vph, within ± 400 vph of observed traffic volumes.

Table 7: VISSIM Travel Time Calibration Summary

Intersection	Movement	AM Peak Travel Time (mm:ss)		AM Peak Meets Target?[1]	PM Peak Travel Time (mm:ss)		PM Peak Meets Target?[1]
		Field	Model		Field	Model	
Santa Fe Drive at Mineral Avenue	NBT	01:44	02:15	Y	02:28	01:54	Y
	SBT	04:07	03:25	Y	08:03	09:04	Y
	EBT	02:54	04:46	N	02:45	02:26	Y
	WBT	02:17	02:32	Y	04:00	04:42	Y

[1] **Per the CDOT *Traffic Analysis and Forecasting Guidelines*, simulated travel time calibration targets are:**
For routes less than seven minutes, within ± 60 seconds of observed travel time; or
For routes longer than seven minutes, within ± 15 percent of observed travel time.

Table 8: VISSIM Maximum Queue Length Calibration Summary

Intersection	Movement	AM Peak Max. Queue (ft)		AM Peak Meets Target?[1]	PM Peak Max. Queue (ft)		PM Peak Meets Target?[1]
		Field	Model		Field	Model	
Santa Fe Drive at Mineral Avenue	NBT/NBL[2]	1,950	1,710	Y	1,400	1,320	Y
	SBT	1,075	1,140	Y	10,325	10,230	Y
	EBT	2,650	2,610	Y	225	480	N
	WBT	250	270	Y	2,150	2,010	Y

[1] Per the CDOT *Traffic Analysis and Forecasting Guidelines*, simulated queue length calibration target is ± 20 percent of observed maximum queue.

As shown in Table 5 and Table 6, all turning movement volumes meet the calibration targets set forth in the Guidelines document. Nearly all average travel times (Table 7) also meet the relevant targets, with one exception: the eastbound travel time in the AM peak model, which falls nearly two minutes above the field-measured time and nearly one minute above the calibration target. It should be noted that, though the value does not meet the target, it falls above the measured data rather than below; therefore, this will result in a more conservative analysis when conducting the future alternatives evaluation.

Finally, nearly all maximum queue lengths (Table 8) also meet the relevant targets, with one exception: the eastbound maximum queue in the PM peak model, which falls outside of the ± 20 percent range set forth in the Guidelines document. Assuming the same 50-foot vehicle spacing that was assumed when developing demand volumes, the modeled queue length is just over four vehicle lengths above the field-measured queue—a negligible distance. As such, the models should still be considered calibrated and should be carried forward for use in the future alternatives evaluation.

The calibrated peak hour VISSIM models were simulated for a total of ten runs each, and the results were averaged between the runs. A summary of this analysis is provided in Table 9; full VISSIM outputs are provided in Attachment B.

Table 9: Existing 2019 VISSIM Analysis Summary

Intersection	Existing Conditions			
	AM Peak		PM Peak	
	Delay (s)	LOS	Delay (s)	LOS
Mineral Avenue at S Platte River Parkway	67.2	E	17.6	B
Santa Fe Drive at Mineral Avenue	62.0	E	116.4	F

Notably, the AM peak hour model results from VISSIM are significantly different than those from Synchro. This is due to VISSIM's ability to account for spillback queues—due to the spillback from the US 85/Mineral Avenue intersection, vehicles are unable to cross through the adjacent Mineral Avenue/Platte River Parkway intersection. This meters traffic able to access the main intersection, resulting in operations that appear better at that location, while causing significant delay to be attributed to the adjacent intersection, resulting in operations that appear much worse. In essence, the Synchro results (Table 3) represented theoretical operations as if each intersection operated in a vacuum, while the VISSIM results (Table 9) represent the conditions occurring when the two closely spaced signals interact as they do in the field.

4 Future Conditions

Preliminary Alternatives Evaluation (December 2018)

To address the capacity and safety deficiencies at the study intersection, multiple conceptual alternatives were developed. In total, twelve—six at-grade and six grade-separated—potential designs were chosen for a high-level analysis:

At-Grade Alternatives

- Existing Intersection
- Expanded Traditional Intersection
- Continuous Flow Intersection (CFI)
- Quadrant Intersection(s)
- Median U-Turn Intersection (MUT)
- Restricted Crossing U-Turn Intersection (RCUT)

Grade-Separated Alternatives

- Traditional Diamond Interchange
- Diverging Diamond Interchange (DDI)
- Displaced Left Turn Interchange (DLT)
- Single Point Urban Interchange (SPUI)
- Partial Cloverleaf Interchange
- "Split Diamond" Interchange

Traffic operations were evaluated based on the Federal Highway Administration's (FHWA's) Capacity Analysis for Planning of Junctions (CAP-X) tool, which provides volume-to-capacity (v/c) ratios for various intersection and interchange designs at user-input volume levels. This process was previously documented in the *Preliminary Traffic Operations Analysis* technical memorandum (Attachment C).

In total, eight evaluation criteria were developed for the high-level analysis: driver safety, traffic operations, bicycle/pedestrian safety, right-of-way (ROW) impacts, stakeholder impacts, cost, constructability, and adaptability for potential future phases (i.e. widening, grade-separation). Each alternative was graded based on these evaluation criteria. A summary of the preliminary evaluation is provided in Figure 10, Figure 11, and Table 10.

Based on the findings of this preliminary evaluation, three at-grade and two grade-separated alternatives were carried forward for a threshold evaluation: the CFI, the quadrant roadway (in the northwest or southwest quadrant), the dual quadrants (in both quadrants), the diamond interchange, and the SPUI.

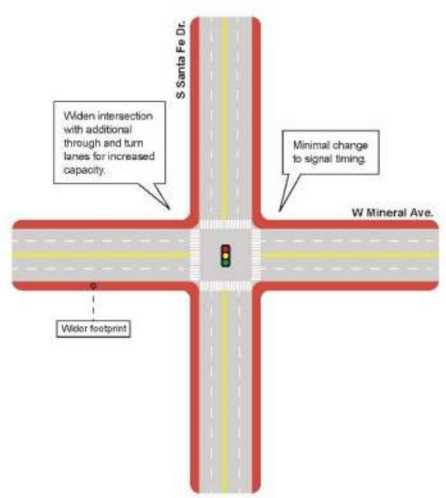
Figure 10: At-Grade Alternatives

NO ACTION

- (+) No construction required
- (+) No right-of-way impacts
- (−) Degrading traffic operations with growth
- (−) Increased transit travel times with increased congestion
- (−) Maintains existing safety deficiencies for all travel modes

ALTERNATIVE 1

Expanded Traditional Intersection



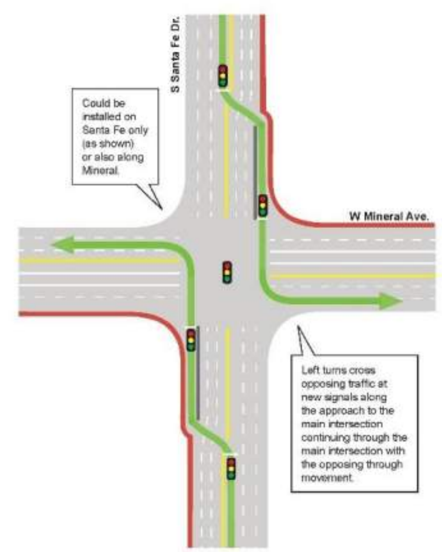
EVALUATION SUMMARY

- (+) Relatively Low-cost alternative
- (+) Minimal right-of-way impacts

- (−) Minimally improves intersection operations compared to No Action alternative
- (−) Increased transit travel times with increased congestion
- (−) Maintains existing safety deficiencies for all users, or worse due to wider intersection

ALTERNATIVE 2

Continuous Flow Intersection



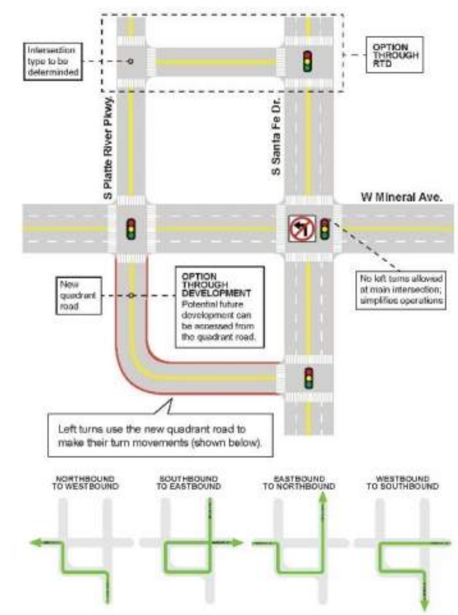
EVALUATION SUMMARY

- (+) Reduces number and severity of left-turn conflicts
- (+) Minimal impacts to adjacent property or RTD parking lot
- (+) Improves traffic operations with increased capacity
- (+) Improves transit operations due to lower congestion

- (−) Requires multi-stage pedestrian crossings
- (−) Large amount of "throwaway" infrastructure if future grade separation occurs

ALTERNATIVE 3

Quadrant Intersection



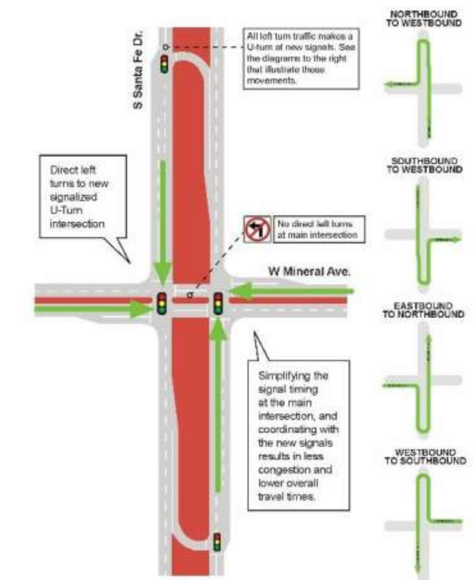
EVALUATION SUMMARY

- (+) Simple construction at low cost
- (+) Greatest improvement to traffic operations among at-grade alternatives
- (+) Improves transit operations due to lower congestion
- (+) Reduces left-turn conflicts

- (−) Requires longer travel distance for some left-turning vehicles especially when there is little to no congestion
- (−) Increases turning movement volumes at adjacent intersection
- (−) Requires right-of-way acquisition from RTD or development property

ALTERNATIVE 4

Median U-Turn Intersection



EVALUATION SUMMARY

- (+) Removes left-turn conflict points from main intersection
- (+) Relatively low cost for construction
- (+) Installs wide median which may be useful for future grade separation

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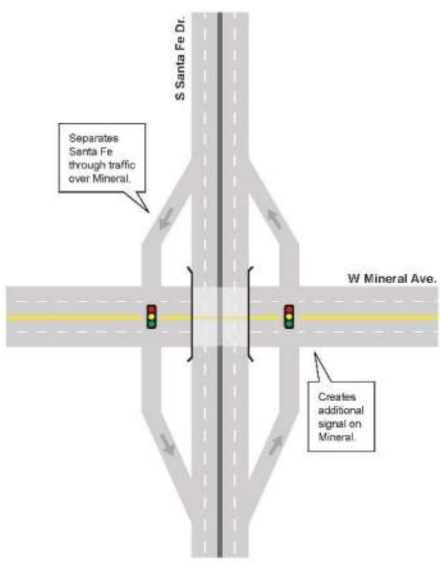
- (−) Requires longer travel distance for left-turning vehicles
- (−) Requires significant roadway widening
- (−) Minimally increases capacity at main intersection

Figure 11: Grade-Separated Alternatives

ALTERNATIVE 5

Diamond Interchange



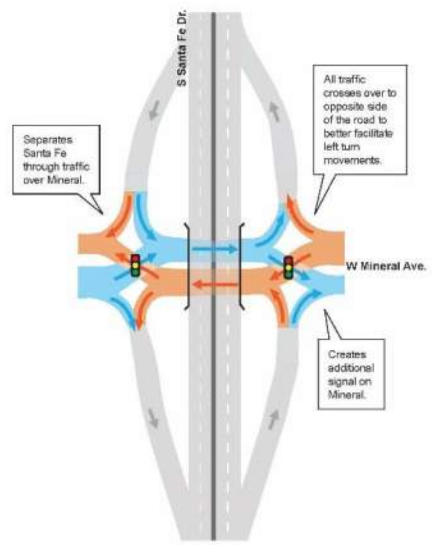
EVALUATION SUMMARY

- (+) Improves traffic/transit operations more than at-grade alternatives
- (+) Separates major traffic flow, improving safety for most users
- (+) Relatively minimal right-of-way requirements

- (−) Long, multi-phased construction period
- (−) Significantly higher cost than at-grade alternatives

ALTERNATIVE 6

Diverging Diamond Interchange



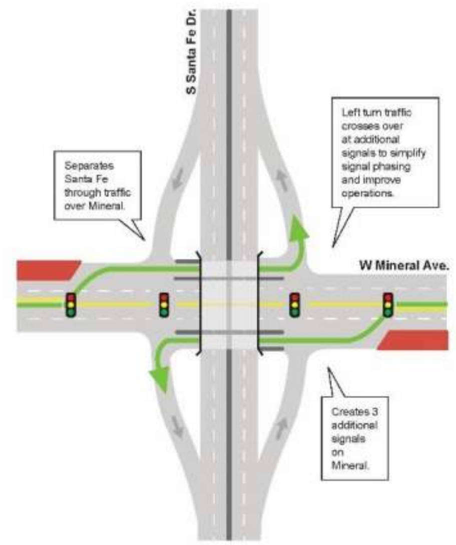
EVALUATION SUMMARY

- (+) Significantly improves traffic/transit operations
- (+) Separates major traffic flow, improving safety for most users

- (−) Requires pedestrians/bicyclists to cross free-flow ramps
- (−) Significant right-of-way impacts to development property and RTD lot
- (−) Long, multi-phased construction period
- (−) One of the highest-cost alternatives

ALTERNATIVE 7

Displaced Left-Turn Interchange



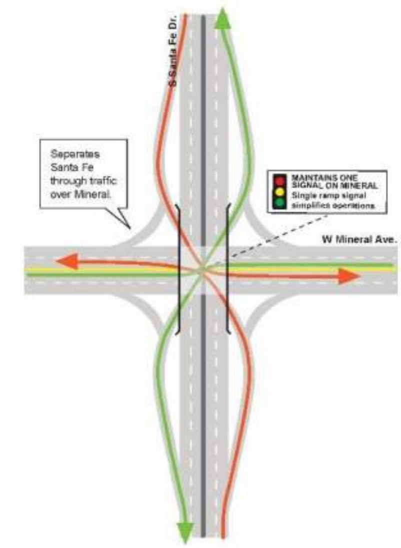
EVALUATION SUMMARY

- (+) Significantly improves traffic/transit operations
- (+) Separates major traffic flow, improving safety for most users

- (−) Requires pedestrians/bicyclists to cross free-flow ramps
- (−) Significant right-of-way impacts to development property and RTD lot
- (−) Long, multi-phased construction period
- (−) One of the highest-cost alternatives

ALTERNATIVE 8

Single Point Urban Interchange



EVALUATION SUMMARY

- (+) Significantly improves traffic/transit operations
- (+) Separates major traffic flow, improving safety for most users
- (+) Relatively minimal right-of-way requirements

- (−) Long, multi-phased construction period
- (−) Significantly higher cost than at-grade alternatives

ALTERNATIVE 9

Partial Cloverleaf Interchange

EVALUATION SUMMARY

- (+) Greatest improvement to traffic/transit operations among all alternatives
- (+) Eliminates most severe left-turn conflicts with loop ramps

- (−) Requires pedestrians/bicyclists to cross free-flow ramps
- (−) Greatest right-of-way impacts of all alternatives
- (−) Long, multi-phased construction period
- (−) Highest cost of all alternatives

Table 10: Preliminary Alternatives Evaluation Summary

EVALUATION CRITERION	AT-GRADE ALTERNATIVES					
	No Action (Existing Intersection)	Expanded Traditional Intersection	Continuous Flow Intersection	Quadrant Intersection	Median U-Turn Intersection	Restricted Crossing U-Turn Intersection
Safety	Maintains all existing conflict points	Maintains all existing conflict points	Reduced left-turn conflict speeds	Reduced left-turn conflict speeds, spreads remaining conflict points between three intersections	Removes almost all left-turn conflicts, but adds U-turn conflict at turnaround points	Removes almost all left-turn conflicts, but adds U-turn conflict at turnaround points
Traffic Operations	Maintains existing signal phasing and geometry with increased traffic volumes and delays	Maintains existing signal phasing, offers only minor improvements to intersection operations	Improved traffic operations, especially where large left-turn volumes are present	Improved traffic operations, but requires longer travel distance for left-turning vehicles	Marginally increased capacity at main intersection, requires longer travel distance for left-turning vehicles	Marginally increased capacity at main intersection, requires longer travel distance for left-turning vehicles
V/C Ratio AM/PM	2.2 / 1.9	1.9 / 1.6	1.3 / 1.4	1.2 / 1.1	1.8 / 1.7	2.0 / 2.5
Bicycles / Pedestrians	Maintains existing crossings and conflict points with turning vehicles	Maintains existing crossings and conflict points with turning vehicles	Requires multi-stage crossings, places pedestrians between adjacent traffic flows	Accommodates pedestrians at all locations, similar to three traditional intersections	Requires large median and two-stage pedestrian crossing	Requires large median and two-stage pedestrian crossing
Right-of-Way	No impacts	Minor right-of-way acquisition required to widen all approaches to three lanes	Requires relatively little right-of-way acquisiton to accommodate crossover geometry and additional medians	Requires right-of-way acquisition in the selected quadrant	Need for a large median requires significant right-of-way acquisition along the main roadway	Need for a large median requires significant right-of-way acquisition along the main roadway
Stakeholder Impacts	Higher difficulty accessing local destinations due to failing intersection operations	Higher difficulty accessing local destinations due to poor intersection operations	Improved operations can lead to improved bus travel times, access to adjacent parcels with minimal impacts to RTD lot or new development	Improved operations can lead to improved bus travel times and local access, but routes traffic through RTD lot or new development	Marignally improved operations can lead to improved bus travel times and local access, but widening would remove spaces from RTD lot	Marginally improved operations can lead to improved bus travel times and local access, but widening would remove spaces from RTD lot
RTD Parking # of Spots Lost	0	0	0	0 (SW) - 75 (NW)	~ 50	~ 50
Constuctability	No construction required	Construction behind bridge piers to accommodate roadway widening creates significant challenges	Some widening required at crossover points, but generally simple construction	Construction mostly occurs outside of existing roadway ROW	Requires significant roadway widening and installation of two new traffic signals	Requires significant roadway widening and installation of two new traffic signals
Costs	No cost	~ $12 million	~ $15 million	~ $10 million	~ $15 million	~ $15 million
Adaptability for Future Phases	Continues to be adaptable to proposed changes in the future	Continues to be adaptable to proposed changes in the future	Installs multiple crossover points with specific infrastructure requirements, lower adaptability	Easily adaptable to future changes, and installs roadway connections useful for future travel patterns	Installs large median which may support grade separation, but also installs new signals, etc. which would be lost	Installs large median which may support grade separation, but also installs new signals, etc. which would be lost

EVALUATION CRITERION	GRADE-SEPARATED ALTERNATIVES					
	Diamond Interchange	Diverging Diamond Interchange	Displaced Left Turn Interchange	Single Point Urban Interchange	Partial Cloverleaf Interchange	"Split Diamond" Interchange
Safety	Separates major traffic flow from interacting with minor street	Separates major traffic flow from interacting with minor street, reduces left-turn conflict speeds	Separates major traffic flow from interacting with minor street, reduces left-turn conflict speeds	Separates major traffic flow from interacting with minor street, requires very long clearance intervals	Eliminates most severe/highest-volume left-turn conflicts via loop ramps	Separates major traffic flow from interacting with minor street
Traffic Operations	Increases capacity over at-grade options, but requires multi-phased signals along minor street	Increases capacity and reduces number of phases required at minor street signals, provides free-flow turning movements	Reduces number of phases at each signal, significantly improving traffic operations	Requires exclusive left-turn phases along each approach, longer clearance times result in less green time per movement	Offers significantly increased capacity, multiple free-flow turning movements via slip/loop ramps	Increases capacity over at-grade options, but requires multi-phased signals along minor street
V/C Ratio AM/PM	1.1 / 1.1	1.1 / 1.3	1.0 / 1.3	0.9 / 1.3	0.9 / 0.6	1.1 / 1.1
Bicycles / Pedestrians	Separates major traffic flow from interacting with bikes/peds, but requires multiple intersection crossings	Separates major traffic flow from interacting with bikes/peds, but requires crossings of free-flow ramps	Separates major traffic flow from interacting with bikes/peds, but requires multiple intersection crossings	Separates major traffic flow from interacting with bikes/peds, but results in long crossing distances	Separates major traffic flow from interacting with bikes/peds, but requires crossings of high-speed, free-flow ramps	Separates major traffic flow from interacting with bikes/peds, but requires multiple intersection crossings
Right-of-Way	Relatively minimal right-of-way requirements compared to other interchanges if using the "tight diamond"	Significant right-of-way impacts to RTD lot and new development	Significant right-of-way impacts to RTD lot and new development	Relatively minimal right-of-way requirements, minor acquisitions required only to accommodate ramps	Requires the largest footprint, resulting in significant right-of-way impacts to all adjacent parcels	Relatively minimal right-of-way requirements, but requires additional right-of-way from new development compared to the traditional diamond
Stakeholder Impacts	Improved operations would result in greatly increased bus travel times and faster access to any destination	Improved mobility, but would remove a large number of parking spaces from the adjacent RTD lot and land from new development	Improved mobility, but would remove a large number of parking spaces from the adjacent RTD lot and land from new development	Improved mobility would result in greatly increased bus travel times and faster access to any destination	Improved mobility, but would remove a large number of parking spaces from the adjacent RTD lot and land from new development	Improved operations would result in greatly increased bus travel times and faster access to any destination
RTD Parking # of Spots Lost	~ 25	~ 250	~ 250	~ 50	300 +	~ 25
Constuctability	Long, multi-phased construction period, significant impacts to traffic	Long, multi-phased construction period, significant impacts to traffic	Long, multi-phased construction period, significant impacts to traffic	Long, multi-phased construction period, significant impacts to traffic	Long, multi-phased construction period, significant impacts to traffic	Long, multi-phased construction period, significant impacts to traffic
Costs	~ $100 million	~ $135 million	~ $125 million	~ $100 million	~ $140 million	~ $115 million
Adaptability for Future Phases	N/A					

Threshold Evaluation (December 2018)

A preliminary threshold evaluation was conducted to identify a growth factor at which the first intersection in the system (e.g. US 85/Mineral Avenue, Mineral Avenue/Platte River Parkway) was found to operate at LOS F. This evaluation was conducted for two sets of alternatives: one without any additional development in the study area, and one including mixed-use development of the parcels in the southwest quadrant of the study intersection. Where the southwest quadrant developments were included, volumes were developed by distributing site-generated volumes provided in the 2017 *Santa Fe Park Development Traffic Impact Study* to each downstream intersection. This allowed for a comparison of the threshold at which each potential alternative begins to fail (i.e. reaches LOS F at one or more intersections in the system) with and without the additional demand caused by development of these parcels. This process was previously documented in the *Preliminary Traffic Operations Analysis* technical memorandum (Attachment C).

A summary of the preliminary threshold analysis results is provided in Table 11. Note that, for scenarios with build-out of the developments, the thresholds indicate the background growth level that can be accommodated in addition to the site-generated trips; for example, a growth factor of 1.3 at failure indicates an alternative which can handle all site-generated trips *and* 30% background growth from other regional development. For scenarios without build-out, the thresholds simply indicate the level of regional growth able to be accommodated by each alternative, without any site access points or trips included.

Based on these results, inclusion of trips generated by future development in the southwest corner reduces the ability of the alternatives to accommodate future background traffic growth by between 20 and 44 percent. Note that this does not necessarily mean that the same intersection fails with and without development trips included; rather, the first intersection in the overall coordinated system fails at the noted threshold. As the development trips were distributed based on provided origin-destination data rather than simply applied proportionally to the existing traffic volumes, under some alternatives a different intersection in the system may experience additional demand and therefore, additional delay compared to the “critical” intersection in scenarios without site-generated trips.

Inclusion of a fourth leg at Mineral Avenue/Platte River Parkway considerably impacts the amount of traffic that intersection can accommodate. Additional signal phases are required to serve this leg, reducing green time for other movements. As a result, in any scenario that includes the fourth leg, this intersection becomes the failure point in the system at a growth factor that is lower than what can be processed at the main intersection. However, this result is highly dependent on the paths the displaced left turns are assumed to take.

Table 11: Threshold Evaluation Summary

Scenario	Intersection	Growth Factor at LOS F Measured from 2018 Existing	
		With SW Development	Without SW Development
Expanded Traditional Intersection	Santa Fe Drive at Mineral Avenue	**1.13**	**1.33**
	Mineral Avenue at S Platte River Parkway	1.36	1.85
Continuous Flow Intersection	Santa Fe Drive at Mineral Avenue	1.43	**1.61**
	Mineral Avenue at S Platte River Parkway	**1.36**	1.85
Northwest Quadrant Roadway	Santa Fe Drive at Mineral Avenue	1.53	**1.68**
	Mineral Avenue at S Platte River Parkway	**1.24**	1.85
	Santa Fe Drive at NW Quadrant Roadway	1.57	1.77
Southwest Quadrant Roadway	Santa Fe Drive at Mineral Avenue	1.36	**1.53**
	Mineral Avenue at S Platte River Parkway	**1.21**	**1.53**
	Santa Fe Drive at SW Quadrant Roadway	1.53	1.81
Dual Quadrant Roadways	Santa Fe Drive at Mineral Avenue	1.57	1.73
	Mineral Avenue at S Platte River Parkway	**1.27**	**1.50**
	Santa Fe Drive at NW Quadrant Roadway	1.68	1.81
	Santa Fe Drive at SW Quadrant Roadway	1.43	1.68

Bold values indicate the critical failure of each alternative, i.e. the lowest threshold for failure.

Updated Analysis

Using the traffic data collected in February 2019, complete analyses were completed using both Synchro and VISSIM modeling software. Recognizing that the long-term solution (i.e. grade-separation) is cost-prohibitive and requires an extensive construction schedule, this analysis focused on at-grade solutions that can be implemented for a lower cost and in a shorter timeframe. Cost estimates for each alternative are provided in Attachment D. The volume development process and traffic analyses are described in the following sections.

Volume Development

A number of previous traffic studies conducted at the US 85/Mineral Avenue intersection were reviewed to determine growth rates that could be applied when developing future year turning movement volumes. Initially, it was determined that a growth rate of 2.4% per year would be applied to all traffic volumes along US 85. However, based on further review of the Denver Regional Council of Government's (DRCOG's) model, it was determined that a growth rate of 0.9% per year was more appropriate for volumes along Mineral Avenue, as this corridor is mostly developed. These growth rates were applied to their respective turning movement volumes to develop 2030 Horizon Year volumes. As the southwest quadrant developments are currently expected to reach build-out in 2028, the site-generated volumes were included when developing 2030 Horizon Year volumes. Trip generation tables were provided by the development team; these trips were distributed to each downstream intersection and added to the background growth to develop a set of final turning movement volumes, shown in Figure 12.

Finally, turning movement volumes for each analysis year were redistributed according to the alternative being analyzed; for example, left-turning volumes at the main intersection were shifted to use the quadrant roadway(s), where appropriate. For 2030 Horizon Year scenarios, access points to the southwest quadrant development sites were shifted to utilize the quadrant roadway. Where the access point and the quadrant roadway meet, a signalized T-intersection was assumed to minimize impacts to the walkability of the developments; similarly, a signalized T-intersection was assumed for the northwest quadrant to minimize impacts to the RTD park-and-ride facility. Other internal access points, such as driveways, were not considered as part of this analysis. 2030 Horizon Year volumes for each alternative (the CFI, the northwest quadrant, the southwest quadrant, and the dual quadrants) with the developments are shown in Figure 13, Figure 14, Figure 15, and Figure 16.

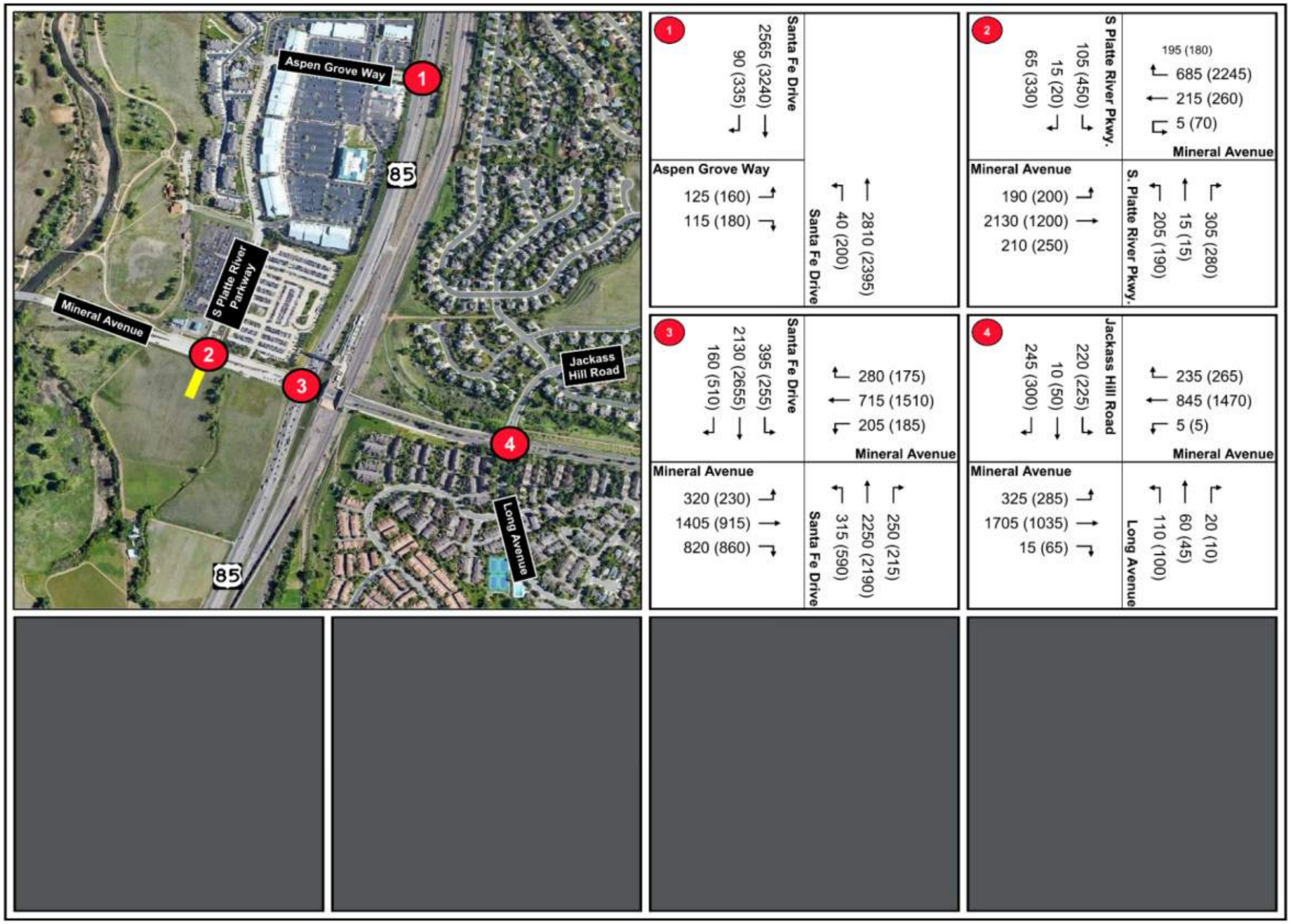
Synchro Analysis

Using the 2019 Existing Conditions model, Synchro models were created for each proposed alternative to conduct a comparative analysis of expected operations in the 2030 horizon year. This analysis looked at operations under “normal” conditions, or an average day’s conditions as represented by the field data collected, and under “incident” conditions, or a high-volume day’s conditions due to incidents/crashes on parallel corridors. Each Synchro model included the trips generated by the southwest quadrant developments and access points to those developments—one access forming a fourth (south) leg at Mineral Avenue/Platte River Parkway and one access at a proposed (by the developers) full-movement traffic signal on US 85 approximately halfway between Mineral Avenue and County Line Road. As noted above, for alternatives that include the southwest quadrant roadway, development trips were provided access to the quadrant roadway via a signalized T-intersection to minimize impacts to the walkability of the developments. Other internal access points, such as driveways, were not considered as part of this analysis. The modeled layouts for each alternative are shown in Figure 17, Figure 18, Figure 19, and Figure 20. Full concept designs are provided in Attachment E.

Normal Conditions

The volumes shown in Figure 12 through Figure 16 were used to model “normal” conditions, or an average day’s conditions as represented by the field data collected. After inputting these volumes into each Synchro model, signal timings—including cycle lengths, splits, phasing, and offsets—were optimized and fine-tuned to maintain operations of LOS E or better at all intersections. With the final timings in place, storage bay lengths were adjusted to be able to accommodate the 95th percentile queue length for each left- and right-turning movement. The delay and queuing results of this analysis are shown in Table 12 and Table 13, respectively, and complete Synchro queuing outputs are provided in Attachment F.

Figure 12: 2030 Horizon Year Base Turning Movement Volumes

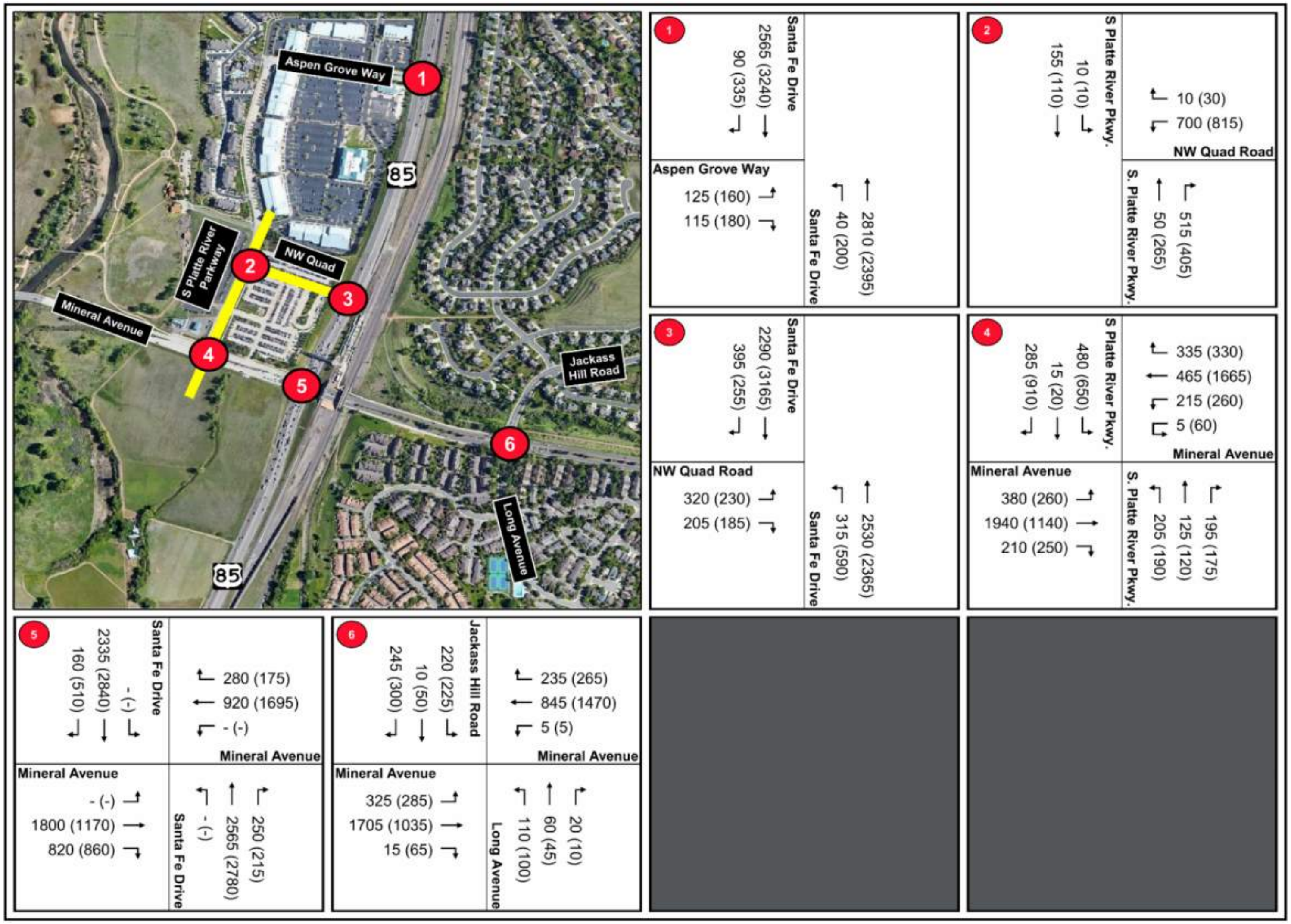


XX (XX) = *AM (PM) Peak Hour Turning Movement Volume*

Figure 13: 2030 Horizon Year CFI Turning Movement Volumes

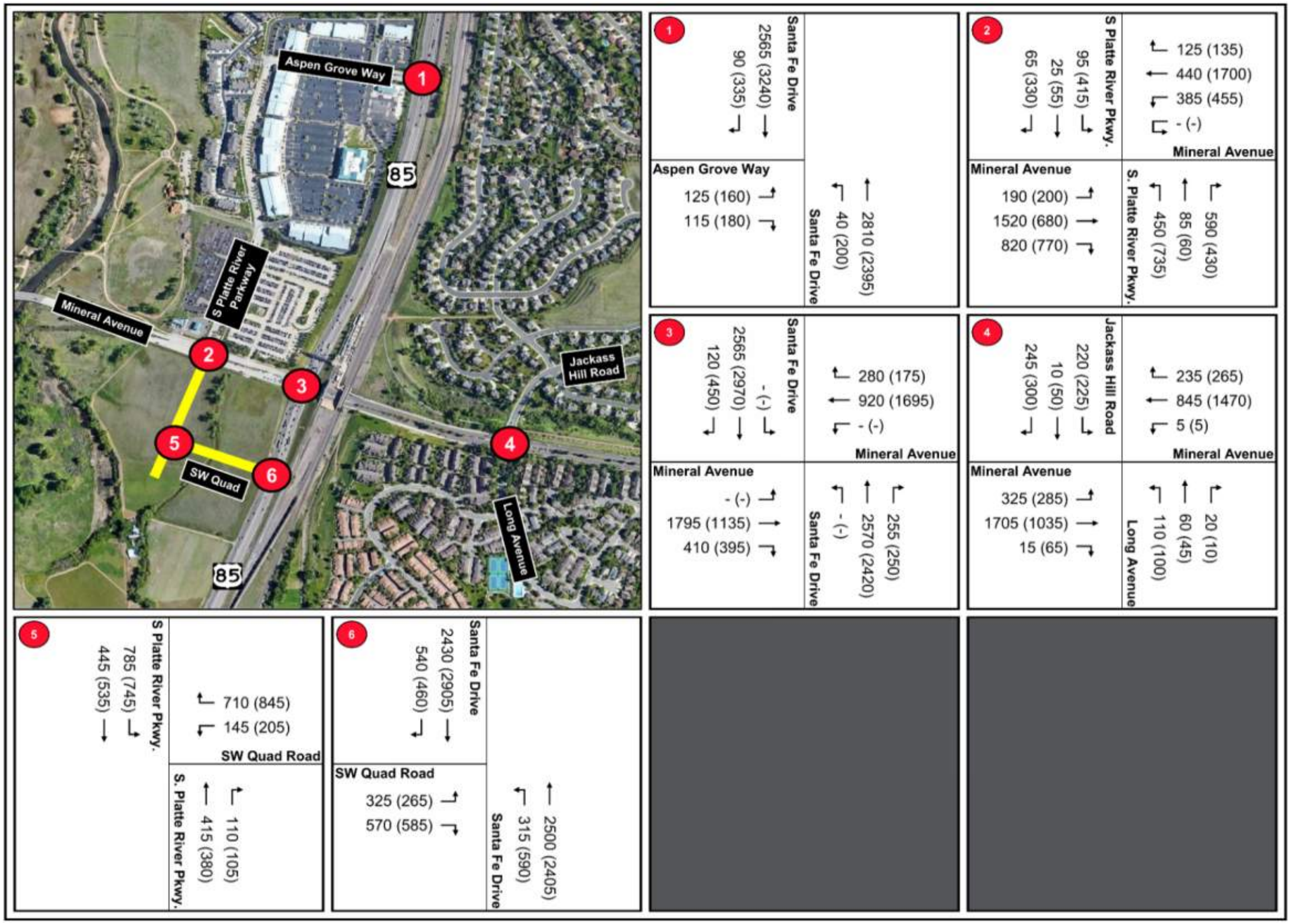
***XX (XX) =** AM (PM) Peak Hour Turning Movement Volume*

Figure 14: 2030 Horizon Year Northwest Quadrant Turning Movement Volumes



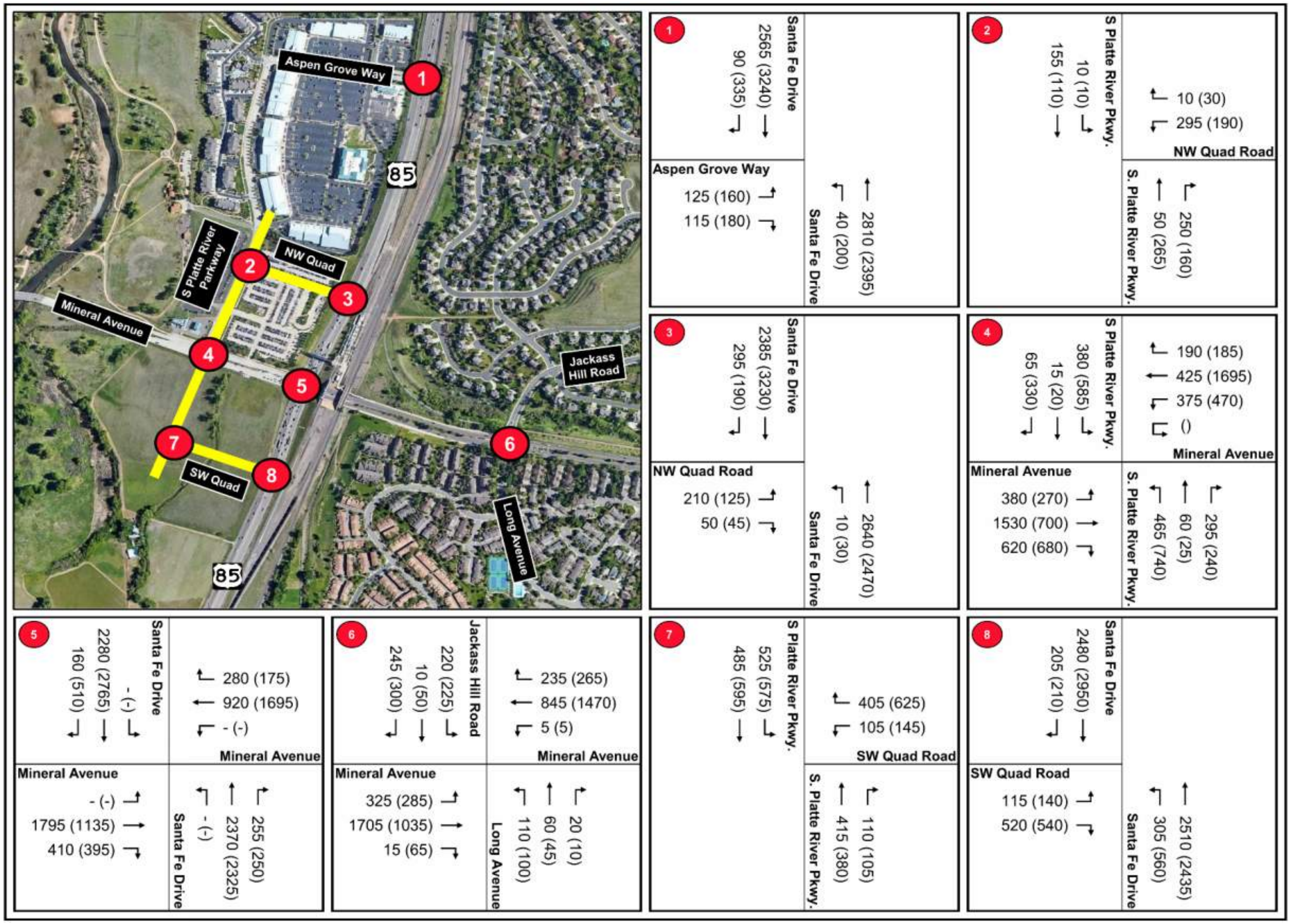
XX (XX) = *AM (PM) Peak Hour Turning Movement Volume*

Figure 15: 2030 Horizon Year Southwest Quadrant Turning Movement Volumes



***XX (XX) =** AM (PM) Peak Hour Turning Movement Volume*

Figure 16: 2030 Horizon Year Dual Quadrants Turning Movement Volumes



***XX (XX) =** AM (PM) Peak Hour Turning Movement Volume*

Figure 17: Synchro CFI Layout

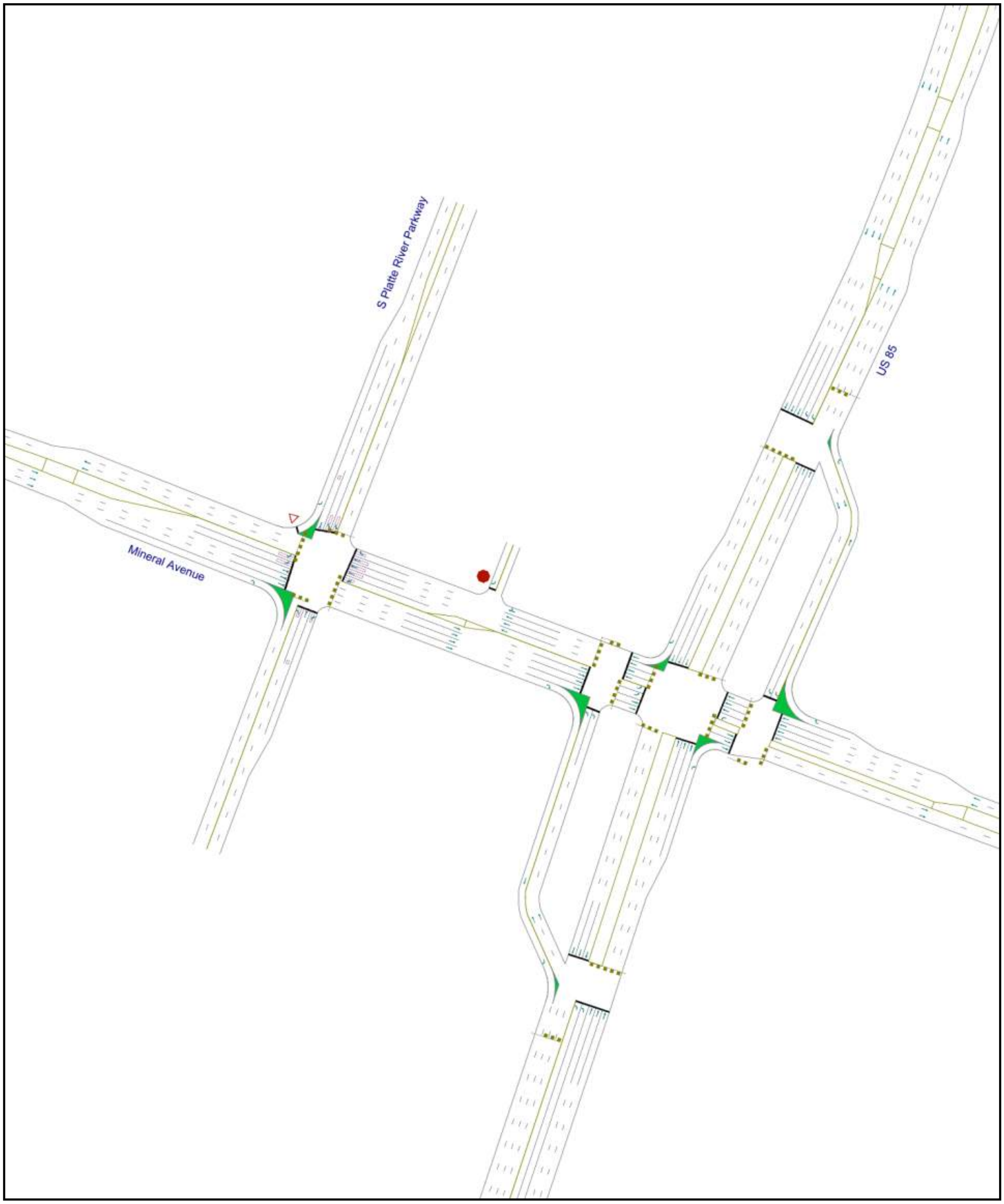


Figure 18: Synchro Northwest Quadrant Layout

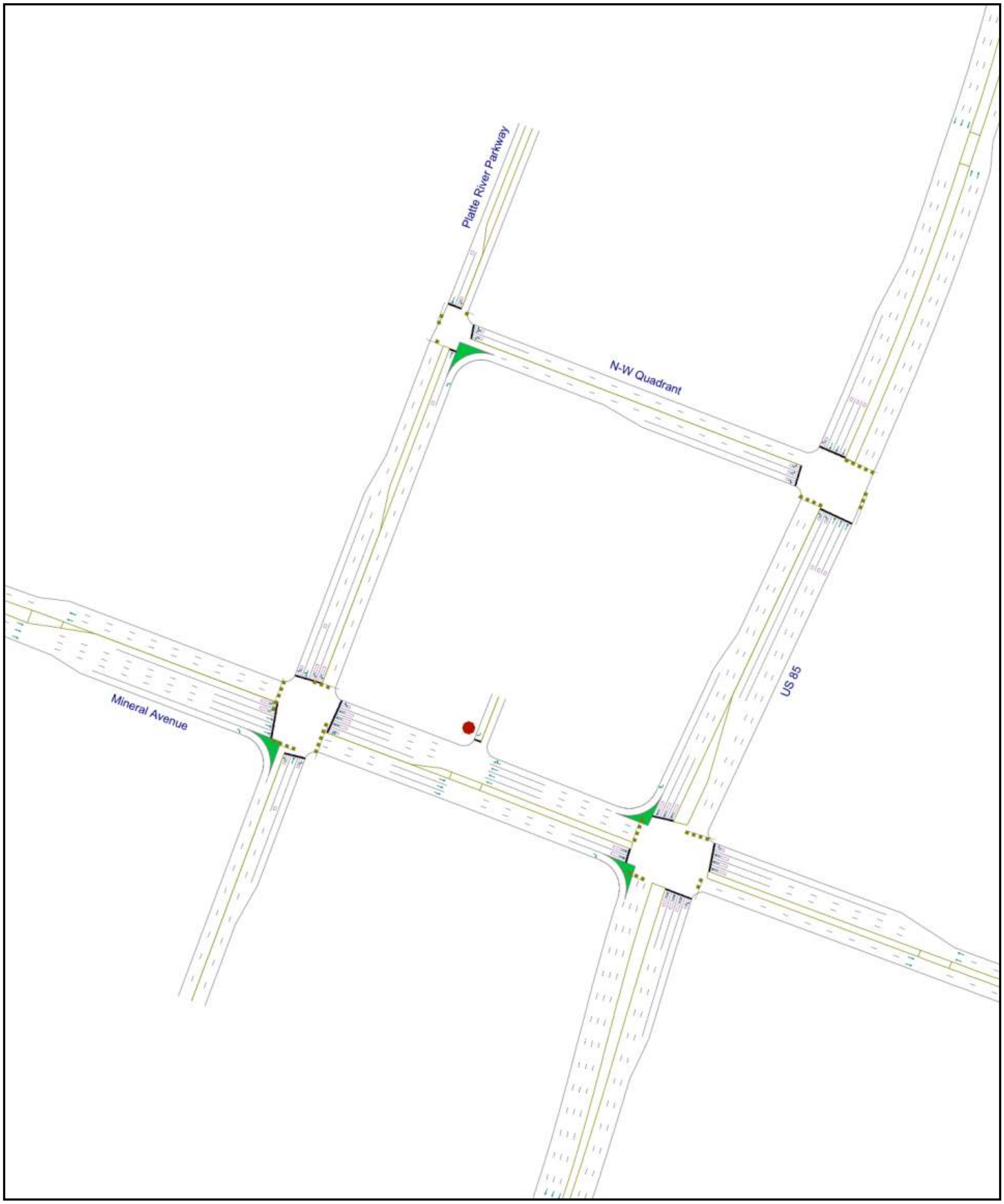


Figure 19: Synchro Southwest Quadrant Layout

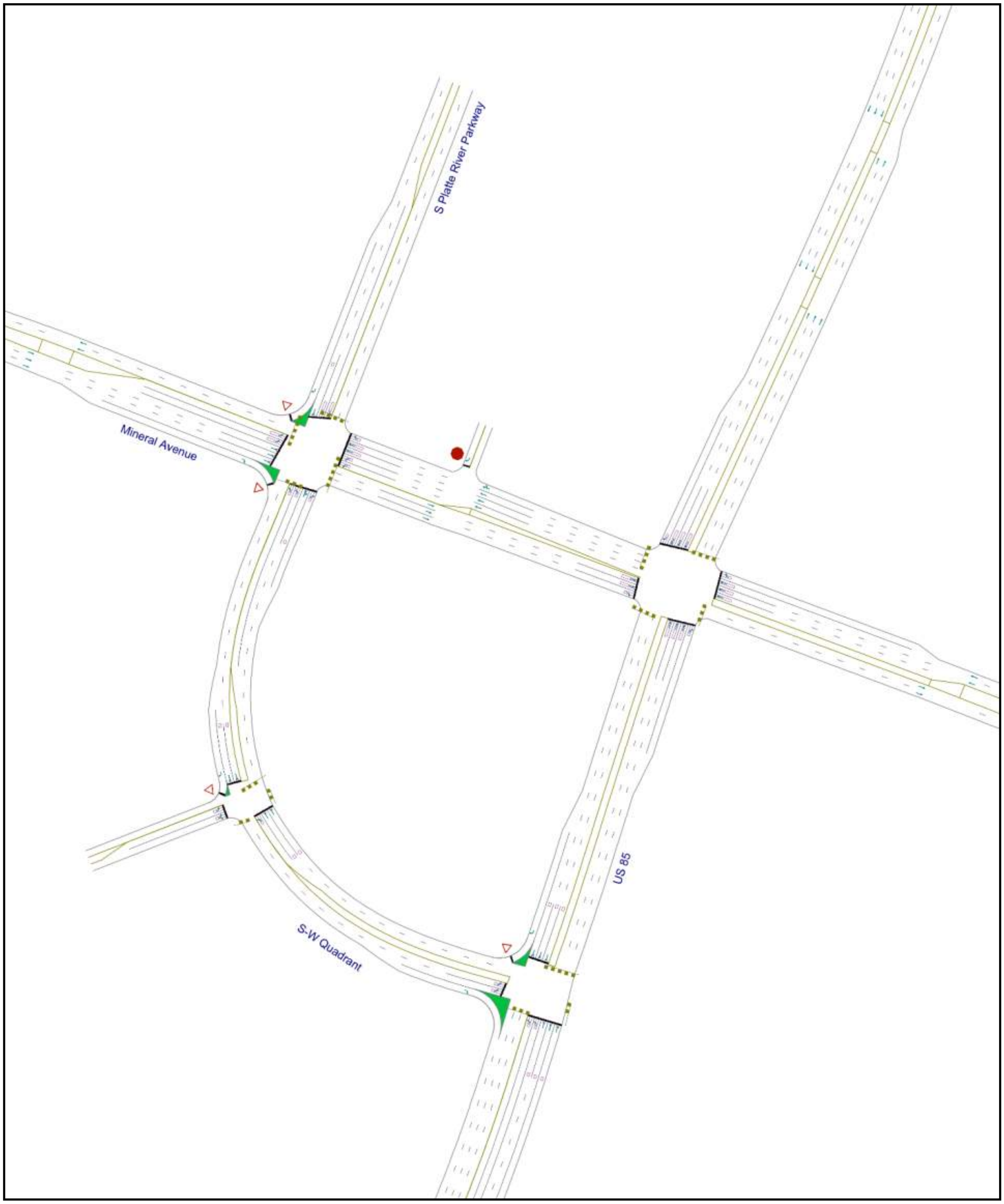


Figure 20: Synchro Dual Quadrants Layout

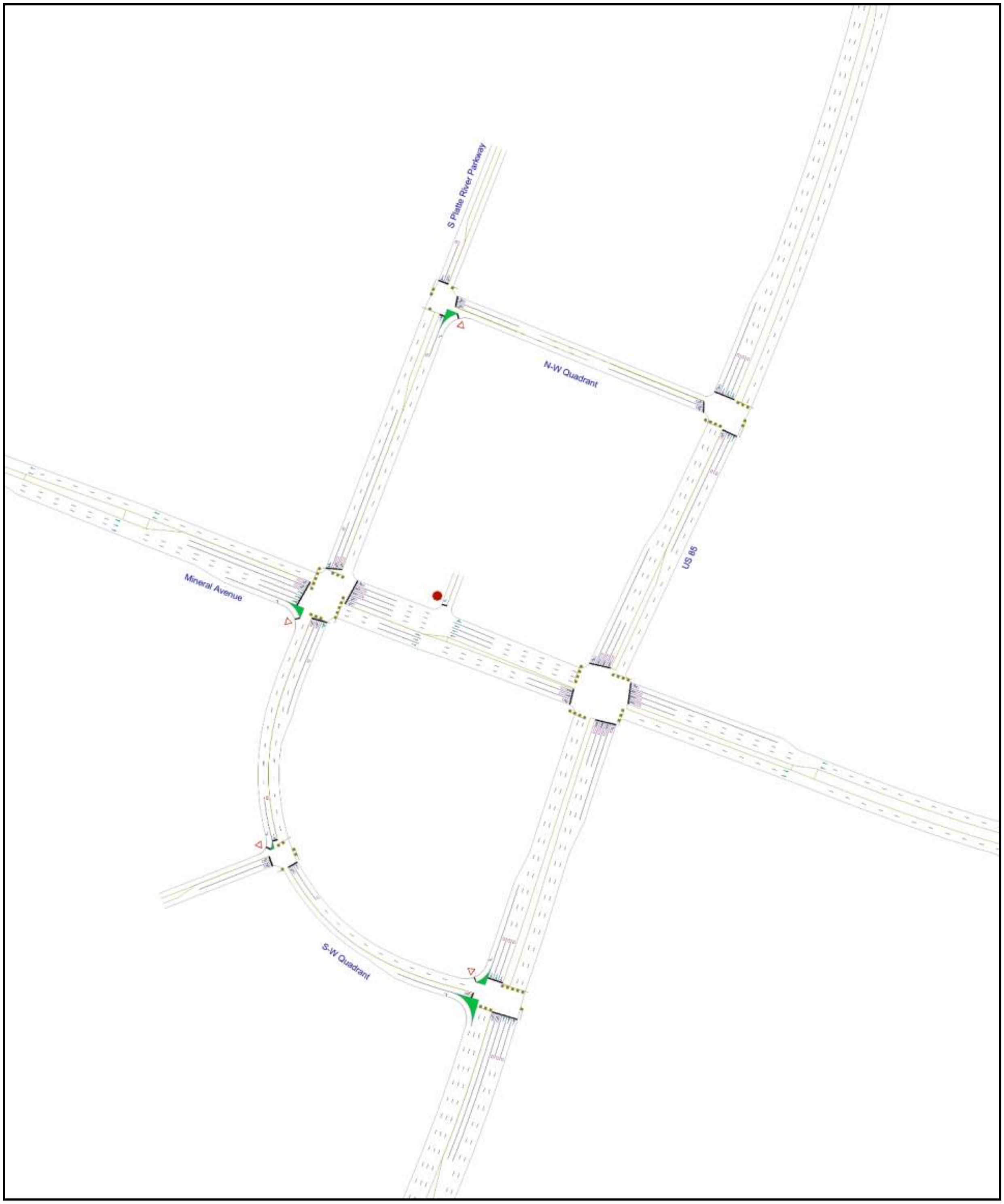


Table 12: 2030 Horizon Year Normal Conditions—Synchro LOS and Delay Summary

Intersection	Approach	2030 Horizon Year Build Conditions															
		Continuous Flow				Northwest Quadrant				Southwest Quadrant				Dual Quadrants			
		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
		Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Mineral Avenue at S Platte River Parkway	Northbound	193.1	F	157.0	F	67.8	E	110.7	F	44.8	D	98.4	F	51.9	D	116.0	F
	Southbound	65.7	E	99.8	F	103.6	F	53.2	D	63.2	E	99.9	F	67.9	E	113.2	F
	Eastbound	29.2	C	51.6	D	36.1	D	51.1	D	30.3	C	44.2	D	41.3	D	72.6	E
	Westbound	22.8	C	12.9	B	39.5	D	30.5	C	30.6	C	23.6	C	36.3	D	50.6	D
	Overall	50.1	D	49.2	D	51.1	D	48.8	D	35.0	D	54.9	D	44.6	D	77.6	E
Santa Fe Drive at Mineral Avenue	Northbound	83.8	F	50.3	D	65.8	E	47.8	D	51.2	D	24.9	C	49.7	D	27.1	C
	Southbound	66.1	E	77.9	E	55.3	E	92.9	F	73.5	E	19.1	B	53.2	D	25.4	C
	Eastbound	88.6	F	43.6	D	40.4	D	21.1	C	67.3	C	59.9	E	44.9	D	51.4	D
	Westbound	24.4	C	41.8	D	21.5	C	9.9	A	22.2	E	49.9	D	20.3	C	38.9	D
	Overall	72.3	E	58.1	E	49.8	D	50.3	D	58.0	E	33.4	C	45.3	D	32.9	C
Santa Fe Drive at Southbound Crossover	Northbound	76.2	E	16.9	B	-	-	-	-	-	-	-	-	-	-	-	-
	Southbound	4.4	A	4.2	A	-	-	-	-	-	-	-	-	-	-	-	-
	Westbound	1.3	A	1.0	A	-	-	-	-	-	-	-	-	-	-	-	-
	Overall	37.6	D	9.2	A	-	-	-	-	-	-	-	-	-	-	-	-
Santa Fe Drive at Northbound Crossover	Northbound	3.2	A	8.4	A	-	-	-	-	-	-	-	-	-	-	-	-
	Southbound	58.4	E	69.5	E	-	-	-	-	-	-	-	-	-	-	-	-
	Eastbound	3.2	A	3.1	A	-	-	-	-	-	-	-	-	-	-	-	-
	Overall	24.8	C	33.7	C	-	-	-	-	-	-	-	-	-	-	-	-
Santa Fe Drive at Northwest Quadrant	Northbound	-	-	-	-	9.2	A	19.2	B	-	-	-	-	30.1	C	21.1	C
	Southbound	-	-	-	-	7.9	A	10.0	B	-	-	-	-	2.7	A	0.8	A
	Eastbound	-	-	-	-	39.4	D	87.7	F	-	-	-	-	90.3	F	93.1	F
	Overall	-	-	-	-	11.3	B	18.7	B	-	-	-	-	19.7	B	11.7	B
S Platte River Parkway at Northwest Quadrant	Northbound	-	-	-	-	3.6	A	17.1	B	-	-	-	-	6.9	A	24.0	C
	Southbound	-	-	-	-	32.1	C	30.8	C	-	-	-	-	31.7	C	30.4	C
	Westbound	-	-	-	-	2.3	A	4.5	A	-	-	-	-	2.8	A	5.6	A
	Overall	-	-	-	-	6.2	A	11.6	B	-	-	-	-	10.6	B	19.7	B
Santa Fe Drive at Southwest Quadrant	Northbound	-	-	-	-	-	-	-	-	14.4	B	15.1	B	11.3	B	17.5	B
	Southbound	-	-	-	-	-	-	-	-	3.6	A	9.0	A	3.7	A	9.5	A
	Eastbound	-	-	-	-	-	-	-	-	24.5	C	34.4	C	14.5	B	24.3	C
	Overall	-	-	-	-	-	-	-	-	11.0	B	14.5	B	8.3	A	14.5	B
S Platte River Parkway at Southwest Quadrant	Northbound	-	-	-	-	-	-	-	-	3.4	A	6.4	A	5.0	A	9.0	A
	Southbound	-	-	-	-	-	-	-	-	24.9	C	17.2	B	22.8	C	45.1	D
	Westbound	-	-	-	-	-	-	-	-	29.5	C	37.5	D	29.5	C	37.5	D
	Overall	-	-	-	-	-	-	-	-	18.8	B	16.7	B	20.1	C	32.1	C
Santa Fe Drive at Aspen Grove Way	Northbound	25.8	C	48.5	D	38.7	D	31.4	C	49.3	D	45.8	D	20.0	B	29.7	C
	Southbound	27.7	C	145.0	F	27.7	C	145.0	F	27.7	C	145.0	F	27.7	C	145.0	F
	Eastbound	68.1	E	85.2	F	68.1	E	85.2	F	68.1	E	85.2	F	68.1	E	85.2	F
	Overall	28.5	C	103.4	F	34.9	C	96.6	F	40.1	D	102.3	F	25.6	C	95.9	F
Mineral Avenue at Jackass Hill Road / Long Avenue	Northbound	51.5	D	20.7	C	51.5	D	20.7	C	51.5	D	20.7	C	51.5	D	20.7	C
	Southbound	64.3	E	23.4	C	64.3	E	23.4	C	64.3	E	23.4	C	64.3	E	23.4	C
	Eastbound	18.1	B	50.9	D	12.2	B	22.1	C	13.0	B	42.5	D	11.5	B	41.6	D
	Westbound	18.5	B	166.8	F	18.5	B	166.8	F	18.5	B	166.8	F	18.5	B	166.8	F
	Overall	25.7	C	97.9	F	22.5	C	87.6	F	22.9	C	94.9	F	22.1	C	94.6	F

Table 13: 2030 Horizon Year Normal Conditions—Synchro Queuing Summary

Intersection	Movement	2030 Horizon Year Build Conditions							
		Continuous Flow		Northwest Quadrant		Southwest Quadrant		Dual Quadrants	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
		95th Percentile Queue Length (ft)							
Mineral Avenue at S Platte River Parkway	NBL	$435^{\#}$	340	255	$445^{\#}$	190	480	200	$600^{\#}$
	NBR	220	215	80	80	135	150	0	0
	SBL	$110^{\#}$	$405^{\#}$	$370^{\#}$	350	80	$380^{\#}$	$255^{\#}$	$520^{\#}$
	SBR	10	320	95	515	0	305	0	0
	EBL	140	$220^{\#}$	240	210	135	$210^{\#}$	240	$295^{\#}$
	EBR	80	95	0	0	85	315	485	220
	WBL	$430^{\#}$	395^{m}	$445^{\#}$	$580^{\#}$	$290^{\#}$	302^{m}	$275^{\#}$	330^{m}
	WBR	0	10^{m}	165	170	0	5^{m}	45	20^{m}
Santa Fe Drive at Mineral Avenue	NBL	230	490	-	-	-	-	-	-
	NBR	0	0	160^{m}	65^{m}	195	130^{m}	225	225^{m}
	SBL	285	220	-	-	-	-	-	-
	SBR	0	0	0^{m}	0^{m}	25^{m}	85^{m}	80m	275
	EBL	180	135	-	-	-	-	-	-
	EBR	105	290^{m}	40^{m}	215	220	565^{m}	210^{m}	535^{m}
	WBL	$90^{\#}$	170	-	-	-	-	-	-
	WBR	100	70^{m}	175	10^{m}	180	115^{m}	175	110^{m}
Santa Fe Drive at Southbound Crossover	SBL	125^{m}	85^{m}	-	-	-	-	-	-
	EBR	0	0	-	-	-	-	-	-
Santa Fe Drive at Northbound Crossover	NBL	105^{m}	300^{m}	-	-	-	-	-	-
	EBR	0	0	-	-	-	-	-	-
Santa Fe Drive at Northwest Quadrant	NBL	-	-	175^{m}	325^{m}	-	-	10^{m}	55^{m}
	SBR	-	-	30^{m}	5^{m}	-	-	0^{m}	0^{m}
	EBL	-	-	190	$245^{\#}$	-	-	$215^{\#}$	140
	EBR	-	-	130	260	-	-	0	0
S Platte River Parkway at Northwest Quadrant	NBR	-	-	280	40	-	-	0	0^{m}
	SBL	-	-	15	15	-	-	15	15
	WBL	-	-	55	455^{m}	-	-	45	40
	WBR	-	-	0	0	-	-	0	0
Santa Fe Drive at Southwest Quadrant	NBL	-	-	-	-	210	360^{m}	165^{m}	335^{m}
	SBR	-	-	-	-	20^{m}	40^{m}	5^{m}	20^{m}
	EBL	-	-	-	-	230	$240^{\#}$	190	$305^{\#}$
	EBR	-	-	-	-	75	155	0	0
S Platte River Parkway at Southwest Quadrant	NBL	-	-	-	-	45^{m}	80^{m}	25^{m}	30^{m}
	SBR	-	-	-	-	115^{m}	70	90^{m}	165^{m}
	EBL	-	-	-	-	145	170	145	170
	EBR	-	-	-	-	0	0	0	0
Santa Fe Drive at Aspen Grove Way	NBL	40^{m}	$380^{m\#}$	60^{m}	$505^{m\#}$	40^{m}	$510^{m\#}$	40^{m}	$435^{m\#}$
	SBR	15	65	15	65	15	65	15	65
	EBL	100	140	100	140	100	140	100	140
	EBR	80	170	80	170	80	170	80	170
Mineral Avenue at Jackass Hill Road / Long Avenue	NBL	165	80	165	80	165	80	165	80
	SBL	$375^{\#}$	180	$375^{\#}$	180	$375^{\#}$	180	$375^{\#}$	180
	SBR	75	75	75	75	75	75	75	75
	EBL	135^{m}	$460^{m\#}$	135^{m}	$225^{\#}$	120^{m}	$340^{\#}$	125^{m}	$360^{\#}$
	EBR	0^{m}	45^{m}	0^{m}	20^{m}	0^{m}	35^{m}	0^{m}	35^{m}
	WBL	5	5	5	5	5	5	5	5
	WBR	45	55	45	55	45	55	45	55

$^{\#}$95th percentile volume exceeds capacity, queue may be longer.

^{m}Volume for 95th percentile queue is metered by upstream signal.

As shown in Table 12, all of the proposed alternatives operate relatively similarly, with most intersections operating at LOS D or better. LOS E operations occur at the US 85/Mineral Avenue intersection during both peak hours for the CFI alternative and during the AM peak hour for the southwest quadrant alternative, as well as at the Mineral Avenue/Platte River Parkway intersection during the PM peak hour for the dual quadrants alternative. Notably, the northwest quadrant, including a fourth (south) leg at the Mineral Avenue/Platte River Parkway intersection, is the only alternative for which all intersections operate at LOS D or better in the 2030 horizon year. These results are driven by how left turns are distributed around each quadrant roadway; for example, the dual quadrant alternative results in significant opposing left turn volumes at the Mineral Avenue/Platte River Parkway intersection, requiring green time to be shifted from the through movements to the left turn movements along all approaches, whereas the single-quadrant alternatives only add left-turning volume to some movements, impacting fewer high-volume through movements. It should be noted that dual quadrant roadway operations may be optimized through active traffic management techniques, such as dynamic message signing directing drivers to use a specific quadrant roadway to complete their left-turn movement based on live traffic conditions.

As shown in Table 13, queues vary between alternatives, particularly where lane use or signal control changes between models. For example:

- For the southwest and dual quadrant(s) alternatives, eastbound right turns at the US 85/Mineral Avenue intersection are no longer free rights; rather, these are controlled by the signal to minimize the weaving condition along southbound US 85 between Mineral Avenue and the quadrant roadway. This results in some additional queuing (approximately 565 feet and 535 feet for the southwest and dual quadrant(s) alternatives, respectively, in the PM peak hour); however, these queues are metered by, and are not expected to reach, the upstream intersection at Platte River Parkway. With the southwest quadrant roadway in place, drivers destined for southbound US 85 have the option to use this controlled right-turn movement or the quadrant roadway. Consideration may also be given to continuing to provide a free right movement at the main intersection, with this traffic then grade-separated from the quadrant roadway intersection and joining the US 85 mainline to the south.
- Additionally, for the southwest and dual quadrant(s) alternatives, westbound U-turns at the Mineral Avenue/Platte River Parkway intersection are banned and shifted to use the quadrant roadway(s); this improves operations for and minimizes conflicts with northbound right-turning vehicles.
- For the CFI and northwest quadrant alternatives, westbound left turns at the Mineral Avenue/Platte River Parkway intersection do not require two lanes; therefore, lane use was repurposed to provide a third westbound through lane to improve operations with the development (south) leg added.
- For the dual quadrants alternative, the cross-section along both quadrant roadways was able to be reduced beyond that in the single-quadrant alternatives. For the parts of each

quadrant roadway connecting Platte River Parkway to US 85, this results in a 3-lane rather than a 4- to 5-leg cross-section.

Based on the results discussed above, all four proposed alternatives generally operate at acceptable levels. Though some alternatives result in LOS E operations at select locations, it should be noted that those alternatives still operate better in the 2030 horizon year than the existing intersection does today.

Incident Conditions

Understanding that traffic often diverts onto US 85 and Mineral Avenue when incidents occur on parallel corridors, the project team also endeavored to determine the resilience of each proposed alternative under high-volume conditions. Two sets of "incident" conditions were modeled: one which assumed an incident on I-25 to the east, and one which assumed an incident on C-470 to the south. Additional volume was added as follows:

- Incident on I-25, AM Peak: 20 percent increase in northbound through volumes
- Incident on I-25, PM Peak: 20 percent increase in southbound through volumes
- Incident on C-470, AM Peak: 20 percent increase in all eastbound volumes
- Incident on C-470, PM Peak: 20 percent increase in all westbound volumes

These increases represent an incident affecting the peak direction, as this is the most critical test of a system's resilience. The timing plans developed for the "normal" conditions analysis were used; unless special incident timing plans are developed in the future, the signals can be expected to operate using these plans regardless of fluctuations in traffic volumes. The LOS and delay results corresponding to incidents on I-25 and on C-470 are shown in Table 14 and Table 15, respectively.

As shown in Table 14 and Table 15, the CFI performs the worst out of all the alternatives, with at least one intersection in the system operating at LOS F during one or both peak hours for both incident scenarios. The dual quadrant also experiences LOS F conditions at the Mineral Avenue/Platte River Parkway intersection in the PM peak hour under the C-470 incident scenario. Both single-quadrant alternatives perform best, with all intersections operating at LOS E or better in both incident scenarios. Additional analysis, accounting for the frequency of nearby incidents and the related volume fluctuations on US 85 and Mineral Avenue, may be useful in selecting a final alternative which can handle traffic beyond the average day.

Table 14: 2030 Horizon Year Conditions (I-25 Incident)—Synchro LOS and Delay Summary

Intersection	Approach	2030 Horizon Year Build Conditions with Incident on I-25															
		Continuous Flow				Northwest Quadrant				Southwest Quadrant				Dual Quadrants			
		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
		Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Mineral Avenue at S Platte River Parkway	Northbound	193.1	F	157.0	F	67.8	E	110.7	F	44.8	D	98.4	F	51.9	D	116.5	F
	Southbound	65.7	E	99.8	F	103.6	F	53.2	D	63.2	E	99.9	F	67.9	E	113.3	F
	Eastbound	29.2	C	51.6	D	36.1	D	51.1	D	30.3	C	44.2	D	41.3	D	72.6	E
	Westbound	22.9	C	12.9	B	39.5	D	30.6	C	30.6	C	23.6	C	36.7	D	50.6	D
	Overall	**50.2**	**D**	**49.2**	**D**	**51.1**	**D**	**48.9**	**D**	**35.0**	**D**	**54.9**	**D**	**44.7**	**D**	**77.7**	**E**
Santa Fe Drive at Mineral Avenue	Northbound	156.0	F	50.3	D	133.2	F	47.8	D	107.2	F	24.9	C	105.8	F	27.1	C
	Southbound	66.1	E	153.0	F	55.3	E	168.6	F	73.5	E	77.9	E	53.2	D	73.6	E
	Eastbound	88.6	F	43.6	D	40.4	D	21.1	C	67.3	E	59.9	E	44.9	D	51.5	D
	Westbound	24.4	C	41.8	D	21.5	C	9.9	A	22.2	C	49.9	D	20.3	C	38.9	D
	Overall	**100.1**	**F**	**89.0**	**F**	**73.3**	**E**	**79.1**	**E**	**77.1**	**E**	**55.6**	**E**	**64.7**	**E**	**51.1**	**D**
Santa Fe Drive at Southbound Crossover	Northbound	157.9	F	16.9	B	-	-	-	-	-	-	-	-	-	-	-	-
	Southbound	4.4	A	4.3	A	-	-	-	-	-	-	-	-	-	-	-	-
	Westbound	1.3	A	1.0	A	-	-	-	-	-	-	-	-	-	-	-	-
	Overall	**81.2**	**F**	**8.9**	**A**	-	-	-	-	-	-	-	-	-	-	-	-
Santa Fe Drive at Northbound Crossover	Northbound	3.0	A	8.4	A	-	-	-	-	-	-	-	-	-	-	-	-
	Southbound	58.4	E	151.0	F	-	-	-	-	-	-	-	-	-	-	-	-
	Eastbound	3.2	A	3.1	A	-	-	-	-	-	-	-	-	-	-	-	-
	Overall	**23.3**	**C**	**73.5**	**E**	-	-	-	-	-	-	-	-	-	-	-	-
Santa Fe Drive at Northwest Quadrant	Northbound	-	-	-	-	12.7	B	19.2	B	-	-	-	-	67.3	E	21.1	C
	Southbound	-	-	-	-	7.9	A	61.5	E	-	-	-	-	2.7	A	3.4	A
	Eastbound	-	-	-	-	39.4	D	87.7	F	-	-	-	-	90.1	F	93.2	F
	Overall	-	-	-	-	**12.9**	**B**	**45.7**	**D**	-	-	-	-	**39.4**	**D**	**12.5**	**B**
S Platte River Parkway at Northwest Quadrant	Northbound	-	-	-	-	3.6	A	17.1	B	-	-	-	-	6.9	A	24.0	C
	Southbound	-	-	-	-	32.1	C	30.8	C	-	-	-	-	31.7	C	30.4	C
	Westbound	-	-	-	-	2.3	A	4.5	A	-	-	-	-	2.8	A	5.6	A
	Overall	-	-	-	-	**6.2**	**A**	**11.6**	**B**	-	-	-	-	**10.6**	**B**	**19.7**	**B**
Santa Fe Drive at Southwest Quadrant	Northbound	-	-	-	-	-	-	-	-	15.0	B	15.1	B	10.7	B	17.5	B
	Southbound	-	-	-	-	-	-	-	-	3.6	A	44.4	D	3.7	A	40.8	D
	Eastbound	-	-	-	-	-	-	-	-	24.5	C	34.4	C	14.5	B	24.3	C
	Overall	-	-	-	-	-	-	-	-	**11.5**	**B**	**31.8**	**C**	**8.2**	**A**	**29.7**	**C**
S Platte River Parkway at Southwest Quadrant	Northbound	-	-	-	-	-	-	-	-	3.4	A	6.6	A	5.0	A	9.0	A
	Southbound	-	-	-	-	-	-	-	-	24.9	C	17.2	B	22.8	C	45.1	D
	Westbound	-	-	-	-	-	-	-	-	29.5	C	37.5	D	29.5	C	37.5	D
	Overall	-	-	-	-	-	-	-	-	**18.8**	**B**	**16.7**	**B**	**20.1**	**C**	**32.1**	**C**
Santa Fe Drive at Aspen Grove Way	Northbound	78.8	E	48.5	D	86.2	F	31.4	C	100.1	F	45.8	D	69.1	E	29.7	C
	Southbound	27.7	C	221.7	F	27.7	C	221.7	F	27.7	C	221.7	F	27.7	C	221.7	F
	Eastbound	68.1	E	85.2	F	68.1	E	85.2	F	68.1	E	85.2	F	68.1	E	85.2	F
	Overall	**56.4**	**E**	**150.6**	**F**	**60.3**	**E**	**144.2**	**F**	**67.7**	**E**	**149.5**	**F**	**51.2**	**D**	**143.6**	**F**
Mineral Avenue at Jackass Hill Road / Long Avenue	Northbound	51.5	D	20.7	C	51.5	D	20.7	C	51.5	D	20.7	C	51.5	D	20.7	C
	Southbound	64.3	E	23.4	C	64.3	E	23.4	C	64.3	E	23.4	C	64.3	E	23.4	C
	Eastbound	18.1	B	50.9	D	12.3	B	22.1	C	12.9	B	42.5	D	11.6	B	41.7	D
	Westbound	18.5	B	166.8	F	18.5	B	166.8	F	18.5	B	166.8	F	18.5	B	166.8	F
	Overall	**25.7**	**C**	**97.9**	**F**	**22.6**	**C**	**87.6**	**F**	**22.9**	**C**	**94.9**	**F**	**22.2**	**C**	**94.6**	**F**

Table 15: 2030 Horizon Year Conditions (C-470 Incident)—Synchro LOS and Delay Summary

Intersection	Approach	2030 Horizon Year Build Conditions with Incident on C-470															
		Continuous Flow				Northwest Quadrant				Southwest Quadrant				Dual Quadrants			
		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
		Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Mineral Avenue at S Platte River Parkway	Northbound	193.1	F	157.0	F	67.8	E	110.7	F	44.0	D	100.3	F	51.8	D	116.1	F
	Southbound	65.7	E	99.8	F	103.2	F	53.5	D	63.3	E	101.6	F	68.2	E	113.5	F
	Eastbound	36.0	D	51.6	D	42.0	D	51.1	D	33.9	C	43.7	D	47.3	D	72.6	E
	Westbound	22.8	C	14.6	B	40.4	D	30.8	C	30.6	C	27.9	C	36.7	D	73.2	E
	Overall	52.5	D	49.3	D	53.4	D	48.5	D	36.5	D	56.2	E	47.8	D	86.2	F
Santa Fe Drive at Mineral Avenue	Northbound	83.8	F	50.3	D	65.8	E	65.6	E	55.1	E	24.9	C	49.7	D	27.5	C
	Southbound	70.6	E	78.6	E	59.8	E	118.6	F	79.7	E	19.5	B	58.1	E	27.3	C
	Eastbound	155.0	F	43.6	D	75.6	E	19.1	B	115.3	F	60.2	E	87.0	F	50.7	D
	Westbound	24.4	C	68.1	E	21.5	C	10.4	B	22.2	C	87.0	F	20.3	C	58.8	E
	Overall	89.9	F	63.3	E	61.7	E	62.7	E	74.3	E	42.0	D	58.7	E	38.1	D
Santa Fe Drive at Southbound Crossover	Northbound	84.1	F	16.9	B	-	-	-	-	-	-	-	-	-	-	-	-
	Southbound	4.3	A	4.2	A	-	-	-	-	-	-	-	-	-	-	-	-
	Westbound	1.3	A	1.1	A	-	-	-	-	-	-	-	-	-	-	-	-
	Overall	41.3	D	9.1	A	-	-	-	-	-	-	-	-	-	-	-	-
Santa Fe Drive at Northbound Crossover	Northbound	3.2	A	8.4	A	-	-	-	-	-	-	-	-	-	-	-	-
	Southbound	65.2	E	77.5	E	-	-	-	-	-	-	-	-	-	-	-	-
	Eastbound	4.2	A	3.1	A	-	-	-	-	-	-	-	-	-	-	-	-
	Overall	27.2	C	37.3	D	-	-	-	-	-	-	-	-	-	-	-	-
Santa Fe Drive at Northwest Quadrant	Northbound	-	-	-	-	9.3	A	18.1	B	-	-	-	-	30.2	C	21.4	C
	Southbound	-	-	-	-	8.8	A	10.1	B	-	-	-	-	2.7	A	0.8	A
	Eastbound	-	-	-	-	41.9	D	84.0	F	-	-	-	-	123.5	F	95.9	F
	Overall	-	-	-	-	12.1	B	18.5	B	-	-	-	-	22.0	C	12.1	B
S Platte River Parkway at Northwest Quadrant	Northbound	-	-	-	-	3.5	A	16.0	B	-	-	-	-	6.2	A	23.2	C
	Southbound	-	-	-	-	32.1	C	30.8	C	-	-	-	-	31.7	C	30.4	C
	Westbound	-	-	-	-	2.2	A	4.5	A	-	-	-	-	2.8	A	5.6	A
	Overall	-	-	-	-	6.1	A	11.3	B	-	-	-	-	10.1	B	19.3	B
Santa Fe Drive at Southwest Quadrant	Northbound	-	-	-	-	-	-	-	-	14.7	B	15.1	B	11.3	B	17.5	B
	Southbound	-	-	-	-	-	-	-	-	4.7	A	9.0	A	4.4	A	9.5	A
	Eastbound	-	-	-	-	-	-	-	-	25.6	C	32.8	C	12.6	B	22.9	C
	Overall	-	-	-	-	-	-	-	-	11.9	B	14.5	B	8.4	A	14.4	B
S Platte River Parkway at Southwest Quadrant	Northbound	-	-	-	-	-	-	-	-	3.7	A	6.5	A	5.5	A	9.5	A
	Southbound	-	-	-	-	-	-	-	-	19.5	B	16.8	B	23.7	C	46.8	D
	Westbound	-	-	-	-	-	-	-	-	29.5	C	37.5	D	29.5	C	37.5	D
	Overall	-	-	-	-	-	-	-	-	16.5	B	16.5	B	20.8	C	33.2	C
Santa Fe Drive at Aspen Grove Way	Northbound	28.9	C	48.3	D	41.9	D	31.9	C	53.8	D	45.3	D	23.0	C	29.2	C
	Southbound	31.0	C	145.7	F	31.0	C	145.7	F	31.0	C	145.7	F	31.0	C	145.7	F
	Eastbound	68.1	E	85.2	F	68.1	E	85.2	F	68.1	E	85.2	F	68.1	E	85.2	F
	Overall	31.5	C	103.2	F	37.9	D	96.5	F	43.8	D	102.0	F	28.5	C	95.5	F
Mineral Avenue at Jackass Hill Road / Long Avenue	Northbound	51.5	D	20.7	C	51.5	D	20.7	C	51.5	D	20.7	C	51.5	D	20.7	C
	Southbound	64.3	E	23.4	C	64.3	E	23.4	C	64.3	E	23.4	C	64.3	E	23.4	C
	Eastbound	26.5	C	50.9	D	16.8	B	22.0	C	17.9	B	42.5	D	14.7	B	41.6	D
	Westbound	18.5	B	254.3	F	18.5	B	254.3	F	18.5	B	254.3	F	18.5	B	254.3	F
	Overall	30.0	C	144.3	F	24.5	C	134.5	F	25.1	C	141.4	F	23.3	C	141.1	F

VISSIM Analysis

As the proposed alternatives are refined, a detailed VISSIM analysis should be conducted to compare the expected operations of each alternative in the 2030 horizon year. Build VISSIM models should use the calibrated 2019 Existing Conditions models as a base; however, as driver behavior can be expected to change with a significant reduction in congestion, some calibration parameter changes—primarily those which aimed to increase the aggressiveness of vehicles in the Existing models—should not be carried forward to the Build models. A summary of the calibration parameters which should and should not be applied to the Build models is provided in Table 16.

Table 16: VISSIM Calibration Parameter Summary

Parameter		Reason?	Apply to Build Models?
Lookback Distance (ft)		Provide for smooth merging and lane changes.	Yes
Emergency Stop Distance (ft)		Provide for smooth merging and lane changes.	Yes
Input Volumes (veh)		Account for unserved demand (e.g. vehicles in a 10,000-foot queue).	Yes
Wiedemann 74 Car Following Model	Average Standstill Distance (ft)	Reduce queue lengths along approaches, as needed.	No
	Additive Part of Safety Distance	n/a	No
	Multiplicative Part of Safety Distance	Lower variation in safety distance (e.g. more cars adhere to average value above).	No
Reduced Safety Distance Close to a Stop Line		Increase number of vehicles able to stack in storage bays, as needed.	No

Secondary Evaluation

Following the traffic operations analysis, each at-grade alternative was again evaluated against the remaining criteria (driver safety, bicycle/pedestrian safety, ROW impacts, stakeholder impacts, cost, constructability, and adaptability for potential future phases). This evaluation is summarized below.

Driver Safety

Each alternative can be expected to improve driver safety to a similar degree. By minimizing congestion, the frequency of rear-end crashes—currently accounting for 72 percent of all crashes at the study intersection—will be significantly reduced. Additional analysis will be required to determine the magnitude of this reduction in crash frequency.

Bicycle/Pedestrian Safety

While the CFI alternative can be designed to accommodate crossings that do not conflict with vehicle traffic, this type of design would require multiple pedestrian crossings and would place some pedestrians between opposing vehicle flows. The CFI alternative can also be designed with fewer crossings by incorporating a pedestrian interval during which left-turning traffic would be stopped; however, this option would provide significantly less crossing time for pedestrians.

By comparison, the quadrant roadway(s) alternatives result in a two-phase signal at the US 85/Mineral Avenue intersection, significantly increasing the crossing time provided for pedestrians. The quadrant roadway(s) alternatives would also provide additional signalized crossings, improving bicycle/pedestrian safety. It should be noted, however, that the quadrant roadway(s) would route significant levels of traffic through the RTD Park-and-Ride lot and/or the southwest quadrant development, where high levels of pedestrian activity are experienced or expected, and therefore may require additional design considerations to separate bicycles/pedestrians from this traffic flow.

ROW Impacts

The CFI alternative would require a small amount of ROW acquisition from both RTD and the southwest quadrant developers. By comparison, the northwest or southwest quadrant roadway alternatives would construct a roadway through one of the properties, requiring more significant ROW acquisition. The ROW required through each property can be reduced by constructing both quadrant roadways, minimizing the cross-section required by each to accommodate separate left-turning traffic flows.

Stakeholder Impacts

The CFI alternative would require the least amount of coordination with adjacent property owners, as the ROW requirements are minimal; however, the CFI would limit access to the southwest quadrant development along US 85 to a right-in/right-out driveway, at most, between the study intersection and the proposed traffic signal nearly one mile to the south. By comparison, the quadrant roadway alternative(s) would provide an additional signalized access point along US 85 to the RTD Park-and-Ride lot and/or the southwest quadrant development, greatly enhancing the development's commercial viability.

Cost

The quadrant roadway alternatives are expected to cost less than the CFI alternative, with preliminary costs of approximately $7.5 million for one quadrant roadway and $12.5 million for the CFI.

Constructability

The CFI alternative would require significant reconstruction along US 85, greatly impacting traffic during the construction process. Constructing the northwest quadrant roadway would impact the RTD Park-and-Ride lot, but would only require restriping of US 85 and Mineral Avenue and construction of a new signal along US 85. The southwest quadrant alternative would have similarly minimal impacts to traffic flow along US 85 and Mineral Avenue, but, as the parcel is currently undeveloped, would have no impacts otherwise.

Adaptability for Future Phases

The additional capacity provided by the quadrant roadway(s) configuration away from the main intersection would make future construction (i.e. grade-separation) significantly easier, less expensive, and less impactful to traffic flow along US 85 and Mineral Avenue compared to the CFI, which would construct infrastructure that both cannot be adapted for future use and offers no alternative route to accommodate traffic around the study intersection during construction. Based on this, the CFI alternative may not be desirable or a proper use of current resources.

5 Engagement Activities

The Santa Fe Drive/Mineral Avenue intersection serves a large amount of local and regional traffic, with average daily traffic volumes through the intersection exceeding 90,000 vehicles. Additionally, multiple alternatives developed for this project would impact adjacent properties, including the RTD park-and-ride and the to-be-developed parcel to the southwest. With the impact of this project affecting such a wide variety of stakeholders, conducting a number of public and stakeholder outreach activities to gain input into the concerns of drivers and to obtain concurrence with the adjacent land owners was an important part of the project process. These activities included a survey, public meeting, and meetings with various stakeholder groups, as described below.

Online Survey

An online survey was posted to Open Littleton, an online citizen engagement tool managed by the City, in September 2018. This survey asked citizens of Littleton and surrounding areas to answer questions regarding their perception of the issues facing the US 85/Mineral Avenue intersection, with 235 responses received prior to the public open house (discussed below). Generally, responders were concerned with the severe congestion and lack of safety at the intersection. A number of citizens indicated that they regularly avoid the intersection due to these issues, in particular those on bike or foot. Many indicated that they would travel more often and spend more money locally if the problems facing the intersection were solved. Other issues apparent from the survey were queuing through adjacent intersections, and cut-through traffic on Prince Street/Jackass Hill Road and Long Avenue.

A full summary of the survey responses is provided in Attachment G.

Public Open House

The City hosted an open house on September 13, 2018 to give the public an opportunity to talk with the project team and to provide their feedback on the project. The event featured boards presenting the need for the study, existing conditions at the US 85/Mineral Avenue intersection, future traffic projections and increased congestion, and the preliminary short- and long-term solutions. Over 60 citizens attended this open house to voice their concerns about the intersection's operations and safety. Generally, attendees were most supportive of the quadrant roadway alternatives, and most confused by the CFI and median U-turn alternatives. Many attendees voiced concern that the at-grade solutions would not solve the problems at the intersection; however, many other attendees voiced concern that the grade-separated alternatives would create noise and visual impacts. In general, it was understood that grade-separation would be the best fix, but that the associated costs were prohibitive at this time.

A full summary of the open house comments is also provided in Attachment G.

Stakeholder Coordination

Regional Transportation District (RTD)

The City met with RTD on three occasions throughout the project to discuss options for the northwest quadrant road, which would traverse the RTD Park-and-Ride. In general, these discussions were to identify potential impacts to the number of parking spaces and the operations of the bus lines that use the station. RTD's position is that losing spaces at this station would negatively impact their patrons, and that bus operations currently utilize all five bus bays at the station and are expected to continue to do so. If these impacts can be mitigated and RTD "made whole," they have indicated that they would be supportive of the project. The *RTD Park-and-Ride Mitigation* technical memorandum (Attachment H) was subsequently developed to determine if the northwest quadrant roadway could be designed without resulting in the loss any existing parking spaces or bus bays. For the purpose of this memorandum, the quadrant roadway was redesigned to curve through the existing Park-and-Ride to show the "worst-case" scenario for mitigation requirements. The Park-and-Ride layout was reconfigured around the curved roadway, resulting in seven additional parking spaces while maintaining the existing bus loop and all bus bays. A detailed traffic analysis was not conducted for the updated design; however, it is expected that operations would be similar to those of the previous design as described in this report.

Another potential solution discussed at the coordination meetings was the construction of a new parking garage on a portion of the existing park-and-ride surface lot. This would consolidate parking on one side of the quadrant road, reducing pedestrian conflicts with vehicle traffic and opening the remainder of the existing surface lot to potential development. As of this report, however, a final determination has not been made regarding the funding required to construct such a garage or the final design of a reconfigured park-and-ride.

CDOT and Arapahoe County

Two coordination meetings were conducted with CDOT and Arapahoe County. These meetings allowed the project team to incorporate feedback from these agencies and potential partners into the traffic analysis and to establish preferences from these agencies. Both agencies recognized the importance of addressing this significant congestion problem.

Southwest Quadrant Developers

Several meetings with landowners on the southwest parcel were conducted to work through potential design issues with the southwest quadrant road. These meetings have resulted in the identification of several different alignments and intersection locations. As of this report, a final determination has not been made about a solution that is amenable to all parties.

6 Conclusions and Next Steps

In response to severe congestion and safety issues at the US 85/Mineral Avenue intersection, the City of Littleton is conducting an evaluation to identify and analyze potential solutions, aiming to mitigate congestion and improve safety both at the intersection and along the study corridors. Recognizing that the long-term solution may involve a grade-separated interchange that has a steep price tag, the City has endeavored to identify solutions that can be implemented for a lower cost and in a shorter timeframe. In total, twelve—six at-grade and six grade-separated—potential designs were chosen for a high-level evaluation, and four at-grade alternatives were carried forward for a detailed traffic analysis. These alternatives were the CFI, the northwest quadrant roadway, the southwest quadrant roadway, and dual quadrant roadways.

All four alternatives can be expected to address the capacity issues at the study intersection—under "normal" conditions, or an average day's conditions as represented by the field data collected, each alternative operates similarly. While some intersections in the CFI and dual quadrants alternatives operate at LOS E in the 2030 horizon year, this level is still significantly better than operations at the existing intersection today. Notably, the northwest quadrant, including a fourth (south) leg at the Mineral Avenue/Platte River Parkway intersection, is the only alternative for which all intersections operate at LOS D or better in the 2030 horizon year for an average day. These results are driven by how left turns are distributed around each quadrant roadway; for example, the dual quadrant alternative results in significant opposing left turn volumes at the Mineral Avenue/Platte River Parkway intersection, requiring green time to be shifted from the through movements to the left turn movements along all approaches, whereas the single-quadrant alternatives only add left-turning volume to some movements, impacting fewer high-volume through movements. Note that dual quadrant roadway operations may be optimized through active traffic management techniques, such as dynamic message signing directing drivers to use a specific quadrant roadway to complete their left-turn movement based on live traffic conditions.

Under "incident" conditions, or a high-volume day's conditions due to incidents/crashes on parallel corridors, the CFI fails when faced with volumes beyond those of an average day. The dual quadrants alternative also begins to fail when faced with additional left-turn demand at the Mineral Avenue/Platte River Parkway intersection, while the single-quadrant alternatives continue to operate at LOS E or better at all intersections in the system.

When considering additional criteria (driver safety, bicycle/pedestrian safety, ROW impacts, stakeholder impacts, cost, constructability, and adaptability for potential future phases), the quadrant roadway(s) alternatives are significantly more desirable than the CFI. While the ROW and stakeholder impacts of the quadrant roadway(s) are greater than those of the CFI, the safety benefits are also greater, the cost is lower, and the improvements are much more easily constructed. When considering the adaptability of each alternative for future improvements, the additional capacity provided by the quadrant roadway(s) configuration away from the main intersection would make future construction (i.e. grade-separation) significantly easier, less expensive, and less impactful to traffic flow along US 85 and Mineral Avenue compared to the CFI, which would construct infrastructure that both cannot be adapted for future use and offers no alternative route to accommodate traffic around the study intersection during construction. Based on this, the CFI alternative may not be desirable or a proper use of current resources.

Based on these findings, the single-quadrant alternatives should be pursued first; however, selection of the CFI or dual quadrants alternatives based on other factors (e.g. stakeholder coordination, public input, constructability) will still result in significantly improved operations in the 2030 horizon year compared to those in the field today.

Next steps for the project include, but are not limited to:

- Coordination with CDOT for input when selecting the final alternative and concurrence when completing construction and installing of new traffic signals along US 85.
- Stakeholder partnerships, including RTD and the southwest quadrant developers, for right-of-way needs and potential quadrant roadways through one or both properties.
- A detailed VISSIM traffic operations analysis of the final proposed alternative(s), with refinements to signal timings and geometry. The final model(s) should be thoroughly reviewed by CDOT prior to selecting and constructing the preferred alternative.

Attachment A

Synchro HCM Outputs

2019 Existing

AM Peak Hour

Movement	EBL	EBT	WBU	WBT	WBR	SBL	SBR
Lane Configurations							
Traffic Volume (vph)	170	1950	5	640	175	95	60
Future Volume (vph)	170	1950	5	640	175	95	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0	6.0	6.0	6.0	5.0	5.0
Lane Util. Factor	0.97	0.91	1.00	0.95	1.00	0.97	1.00
Frt	1.00	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	5085	1770	3539	1583	3433	1583
Flt Permitted	0.38	1.00	0.09	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1391	5085	175	3539	1583	3433	1583
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	175	2010	5	660	180	98	62
RTOR Reduction (vph)	0	0	0	0	35	0	58
Lane Group Flow (vph)	175	2010	5	660	145	98	4
Turn Type	pm+pt	NA	Perm	NA	Perm	Prot	Perm
Protected Phases	3	8		4		2	
Permitted Phases	8		4		4		2
Actuated Green, G (s)	130.3	130.3	120.8	120.8	120.8	8.7	8.7
Effective Green, g (s)	130.3	130.3	120.8	120.8	120.8	8.7	8.7
Actuated g/C Ratio	0.87	0.87	0.81	0.81	0.81	0.06	0.06
Clearance Time (s)	4.0	6.0	6.0	6.0	6.0	5.0	5.0
Vehicle Extension (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lane Grp Cap (vph)	1283	4417	140	2850	1274	199	91
v/s Ratio Prot	0.01	c0.40		0.19		c0.03	
v/s Ratio Perm	0.11		0.03		0.09		0.00
v/c Ratio	0.14	0.46	0.04	0.23	0.11	0.49	0.04
Uniform Delay, d1	1.5	2.1	2.9	3.5	3.1	68.5	66.7
Progression Factor	1.00	1.00	0.23	0.18	0.00	1.00	1.00
Incremental Delay, d2	0.0	0.3	0.4	0.2	0.2	0.7	0.1
Delay (s)	1.5	2.5	1.1	0.8	0.2	69.2	66.8
Level of Service	A	A	A	A	A	E	E
Approach Delay (s)		2.4		0.7		68.3	
Approach LOS		A		A		E	

Intersection Summary			
HCM 2000 Control Delay	5.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	76.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	190	1115	745	145	505	255	285	1595	200	360	1415	110
Future Volume (vph)	190	1115	745	145	505	255	285	1595	200	360	1415	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0	4.0	4.0	6.0	6.0	4.0	7.0	7.0	4.0	7.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	1770	3539	1583	3433	3539	1583	3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	1770	3539	1583	3433	3539	1583	3433	3539	1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	194	1138	760	148	515	260	291	1628	204	367	1444	112
RTOR Reduction (vph)	0	0	0	0	0	65	0	0	119	0	0	0
Lane Group Flow (vph)	194	1138	760	148	515	195	291	1628	85	367	1444	112
Turn Type	Prot	NA	Free	Prot	NA	pt+ov	Prot	NA	Perm	Prot	NA	Free
Protected Phases	3	8		7	4	4 5	1	6		5	2	
Permitted Phases			Free						6			Free
Actuated Green, G (s)	12.9	38.0	150.0	13.8	38.9	59.9	16.0	62.2	62.2	15.0	61.2	150.0
Effective Green, g (s)	12.9	38.0	150.0	13.8	38.9	59.9	16.0	62.2	62.2	15.0	61.2	150.0
Actuated g/C Ratio	0.09	0.25	1.00	0.09	0.26	0.40	0.11	0.41	0.41	0.10	0.41	1.00
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	7.0	7.0	4.0	7.0	
Vehicle Extension (s)	2.0	3.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	295	896	1583	162	917	632	366	1467	656	343	1443	1583
v/s Ratio Prot	0.06	c0.32		c0.08	0.15	0.12	0.08	c0.46		0.11	c0.41	
v/s Ratio Perm			0.48						0.05			0.07
v/c Ratio	0.66	1.27	0.48	0.91	0.56	0.31	0.80	1.11	0.13	1.07	1.00	0.07
Uniform Delay, d1	66.4	56.0	0.0	67.5	48.2	30.9	65.4	43.9	27.1	67.5	44.4	0.0
Progression Factor	0.97	0.99	1.00	0.86	0.80	0.68	1.36	1.49	5.81	0.91	0.86	1.00
Incremental Delay, d2	3.7	129.8	1.0	44.1	0.5	0.1	6.4	55.8	0.2	62.3	20.8	0.1
Delay (s)	68.4	185.1	1.0	102.1	39.1	21.0	95.3	121.3	158.1	123.4	58.9	0.1
Level of Service	E	F	A	F	D	C	F	F	F	F	E	A
Approach Delay (s)		107.4			44.1			121.3			67.8	
Approach LOS		F			D			F			E	

Intersection Summary			
HCM 2000 Control Delay	92.5	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.13		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	110.7%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

2019 Existing

PM Peak Hour

HCM Signalized Intersection Capacity Analysis
100: Mineral Avenue & Platte River Parkway

04/15/2019

Movement	EBL	EBT	WBU	WBT	WBR	SBL	SBR
Lane Configurations							
Traffic Volume (vph)	180	1105	65	2045	165	410	300
Future Volume (vph)	180	1105	65	2045	165	410	300
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0	6.0	6.0	6.0	5.0	5.0
Lane Util. Factor	0.97	0.91	1.00	0.95	1.00	0.97	1.00
Frt	1.00	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	5085	1770	3539	1583	3433	1583
Flt Permitted	0.03	1.00	0.23	1.00	1.00	0.95	1.00
Satd. Flow (perm)	111	5085	425	3539	1583	3433	1583
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	191	1176	69	2176	176	436	319
RTOR Reduction (vph)	0	0	0	0	29	0	93
Lane Group Flow (vph)	191	1176	69	2176	147	436	226
Turn Type	pm+pt	NA	Perm	NA	Perm	Prot	Perm
Protected Phases	3	8		4		2	
Permitted Phases	8		4		4		2
Actuated Green, G (s)	139.6	139.6	126.2	126.2	126.2	29.4	29.4
Effective Green, g (s)	139.6	139.6	126.2	126.2	126.2	29.4	29.4
Actuated g/C Ratio	0.78	0.78	0.70	0.70	0.70	0.16	0.16
Clearance Time (s)	4.0	6.0	6.0	6.0	6.0	5.0	5.0
Vehicle Extension (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lane Grp Cap (vph)	259	3943	297	2481	1109	560	258
v/s Ratio Prot	c0.04	0.23		c0.61		0.13	
v/s Ratio Perm	0.53		0.16		0.09		c0.14
v/c Ratio	0.74	0.30	0.23	0.88	0.13	0.78	0.88
Uniform Delay, d1	57.3	5.9	9.6	20.9	8.9	72.2	73.5
Progression Factor	1.00	1.00	0.29	0.55	0.00	1.00	1.00
Incremental Delay, d2	9.1	0.2	0.9	2.4	0.1	6.2	25.9
Delay (s)	66.4	6.1	3.6	13.8	0.1	78.4	99.4
Level of Service	E	A	A	B	A	E	F
Approach Delay (s)		14.5		12.5		87.2	
Approach LOS		B		B		F	

Intersection Summary			
HCM 2000 Control Delay	25.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	85.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	115	685	780	110	1195	160	535	1535	170	230	1775	410
Future Volume (vph)	115	685	780	110	1195	160	535	1535	170	230	1775	410
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0	4.0	4.0	6.0	6.0	4.0	7.0	7.0	4.0	7.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	1770	3539	1583	3433	3539	1583	3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	1770	3539	1583	3433	3539	1583	3433	3539	1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	117	699	796	112	1219	163	546	1566	173	235	1811	418
RTOR Reduction (vph)	0	0	0	0	0	53	0	0	95	0	0	0
Lane Group Flow (vph)	117	699	796	112	1219	110	546	1566	78	235	1811	418
Turn Type	Prot	NA	Free	Prot	NA	pt+ov	Prot	NA	Perm	Prot	NA	Free
Protected Phases	3	8		7	4	4 5	1	6		5	2	
Permitted Phases			Free						6			Free
Actuated Green, G (s)	9.3	40.7	180.0	20.6	52.0	74.2	26.0	81.5	81.5	16.2	71.7	180.0
Effective Green, g (s)	9.3	40.7	180.0	20.6	52.0	74.2	26.0	81.5	81.5	16.2	71.7	180.0
Actuated g/C Ratio	0.05	0.23	1.00	0.11	0.29	0.41	0.14	0.45	0.45	0.09	0.40	1.00
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	7.0	7.0	4.0	7.0	
Vehicle Extension (s)	2.0	3.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	177	800	1583	202	1022	652	495	1602	716	308	1409	1583
v/s Ratio Prot	0.03	c0.20		0.06	c0.34	0.07	c0.16	0.44		0.07	c0.51	
v/s Ratio Perm			0.50						0.05			0.26
v/c Ratio	0.66	0.87	0.50	0.55	1.19	0.17	1.10	0.98	0.11	0.76	1.29	0.26
Uniform Delay, d1	83.8	67.2	0.0	75.4	64.0	33.4	77.0	48.4	28.4	80.0	54.1	0.0
Progression Factor	0.91	1.01	1.00	0.84	0.82	1.01	1.00	1.00	1.00	0.87	0.86	1.00
Incremental Delay, d2	6.6	9.9	1.1	1.0	92.3	0.0	71.6	17.7	0.3	4.5	130.9	0.2
Delay (s)	83.1	77.7	1.1	64.0	144.5	33.8	148.6	66.1	28.7	74.3	177.5	0.2
Level of Service	F	E	A	E	F	C	F	E	C	E	F	A
Approach Delay (s)		40.2			126.4			83.0			137.6	
Approach LOS		D			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	99.6	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.21		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	118.2%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

2030 CFI

AM Peak Hour

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	190	2130	210	5	215	685	195	205	15	305	105	15
Future Volume (vph)	190	2130	210	5	215	685	195	205	15	305	105	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0	6.0		5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	0.97	0.91	1.00		1.00	0.91	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	1.00	0.85		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	5085	1583		1770	5085	1583	1770	1863	1583	3433	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00	1.00	0.44	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	5085	1583		1770	5085	1583	828	1863	1583	3433	1863
Peak-hour factor, PHF	0.97	0.97	0.90	0.97	0.90	0.97	0.97	0.90	0.90	0.90	0.97	0.90
Adj. Flow (vph)	196	2196	233	5	239	706	201	228	17	339	108	17
RTOR Reduction (vph)	0	0	77	0	0	0	77	0	0	201	0	0
Lane Group Flow (vph)	196	2196	156	0	244	706	124	228	17	138	108	17
Turn Type	Prot	NA	Perm	Prot	Prot	NA	Perm	pm+pt	NA	Perm	Prot	NA
Protected Phases	3	8		7	7	4		5	2		1	6
Permitted Phases			8				4	2		2		
Actuated Green, G (s)	12.3	85.1	85.1		20.0	92.8	92.8	16.9	16.9	16.9	7.0	16.0
Effective Green, g (s)	12.3	85.1	85.1		20.0	92.8	92.8	16.9	16.9	16.9	7.0	16.0
Actuated g/C Ratio	0.08	0.57	0.57		0.13	0.62	0.62	0.11	0.11	0.11	0.05	0.11
Clearance Time (s)	5.0	6.0	6.0		5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lane Grp Cap (vph)	281	2884	898		236	3145	979	142	209	178	160	198
v/s Ratio Prot	0.06	c0.43			c0.14	0.14		c0.08	0.01		c0.03	0.01
v/s Ratio Perm			0.10				0.08	c0.10		0.09		
v/c Ratio	0.70	0.76	0.17		1.03	0.22	0.13	1.61	0.08	0.77	0.68	0.09
Uniform Delay, d1	67.0	24.7	15.6		65.0	12.7	11.8	65.8	59.6	64.7	70.4	60.4
Progression Factor	1.00	1.00	1.00		0.53	0.18	0.08	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	6.0	2.0	0.4		65.1	0.2	0.2	302.8	0.1	17.1	8.5	0.1
Delay (s)	73.0	26.7	16.0		99.6	2.4	1.2	368.6	59.7	81.8	78.9	60.5
Level of Service	E	C	B		F	A	A	F	E	F	E	E
Approach Delay (s)		29.2				22.8			193.1			65.7
Approach LOS		C				C			F			E

Intersection Summary			
HCM 2000 Control Delay	50.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	93.1%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	65
Future Volume (vph)	65
Ideal Flow (vphpl)	1900
Total Lost time (s)	5.0
Lane Util. Factor	1.00
Frt	0.85
Flt Protected	1.00
Satd. Flow (prot)	1583
Flt Permitted	1.00
Satd. Flow (perm)	1583
Peak-hour factor, PHF	0.97
Adj. Flow (vph)	67
RTOR Reduction (vph)	52
Lane Group Flow (vph)	15
Turn Type	custom
Protected Phases	
Permitted Phases	3 6
Actuated Green, G (s)	33.3
Effective Green, g (s)	33.3
Actuated g/C Ratio	0.22
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	351
v/s Ratio Prot	
v/s Ratio Perm	0.01
v/c Ratio	0.04
Uniform Delay, d1	45.8
Progression Factor	1.00
Incremental Delay, d2	0.0
Delay (s)	45.8
Level of Service	D
Approach Delay (s)	
Approach LOS	

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	320	1405	0	205	715	0	0	2250	250	0	2130	160
Future Volume (vph)	320	1405	0	205	715	0	0	2250	250	0	2130	160
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			6.0	4.0		6.0	4.0
Lane Util. Factor	0.97	0.95		1.00	0.91			0.91	1.00		0.91	1.00
Frt	1.00	1.00		1.00	1.00			1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00		1.00	1.00
Satd. Flow (prot)	3433	3539		1770	5085			5085	1583		5085	1583
Flt Permitted	0.95	1.00		0.08	1.00			1.00	1.00		1.00	1.00
Satd. Flow (perm)	3433	3539		152	5085			5085	1583		5085	1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	327	1434	0	209	730	0	0	2296	255	0	2173	163
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	327	1434	0	209	730	0	0	2296	255	0	2173	163
Turn Type	Prot	NA		pm+pt	NA			NA	Free		NA	Free
Protected Phases	3	8		7	4			2			2	
Permitted Phases				4					Free			Free
Actuated Green, G (s)	23.0	53.0		68.0	49.0			62.0	150.0		62.0	150.0
Effective Green, g (s)	23.0	53.0		68.0	49.0			62.0	150.0		62.0	150.0
Actuated g/C Ratio	0.15	0.35		0.45	0.33			0.41	1.00		0.41	1.00
Clearance Time (s)	5.0	5.0		5.0	5.0			6.0			6.0	
Lane Grp Cap (vph)	526	1250		273	1661			2101	1583		2101	1583
v/s Ratio Prot	0.10	c0.41		c0.10	0.14			c0.45			0.43	
v/s Ratio Perm				0.25					0.16			0.10
v/c Ratio	0.62	1.15		0.77	0.44			1.09	0.16		1.03	0.10
Uniform Delay, d1	59.4	48.5		41.3	39.7			44.0	0.0		44.0	0.0
Progression Factor	1.07	0.40		0.67	0.44			1.15	1.00		1.11	1.00
Incremental Delay, d2	4.1	73.8		17.8	0.8			49.0	0.2		28.0	0.1
Delay (s)	67.9	93.3		45.3	18.4			99.7	0.2		76.8	0.1
Level of Service	E	F		D	B			F	A		E	A
Approach Delay (s)		88.6			24.4			89.8			71.4	
Approach LOS		F			C			F			E	

Intersection Summary			
HCM 2000 Control Delay	75.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.11		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	107.0%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1725	820	0	875	315	0
Future Volume (vph)	1725	820	0	875	315	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	4.0		5.0	5.0	
Lane Util. Factor	0.86	1.00		0.86	0.97	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	1.00	1.00		1.00	0.95	
Satd. Flow (prot)	6408	1583		6408	3433	
Flt Permitted	1.00	1.00		1.00	0.95	
Satd. Flow (perm)	6408	1583		6408	3433	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	1917	911	0	972	350	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	1917	911	0	972	350	0
Turn Type	NA	Free		NA	Prot	
Protected Phases	4 7			8	5	
Permitted Phases		Free				
Actuated Green, G (s)	68.0	150.0		53.0	33.0	
Effective Green, g (s)	68.0	150.0		53.0	33.0	
Actuated g/C Ratio	0.45	1.00		0.35	0.22	
Clearance Time (s)				5.0	5.0	
Lane Grp Cap (vph)	2904	1583		2264	755	
v/s Ratio Prot	c0.30			0.15	0.10	
v/s Ratio Perm		c0.58				
v/c Ratio	0.66	0.58		0.43	0.46	
Uniform Delay, d1	32.0	0.0		37.0	50.8	
Progression Factor	0.44	1.00		0.27	0.68	
Incremental Delay, d2	0.9	1.1		0.6	2.0	
Delay (s)	14.9	1.1		10.6	36.3	
Level of Service	B	A		B	D	
Approach Delay (s)	10.4			10.6	36.3	
Approach LOS	B			B	D	

Intersection Summary			
HCM 2000 Control Delay	12.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	42.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	1655	920	280	395	0
Future Volume (vph)	0	1655	920	280	395	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0	5.0	5.0	
Lane Util. Factor		0.91	0.86	1.00	0.97	
Frt		1.00	1.00	0.85	1.00	
Flt Protected		1.00	1.00	1.00	0.95	
Satd. Flow (prot)		5085	6408	1583	3433	
Flt Permitted		1.00	1.00	1.00	0.95	
Satd. Flow (perm)		5085	6408	1583	3433	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	1839	1022	311	439	0
RTOR Reduction (vph)	0	0	0	151	0	0
Lane Group Flow (vph)	0	1839	1022	160	439	0
Turn Type		NA	NA	Perm	Prot	
Protected Phases		4	3 8		1	
Permitted Phases				3 8		
Actuated Green, G (s)		49.0	76.0	76.0	33.0	
Effective Green, g (s)		49.0	76.0	76.0	33.0	
Actuated g/C Ratio		0.33	0.51	0.51	0.22	
Clearance Time (s)		5.0			5.0	
Lane Grp Cap (vph)		1661	3246	802	755	
v/s Ratio Prot		c0.36	c0.16		c0.13	
v/s Ratio Perm				0.10		
v/c Ratio		1.11	0.31	0.20	0.58	
Uniform Delay, d1		50.5	21.7	20.3	52.3	
Progression Factor		0.28	1.10	2.64	0.61	
Incremental Delay, d2		52.2	0.2	0.5	3.1	
Delay (s)		66.3	24.1	54.2	35.1	
Level of Service		E	C	D	D	
Approach Delay (s)		66.3	31.1		35.1	
Approach LOS		E	C		D	

Intersection Summary			
HCM 2000 Control Delay	49.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	51.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	0	280	2570	0	395	2290
Future Volume (vph)	0	280	2570	0	395	2290
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	6.0
Lane Util. Factor		1.00	0.91		0.97	0.91
Frt		0.86	1.00		1.00	1.00
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		1611	5085		3433	5085
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		1611	5085		3433	5085
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	311	2856	0	439	2544
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	311	2856	0	439	2544
Turn Type		pt+ov	NA		Prot	NA
Protected Phases		4 20!	3 14 16!		4 20!	2 3 4
Permitted Phases		3 16				
Actuated Green, G (s)		140.0	80.0		60.0	150.0
Effective Green, g (s)		134.0	74.0		60.0	140.0
Actuated g/C Ratio		0.89	0.49		0.40	0.93
Clearance Time (s)						
Lane Grp Cap (vph)		1546	2508		1373	4746
v/s Ratio Prot		c0.08	c0.56		0.13	c0.50
v/s Ratio Perm		0.11				
v/c Ratio		0.20	1.14		0.32	0.54
Uniform Delay, d1		1.0	38.0		31.0	0.7
Progression Factor		1.00	0.31		0.79	1.00
Incremental Delay, d2		0.3	64.3		0.3	0.2
Delay (s)		1.3	76.2		24.8	0.8
Level of Service		A	E		C	A
Approach Delay (s)	1.3		76.2			4.4
Approach LOS	A		E			A

Intersection Summary			
HCM 2000 Control Delay	37.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	75.3%	ICU Level of Service	D
Analysis Period (min)	15		

! Phase conflict between lane groups.
c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	0	820	315	2500	2335	0
Future Volume (vph)	0	820	315	2500	2335	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0	6.0	5.0	
Lane Util. Factor		1.00	0.97	0.91	0.91	
Frt		0.86	1.00	1.00	1.00	
Flt Protected		1.00	0.95	1.00	1.00	
Satd. Flow (prot)		1611	3433	5085	5085	
Flt Permitted		1.00	0.95	1.00	1.00	
Satd. Flow (perm)		1611	3433	5085	5085	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	911	350	2778	2594	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	911	350	2778	2594	0
Turn Type		pt+ov	Prot	NA	NA	
Protected Phases		8 20!	8 20!	2 7 8	7 12 16!	
Permitted Phases		7 16				
Actuated Green, G (s)		140.0	64.0	150.0	76.0	
Effective Green, g (s)		134.0	64.0	140.0	70.0	
Actuated g/C Ratio		0.89	0.43	0.93	0.47	
Clearance Time (s)						
Lane Grp Cap (vph)		1546	1464	4746	2373	
v/s Ratio Prot		c0.25	0.10	0.55	c0.51	
v/s Ratio Perm		0.31				
v/c Ratio		0.59	0.24	0.59	1.09	
Uniform Delay, d1		1.8	27.5	0.7	40.0	
Progression Factor		1.00	0.78	1.00	0.34	
Incremental Delay, d2		1.4	0.1	0.1	44.9	
Delay (s)		3.2	21.6	0.9	58.4	
Level of Service		A	C	A	E	
Approach Delay (s)	3.2			3.2	58.4	
Approach LOS	A			A	E	

Intersection Summary			
HCM 2000 Control Delay	24.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	104.2%	ICU Level of Service	G
Analysis Period (min)	15		
! Phase conflict between lane groups.			
c Critical Lane Group			

2030 CFI

PM Peak Hour

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	200	1200	250	70	260	2245	180	190	15	280	450	20
Future Volume (vph)	200	1200	250	70	260	2245	180	190	15	280	450	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0	6.0		5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	0.97	0.91	1.00		1.00	0.91	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	1.00	0.85		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	5085	1583		1770	5085	1583	1770	1863	1583	3433	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	5085	1583		1770	5085	1583	1863	1863	1583	3433	1863
Peak-hour factor, PHF	0.97	0.97	0.90	0.97	0.90	0.97	0.97	0.90	0.90	0.90	0.97	0.90
Adj. Flow (vph)	206	1237	278	72	289	2314	186	211	17	311	464	22
RTOR Reduction (vph)	0	0	145	0	0	0	42	0	0	209	0	0
Lane Group Flow (vph)	206	1237	133	0	361	2314	144	211	17	102	464	22
Turn Type	Prot	NA	Perm	Prot	Prot	NA	Perm	pm+pt	NA	Perm	Prot	NA
Protected Phases	3	8		7	7	4		5	2		1	6
Permitted Phases			8				4	2		2		
Actuated Green, G (s)	11.0	76.2	76.2		42.0	107.2	107.2	15.8	15.8	15.8	25.0	25.8
Effective Green, g (s)	11.0	76.2	76.2		42.0	107.2	107.2	15.8	15.8	15.8	25.0	25.8
Actuated g/C Ratio	0.06	0.42	0.42		0.23	0.60	0.60	0.09	0.09	0.09	0.14	0.14
Clearance Time (s)	5.0	6.0	6.0		5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lane Grp Cap (vph)	209	2152	670		413	3028	942	163	163	138	476	267
v/s Ratio Prot	0.06	0.24			c0.20	c0.46		0.11	0.01		c0.14	0.01
v/s Ratio Perm			0.08				0.09	c0.01		0.06		
v/c Ratio	0.99	0.57	0.20		0.87	0.76	0.15	1.29	0.10	0.74	0.97	0.08
Uniform Delay, d1	84.4	39.6	32.7		66.5	27.0	16.2	82.5	75.6	80.1	77.2	66.8
Progression Factor	1.00	1.00	1.00		0.57	0.35	0.11	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	57.5	1.1	0.7		2.0	0.2	0.0	170.3	0.1	16.3	34.3	0.0
Delay (s)	142.0	40.7	33.3		40.1	9.5	1.8	252.8	75.7	96.4	111.5	66.9
Level of Service	F	D	C		D	A	A	F	E	F	F	E
Approach Delay (s)		51.6				12.9			157.0			99.8
Approach LOS		D				B			F			F

Intersection Summary			
HCM 2000 Control Delay	49.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	89.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	330
Future Volume (vph)	330
Ideal Flow (vphpl)	1900
Total Lost time (s)	5.0
Lane Util. Factor	1.00
Frt	0.85
Flt Protected	1.00
Satd. Flow (prot)	1583
Flt Permitted	1.00
Satd. Flow (perm)	1583
Peak-hour factor, PHF	0.97
Adj. Flow (vph)	340
RTOR Reduction (vph)	68
Lane Group Flow (vph)	272
Turn Type	custom
Protected Phases	
Permitted Phases	3 6
Actuated Green, G (s)	36.8
Effective Green, g (s)	36.8
Actuated g/C Ratio	0.20
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	323
v/s Ratio Prot	
v/s Ratio Perm	0.17
v/c Ratio	0.84
Uniform Delay, d1	68.8
Progression Factor	1.00
Incremental Delay, d2	17.2
Delay (s)	86.0
Level of Service	F
Approach Delay (s)	
Approach LOS	

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	230	915	0	185	1510	0	0	2190	215	0	2655	510
Future Volume (vph)	230	915	0	185	1510	0	0	2190	215	0	2655	510
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			6.0	4.0		6.0	4.0
Lane Util. Factor	0.97	0.95		1.00	0.91			0.91	1.00		0.91	1.00
Frt	1.00	1.00		1.00	1.00			1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00		1.00	1.00
Satd. Flow (prot)	3433	3539		1770	5085			5085	1583		5085	1583
Flt Permitted	0.95	1.00		0.07	1.00			1.00	1.00		1.00	1.00
Satd. Flow (perm)	3433	3539		138	5085			5085	1583		5085	1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	235	934	0	189	1541	0	0	2235	219	0	2709	520
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	235	934	0	189	1541	0	0	2235	219	0	2709	520
Turn Type	Prot	NA		pm+pt	NA			NA	Free		NA	Free
Protected Phases	3	8		7	4			2			2	
Permitted Phases				4					Free			Free
Actuated Green, G (s)	26.0	53.0		81.0	54.0			84.0	180.0		84.0	180.0
Effective Green, g (s)	26.0	53.0		81.0	54.0			84.0	180.0		84.0	180.0
Actuated g/C Ratio	0.14	0.29		0.45	0.30			0.47	1.00		0.47	1.00
Clearance Time (s)	5.0	5.0		5.0	5.0			6.0			6.0	
Lane Grp Cap (vph)	495	1042		306	1525			2373	1583		2373	1583
v/s Ratio Prot	0.07	0.26		c0.09	c0.30			0.44			c0.53	
v/s Ratio Perm				0.18					0.14			c0.33
v/c Ratio	0.47	0.90		0.62	1.01			0.94	0.14		1.14	0.33
Uniform Delay, d1	70.7	60.9		46.5	63.0			45.7	0.0		48.0	0.0
Progression Factor	0.99	0.41		0.93	0.29			1.08	1.00		0.60	1.00
Incremental Delay, d2	3.0	11.0		6.7	22.4			8.1	0.2		67.8	0.4
Delay (s)	72.9	36.3		49.9	40.8			57.3	0.2		96.8	0.4
Level of Service	E	D		D	D			E	A		F	A
Approach Delay (s)		43.6			41.8			52.2			81.3	
Approach LOS		D			D			D			F	

Intersection Summary			
HCM 2000 Control Delay	59.9	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	100.4%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1145	860	0	2020	590	0
Future Volume (vph)	1145	860	0	2020	590	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	4.0		5.0	5.0	
Lane Util. Factor	0.86	1.00		0.86	0.97	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	1.00	1.00		1.00	0.95	
Satd. Flow (prot)	6408	1583		6408	3433	
Flt Permitted	1.00	1.00		1.00	0.95	
Satd. Flow (perm)	6408	1583		6408	3433	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	1272	956	0	2244	656	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	1272	956	0	2244	656	0
Turn Type	NA	Free		NA	Prot	
Protected Phases	4 7			8	5	
Permitted Phases		Free				
Actuated Green, G (s)	81.0	180.0		53.0	55.0	
Effective Green, g (s)	81.0	180.0		53.0	55.0	
Actuated g/C Ratio	0.45	1.00		0.29	0.31	
Clearance Time (s)				5.0	5.0	
Lane Grp Cap (vph)	2883	1583		1886	1048	
v/s Ratio Prot	0.20			c0.35	0.19	
v/s Ratio Perm		c0.60				
v/c Ratio	0.44	0.60		1.19	0.63	
Uniform Delay, d1	34.0	0.0		63.5	53.7	
Progression Factor	0.41	1.00		0.40	0.75	
Incremental Delay, d2	0.4	1.3		89.0	2.4	
Delay (s)	14.4	1.3		114.2	42.7	
Level of Service	B	A		F	D	
Approach Delay (s)	8.8			114.2	42.7	
Approach LOS	A			F	D	

Intersection Summary			
HCM 2000 Control Delay	59.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	54.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	1130	1695	175	255	0
Future Volume (vph)	0	1130	1695	175	255	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0	5.0	5.0	
Lane Util. Factor		0.91	0.86	1.00	0.97	
Frt		1.00	1.00	0.85	1.00	
Flt Protected		1.00	1.00	1.00	0.95	
Satd. Flow (prot)		5085	6408	1583	3433	
Flt Permitted		1.00	1.00	1.00	0.95	
Satd. Flow (perm)		5085	6408	1583	3433	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	1256	1883	194	283	0
RTOR Reduction (vph)	0	0	0	43	0	0
Lane Group Flow (vph)	0	1256	1883	151	283	0
Turn Type		NA	NA	Perm	Prot	
Protected Phases		4	3 8		1	
Permitted Phases				3 8		
Actuated Green, G (s)		54.0	79.0	79.0	55.0	
Effective Green, g (s)		54.0	79.0	79.0	55.0	
Actuated g/C Ratio		0.30	0.44	0.44	0.31	
Clearance Time (s)		5.0			5.0	
Lane Grp Cap (vph)		1525	2812	694	1048	
v/s Ratio Prot		c0.25	c0.29		c0.08	
v/s Ratio Perm				0.10		
v/c Ratio		0.82	0.67	0.22	0.27	
Uniform Delay, d1		58.6	40.1	31.3	47.3	
Progression Factor		0.24	0.64	0.57	0.74	
Incremental Delay, d2		3.7	0.1	0.1	0.6	
Delay (s)		17.8	26.0	18.0	35.6	
Level of Service		B	C	B	D	
Approach Delay (s)		17.8	25.2		35.6	
Approach LOS		B	C		D	

Intersection Summary			
HCM 2000 Control Delay	23.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	40.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	0	175	2420	0	255	3165
Future Volume (vph)	0	175	2420	0	255	3165
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	6.0
Lane Util. Factor		1.00	0.91		0.97	0.91
Frt		0.86	1.00		1.00	1.00
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		1611	5085		3433	5085
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		1611	5085		3433	5085
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	194	2689	0	283	3517
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	194	2689	0	283	3517
Turn Type		pt+ov	NA		Prot	NA
Protected Phases		4 20!	3 14 16!		4 20!	2 3 4
Permitted Phases		3 16				
Actuated Green, G (s)		170.0	105.0		65.0	180.0
Effective Green, g (s)		164.0	99.0		65.0	170.0
Actuated g/C Ratio		0.91	0.55		0.36	0.94
Clearance Time (s)						
Lane Grp Cap (vph)		1557	2796		1239	4802
v/s Ratio Prot		c0.04	c0.53		0.08	c0.69
v/s Ratio Perm		0.08				
v/c Ratio		0.12	0.96		0.23	0.73
Uniform Delay, d1		0.8	38.7		40.0	0.9
Progression Factor		1.00	0.27		1.10	1.00
Incremental Delay, d2		0.2	6.4		0.0	0.1
Delay (s)		1.0	16.9		44.0	1.0
Level of Service		A	B		D	A
Approach Delay (s)	1.0		16.9			4.2
Approach LOS	A		B			A

Intersection Summary			
HCM 2000 Control Delay	9.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	66.2%	ICU Level of Service	C
Analysis Period (min)	15		

! Phase conflict between lane groups.

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	0	860	590	2405	2840	0
Future Volume (vph)	0	860	590	2405	2840	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0	6.0	5.0	
Lane Util. Factor		1.00	0.97	0.91	0.91	
Frt		0.86	1.00	1.00	1.00	
Flt Protected		1.00	0.95	1.00	1.00	
Satd. Flow (prot)		1611	3433	5085	5085	
Flt Permitted		1.00	0.95	1.00	1.00	
Satd. Flow (perm)		1611	3433	5085	5085	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	956	656	2672	3156	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	956	656	2672	3156	0
Turn Type		pt+ov	Prot	NA	NA	
Protected Phases		8 20!	8 20!	2 7 8	7 12 16!	
Permitted Phases		7 16				
Actuated Green, G (s)		170.0	64.0	180.0	106.0	
Effective Green, g (s)		164.0	64.0	170.0	100.0	
Actuated g/C Ratio		0.91	0.36	0.94	0.56	
Clearance Time (s)						
Lane Grp Cap (vph)		1557	1220	4802	2825	
v/s Ratio Prot		c0.22	0.19	0.53	c0.62	
v/s Ratio Perm		0.38				
v/c Ratio		0.61	0.54	0.56	1.12	
Uniform Delay, d1		1.6	46.2	0.6	40.0	
Progression Factor		1.00	0.87	1.00	0.41	
Incremental Delay, d2		1.5	0.2	0.0	53.3	
Delay (s)		3.1	40.2	0.6	69.5	
Level of Service		A	D	A	E	
Approach Delay (s)	3.1			8.4	69.5	
Approach LOS	A			A	E	

Intersection Summary			
HCM 2000 Control Delay	33.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	116.5%	ICU Level of Service	H
Analysis Period (min)	15		
! Phase conflict between lane groups.			
c Critical Lane Group			

2030 Northwest Quadrant

AM Peak Hour

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	380	1940	210	5	215	465	335	205	125	195	480	15
Future Volume (vph)	380	1940	210	5	215	465	335	205	125	195	480	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0	4.0		5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	*1.00	*1.00	1.00		1.00	0.91	1.00	1.00	1.00	1.00	0.97	0.95
Frt	1.00	1.00	0.85		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.87
Flt Protected	0.95	1.00	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3539	5588	1583		1770	5085	1583	1770	1863	1583	3433	1533
Flt Permitted	0.95	1.00	1.00		0.95	1.00	1.00	0.58	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3539	5588	1583		1770	5085	1583	1079	1863	1583	3433	1533
Peak-hour factor, PHF	0.97	0.97	0.90	0.97	0.90	0.97	0.97	0.90	0.90	0.90	0.97	0.90
Adj. Flow (vph)	392	2000	233	5	239	479	345	228	139	217	495	17
RTOR Reduction (vph)	0	0	0	0	0	0	180	0	0	194	0	120
Lane Group Flow (vph)	392	2000	233	0	244	479	165	228	139	23	495	38
Turn Type	Prot	NA	Free	Prot	Prot	NA	Perm	pm+pt	NA	Perm	Prot	NA
Protected Phases	3	8		7	7	4		5	2		1	6
Permitted Phases			Free				4	2		2		
Actuated Green, G (s)	20.5	72.4	150.0		20.0	71.9	71.9	30.3	15.6	15.6	21.0	21.9
Effective Green, g (s)	20.5	72.4	150.0		20.0	71.9	71.9	30.3	15.6	15.6	21.0	21.9
Actuated g/C Ratio	0.14	0.48	1.00		0.13	0.48	0.48	0.20	0.10	0.10	0.14	0.15
Clearance Time (s)	5.0	6.0			5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	2.0	2.0			2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lane Grp Cap (vph)	483	2697	1583		236	2437	758	285	193	164	480	223
v/s Ratio Prot	0.11	c0.36			c0.14	0.09		0.08	0.07		c0.14	0.02
v/s Ratio Perm			0.15				0.10	c0.08		0.01		
v/c Ratio	0.81	0.74	0.15		1.03	0.20	0.22	0.80	0.72	0.14	1.03	0.17
Uniform Delay, d1	62.9	31.3	0.0		65.0	22.4	22.7	55.2	65.1	61.1	64.5	56.1
Progression Factor	1.00	1.00	1.00		0.78	0.41	1.12	1.00	1.00	1.00	0.85	1.49
Incremental Delay, d2	9.5	1.9	0.2		66.8	0.2	0.6	14.0	10.6	0.1	48.8	0.1
Delay (s)	72.4	33.1	0.2		117.5	9.4	26.2	69.2	75.7	61.2	103.4	83.7
Level of Service	E	C	A		F	A	C	E	E	E	F	F
Approach Delay (s)		36.1				39.5			67.8			103.6
Approach LOS		D				D			E			F

Intersection Summary			
HCM 2000 Control Delay	51.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	92.9%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	285
Future Volume (vph)	285
Ideal Flow (vphpl)	1900
Total Lost time (s)	5.0
Lane Util. Factor	0.95
Frt	0.85
Flt Protected	1.00
Satd. Flow (prot)	1504
Flt Permitted	1.00
Satd. Flow (perm)	1504
Peak-hour factor, PHF	0.97
Adj. Flow (vph)	294
RTOR Reduction (vph)	110
Lane Group Flow (vph)	43
Turn Type	pm+ov
Protected Phases	3
Permitted Phases	6
Actuated Green, G (s)	42.4
Effective Green, g (s)	42.4
Actuated g/C Ratio	0.28
Clearance Time (s)	5.0
Vehicle Extension (s)	2.0
Lane Grp Cap (vph)	475
v/s Ratio Prot	0.01
v/s Ratio Perm	0.02
v/c Ratio	0.09
Uniform Delay, d1	39.6
Progression Factor	3.15
Incremental Delay, d2	0.0
Delay (s)	124.7
Level of Service	F
Approach Delay (s)	
Approach LOS	

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱		↑↑↑	↱		↑↑↑	↱		↑↑↑	↱
Traffic Volume (vph)	0	1800	820	0	920	280	0	2565	250	0	2335	160
Future Volume (vph)	0	1800	820	0	920	280	0	2565	250	0	2335	160
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	4.0		6.0	6.0		7.0	7.0		7.0	4.0
Lane Util. Factor		*1.00	1.00		*1.00	1.00		*1.00	1.00		0.91	1.00
Frt		1.00	0.85		1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00
Satd. Flow (prot)		3725	1583		5588	1583		5588	1583		5085	1583
Flt Permitted		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00
Satd. Flow (perm)		3725	1583		5588	1583		5588	1583		5085	1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1837	837	0	939	286	0	2617	255	0	2383	163
RTOR Reduction (vph)	0	0	0	0	0	15	0	0	12	0	0	0
Lane Group Flow (vph)	0	1837	837	0	939	271	0	2617	243	0	2383	163
Turn Type		NA	Free		NA	Prot		NA	Perm		NA	Free
Protected Phases		8			4	4		6			2	
Permitted Phases			Free						6			Free
Actuated Green, G (s)		70.0	150.0		70.0	70.0		67.0	67.0		67.0	150.0
Effective Green, g (s)		70.0	150.0		70.0	70.0		67.0	67.0		67.0	150.0
Actuated g/C Ratio		0.47	1.00		0.47	0.47		0.45	0.45		0.45	1.00
Clearance Time (s)		6.0			6.0	6.0		7.0	7.0		7.0	
Vehicle Extension (s)		2.0			2.0	2.0		2.0	2.0		2.0	
Lane Grp Cap (vph)		1738	1583		2607	738		2495	707		2271	1583
v/s Ratio Prot		c0.49			0.17	0.17		0.47			c0.47	
v/s Ratio Perm			0.53						0.15			0.10
v/c Ratio		1.06	0.53		0.36	0.37		1.05	0.34		1.05	0.10
Uniform Delay, d1		40.0	0.0		25.6	25.7		41.5	27.1		41.5	0.0
Progression Factor		0.58	1.00		0.84	0.82		1.04	1.11		0.69	1.00
Incremental Delay, d2		35.2	0.9		0.0	0.1		26.0	0.4		30.5	0.1
Delay (s)		58.3	0.9		21.5	21.3		69.2	30.5		59.1	0.1
Level of Service		E	A		C	C		E	C		E	A
Approach Delay (s)		40.4			21.5			65.8			55.3	
Approach LOS		D			C			E			E	

Intersection Summary			
HCM 2000 Control Delay	49.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	110.1%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	320	205	315	2530	2290	395
Future Volume (vph)	320	205	315	2530	2290	395
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	7.0	7.0	7.0
Lane Util. Factor	0.97	1.00	0.97	0.91	0.91	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	3433	5085	5085	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	3433	5085	5085	1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	333	214	328	2635	2385	411
RTOR Reduction (vph)	0	3	0	0	0	115
Lane Group Flow (vph)	333	211	328	2635	2385	296
Turn Type	Prot	pm+ov	Prot	NA	NA	Perm
Protected Phases	4	5	5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	18.7	40.7	22.0	120.3	94.3	94.3
Effective Green, g (s)	18.7	40.7	22.0	120.3	94.3	94.3
Actuated g/C Ratio	0.12	0.27	0.15	0.80	0.63	0.63
Clearance Time (s)	4.0	4.0	4.0	7.0	7.0	7.0
Vehicle Extension (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lane Grp Cap (vph)	427	471	503	4078	3196	995
v/s Ratio Prot	c0.10	0.07	c0.10	0.52	c0.47	
v/s Ratio Perm		0.07				0.19
v/c Ratio	0.78	0.45	0.65	0.65	0.75	0.30
Uniform Delay, d1	63.7	45.3	60.4	6.1	19.5	12.7
Progression Factor	0.66	0.51	0.99	0.43	0.40	0.39
Incremental Delay, d2	7.7	0.2	0.7	0.2	0.5	0.2
Delay (s)	49.7	23.5	60.7	2.8	8.4	5.1
Level of Service	D	C	E	A	A	A
Approach Delay (s)	39.4			9.2	7.9	
Approach LOS	D			A	A	

Intersection Summary			
HCM 2000 Control Delay	11.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	74.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	700	10	50	515	10	155
Future Volume (vph)	700	10	50	515	10	155
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		5.0	4.0	5.0	5.0
Lane Util. Factor	0.97		1.00	1.00	1.00	1.00
Frt	1.00		1.00	0.85	1.00	1.00
Flt Protected	0.95		1.00	1.00	0.95	1.00
Satd. Flow (prot)	3437		1863	1583	1770	1863
Flt Permitted	0.95		1.00	1.00	0.72	1.00
Satd. Flow (perm)	3437		1863	1583	1347	1863
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	729	10	52	536	10	161
RTOR Reduction (vph)	1	0	0	0	0	0
Lane Group Flow (vph)	738	0	52	536	10	161
Turn Type	Prot		NA	Free	Perm	NA
Protected Phases	8		2			6
Permitted Phases				Free	6	
Actuated Green, G (s)	54.1		10.9	75.0	10.9	10.9
Effective Green, g (s)	54.1		10.9	75.0	10.9	10.9
Actuated g/C Ratio	0.72		0.15	1.00	0.15	0.15
Clearance Time (s)	5.0		5.0		5.0	5.0
Vehicle Extension (s)	2.0		2.0		2.0	2.0
Lane Grp Cap (vph)	2479		270	1583	195	270
v/s Ratio Prot	0.21		0.03			c0.09
v/s Ratio Perm				c0.34	0.01	
v/c Ratio	0.30		0.19	0.34	0.05	0.60
Uniform Delay, d1	3.7		28.2	0.0	27.6	30.0
Progression Factor	0.54		1.26	1.00	1.00	1.00
Incremental Delay, d2	0.3		0.1	0.5	0.0	2.4
Delay (s)	2.3		35.6	0.5	27.6	32.3
Level of Service	A		D	A	C	C
Approach Delay (s)	2.3		3.6			32.1
Approach LOS	A		A			C

Intersection Summary			
HCM 2000 Control Delay	6.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	36.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

2030 Northwest Quadrant

PM Peak Hour

Movement	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	260	1140	250	60	260	1665	330	190	120	175	650	20
Future Volume (vph)	260	1140	250	60	260	1665	330	190	120	175	650	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0	4.0		5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	*1.00	*1.00	1.00		1.00	0.91	1.00	1.00	1.00	1.00	0.97	0.95
Frt	1.00	1.00	0.85		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.86
Flt Protected	0.95	1.00	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3539	5588	1583		1770	5085	1583	1770	1863	1583	3433	1516
Flt Permitted	0.95	1.00	1.00		0.95	1.00	1.00	0.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3539	5588	1583		1770	5085	1583	0	1863	1583	3433	1516
Peak-hour factor, PHF	0.97	0.97	0.90	0.97	0.90	0.97	0.97	0.90	0.90	0.90	0.97	0.90
Adj. Flow (vph)	268	1175	278	62	289	1716	340	211	133	194	670	22
RTOR Reduction (vph)	0	0	0	0	0	0	102	0	0	175	0	178
Lane Group Flow (vph)	268	1175	278	0	351	1716	238	211	133	19	670	304
Turn Type	Prot	NA	Free	Prot	Prot	NA	Perm	pm+pt	NA	Perm	Prot	NA
Protected Phases	3	8		7	7	4		5	2		1	6
Permitted Phases			Free				4	2		2		
Actuated Green, G (s)	17.0	58.5	180.0		41.0	82.5	82.5	20.6	17.3	17.3	42.2	38.9
Effective Green, g (s)	17.0	58.5	180.0		41.0	82.5	82.5	20.6	17.3	17.3	42.2	38.9
Actuated g/C Ratio	0.09	0.32	1.00		0.23	0.46	0.46	0.11	0.10	0.10	0.23	0.22
Clearance Time (s)	5.0	6.0			5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	2.0	2.0			2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lane Grp Cap (vph)	334	1816	1583		403	2330	725	202	179	152	804	327
v/s Ratio Prot	0.08	0.21			c0.20	c0.34		c0.12	0.07		c0.20	c0.20
v/s Ratio Perm			0.18				0.15			0.01		
v/c Ratio	0.80	0.65	0.18		0.87	0.74	0.33	1.04	0.74	0.12	0.83	0.93
Uniform Delay, d1	79.9	51.9	0.0		67.0	39.9	31.1	79.7	79.2	74.4	65.6	69.2
Progression Factor	1.00	1.00	1.00		0.70	0.60	0.65	1.00	1.00	1.00	0.69	0.42
Incremental Delay, d2	12.3	1.8	0.2		15.1	1.8	1.0	75.5	13.5	0.1	7.0	31.1
Delay (s)	92.2	53.7	0.2		62.2	25.8	21.3	155.2	92.7	74.5	52.1	60.5
Level of Service	F	D	A		E	C	C	F	F	E	D	E
Approach Delay (s)		51.1				30.5			110.7			53.2
Approach LOS		D				C			F			D

Intersection Summary			
HCM 2000 Control Delay	48.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	93.6%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBR
Lane Configurations	
Traffic Volume (vph)	910
Future Volume (vph)	910
Ideal Flow (vphpl)	1900
Total Lost time (s)	5.0
Lane Util. Factor	0.95
Frt	0.85
Flt Protected	1.00
Satd. Flow (prot)	1504
Flt Permitted	1.00
Satd. Flow (perm)	1504
Peak-hour factor, PHF	0.97
Adj. Flow (vph)	938
RTOR Reduction (vph)	59
Lane Group Flow (vph)	419
Turn Type	pm+ov
Protected Phases	3
Permitted Phases	6
Actuated Green, G (s)	55.9
Effective Green, g (s)	55.9
Actuated g/C Ratio	0.31
Clearance Time (s)	5.0
Vehicle Extension (s)	2.0
Lane Grp Cap (vph)	508
v/s Ratio Prot	c0.08
v/s Ratio Perm	0.20
v/c Ratio	0.83
Uniform Delay, d1	57.5
Progression Factor	0.65
Incremental Delay, d2	9.9
Delay (s)	47.4
Level of Service	D
Approach Delay (s)	
Approach LOS	

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1170	860	0	1695	175	0	2780	215	0	2840	510
Future Volume (vph)	0	1170	860	0	1695	175	0	2780	215	0	2840	510
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	4.0		6.0	6.0		7.0	7.0		7.0	4.0
Lane Util. Factor		*1.00	1.00		*1.00	1.00		*1.00	1.00		0.91	1.00
Frt		1.00	0.85		1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00
Satd. Flow (prot)		3725	1583		5588	1583		5588	1583		5085	1583
Flt Permitted		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00
Satd. Flow (perm)		3725	1583		5588	1583		5588	1583		5085	1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1194	878	0	1730	179	0	2837	219	0	2898	520
RTOR Reduction (vph)	0	0	0	0	0	30	0	0	19	0	0	0
Lane Group Flow (vph)	0	1194	878	0	1730	149	0	2837	200	0	2898	520
Turn Type		NA	Free		NA	Prot		NA	Perm		NA	Free
Protected Phases		8			4	4		6			2	
Permitted Phases			Free						6			Free
Actuated Green, G (s)		33.8	90.0		33.8	33.8		43.2	43.2		43.2	90.0
Effective Green, g (s)		33.8	90.0		33.8	33.8		43.2	43.2		43.2	90.0
Actuated g/C Ratio		0.38	1.00		0.38	0.38		0.48	0.48		0.48	1.00
Clearance Time (s)		6.0			6.0	6.0		7.0	7.0		7.0	
Vehicle Extension (s)		2.0			2.0	2.0		2.0	2.0		2.0	
Lane Grp Cap (vph)		1398	1583		2098	594		2682	759		2440	1583
v/s Ratio Prot		c0.32			0.31	0.09		0.51			c0.57	
v/s Ratio Perm			0.55						0.13			0.33
v/c Ratio		0.85	0.55		0.82	0.25		1.06	0.26		1.19	0.33
Uniform Delay, d1		25.8	0.0		25.4	19.4		23.4	13.9		23.4	0.0
Progression Factor		1.23	1.00		0.41	0.10		1.00	0.94		1.01	1.00
Incremental Delay, d2		4.0	1.1		0.2	0.0		27.1	0.1		85.9	0.2
Delay (s)		35.9	1.1		10.7	2.0		50.4	13.2		109.6	0.2
Level of Service		D	A		B	A		D	B		F	A
Approach Delay (s)		21.1			9.9			47.8			92.9	
Approach LOS		C			A			D			F	

Intersection Summary			
HCM 2000 Control Delay	50.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	98.5%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	230	185	590	2365	3165	255
Future Volume (vph)	230	185	590	2365	3165	255
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	7.0	7.0	7.0
Lane Util. Factor	0.97	1.00	0.97	0.91	0.91	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	3433	5085	5085	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	3433	5085	5085	1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	240	193	615	2464	3297	266
RTOR Reduction (vph)	0	1	0	0	0	48
Lane Group Flow (vph)	240	192	615	2464	3297	218
Turn Type	Prot	pm+ov	Prot	NA	NA	Perm
Protected Phases	4	5	5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	13.0	46.0	33.0	156.0	119.0	119.0
Effective Green, g (s)	13.0	46.0	33.0	156.0	119.0	119.0
Actuated g/C Ratio	0.07	0.26	0.18	0.87	0.66	0.66
Clearance Time (s)	4.0	4.0	4.0	7.0	7.0	7.0
Vehicle Extension (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lane Grp Cap (vph)	247	439	629	4407	3361	1046
v/s Ratio Prot	c0.07	0.08	c0.18	0.48	c0.65	
v/s Ratio Perm		0.04				0.14
v/c Ratio	0.97	0.44	0.98	0.56	0.98	0.21
Uniform Delay, d1	83.3	56.2	73.1	3.1	29.4	12.0
Progression Factor	0.87	0.82	0.87	1.55	0.30	0.09
Incremental Delay, d2	48.3	0.2	12.8	0.1	2.0	0.0
Delay (s)	121.1	46.2	76.1	4.9	10.7	1.1
Level of Service	F	D	E	A	B	A
Approach Delay (s)	87.7			19.2	10.0	
Approach LOS	F			B	B	

Intersection Summary			
HCM 2000 Control Delay	18.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	97.0%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	815	30	265	405	10	110
Future Volume (vph)	815	30	265	405	10	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		5.0	4.0	5.0	5.0
Lane Util. Factor	0.97		1.00	1.00	1.00	1.00
Frt	0.99		1.00	0.85	1.00	1.00
Flt Protected	0.95		1.00	1.00	0.95	1.00
Satd. Flow (prot)	3429		1863	1583	1770	1863
Flt Permitted	0.95		1.00	1.00	0.32	1.00
Satd. Flow (perm)	3429		1863	1583	604	1863
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	849	31	276	422	10	115
RTOR Reduction (vph)	2	0	0	0	0	0
Lane Group Flow (vph)	878	0	276	422	10	115
Turn Type	Prot		NA	Free	Perm	NA
Protected Phases	8		2			6
Permitted Phases				Free	6	
Actuated Green, G (s)	62.1		17.9	90.0	17.9	17.9
Effective Green, g (s)	62.1		17.9	90.0	17.9	17.9
Actuated g/C Ratio	0.69		0.20	1.00	0.20	0.20
Clearance Time (s)	5.0		5.0		5.0	5.0
Vehicle Extension (s)	2.0		2.0		2.0	2.0
Lane Grp Cap (vph)	2366		370	1583	120	370
v/s Ratio Prot	c0.26		c0.15			0.06
v/s Ratio Perm				0.27	0.02	
v/c Ratio	0.37		0.75	0.27	0.08	0.31
Uniform Delay, d1	5.8		33.9	0.0	29.4	30.8
Progression Factor	0.73		1.08	1.00	1.00	1.00
Incremental Delay, d2	0.3		6.1	0.4	0.1	0.2
Delay (s)	4.5		42.7	0.4	29.5	31.0
Level of Service	A		D	A	C	C
Approach Delay (s)	4.5		17.1			30.8
Approach LOS	A		B			C

Intersection Summary			
HCM 2000 Control Delay	11.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	46.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

2030 Southwest Quadrant

AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	190	1520	820	385	440	125	450	85	590	95	25	65
Future Volume (vph)	190	1520	820	385	440	125	450	85	590	95	25	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0	5.0	5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	*1.00	0.91	1.00	0.97	0.95	1.00	0.97	0.95	0.95	0.97	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.89	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3539	5085	1583	3433	3539	1583	3433	1570	1504	3433	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.56	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3539	5085	1583	3433	3539	1583	2020	1570	1504	3433	1863	1583
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	196	1567	845	397	454	129	464	88	608	98	26	67
RTOR Reduction (vph)	0	0	253	0	0	63	0	88	179	0	0	55
Lane Group Flow (vph)	196	1567	592	397	454	66	464	268	161	98	26	12
Turn Type	Prot	NA	custom	Prot	NA	Perm	pm+pt	NA	Perm	Prot	NA	custom
Protected Phases	3	8		7	4		5	2		1	6	
Permitted Phases			5 8			4	2		2			3 6
Actuated Green, G (s)	12.4	70.2	94.2	19.4	77.2	77.2	44.4	31.9	31.9	7.5	15.4	27.8
Effective Green, g (s)	12.4	70.2	94.2	19.4	77.2	77.2	44.4	31.9	31.9	7.5	15.4	27.8
Actuated g/C Ratio	0.08	0.47	0.63	0.13	0.51	0.51	0.30	0.21	0.21	0.05	0.10	0.19
Clearance Time (s)	5.0	6.0		5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	292	2379	994	444	1821	814	824	333	319	171	191	293
v/s Ratio Prot	0.06	c0.31		c0.12	0.13		0.09	c0.17		0.03	0.01	
v/s Ratio Perm			c0.37			0.04	0.08		0.11			0.01
v/c Ratio	0.67	0.66	0.60	0.89	0.25	0.08	0.56	0.80	0.51	0.57	0.14	0.04
Uniform Delay, d1	66.8	30.7	16.6	64.3	20.3	18.4	43.1	56.1	52.1	69.7	61.2	50.2
Progression Factor	1.00	1.00	1.00	0.75	0.35	0.04	0.89	0.84	0.72	1.00	1.00	1.00
Incremental Delay, d2	4.7	1.4	0.6	18.8	0.3	0.2	0.5	11.7	0.4	2.9	0.1	0.0
Delay (s)	71.5	32.1	17.2	66.9	7.4	1.0	39.0	59.0	38.1	72.6	61.4	50.2
Level of Service	E	C	B	E	A	A	D	E	D	E	E	D
Approach Delay (s)		30.3			30.6			44.8			63.2	
Approach LOS		C			C			D			E	

Intersection Summary			
HCM 2000 Control Delay	35.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	77.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1795	410	0	920	280	0	2570	255	0	2565	120
Future Volume (vph)	0	1795	410	0	920	280	0	2570	255	0	2565	120
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0	6.0		7.0	7.0		7.0	7.0
Lane Util. Factor		*1.00	1.00		0.91	1.00		*1.00	1.00		0.91	1.00
Frt		1.00	0.85		1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00
Satd. Flow (prot)		3725	1583		5085	1583		5588	1583		5085	1583
Flt Permitted		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00
Satd. Flow (perm)		3725	1583		5085	1583		5588	1583		5085	1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1832	418	0	939	286	0	2622	260	0	2617	122
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	12	0	0	30
Lane Group Flow (vph)	0	1832	418	0	939	286	0	2622	248	0	2617	92
Turn Type		NA	Perm		NA	Perm		NA	Perm		NA	Perm
Protected Phases		8			4			6			2	
Permitted Phases			8			4			6			2
Actuated Green, G (s)		67.0	67.0		67.0	67.0		70.0	70.0		70.0	70.0
Effective Green, g (s)		67.0	67.0		67.0	67.0		70.0	70.0		70.0	70.0
Actuated g/C Ratio		0.45	0.45		0.45	0.45		0.47	0.47		0.47	0.47
Clearance Time (s)		6.0	6.0		6.0	6.0		7.0	7.0		7.0	7.0
Vehicle Extension (s)		2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0
Lane Grp Cap (vph)		1663	707		2271	707		2607	738		2373	738
v/s Ratio Prot		c0.49			0.18			0.47			c0.51	
v/s Ratio Perm			0.26			0.18			0.16			0.06
v/c Ratio		1.10	0.59		0.41	0.40		1.01	0.34		1.10	0.12
Uniform Delay, d1		41.5	31.2		28.2	28.0		40.0	25.3		40.0	22.6
Progression Factor		0.60	0.51		0.79	0.79		0.93	0.83		0.69	0.40
Incremental Delay, d2		54.0	0.7		0.0	0.1		16.8	0.9		48.7	0.1
Delay (s)		78.9	16.5		22.2	22.1		54.1	22.0		76.5	9.3
Level of Service		E	B		C	C		D	C		E	A
Approach Delay (s)		67.3			22.2			51.2			73.5	
Approach LOS		E			C			D			E	

Intersection Summary			
HCM 2000 Control Delay	58.0	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	110.1%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	325	570	315	2500	2430	540
Future Volume (vph)	325	570	315	2500	2430	540
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	7.0	7.0	4.0
Lane Util. Factor	0.97	1.00	*1.00	0.91	0.91	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	3539	5085	5085	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	3539	5085	5085	1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	339	594	328	2604	2531	562
RTOR Reduction (vph)	0	0	0	0	0	8
Lane Group Flow (vph)	339	594	328	2604	2531	555
Turn Type	Prot	Free	Prot	NA	NA	custom
Protected Phases	4		5	2	6	
Permitted Phases		Free				4 6
Actuated Green, G (s)	18.9	150.0	17.6	120.1	98.5	124.4
Effective Green, g (s)	18.9	150.0	17.6	120.1	98.5	117.4
Actuated g/C Ratio	0.13	1.00	0.12	0.80	0.66	0.78
Clearance Time (s)	4.0		4.0	7.0	7.0	
Vehicle Extension (s)	2.0		2.0	2.0	2.0	
Lane Grp Cap (vph)	432	1583	415	4071	3339	1238
v/s Ratio Prot	c0.10		c0.09	0.51	c0.50	
v/s Ratio Perm		0.38				0.35
v/c Ratio	0.78	0.38	0.79	0.64	0.76	0.45
Uniform Delay, d1	63.6	0.0	64.4	6.1	17.6	5.5
Progression Factor	0.92	1.00	1.00	1.00	0.23	0.14
Incremental Delay, d2	7.6	0.6	9.2	0.8	0.2	0.0
Delay (s)	66.4	0.6	73.6	6.9	4.3	0.8
Level of Service	E	A	E	A	A	A
Approach Delay (s)	24.5			14.4	3.6	
Approach LOS	C			B	A	

Intersection Summary			
HCM 2000 Control Delay	11.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	77.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	415	110	145	710	785	445
Future Volume (vph)	415	110	145	710	785	445
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	5.0	5.0	5.0
Lane Util. Factor	0.97		1.00	0.95	0.95	1.00
Frt	0.97		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	3367		1770	3539	3539	1583
Flt Permitted	0.96		0.26	1.00	1.00	1.00
Satd. Flow (perm)	3367		481	3539	3539	1583
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	428	113	149	732	809	459
RTOR Reduction (vph)	36	0	0	0	0	219
Lane Group Flow (vph)	505	0	149	732	809	240
Turn Type	Prot		pm+pt	NA	NA	Perm
Protected Phases	8		5	2	6	
Permitted Phases			2			6
Actuated Green, G (s)	16.5		49.5	49.5	37.6	37.6
Effective Green, g (s)	16.5		49.5	49.5	37.6	37.6
Actuated g/C Ratio	0.22		0.66	0.66	0.50	0.50
Clearance Time (s)	4.0		4.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	740		453	2335	1774	793
v/s Ratio Prot	c0.15		0.03	c0.21	c0.23	
v/s Ratio Perm			0.18			0.15
v/c Ratio	0.68		0.33	0.31	0.46	0.30
Uniform Delay, d1	26.8		5.7	5.5	12.1	11.0
Progression Factor	1.00		0.74	0.53	1.25	3.69
Incremental Delay, d2	2.6		0.4	0.3	0.6	0.7
Delay (s)	29.5		4.6	3.2	15.7	41.3
Level of Service	C		A	A	B	D
Approach Delay (s)	29.5			3.4	24.9	
Approach LOS	C			A	C	

Intersection Summary			
HCM 2000 Control Delay	18.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	55.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

2030 Southwest Quadrant

PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	200	680	770	455	1700	135	735	60	430	415	55	330
Future Volume (vph)	200	680	770	455	1700	135	735	60	430	415	55	330
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0	5.0	5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	*1.00	0.91	1.00	0.97	0.95	1.00	0.97	0.95	0.95	0.97	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.89	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3539	5085	1583	3433	3539	1583	3433	1568	1504	3433	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.72	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3539	5085	1583	3433	3539	1583	2597	1568	1504	3433	1863	1583
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	206	701	794	469	1753	139	758	62	443	428	57	340
RTOR Reduction (vph)	0	0	194	0	0	33	0	67	213	0	0	68
Lane Group Flow (vph)	206	701	600	469	1753	106	758	190	35	428	57	272
Turn Type	Prot	NA	custom	Prot	NA	Perm	pm+pt	NA	Perm	Prot	NA	custom
Protected Phases	3	8		7	4		5	2		1	6	
Permitted Phases			5 8			4	2		2			3 6
Actuated Green, G (s)	11.0	77.3	100.3	33.0	99.3	99.3	48.7	25.7	25.7	23.0	25.7	36.7
Effective Green, g (s)	11.0	77.3	100.3	33.0	99.3	99.3	48.7	25.7	25.7	23.0	25.7	36.7
Actuated g/C Ratio	0.06	0.43	0.56	0.18	0.55	0.55	0.27	0.14	0.14	0.13	0.14	0.20
Clearance Time (s)	5.0	6.0		5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	216	2183	882	629	1952	873	809	223	214	438	265	322
v/s Ratio Prot	c0.06	0.14		0.14	c0.50		0.12	0.12		c0.12	0.03	
v/s Ratio Perm			0.38			0.07	c0.13		0.02			0.17
v/c Ratio	0.95	0.32	0.68	0.75	0.90	0.12	0.94	0.85	0.17	0.98	0.22	0.85
Uniform Delay, d1	84.2	34.0	28.4	69.5	35.9	19.4	62.4	75.3	67.7	78.2	68.2	68.9
Progression Factor	1.00	1.00	1.00	0.67	0.39	0.14	0.92	0.92	2.63	1.00	1.00	1.00
Incremental Delay, d2	47.6	0.4	1.7	2.6	4.4	0.2	16.8	23.3	0.1	36.5	0.1	17.4
Delay (s)	131.8	34.4	30.1	49.0	18.5	2.8	74.2	92.2	178.6	114.8	68.4	86.4
Level of Service	F	C	C	D	B	A	E	F	F	F	E	F
Approach Delay (s)		44.2			23.6			98.4			99.9	
Approach LOS		D			C			F			F	

Intersection Summary			
HCM 2000 Control Delay	54.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	101.7%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1135	395	0	1695	175	0	2420	250	0	2970	450
Future Volume (vph)	0	1135	395	0	1695	175	0	2420	250	0	2970	450
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0	6.0		7.0	7.0		7.0	7.0
Lane Util. Factor		*1.00	1.00		0.91	1.00		*1.00	1.00		0.91	1.00
Frt		1.00	0.85		1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00
Satd. Flow (prot)		3725	1583		5085	1583		5588	1583		5085	1583
Flt Permitted		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00
Satd. Flow (perm)		3725	1583		5085	1583		5588	1583		5085	1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1158	403	0	1730	179	0	2469	255	0	3031	459
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	7	0	0	7
Lane Group Flow (vph)	0	1158	403	0	1730	179	0	2469	248	0	3031	452
Turn Type		NA	Perm		NA	Perm		NA	Perm		NA	Perm
Protected Phases		8			4			6			2	
Permitted Phases			8			4			6			2
Actuated Green, G (s)		60.0	60.0		60.0	60.0		107.0	107.0		107.0	107.0
Effective Green, g (s)		60.0	60.0		60.0	60.0		107.0	107.0		107.0	107.0
Actuated g/C Ratio		0.33	0.33		0.33	0.33		0.59	0.59		0.59	0.59
Clearance Time (s)		6.0	6.0		6.0	6.0		7.0	7.0		7.0	7.0
Vehicle Extension (s)		2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0
Lane Grp Cap (vph)		1241	527		1695	527		3321	941		3022	941
v/s Ratio Prot		0.31			c0.34			0.44			c0.60	
v/s Ratio Perm			0.25			0.11			0.16			0.29
v/c Ratio		0.93	0.76		1.02	0.34		0.74	0.26		1.00	0.48
Uniform Delay, d1		58.1	53.7		60.0	45.1		26.5	17.5		36.5	20.7
Progression Factor		0.89	0.87		0.65	0.70		0.92	0.93		0.42	0.27
Incremental Delay, d2		11.1	5.1		12.7	0.0		1.2	0.5		5.6	0.2
Delay (s)		62.7	51.9		51.8	31.6		25.8	16.8		21.1	5.8
Level of Service		E	D		D	C		C	B		C	A
Approach Delay (s)		59.9			49.9			24.9			19.1	
Approach LOS		E			D			C			B	

Intersection Summary			
HCM 2000 Control Delay	33.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	101.0%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	265	585	590	2405	2905	460
Future Volume (vph)	265	585	590	2405	2905	460
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	7.0	7.0	4.0
Lane Util. Factor	0.97	1.00	*1.00	0.91	0.91	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	3539	5085	5085	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	3539	5085	5085	1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	276	609	615	2505	3026	479
RTOR Reduction (vph)	0	0	0	0	0	3
Lane Group Flow (vph)	276	609	615	2505	3026	476
Turn Type	Prot	Free	Prot	NA	NA	custom
Protected Phases	4		5	2	6	
Permitted Phases		Free				4 6
Actuated Green, G (s)	17.6	180.0	34.0	151.4	113.4	135.0
Effective Green, g (s)	17.6	180.0	34.0	151.4	113.4	135.0
Actuated g/C Ratio	0.10	1.00	0.19	0.84	0.63	0.75
Clearance Time (s)	4.0		4.0	7.0	7.0	
Vehicle Extension (s)	2.0		2.0	2.0	2.0	
Lane Grp Cap (vph)	335	1583	668	4277	3203	1187
v/s Ratio Prot	c0.08		c0.17	0.49	c0.60	
v/s Ratio Perm		0.38				0.30
v/c Ratio	0.82	0.38	0.92	0.59	0.94	0.40
Uniform Delay, d1	79.7	0.0	71.7	4.5	30.4	8.0
Progression Factor	1.20	1.00	0.94	0.35	0.24	0.29
Incremental Delay, d2	13.5	0.7	2.3	0.1	2.7	0.0
Delay (s)	108.9	0.7	69.9	1.6	10.0	2.4
Level of Service	F	A	E	A	B	A
Approach Delay (s)	34.4			15.1	9.0	
Approach LOS	C			B	A	

Intersection Summary			
HCM 2000 Control Delay	14.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	93.0%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	380	105	205	845	745	535
Future Volume (vph)	380	105	205	845	745	535
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	5.0	5.0	5.0
Lane Util. Factor	0.97		1.00	0.95	0.95	1.00
Frt	0.97		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	3365		1770	3539	3539	1583
Flt Permitted	0.96		0.29	1.00	1.00	1.00
Satd. Flow (perm)	3365		541	3539	3539	1583
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	392	108	211	871	768	552
RTOR Reduction (vph)	31	0	0	0	0	244
Lane Group Flow (vph)	469	0	211	871	768	308
Turn Type	Prot		pm+pt	NA	NA	Perm
Protected Phases	8		5	2	6	
Permitted Phases			2			6
Actuated Green, G (s)	17.6		63.4	63.4	50.2	50.2
Effective Green, g (s)	17.6		63.4	63.4	50.2	50.2
Actuated g/C Ratio	0.20		0.70	0.70	0.56	0.56
Clearance Time (s)	4.0		4.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	658		506	2493	1973	882
v/s Ratio Prot	c0.14		c0.04	0.25	0.22	
v/s Ratio Perm			c0.25			0.19
v/c Ratio	0.71		0.42	0.35	0.39	0.35
Uniform Delay, d1	33.8		5.4	5.2	11.2	10.9
Progression Factor	1.00		0.98	1.22	0.94	2.31
Incremental Delay, d2	3.7		0.4	0.3	0.4	0.7
Delay (s)	37.5		5.6	6.6	10.9	26.0
Level of Service	D		A	A	B	C
Approach Delay (s)	37.5			6.4	17.2	
Approach LOS	D			A	B	

Intersection Summary			
HCM 2000 Control Delay	16.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	56.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

2030 Dual Quadrants

AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	380	1530	620	375	425	190	465	60	295	380	15	65
Future Volume (vph)	380	1530	620	375	425	190	465	60	295	380	15	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	5.0		5.0	5.0	
Lane Util. Factor	*1.00	0.91	1.00	0.97	0.95	1.00	0.97	1.00		0.97	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.88		1.00	0.88	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3539	5085	1583	3433	3539	1583	3433	1631		3433	1634	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.70	1.00		0.95	1.00	
Satd. Flow (perm)	3539	5085	1583	3433	3539	1583	2543	1631		3433	1634	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	392	1577	639	387	438	196	479	62	304	392	15	67
RTOR Reduction (vph)	0	0	188	0	0	116	0	127	0	0	52	0
Lane Group Flow (vph)	392	1577	451	387	438	80	479	239	0	392	30	0
Turn Type	Prot	NA	Perm	Prot	NA	Perm	pm+pt	NA		Prot	NA	
Protected Phases	3	8		7	4		5	2		1	6	
Permitted Phases			8			4	2					
Actuated Green, G (s)	23.2	65.1	65.1	19.2	61.1	61.1	36.4	25.4		19.3	33.7	
Effective Green, g (s)	23.2	65.1	65.1	19.2	61.1	61.1	36.4	25.4		19.3	33.7	
Actuated g/C Ratio	0.15	0.43	0.43	0.13	0.41	0.41	0.24	0.17		0.13	0.22	
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	5.0		5.0	5.0	
Vehicle Extension (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Lane Grp Cap (vph)	547	2206	687	439	1441	644	682	276		441	367	
v/s Ratio Prot	c0.11	c0.31		c0.11	0.12		0.05	c0.15		c0.11	0.02	
v/s Ratio Perm			0.28			0.05	0.12					
v/c Ratio	0.72	0.71	0.66	0.88	0.30	0.12	0.70	0.87		0.89	0.08	
Uniform Delay, d1	60.3	34.8	33.6	64.3	30.1	27.7	50.5	60.6		64.3	45.9	
Progression Factor	1.00	1.00	1.00	0.73	0.67	0.60	0.75	0.76		0.86	0.86	
Incremental Delay, d2	3.7	2.0	4.9	17.2	0.5	0.4	2.5	21.3		18.6	0.0	
Delay (s)	64.0	36.8	38.5	63.9	20.6	17.1	40.2	67.1		73.9	39.7	
Level of Service	E	D	D	E	C	B	D	E		E	D	
Approach Delay (s)		41.3			36.3			51.9			67.9	
Approach LOS		D			D			D			E	

Intersection Summary			
HCM 2000 Control Delay	44.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	89.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱		↑↑↑	↱		↑↑↑	↱		↑↑↑	↱
Traffic Volume (vph)	0	1795	410	0	920	280	0	2370	255	0	2280	160
Future Volume (vph)	0	1795	410	0	920	280	0	2370	255	0	2280	160
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0	6.0		7.0	7.0		7.0	7.0
Lane Util. Factor		*1.00	1.00		0.91	1.00		*1.00	1.00		0.91	1.00
Frt		1.00	0.85		1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00
Satd. Flow (prot)		3725	1583		5085	1583		5588	1583		5085	1583
Flt Permitted		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00
Satd. Flow (perm)		3725	1583		5085	1583		5588	1583		5085	1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1832	418	0	939	286	0	2418	260	0	2327	163
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	12	0	0	44
Lane Group Flow (vph)	0	1832	418	0	939	286	0	2418	248	0	2327	119
Turn Type		NA	Perm		NA	Perm		NA	Perm		NA	Perm
Protected Phases		8			4			6			2	
Permitted Phases			8			4			6			2
Actuated Green, G (s)		71.0	71.0		71.0	71.0		66.0	66.0		66.0	66.0
Effective Green, g (s)		71.0	71.0		71.0	71.0		66.0	66.0		66.0	66.0
Actuated g/C Ratio		0.47	0.47		0.47	0.47		0.44	0.44		0.44	0.44
Clearance Time (s)		6.0	6.0		6.0	6.0		7.0	7.0		7.0	7.0
Vehicle Extension (s)		2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0
Lane Grp Cap (vph)		1763	749		2406	749		2458	696		2237	696
v/s Ratio Prot		c0.49			0.18			0.43			c0.46	
v/s Ratio Perm			0.26			0.18			0.16			0.08
v/c Ratio		1.04	0.56		0.39	0.38		0.98	0.36		1.04	0.17
Uniform Delay, d1		39.5	28.3		25.5	25.4		41.5	27.9		42.0	25.4
Progression Factor		0.57	0.51		0.80	0.79		0.95	0.94		0.65	0.58
Incremental Delay, d2		29.3	0.4		0.0	0.1		12.7	1.1		28.6	0.4
Delay (s)		51.7	14.8		20.4	20.3		52.1	27.4		55.9	15.2
Level of Service		D	B		C	C		D	C		E	B
Approach Delay (s)		44.9			20.3			49.7			53.2	
Approach LOS		D			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	45.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	106.2%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	210	50	10	2640	2385	295
Future Volume (vph)	210	50	10	2640	2385	295
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	7.0	7.0	7.0
Lane Util. Factor	0.97		1.00	0.95	0.91	1.00
Frt	0.97		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	3373		1770	3539	5085	1583
Flt Permitted	0.96		0.95	1.00	1.00	1.00
Satd. Flow (perm)	3373		1770	3539	5085	1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	219	52	10	2750	2484	307
RTOR Reduction (vph)	15	0	0	0	0	62
Lane Group Flow (vph)	256	0	10	2750	2484	245
Turn Type	Prot		Prot	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases						6
Actuated Green, G (s)	12.9		2.4	126.1	119.7	119.7
Effective Green, g (s)	12.9		2.4	126.1	119.7	119.7
Actuated g/C Ratio	0.09		0.02	0.84	0.80	0.80
Clearance Time (s)	4.0		4.0	7.0	7.0	7.0
Vehicle Extension (s)	2.0		2.0	2.0	2.0	2.0
Lane Grp Cap (vph)	290		28	2975	4057	1263
v/s Ratio Prot	c0.08		c0.01	c0.78	0.49	
v/s Ratio Perm						0.15
v/c Ratio	0.88		0.36	0.92	0.61	0.19
Uniform Delay, d1	67.8		73.0	8.5	6.0	3.6
Progression Factor	0.96		0.61	3.18	0.44	0.24
Incremental Delay, d2	25.0		1.2	2.8	0.2	0.1
Delay (s)	90.3		45.4	30.0	2.9	1.0
Level of Service	F		D	C	A	A
Approach Delay (s)	90.3			30.1	2.7	
Approach LOS	F			C	A	

Intersection Summary			
HCM 2000 Control Delay	19.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	89.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	115	520	305	2510	2480	205
Future Volume (vph)	115	520	305	2510	2480	205
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	7.0	7.0	4.0
Lane Util. Factor	1.00	1.00	*1.00	0.91	0.91	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	3539	5085	5085	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	3539	5085	5085	1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	120	542	318	2615	2583	214
RTOR Reduction (vph)	0	0	0	0	0	9
Lane Group Flow (vph)	120	542	318	2615	2583	205
Turn Type	Prot	Free	Prot	NA	NA	custom
Protected Phases	4		5	2	6	
Permitted Phases		Free				4 6
Actuated Green, G (s)	14.0	150.0	17.3	125.0	103.7	124.7
Effective Green, g (s)	14.0	150.0	17.3	125.0	103.7	117.7
Actuated g/C Ratio	0.09	1.00	0.12	0.83	0.69	0.78
Clearance Time (s)	4.0		4.0	7.0	7.0	
Vehicle Extension (s)	2.0		2.0	2.0	2.0	
Lane Grp Cap (vph)	165	1583	408	4237	3515	1242
v/s Ratio Prot	c0.07		c0.09	0.51	c0.51	
v/s Ratio Perm		0.34				0.13
v/c Ratio	0.73	0.34	0.78	0.62	0.73	0.16
Uniform Delay, d1	66.1	0.0	64.5	4.3	14.5	4.0
Progression Factor	1.01	1.00	0.97	1.07	0.24	0.14
Incremental Delay, d2	11.0	0.5	2.4	0.2	0.5	0.0
Delay (s)	77.7	0.5	65.1	4.8	3.9	0.6
Level of Service	E	A	E	A	A	A
Approach Delay (s)	14.5			11.3	3.7	
Approach LOS	B			B	A	

Intersection Summary			
HCM 2000 Control Delay	8.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	75.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	295	10	50	250	10	155
Future Volume (vph)	295	10	50	250	10	155
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		5.0	4.0	5.0	5.0
Lane Util. Factor	0.97		1.00	1.00	1.00	1.00
Frt	1.00		1.00	0.85	1.00	1.00
Flt Protected	0.95		1.00	1.00	0.95	1.00
Satd. Flow (prot)	3431		1863	1583	1770	1863
Flt Permitted	0.95		1.00	1.00	0.72	1.00
Satd. Flow (perm)	3431		1863	1583	1347	1863
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	307	10	52	260	10	161
RTOR Reduction (vph)	2	0	0	0	0	0
Lane Group Flow (vph)	315	0	52	260	10	161
Turn Type	Prot		NA	Free	Perm	NA
Protected Phases	8		2			6
Permitted Phases				Free	6	
Actuated Green, G (s)	54.0		11.0	75.0	11.0	11.0
Effective Green, g (s)	54.0		11.0	75.0	11.0	11.0
Actuated g/C Ratio	0.72		0.15	1.00	0.15	0.15
Clearance Time (s)	5.0		5.0		5.0	5.0
Vehicle Extension (s)	2.0		2.0		2.0	2.0
Lane Grp Cap (vph)	2470		273	1583	197	273
v/s Ratio Prot	0.09		0.03			c0.09
v/s Ratio Perm				c0.16	0.01	
v/c Ratio	0.13		0.19	0.16	0.05	0.59
Uniform Delay, d1	3.2		28.1	0.0	27.5	29.9
Progression Factor	0.84		1.44	1.00	1.00	1.00
Incremental Delay, d2	0.1		0.1	0.2	0.0	2.1
Delay (s)	2.8		40.4	0.2	27.6	32.0
Level of Service	A		D	A	C	C
Approach Delay (s)	2.8		6.9			31.7
Approach LOS	A		A			C

Intersection Summary			
HCM 2000 Control Delay	10.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.25		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	25.2%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	415	110	105	405	525	485
Future Volume (vph)	415	110	105	405	525	485
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	5.0	5.0	5.0
Lane Util. Factor	0.97		1.00	1.00	1.00	1.00
Frt	0.97		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	3367		1770	1863	1863	1583
Flt Permitted	0.96		0.31	1.00	1.00	1.00
Satd. Flow (perm)	3367		577	1863	1863	1583
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	428	113	108	418	541	500
RTOR Reduction (vph)	36	0	0	0	0	237
Lane Group Flow (vph)	505	0	108	418	541	263
Turn Type	Prot		pm+pt	NA	NA	Perm
Protected Phases	8		5	2	6	
Permitted Phases			2			6
Actuated Green, G (s)	16.5		49.5	49.5	39.4	39.4
Effective Green, g (s)	16.5		49.5	49.5	39.4	39.4
Actuated g/C Ratio	0.22		0.66	0.66	0.53	0.53
Clearance Time (s)	4.0		4.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	740		477	1229	978	831
v/s Ratio Prot	c0.15		0.02	c0.22	c0.29	
v/s Ratio Perm			0.13			0.17
v/c Ratio	0.68		0.23	0.34	0.55	0.32
Uniform Delay, d1	26.8		6.2	5.6	11.9	10.1
Progression Factor	1.00		0.74	0.79	1.15	3.01
Incremental Delay, d2	2.6		0.2	0.7	1.4	0.6
Delay (s)	29.5		4.8	5.1	15.1	31.1
Level of Service	C		A	A	B	C
Approach Delay (s)	29.5			5.0	22.8	
Approach LOS	C			A	C	

Intersection Summary			
HCM 2000 Control Delay	20.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	59.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

2030 Dual Quadrants

PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	270	700	680	470	1695	185	740	25	240	585	20	330
Future Volume (vph)	270	700	680	470	1695	185	740	25	240	585	20	330
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	5.0		5.0	5.0	
Lane Util. Factor	*1.00	0.91	1.00	0.97	0.95	1.00	0.97	1.00		0.97	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.86		1.00	0.86	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3539	5085	1583	3433	3539	1583	3433	1610		3433	1600	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.12	1.00		0.95	1.00	
Satd. Flow (perm)	3539	5085	1583	3433	3539	1583	450	1610		3433	1600	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	278	722	701	485	1747	191	763	26	247	603	21	340
RTOR Reduction (vph)	0	0	414	0	0	44	0	194	0	0	94	0
Lane Group Flow (vph)	278	722	287	485	1747	147	763	79	0	603	267	0
Turn Type	Prot	NA	Perm	Prot	NA	Perm	pm+pt	NA		Prot	NA	
Protected Phases	3	8		7	4		5	2		1	6	
Permitted Phases			8			4	2					
Actuated Green, G (s)	12.0	62.9	62.9	33.0	83.9	83.9	63.1	32.1		31.0	32.1	
Effective Green, g (s)	12.0	62.9	62.9	33.0	83.9	83.9	63.1	32.1		31.0	32.1	
Actuated g/C Ratio	0.07	0.35	0.35	0.18	0.47	0.47	0.35	0.18		0.17	0.18	
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	5.0		5.0	5.0	
Vehicle Extension (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	
Lane Grp Cap (vph)	235	1776	553	629	1649	737	671	287		591	285	
v/s Ratio Prot	c0.08	0.14		0.14	c0.49		c0.20	0.05		0.18	0.17	
v/s Ratio Perm			0.18			0.09	c0.20					
v/c Ratio	1.18	0.41	0.52	0.77	1.06	0.20	1.14	0.28		1.02	0.94	
Uniform Delay, d1	84.0	44.4	46.5	69.9	48.0	28.3	58.4	63.9		74.5	72.9	
Progression Factor	1.00	1.00	1.00	0.69	0.40	0.24	0.69	1.76		0.99	1.00	
Incremental Delay, d2	117.1	0.7	3.4	3.5	36.1	0.4	77.0	0.2		42.2	35.8	
Delay (s)	201.1	45.1	50.0	51.4	55.1	7.2	117.1	112.7		116.1	108.4	
Level of Service	F	D	D	D	E	A	F	F		F	F	
Approach Delay (s)		72.6			50.6			116.0			113.2	
Approach LOS		E			D			F			F	

Intersection Summary			
HCM 2000 Control Delay	77.6	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	114.6%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1135	395	0	1695	175	0	2325	250	0	2765	510
Future Volume (vph)	0	1135	395	0	1695	175	0	2325	250	0	2765	510
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0		6.0	6.0		7.0	7.0		7.0	7.0
Lane Util. Factor		*1.00	1.00		0.91	1.00		*1.00	1.00		0.91	1.00
Frt		1.00	0.85		1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00
Satd. Flow (prot)		3725	1583		5085	1583		5588	1583		5085	1583
Flt Permitted		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00
Satd. Flow (perm)		3725	1583		5085	1583		5588	1583		5085	1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1158	403	0	1730	179	0	2372	255	0	2821	520
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	8	0	0	8
Lane Group Flow (vph)	0	1158	403	0	1730	179	0	2372	247	0	2821	512
Turn Type		NA	Perm		NA	Perm		NA	Perm		NA	Perm
Protected Phases		8			4			6			2	
Permitted Phases			8			4			6			2
Actuated Green, G (s)		63.4	63.4		63.4	63.4		103.6	103.6		103.6	103.6
Effective Green, g (s)		63.4	63.4		63.4	63.4		103.6	103.6		103.6	103.6
Actuated g/C Ratio		0.35	0.35		0.35	0.35		0.58	0.58		0.58	0.58
Clearance Time (s)		6.0	6.0		6.0	6.0		7.0	7.0		7.0	7.0
Vehicle Extension (s)		2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0
Lane Grp Cap (vph)		1312	557		1791	557		3216	911		2926	911
v/s Ratio Prot		0.31			c0.34			0.42			c0.55	
v/s Ratio Perm			0.25			0.11			0.16			0.32
v/c Ratio		0.88	0.72		0.97	0.32		0.74	0.27		0.96	0.56
Uniform Delay, d1		54.8	50.7		57.2	42.6		28.2	19.2		36.4	24.0
Progression Factor		0.87	0.85		0.66	0.71		0.95	0.93		0.57	0.51
Incremental Delay, d2		5.8	3.1		2.1	0.0		1.2	0.6		6.6	1.4
Delay (s)		53.3	46.1		39.8	30.2		28.1	18.4		27.6	13.7
Level of Service		D	D		D	C		C	B		C	B
Approach Delay (s)		51.4			38.9			27.1			25.4	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	32.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	97.0%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	125	45	30	2470	3230	190
Future Volume (vph)	125	45	30	2470	3230	190
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	7.0	7.0	7.0
Lane Util. Factor	0.97		1.00	0.95	0.91	1.00
Frt	0.96		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	3347		1770	3539	5085	1583
Flt Permitted	0.96		0.95	1.00	1.00	1.00
Satd. Flow (perm)	3347		1770	3539	5085	1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	130	47	31	2573	3365	198
RTOR Reduction (vph)	21	0	0	0	0	28
Lane Group Flow (vph)	156	0	31	2573	3365	170
Turn Type	Prot		Prot	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases						6
Actuated Green, G (s)	12.5		6.2	156.5	146.3	146.3
Effective Green, g (s)	12.5		6.2	156.5	146.3	146.3
Actuated g/C Ratio	0.07		0.03	0.87	0.81	0.81
Clearance Time (s)	4.0		4.0	7.0	7.0	7.0
Vehicle Extension (s)	2.0		2.0	2.0	2.0	2.0
Lane Grp Cap (vph)	232		60	3076	4132	1286
v/s Ratio Prot	c0.05		0.02	c0.73	0.66	
v/s Ratio Perm						0.11
v/c Ratio	0.67		0.52	0.84	0.81	0.13
Uniform Delay, d1	81.7		85.4	5.6	9.3	3.5
Progression Factor	1.07		1.10	3.22	0.07	0.00
Incremental Delay, d2	5.9		2.2	2.1	0.2	0.0
Delay (s)	93.1		96.4	20.2	0.8	0.0
Level of Service	F		F	C	A	A
Approach Delay (s)	93.1			21.1	0.8	
Approach LOS	F			C	A	

Intersection Summary			
HCM 2000 Control Delay	11.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	82.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	140	540	560	2435	2950	210
Future Volume (vph)	140	540	560	2435	2950	210
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	7.0	7.0	4.0
Lane Util. Factor	1.00	1.00	*1.00	0.91	0.91	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	3539	5085	5085	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	3539	5085	5085	1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	146	562	583	2536	3073	219
RTOR Reduction (vph)	0	0	0	0	0	3
Lane Group Flow (vph)	146	563	583	2536	3073	216
Turn Type	Prot	Free	Prot	NA	NA	custom
Protected Phases	4		5	2	6	
Permitted Phases		Free				4 6
Actuated Green, G (s)	17.0	180.0	31.4	152.0	116.6	140.6
Effective Green, g (s)	17.0	180.0	31.4	152.0	116.6	133.6
Actuated g/C Ratio	0.09	1.00	0.17	0.84	0.65	0.74
Clearance Time (s)	4.0		4.0	7.0	7.0	
Vehicle Extension (s)	2.0		2.0	2.0	2.0	
Lane Grp Cap (vph)	167	1583	617	4294	3293	1174
v/s Ratio Prot	c0.08		c0.16	0.50	c0.60	
v/s Ratio Perm		0.36				0.14
v/c Ratio	0.87	0.36	0.94	0.59	0.93	0.18
Uniform Delay, d1	80.4	0.0	73.4	4.3	28.2	6.9
Progression Factor	1.05	1.00	0.91	1.20	0.26	0.38
Incremental Delay, d2	31.1	0.5	3.5	0.1	2.7	0.0
Delay (s)	115.8	0.5	70.7	5.3	10.0	2.6
Level of Service	F	A	E	A	A	A
Approach Delay (s)	24.3			17.5	9.5	
Approach LOS	C			B	A	

Intersection Summary			
HCM 2000 Control Delay	14.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	93.2%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	190	30	265	160	10	110
Future Volume (vph)	190	30	265	160	10	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		5.0	4.0	5.0	5.0
Lane Util. Factor	0.97		1.00	1.00	1.00	1.00
Frt	0.98		1.00	0.85	1.00	1.00
Flt Protected	0.96		1.00	1.00	0.95	1.00
Satd. Flow (prot)	3394		1863	1583	1770	1863
Flt Permitted	0.96		1.00	1.00	0.33	1.00
Satd. Flow (perm)	3394		1863	1583	623	1863
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	198	31	276	167	10	115
RTOR Reduction (vph)	7	0	0	0	0	0
Lane Group Flow (vph)	222	0	276	167	10	115
Turn Type	Prot		NA	Free	Perm	NA
Protected Phases	8		2			6
Permitted Phases				Free	6	
Actuated Green, G (s)	61.6		18.4	90.0	18.4	18.4
Effective Green, g (s)	61.6		18.4	90.0	18.4	18.4
Actuated g/C Ratio	0.68		0.20	1.00	0.20	0.20
Clearance Time (s)	5.0		5.0		5.0	5.0
Vehicle Extension (s)	2.0		2.0		2.0	2.0
Lane Grp Cap (vph)	2323		380	1583	127	380
v/s Ratio Prot	0.07		c0.15			0.06
v/s Ratio Perm				c0.11	0.02	
v/c Ratio	0.10		0.73	0.11	0.08	0.30
Uniform Delay, d1	4.8		33.4	0.0	28.9	30.4
Progression Factor	1.14		1.05	1.00	1.00	1.00
Incremental Delay, d2	0.1		3.5	0.1	0.1	0.2
Delay (s)	5.6		38.5	0.1	29.0	30.5
Level of Service	A		D	A	C	C
Approach Delay (s)	5.6		24.0			30.4
Approach LOS	A		C			C

Intersection Summary			
HCM 2000 Control Delay	19.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.25		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	28.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	380	105	145	625	575	595
Future Volume (vph)	380	105	145	625	575	595
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	5.0	5.0	5.0
Lane Util. Factor	0.97		1.00	1.00	1.00	1.00
Frt	0.97		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	3365		1770	1863	1863	1583
Flt Permitted	0.96		0.30	1.00	1.00	1.00
Satd. Flow (perm)	3365		555	1863	1863	1583
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	392	108	149	644	593	613
RTOR Reduction (vph)	31	0	0	0	0	263
Lane Group Flow (vph)	469	0	149	644	593	350
Turn Type	Prot		pm+pt	NA	NA	Perm
Protected Phases	8		5	2	6	
Permitted Phases			2			6
Actuated Green, G (s)	17.6		63.4	63.4	51.4	51.4
Effective Green, g (s)	17.6		63.4	63.4	51.4	51.4
Actuated g/C Ratio	0.20		0.70	0.70	0.57	0.57
Clearance Time (s)	4.0		4.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	658		498	1312	1063	904
v/s Ratio Prot	c0.14		0.03	c0.35	c0.32	
v/s Ratio Perm			0.18			0.22
v/c Ratio	0.71		0.30	0.49	0.56	0.39
Uniform Delay, d1	33.8		6.5	6.0	12.1	10.6
Progression Factor	1.00		1.15	1.40	0.96	7.08
Incremental Delay, d2	3.7		0.2	0.9	1.4	0.8
Delay (s)	37.5		7.7	9.3	13.1	76.0
Level of Service	D		A	A	B	E
Approach Delay (s)	37.5			9.0	45.1	
Approach LOS	D			A	D	

Intersection Summary			
HCM 2000 Control Delay	32.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	63.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Attachment B

Existing Conditions VISSIM Outputs

VISSIM Microsimulation Summary

2019 Existing Conditions - AM Peak

Intersection	Approach	Movement	Input Vehicles	Model Vehicles	Delay (s)	LOS	Average Queue (ft)	Maximum Queue (ft)	Travel Time (mm:ss)
Santa Fe Drive at Mineral Avenue	Northbound	Left	275	276	125.6	F	132	705	03:18
		Through	1,535	1,605	68.3	E	615	1,702	02:15
		Right	190	192	43.4	D	17	201	01:58
		Overall	**2,000**	**2,073**	**73.6**	**E**	-	-	-
	Southbound	Left	360	359	127.2	F	166	420	04:51
		Through	1,415	1,411	46.2	D	345	1,132	03:25
		Right	110	111	3.6	A	0	0	02:45
		Overall	**1,885**	**1,881**	**59.1**	**E**	-	-	-
	Eastbound	Left	180	180	78.9	E	52	209	04:38
		Through	1,055	1,069	93.1	F	1,069	2,598	04:46
		Right	705	723	2.6	A	0	0	02:24
		Overall	**1,940**	**1,972**	**58.7**	**E**	-	-	-
	Westbound	Left	145	143	154.7	F	149	395	04:28
		Through	505	494	40.8	D	67	279	02:32
		Right	255	265	7.2	A	5	137	01:58
		Overall	**905**	**902**	**49.0**	**D**	-	-	-
	Overall Intersection		**6,730**	**6,828**	**62.0**	**E**	-	-	-

Intersection	Approach	Movement	Input Vehicles	Model Vehicles	Delay (s)	LOS	Average Queue (ft)	Maximum Queue (ft)	Travel Time (mm:ss)
Mineral Avenue at Platte River Parkway	Southbound	Left	95	98	104.5	F	32	123	n/a
		Right	60	61	6.8	A	32	123	
		Overall	**155**	**159**	**67.0**	**E**	-	-	
	Eastbound	Left	170	162	79.7	E	2	82	
		Through	1,840	1,866	94.6	F	1,322	3,308	
		Overall	**2,010**	**2,028**	**93.4**	**F**	-	-	
	Westbound	U-Turn	5	5	49.0	D	0	9	
		Through	630	628	0.9	A	1	56	
		Right	175	177	2.8	A	0	41	
		Overall	**810**	**810**	**1.6**	**A**	-	-	
	Overall Intersection		**2,975**	**2,997**	**67.2**	**E**	-	-	

VISSIM Microsimulation Summary

2019 Existing Conditions - PM Peak

Intersection	Approach	Movement	Input Vehicles	Model Vehicles	Delay (s)	LOS	Average Queue (ft)	Maximum Queue (ft)	Travel Time (mm:ss)
Santa Fe Drive at Mineral Avenue	Northbound	Left	535	530	155.4	F	411	1,308	03:46
		Through	1,535	1,538	43.8	D	438	1,517	01:54
		Right	170	166	12.5	B	4	141	01:27
		Overall	**2,240**	**2,234**	**67.9**	**E**	-	-	-
	Southbound	Left	190	204	189.4	F	55	211	08:27
		Through	1,475	1,535	235.1	F	5,508	10,241	09:04
		Right	340	366	184.1	F	0	28	08:38
		Overall	**2,005**	**2,105**	**221.8**	**F**	-	-	-
	Eastbound	Left	115	114	72.0	E	31	118	02:47
		Through	685	680	61.3	E	130	473	02:26
		Right	780	794	1.8	A	0	0	01:23
		Overall	**1,580**	**1,588**	**32.3**	**C**	-	-	-
	Westbound	Left	110	109	145.3	F	64	218	04:53
		Through	1,105	1,189	136.7	F	1,015	2,007	04:42
		Right	160	164	72.6	E	4	115	03:38
		Overall	**1,375**	**1,462**	**130.2**	**F**	-	-	-
	Overall Intersection		**7,200**	**7,389**	**116.4**	**F**	-	-	-

Intersection	Approach	Movement	Input Vehicles	Model Vehicles	Delay (s)	LOS	Average Queue (ft)	Maximum Queue (ft)	Travel Time (mm:ss)
Mineral Avenue at Platte River Parkway	Southbound	Left	410	414	76.6	E	141	516	n/a
		Right	300	303	36.5	D	141	516	
		Overall	**710**	**717**	**59.7**	**E**	-	-	
	Eastbound	Left	180	178	25.2	C	7	97	
		Through	1,105	1,107	6.7	A	21	258	
		Overall	**1,285**	**1,285**	**9.3**	**A**	-	-	
	Westbound	U-Turn	65	65	50.7	D	50	566	
		Through	1,885	1,979	7.5	A	62	574	
		Right	165	167	7.8	A	23	515	
		Overall	**2,115**	**2,211**	**8.8**	**A**	-	-	
	Overall Intersection		**4,110**	**4,213**	**17.6**	**B**	-	-	

Attachment C

Preliminary Traffic Operations Analysis Technical Memorandum

Technical Memorandum

Date:	Wednesday, December 12, 2018
Project:	City of Littleton, Santa Fe & Mineral Intersection Study
To:	Project Team
From:	Tyler Hopkins, HDR David Millar, HDR Keith Borsheim, HDR
Subject:	Preliminary Traffic Operations Analysis

| Introduction

In response to severe traffic congestion and safety issues at the Santa Fe Drive (US 85)/Mineral Avenue intersection, the City of Littleton (the City) is conducting an evaluation of the intersection to identify and analyze potential solutions. Recognizing that the long-term solution may involve a grade-separated interchange that has a steep price tag, the City has endeavored to also identify solutions that can be implemented for a lower cost and in a shorter timeframe.

This memorandum presents the methods used to forecast traffic at the intersection, analyze traffic operations, and evaluate alternatives. This memo is intended to be informational, and will be followed by a complete report that documents the process, assumptions, public and stakeholder involvement, and technical analysis of the intersection and potential solutions. The purpose of this memo is to provide the Colorado Department of Transportation (CDOT) Region 1 Traffic Engineering Department and Arapahoe County with the information they need to assess their support of the overall process and of the conclusions drawn.

| Volume Development

Methodology

Multiple previous traffic studies conducted within the study area were reviewed for existing turning movement volumes and future volume projections. These studies included:

- The Conceptual Design of Traffic Capacity Improvements study from FHU (2014)
    - 2014 turning movement and ADT volumes (no raw data)
    - 2035 turning movement and ADT volume projections

- The US 85 Volume Forecasts Workbook, from the US 85 PEL study (2015)
    - 2015 ADT volumes for US 85 south of County Line, and estimated ADT volumes for south of Mineral
    - 2040 ADT volumes for US 85 south of County Line, and ADT volume projections based on the 2015 estimations south of Mineral

- The Santa Fe Park Development Traffic Impact Study from FTH (2017)
    - 2017 turning movement counts (volumes & raw data)
    - 2017 tube counts (volumes & 24-hour, 7-day raw data)

It should be noted that the Santa Fe Park developments in the southwest quadrant of the Santa Fe Drive/Mineral Avenue intersection are not approved, and therefore the site-generated traffic volumes provided in the 2017 FTH study are subject to changes over the course of this project. Traffic volumes were analyzed for scenarios both with and without build-out of the southwest quadrant developments, allowing the project team to determine the impacts of any proposed alternative vs. the impacts of the adjacent development.

Comparing the 2014 and 2017 turning movement counts to each other showed that, generally, the differences along Mineral Avenue were much larger than expected; for example, the 2017 ADT volumes along Mineral Avenue fall much closer to the 2035 volumes that FHU developed than the 2014 counts they provided. Continuing to extrapolate volumes at these rates would result in excessive (6-8%) annual growth along the Mineral Avenue corridor, while growth along US 85 was found to be within reason; therefore, the mainline (US 85) volumes were compared when calculating annual growth rates.

Average Daily Traffic Volumes

Comparing the 2014 and 2035 volumes provided in the FHU study, background growth rates of 2.0-2.5% per year along US 85 and approximately 1.5% along Mineral Avenue were calculated. Similarly, Douglas County's 2015 *US 85 NEPA Reevaluation* was reviewed, which collected 2015 ADT volumes south of County Line Road (44,000) and also estimated 2015 ADT volumes south of Mineral Avenue (45,000). This study also projected volumes at these locations to a design year of 2040; these volumes were 88,000 and 87,000 vehicles, respectively. This corresponds to a growth rate of 2.4% per year, which falls in line with the US 85 growth rates identified in the FHU study.

The highest 2017 volume in the FTH study was that on US 85 north of Mineral Avenue, at approximately 57,000 vehicles per day. Using the 2.4% growth rate, this corresponds to a 2040 ADT volume of approximately 88,000 vehicles per day. Comparatively, FHU projected approximately 79,500 vehicles per day at this location; note, however, that this did not include five additional years of growth. While the volumes may still be slightly higher than expected, this should offer a more conservative approach to analyzing the alternatives to be developed. In addition to these previous studies, the Denver Regional Council of Governments' (DRCOG) future traffic forecasting model was used to determine expected growth within the study area. Per the DRCOG model, growth along US 85 at this location is expected to be only 1.2% per year—significantly lower than the previous study review found (**Figure 1**). This may be a result of the existing oversaturated conditions along US 85, which could result in drivers using alternative routes to avoid significant congestion.

Two mixed-use developments in the southwest quadrant of the Santa Fe Drive/Mineral Avenue intersection are planned and have been studied previously. Entering/exiting volumes for these developments, from the 2017 FTH study, were included in future volume projections beginning in 2028, when full build-out of both developments is expected. The resulting range of future ADT volumes along US 85 is shown in **Figure 2**. Note that these developments are not approved, and the site-generated traffic volumes are not included in scenarios which analyze operations without these adjacent developments ("Without Southwest Quadrant Developments" scenarios).

Figure 1: US 85 ADT Volume Forecasting

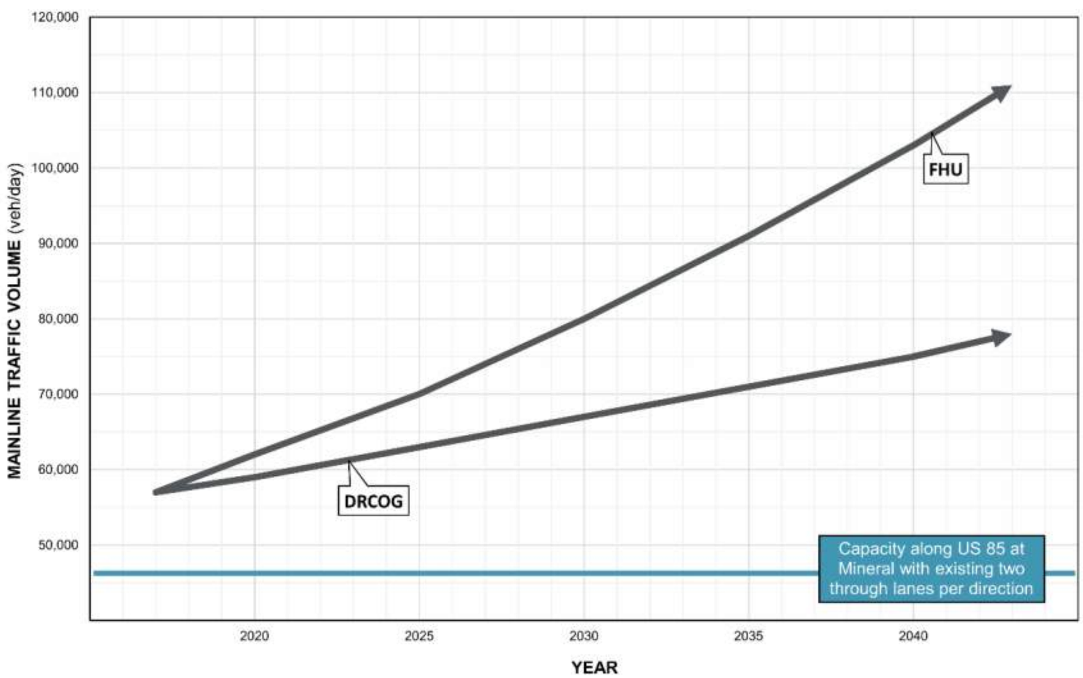
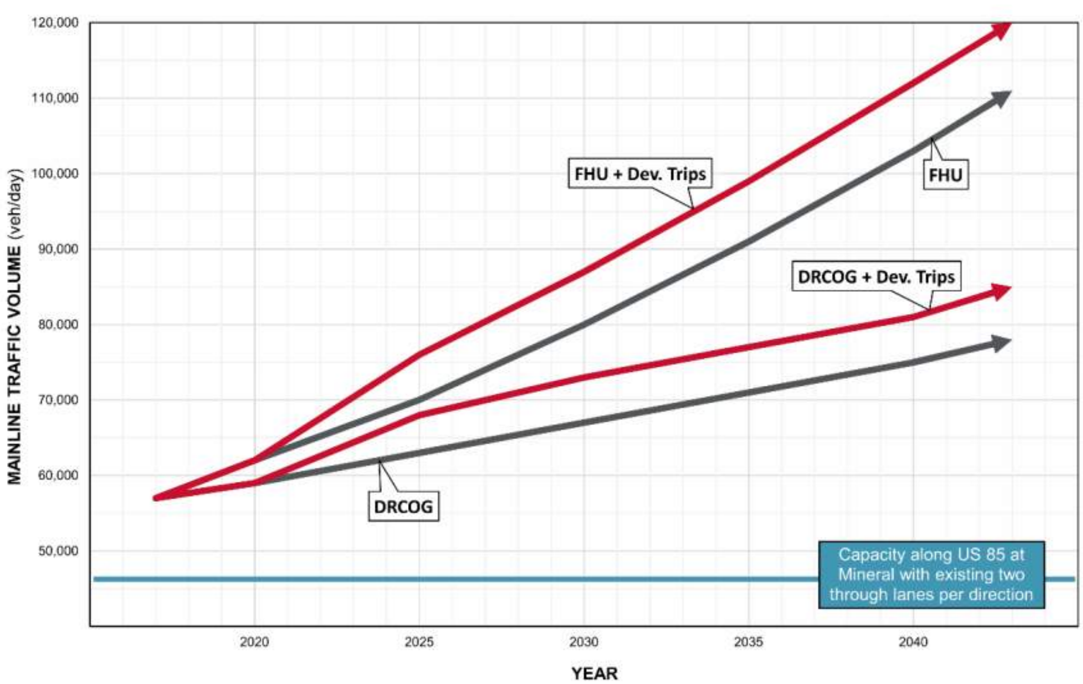


Figure 2: US 85 ADT Volume Forecasting with Southwest Quadrant Developments



Intersection Turning Movement Volumes

Next, each intersection turning movement volume from the 2017 FTH study was increased by the 2.4% annual rate for one year to develop 2018 projections as a “base” scenario. The volumes were balanced according to the National Cooperative Highway Research Program (NCHRP) guidelines, which require that volumes be distributed to each downstream movement based on their respective proportion of the overall approach volume. The final balanced base turning movement volumes are provided in **Figure 3**.

It should be noted that these turning movement volumes are based on the traffic being processed by the intersection, and have not been increased to reflect unmet demand. The queues at this intersection are very long, and delays are not consistent day-to-day. As such, the turning movement volumes developed for this study may underestimate the actual demand within the study area; this is discussed further in the **Traffic Operations Analysis** section.

Attachment D

Preliminary Cost Estimates

Continuous Flow Intersection

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	BID PRICE	COST
		PAY ITEMS			
	CDOT Staff Signal Timing Testing	L S	1	$ 250.00	$ 250.00
	CDOT Staff Signal Timing Implementation	LS	1	$ 250.00	$ 250.00
202-00010	Removal of Tree	EACH	0	$ 575.00	$ -
202-00019	Removal of Inlet	EACH	6	$ 900.00	$ 5,400.00
202-00021	Removal of Manhole	EACH	5	$ 1,500.00	$ 7,500.00
202-00090	Removal of Delineator	EACH	50	$ 9.00	$ 450.00
202-00200	Removal of Sidewalk	SY	565	$ 30.00	$ 16,950.00
202-00201	Removal of Curb	LF	5,605	$ 10.00	$ 56,050.00
202-00210	Removal of Concrete Pavement	SY	1,630	$ 30.00	$ 48,900.00
202-00220	Removal of Asphalt Mat	SY	4,900	$ 11.00	$ 53,900.00
202-00240	Removal of Asphalt Mat (Planing)	SY	35,245	$ 3.00	$ 105,735.00
202-00250	Removal of Pavement Marking	SF	100	$ 2.00	$ 200.00
202-00810	Removal of Ground Sign	EACH	26	$ 90.00	$ 2,340.00
202-05006	Sawing Concrete (6 Inch)	LF	220	$ 15.00	$ 3,300.00
202-05026	Sawing Asphalt Material (6 Inch)	LF	310	$ 11.00	$ 3,410.00
203-00010	Unclassified Excavation (Complete In Place)	CY	5,000	$ 50.00	$ 250,000.00
203-01597	Potholing	HOUR	40	$ 250.00	$ 10,000.00
203-02330	Laborer	HOUR	40	$ 45.00	$ 1,800.00
207-00205	Topsoil	CY	640	$ 50.00	$ 32,000.00
210	Reset Power Pole	EACH	1	$ 2,000.00	$ 2,000.00
210-00755	Reset Light Standard Steel High Mast	EACH	12	$ 1,600.00	$ 19,200.00
210-00760	Reset Luminaire	EACH	3	$ 275.00	$ 825.00
210-00810	Reset Ground Sign	EACH	0	$ 300.00	$ -
210-00840	Reset Traffic Signal Pole	EACH	1	$ 2,510.00	$ 2,510.00
210-04010	Adjust Manhole	EACH	1	$ 2,000.00	$ 2,000.00
212-00858	Reset Pedestrian Pole	EACH	1	$ 2,000.00	$ 2,000.00
214-00230	Deciduous Tree (3 inch Caliper)	EACH	0	$ 600.00	$ -
304-06007	Aggregate Base Course (Class 6)	CY	3,993	$ 55.00	$ 219,620.50
306-01000	Reconditioning	SY	6,505	$ 4.00	$ 26,018.08
403-34721	Hot Mix Asphalt (Grading S) (75) (PG 58-28)	TON	10,826	$ 110.00	$ 1,190,888.89
411-10255	Emulsified Asphalt (Slow-Setting)	GAL	5,132	$ 3.00	$ 15,395.58
412-00600	Concrete Pavement (6 Inch)	SY	1,630	$ 70.00	$ 114,100.00
601	Wall	SF	8,550	$ 125.00	$ 1,068,750.00
604-19110	Inlet Type R L 5 (10 Foot)	EACH	2	$ 6,000.00	$ 12,000.00
604-19210	Inlet Type R L 10 (10 Foot)	EACH	1	$ 11,000.00	$ 11,000.00
604-19310	Inlet Type R L 15 (10 Foot)	EACH	3	$ 25,000.00	$ 75,000.00
604-30015	Manhole Slab Base (15 foot)	EACH	1	$ 8,000.00	$ 8,000.00
606-00310	Guardrail Type 3	LF	775	$ 40.00	$ 31,000.00
608-00006	Concrete Sidewalk (6 Inch)	SY	563	$ 70.00	$ 39,381.30
608-00010	Concrete Curb Ramp	SY	150	$ 220.00	$ 33,000.00
609-21010	Curb and Gutter Type 2 (Section I-B)	LF	6,620	$ 25.00	$ 165,500.00
609-21020	Curb and Gutter Type 2 (Section II-B)	LF	8,744	$ 30.00	$ 262,320.00
612-00001	Delineator (Type I)	EACH	6	$ 25.00	$ 150.00
612-00001	Delineator (Type II)	EACH	45	$ 30.00	$ 1,350.00
614-00011	Sign Panel (Class I)	SF	130	$ 22.00	$ 2,860.00
614-00012	Sign Panel (Class II)	SF	60	$ 30.00	$ 1,800.00
614-00013	Sign Panel (Class III)	SF	40	$ 35.00	$ 1,400.00
614-01503	Steel Sign Support (2-Inch Round)(Post & Socket)	EACH	23	$ 250.00	$ 5,750.00
614-10160	Signal Head Backplates	EACH	1	$ 130.00	$ 130.00
614-70324	Traffic Signal Face (12-12-12)	EACH	1	$ 700.00	$ 700.00
614-70432	Traffic Signal Face (12-12-12-12)	EACH	1	$ 860.00	$ 860.00
614-81000	Traffic Signal-Light Pole	EACH	2	$ 16,000.00	$ 32,000.00
614	Traffic Signal	LS	6	$ 350,000.00	$ 2,100,000.00
625-00000	Construction Surveying	LS	1	$ 50,000.00	$ 50,000.00
625-00001	Construction Surveying (Hourly)	HOUR	40	$ 180.00	$ 7,200.00
626-00000	Mobilization	L S	1.00	$ 450,000.00	$ 450,000.00
626-01000	Public Information Services	L S	1.00	$ 20,000.00	$ 20,000.00
627-00008	Epoxy Pavement Marking	GAL	134	$ 250.00	$ 33,571.56
627-30410	Preformed Thermoplastic Pavement Marking	SF	4,465	$ 16.00	$ 71,440.00
	PROJECT TOTAL				**$ 6,678,155.90**

Construction Est	$ 8,681,602.67	includes 30% contengency
ROW	$ -	all within current ROW now
Utilities	$ 667,815.59	10% of project total
MOT	$ 667,815.59	10% of project total - traffic control devices
Erosion Control	$ 667,815.59	10% of project total
Design Est	$ 1,001,723.39	15% of project total
Constr. Eng. & Insp	$ 801,378.71	12% of project total
Total	$ 12,488,151.54	
Rounded Total	**$ 12,488,160.00**	

Continuous Flow Intersection with Full-Depth Reconstrution of Mineral Avenue

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	BID PRICE	COST
		PAY ITEMS			
	CDOT Staff Signal Timing Testing	L S	1	$ 250.00	$ 250.00
	CDOT Staff Signal Timing Implementation	LS	1	$ 250.00	$ 250.00
202-00010	Removal of Tree	EACH	0	$ 575.00	$ -
202-00019	Removal of Inlet	EACH	6	$ 900.00	$ 5,400.00
202-00021	Removal of Manhole	EACH	5	$ 1,500.00	$ 7,500.00
202-00090	Removal of Delineator	EACH	50	$ 9.00	$ 450.00
202-00200	Removal of Sidewalk	SY	565	$ 30.00	$ 16,950.00
202-00201	Removal of Curb	LF	5,605	$ 10.00	$ 56,050.00
202-00210	Removal of Concrete Pavement	SY	9,705	$ 30.00	$ 291,150.00
202-00220	Removal of Asphalt Mat	SY	4,900	$ 11.00	$ 53,900.00
202-00240	Removal of Asphalt Mat (Planing)	SY	35,245	$ 3.00	$ 105,735.00
202-00250	Removal of Pavement Marking	SF	0	$ 2.00	$ -
202-00810	Removal of Ground Sign	EACH	26	$ 90.00	$ 2,340.00
202-05006	Sawing Concrete (6 Inch)	LF	220	$ 15.00	$ 3,300.00
202-05026	Sawing Asphalt Material (6 Inch)	LF	310	$ 11.00	$ 3,410.00
203-00010	Unclassified Excavation (Complete In Place)	CY	5,000	$ 50.00	$ 250,000.00
203-01597	Potholing	HOUR	40	$ 250.00	$ 10,000.00
203-02330	Laborer	HOUR	40	$ 45.00	$ 1,800.00
207-00205	Topsoil	CY	640	$ 50.00	$ 32,000.00
210	Reset Power Pole	EACH	1	$ 2,000.00	$ 2,000.00
210-00755	Reset Light Standard Steel High Mast	EACH	12	$ 1,600.00	$ 19,200.00
210-00760	Reset Luminaire	EACH	3	$ 275.00	$ 825.00
210-00810	Reset Ground Sign	EACH	0	$ 300.00	$ -
210-00840	Reset Traffic Signal Pole	EACH	1	$ 2,510.00	$ 2,510.00
210-04010	Adjust Manhole	EACH	1	$ 2,000.00	$ 2,000.00
212-00858	Reset Pedestrian Pole	EACH	1	$ 2,000.00	$ 2,000.00
214-00230	Deciduous Tree (3 inch Caliper)	EACH	0	$ 600.00	$ -
304-06007	Aggregate Base Course (Class 6)	CY	3,993	$ 55.00	$ 219,620.50
306-01000	Reconditioning	SY	6,505	$ 4.00	$ 26,018.08
403-34721	Hot Mix Asphalt (Grading S) (75) (PG 58-28)	TON	10,826	$ 110.00	$ 1,190,888.89
411-10255	Emulsified Asphalt (Slow-Setting)	GAL	5,132	$ 3.00	$ 15,395.58
412-00600	Concrete Pavement (6 Inch)	SY	8,132	$ 70.00	$ 569,251.20
601	Wall	SF	8,550	$ 125.00	$ 1,068,750.00
604-19110	Inlet Type R L 5 (10 Foot)	EACH	2	$ 6,000.00	$ 12,000.00
604-19210	Inlet Type R L 10 (10 Foot)	EACH	1	$ 11,000.00	$ 11,000.00
604-19310	Inlet Type R L 15 (10 Foot)	EACH	3	$ 25,000.00	$ 75,000.00
604-30015	Manhole Slab Base (15 foot)	EACH	1	$ 8,000.00	$ 8,000.00
606-00310	Guardrail Type 3	LF	775	$ 40.00	$ 31,000.00
608-00006	Concrete Sidewalk (6 Inch)	SY	563	$ 70.00	$ 39,381.30
608-00010	Concrete Curb Ramp	SY	150	$ 220.00	$ 33,000.00
609-21010	Curb and Gutter Type 2 (Section I-B)	LF	6,620	$ 25.00	$ 165,500.00
609-21020	Curb and Gutter Type 2 (Section II-B)	LF	8,744	$ 30.00	$ 262,320.00
612-00001	Delineator (Type I)	EACH	6	$ 25.00	$ 150.00
612-00001	Delineator (Type II)	EACH	45	$ 30.00	$ 1,350.00
614-00011	Sign Panel (Class I)	SF	130	$ 22.00	$ 2,860.00
614-00012	Sign Panel (Class II)	SF	60	$ 30.00	$ 1,800.00
614-00013	Sign Panel (Class III)	SF	40	$ 35.00	$ 1,400.00
614-01503	Steel Sign Support (2-Inch Round)(Post & Socket)	EACH	23	$ 250.00	$ 5,750.00
614-10160	Signal Head Backplates	EACH	1	$ 130.00	$ 130.00
614-70324	Traffic Signal Face (12-12-12)	EACH	1	$ 700.00	$ 700.00
614-70432	Traffic Signal Face (12-12-12-12)	EACH	1	$ 860.00	$ 860.00
614-81000	Traffic Signal-Light Pole	EACH	2	$ 16,000.00	$ 32,000.00
614	Traffic Signal	LS	6	$ 350,000.00	$ 2,100,000.00
625-00000	Construction Surveying	LS	1	$ 50,000.00	$ 50,000.00
625-00001	Construction Surveying (Hourly)	HOUR	40	$ 180.00	$ 7,200.00
626-00000	Mobilization	L S	1.00	$ 350,000.00	$ 350,000.00
626-01000	Public Information Services	L S	1.00	$ 20,000.00	$ 20,000.00
627-00008	Epoxy Pavement Marking	GAL	134	$ 250.00	$ 33,571.56
627-30410	Preformed Thermoplastic Pavement Marking	SF	4,465	$ 16.00	$ 71,440.00
	PROJECT TOTAL				**$ 7,275,357.10**

Construction Est	$ 9,457,964.23	includes 30% contengency
ROW	$ -	all within current ROW now
Utilities	$ 727,535.71	10% of project total
MOT	$ 727,535.71	10% of project total - traffic control devices
Erosion Control	$ 509,275.00	7% of project total
Design Est	$ 873,042.85	12% of project total
Constr. Eng. & Insp	$ 1,382,317.85	19% of project total
Total	$ 13,677,671.35	
Rounded Total	**$ 13,677,680.00**	

Single Quadrant Roadway*

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	BID PRICE	COST
		PAY ITEMS			
	CDOT Staff Signal Timing Testing	L S	1	$ 250.00	$ 250.00
	CDOT Staff Signal Timing Implementation	LS	1	$ 250.00	$ 250.00
202-00010	Removal of Tree	EACH	8	$ 575.00	$ 4,600.00
202-00019	Removal of Inlet	EACH	6	$ 900.00	$ 5,400.00
202-00021	Removal of Manhole	EACH	5	$ 1,500.00	$ 7,500.00
202-00090	Removal of Delineator	EACH	50	$ 9.00	$ 450.00
202-00200	Removal of Sidewalk	SY	2,000	$ 30.00	$ 60,000.00
202-00201	Removal of Curb	LF	10,000	$ 10.00	$ 100,000.00
202-00210	Removal of Concrete Pavement	SY	1,000	$ 30.00	$ 30,000.00
202-00220	Removal of Asphalt Mat	SY	3,691	$ 11.00	$ 40,601.00
202-00240	Removal of Asphalt Mat (Planing)	SY	34,382	$ 3.00	$ 103,146.72
202-00250	Removal of Pavement Marking	SF	2,500	$ 2.00	$ 5,000.00
202-00810	Removal of Ground Sign	EACH	23	$ 90.00	$ 2,070.00
202-05006	Sawing Concrete (6 Inch)	LF	1,020	$ 15.00	$ 15,300.00
202-05026	Sawing Asphalt Material (6 Inch)	LF	270	$ 11.00	$ 2,970.00
203-00010	Unclassified Excavation (Complete In Place)	CY	5,000	$ 50.00	$ 250,000.00
203-01597	Potholing	HOUR	40	$ 250.00	$ 10,000.00
203-02330	Laborer	HOUR	40	$ 45.00	$ 1,800.00
207-00205	Topsoil	CY	640	$ 50.00	$ 32,000.00
210	Reset Power Pole	EACH	1	$ 2,000.00	$ 2,000.00
210-00755	Reset Light Standard Steel High Mast	EACH	15	$ 1,600.00	$ 24,000.00
210-00760	Reset Luminaire	EACH	3	$ 275.00	$ 825.00
210-00810	Reset Ground Sign	EACH	1	$ 300.00	$ 300.00
210-00840	Reset Traffic Signal Pole	EACH	1	$ 2,510.00	$ 2,510.00
210-04010	Adjust Manhole	EACH	1	$ 2,000.00	$ 2,000.00
212-00858	Reset Pedestrian Pole	EACH	1	$ 2,000.00	$ 2,000.00
214-00230	Deciduous Tree (3 inch Caliper)	EACH	8	$ 600.00	$ 4,800.00
304-06007	Aggregate Base Course (Class 6)	CY	3,622	$ 55.00	$ 199,210.00
306-01000	Reconditioning	SY	0	$ 4.00	$ -
403-34721	Hot Mix Asphalt (Grading S) (75) (PG 58-28)	TON	5,110	$ 110.00	$ 562,084.70
411-10255	Emulsified Asphalt (Slow-Setting)	GAL	3,753	$ 3.00	$ 11,260.05
412-00600	Concrete Pavement (6 Inch)	SY	9,500	$ 70.00	$ 665,000.00
604-19110	Inlet Type R L 5 (10 Foot)	EACH	2	$ 6,000.00	$ 12,000.00
604-19210	Inlet Type R L 10 (10 Foot)	EACH	1	$ 11,000.00	$ 11,000.00
604-19310	Inlet Type R L 15 (10 Foot)	EACH	3	$ 25,000.00	$ 75,000.00
604-30015	Manhole Slab Base (15 foot)	EACH	1	$ 8,000.00	$ 8,000.00
606-00310	Guardrail Type 3	LF	225	$ 40.00	$ 9,000.00
608-00006	Concrete Sidewalk (6 Inch)	SY	2,240	$ 70.00	$ 156,800.00
608-00010	Concrete Curb Ramp	SY	210	$ 220.00	$ 46,200.00
609-21010	Curb and Gutter Type 2 (Section I-B)	LF	4,130	$ 25.00	$ 103,250.00
609-21020	Curb and Gutter Type 2 (Section II-B)	LF	7,005	$ 30.00	$ 210,150.00
612-00001	Delineator (Type I)	EACH	6	$ 25.00	$ 150.00
612-00001	Delineator (Type II)	EACH	45	$ 30.00	$ 1,350.00
614-00011	Sign Panel (Class I)	SF	100	$ 22.00	$ 2,200.00
614-00012	Sign Panel (Class II)	SF	20	$ 30.00	$ 600.00
614-00013	Sign Panel (Class III)	SF	40	$ 35.00	$ 1,400.00
614-01503	Steel Sign Support (2-Inch Round)(Post & Socket)	EACH	23	$ 250.00	$ 5,750.00
614-10160	Signal Head Backplates	EACH	1	$ 130.00	$ 130.00
614-70324	Traffic Signal Face (12-12-12)	EACH	1	$ 700.00	$ 700.00
614-70432	Traffic Signal Face (12-12-12-12)	EACH	1	$ 860.00	$ 860.00
614-81000	Traffic Signal-Light Pole	EACH	2	$ 16,000.00	$ 32,000.00
614	Traffic Signal	LS	2	$ 350,000.00	$ 700,000.00
625-00000	Construction Surveying	LS	1	$ 50,000.00	$ 50,000.00
625-00001	Construction Surveying (Hourly)	HOUR	40	$ 180.00	$ 7,200.00
626-00000	Mobilization	L S	1.00	$ 300,000.00	$ 300,000.00
626-01000	Public Information Services	L S	1.00	$ 20,000.00	$ 20,000.00
627-00008	Epoxy Pavement Marking	GAL	134	$ 250.00	$ 33,571.56
627-30410	Preformed Thermoplastic Pavement Marking	SF	5,250	$ 16.00	$ 84,000.00
	PROJECT TOTAL				$ 4,018,639.02

**This estimate applies to either single quadrant roadway and does not include mitigation measures such as parking lot redesign.*

Construction Est	$	5,224,230.73	includes 30% contengency
ROW	$	-	all within current ROW now
Utilities	$	401,863.90	10% of project total
MOT	$	401,863.90	10% of project total - traffic control devices
Erosion Control	$	281,304.73	7% of project total
Design Est	$	482,236.68	12% of project total
Constr. Eng. & Insp	$	763,541.41	19% of project total
Total	$	7,555,041.36	
Rounded Total	**$**	**7,555,050.00**	

Single Quadrant Roadway with Full-Depth Reconstruction of Mineral Avenue*

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	BID PRICE	COST
		PAY ITEMS			
	CDOT Staff Signal Timing Testing	L S	1	$ 250.00	$ 250.00
	CDOT Staff Signal Timing Implementation	LS	1	$ 250.00	$ 250.00
202-00010	Removal of Tree	EACH	8	$ 575.00	$ 4,600.00
202-00019	Removal of Inlet	EACH	6	$ 900.00	$ 5,400.00
202-00021	Removal of Manhole	EACH	5	$ 1,500.00	$ 7,500.00
202-00090	Removal of Delineator	EACH	50	$ 9.00	$ 450.00
202-00200	Removal of Sidewalk	SY	2,000	$ 30.00	$ 60,000.00
202-00201	Removal of Curb	LF	10,000	$ 10.00	$ 100,000.00
202-00210	Removal of Concrete Pavement	SY	27,000	$ 30.00	$ 810,000.00
202-00220	Removal of Asphalt Mat	SY	3,691	$ 11.00	$ 40,601.00
202-00240	Removal of Asphalt Mat (Planing)	SY	34,382	$ 3.00	$ 103,146.72
202-00250	Removal of Pavement Marking	SF	100	$ 2.00	$ 200.00
202-00810	Removal of Ground Sign	EACH	23	$ 90.00	$ 2,070.00
202-05006	Sawing Concrete (6 Inch)	LF	1,020	$ 15.00	$ 15,300.00
202-05026	Sawing Asphalt Material (6 Inch)	LF	270	$ 11.00	$ 2,970.00
203-00010	Unclassified Excavation (Complete In Place)	CY	5,000	$ 50.00	$ 250,000.00
203-01597	Potholing	HOUR	40	$ 250.00	$ 10,000.00
203-02330	Laborer	HOUR	40	$ 45.00	$ 1,800.00
207-00205	Topsoil	CY	640	$ 50.00	$ 32,000.00
210	Reset Power Pole	EACH	1	$ 2,000.00	$ 2,000.00
210-00755	Reset Light Standard Steel High Mast	EACH	15	$ 1,600.00	$ 24,000.00
210-00760	Reset Luminaire	EACH	3	$ 275.00	$ 825.00
210-00810	Reset Ground Sign	EACH	1	$ 300.00	$ 300.00
210-00840	Reset Traffic Signal Pole	EACH	1	$ 2,510.00	$ 2,510.00
210-04010	Adjust Manhole	EACH	1	$ 2,000.00	$ 2,000.00
212-00858	Reset Pedestrian Pole	EACH	1	$ 2,000.00	$ 2,000.00
214-00230	Deciduous Tree (3 inch Caliper)	EACH	8	$ 600.00	$ 4,800.00
304-06007	Aggregate Base Course (Class 6)	CY	3,622	$ 55.00	$ 199,210.00
306-01000	Reconditioning	SY	20,600	$ 4.00	$ 82,400.00
403-34721	Hot Mix Asphalt (Grading S) (75) (PG 58-28)	TON	5,110	$ 110.00	$ 562,084.70
411-10255	Emulsified Asphalt (Slow-Setting)	GAL	3,753	$ 3.00	$ 11,260.05
412-00600	Concrete Pavement (6 Inch)	SY	26,999	$ 70.00	$ 1,889,931.40
604-19110	Inlet Type R L 5 (10 Foot)	EACH	2	$ 6,000.00	$ 12,000.00
604-19210	Inlet Type R L 10 (10 Foot)	EACH	1	$ 11,000.00	$ 11,000.00
604-19310	Inlet Type R L 15 (10 Foot)	EACH	3	$ 25,000.00	$ 75,000.00
604-30015	Manhole Slab Base (15 foot)	EACH	1	$ 8,000.00	$ 8,000.00
606-00310	Guardrail Type 3	LF	225	$ 40.00	$ 9,000.00
608-00006	Concrete Sidewalk (6 Inch)	SY	2,240	$ 70.00	$ 156,800.00
608-00010	Concrete Curb Ramp	SY	210	$ 220.00	$ 46,200.00
609-21010	Curb and Gutter Type 2 (Section I-B)	LF	4,130	$ 25.00	$ 103,250.00
609-21020	Curb and Gutter Type 2 (Section II-B)	LF	7,005	$ 30.00	$ 210,150.00
612-00001	Delineator (Type I)	EACH	6	$ 25.00	$ 150.00
612-00001	Delineator (Type II)	EACH	45	$ 30.00	$ 1,350.00
614-00011	Sign Panel (Class I)	SF	100	$ 22.00	$ 2,200.00
614-00012	Sign Panel (Class II)	SF	20	$ 30.00	$ 600.00
614-00013	Sign Panel (Class III)	SF	40	$ 35.00	$ 1,400.00
614-01503	Steel Sign Support (2-Inch Round)(Post & Socket)	EACH	23	$ 250.00	$ 5,750.00
614-10160	Signal Head Backplates	EACH	1	$ 130.00	$ 130.00
614-70324	Traffic Signal Face (12-12-12)	EACH	1	$ 700.00	$ 700.00
614-70432	Traffic Signal Face (12-12-12-12)	EACH	1	$ 860.00	$ 860.00
614-81000	Traffic Signal-Light Pole	EACH	2	$ 16,000.00	$ 32,000.00
614	Traffic Signal	LS	2	$ 350,000.00	$ 700,000.00
625-00000	Construction Surveying	LS	1	$ 50,000.00	$ 50,000.00
625-00001	Construction Surveying (Hourly)	HOUR	40	$ 180.00	$ 7,200.00
626-00000	Mobilization	L S	1.00	$ 300,000.00	$ 300,000.00
626-01000	Public Information Services	L S	1.00	$ 20,000.00	$ 20,000.00
627-00008	Epoxy Pavement Marking	GAL	134	$ 250.00	$ 33,571.56
627-30410	Preformed Thermoplastic Pavement Marking	SF	5,250	$ 16.00	$ 84,000.00
	PROJECT TOTAL				**$ 6,101,170.42**

This estimate applies to either single quadrant roadway and does not include mitigation measures such as parking lot redesign.

Construction Est	$ 7,931,521.55	includes 30% contengency
ROW	$ -	all within current ROW now
Utilities	$ 610,117.04	10% of project total
MOT	$ 610,117.04	10% of project total - traffic control devices
Erosion Control	$ 427,081.93	7% of project total
Design Est	$ 732,140.45	12% of project total
Constr. Eng. & Insp	$ 1,159,222.38	19% of project total
Total	$ 11,470,200.39	
Rounded Total	**$ 11,470,210.00**	

Tight Diamond Interchange

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	BID PRICE	COST
	PAY ITEMS				
	CDOT Staff Signal Timing Testing	L S	7	$ 250.00	$ 1,750.00
	CDOT Staff Signal Timing Implementation	LS	7	$ 250.00	$ 1,750.00
202-00010	Removal of Tree	EACH	10	$ 500.00	$ 5,000.00
202-00019	Removal of Inlet	EACH	12	$ 800.00	$ 9,600.00
202-00021	Removal of Manhole	EACH	5	$ 1,000.00	$ 5,000.00
202-00090	Removal of Delineator	EACH	50	$ 8.00	$ 400.00
202-00200	Removal of Sidewalk	SY	1,480	$ 15.00	$ 22,200.00
202-00201	Removal of Curb	LF	10,270	$ 5.00	$ 51,350.00
202-00210	Removal of Concrete Pavement	SY	144,034	$ 15.00	$ 2,160,510.00
202-00220	Removal of Asphalt Mat	SY	424,960	$ 5.00	$ 2,124,800.00
202-00240	Removal of Asphalt Mat (Planing)	SY	39,860	$ 2.00	$ 79,720.00
202-00250	Removal of Pavement Marking	SF		$ 1.00	$ -
202-00810	Removal of Ground Sign	EACH	30	$ 90.00	$ 2,700.00
202-00400	Removal of Bridge	EACH	1	$ 100,000.00	$ 100,000.00
202-00035	Removal of Pipe	LF	2,050	$ 20.00	$ 41,000.00
202-05006	Sawing Concrete (6 Inch)	LF	220	$ 10.00	$ 2,200.00
202-05026	Sawing Asphalt Material (6 Inch)	LF	630	$ 5.00	$ 3,150.00
203-00060	Embankment Material (Complete In Place)	CY	60,000	$ 20.00	$ 1,200,000.00
203-01597	Potholing	HOUR	40	$ 200.00	$ 8,000.00
203-02330	Laborer	HOUR	40	$ 45.00	$ 1,800.00
207-00205	Topsoil	CY	2,000	$ 15.00	$ 30,000.00
210	Reset Power Pole	EACH	1	$ 2,000.00	$ 2,000.00
210-00755	Reset Light Standard Steel High Mast	EACH	32	$ 2,000.00	$ 64,000.00
210-00760	Reset Luminaire	EACH	10	$ 200.00	$ 2,000.00
210-00810	Reset Ground Sign	EACH		$ 300.00	$ -
210-00840	Reset Traffic Signal Pole	EACH		$ 2,510.00	$ -
210-04010	Adjust Manhole	EACH	1	$ 500.00	$ 500.00
212-00858	Reset Pedestrian Pole	EACH	1	$ 1,500.00	$ 1,500.00
214-00230	Deciduous Tree (3 inch Caliper)	EACH	10	$ 600.00	$ 6,000.00
304-06007	Aggregate Base Course (Class 6)	CY	14,690	$ 40.00	$ 587,585.19
306-01000	Reconditioning	SY	25,710	$ 4.00	$ 102,840.00
403-34721	Hot Mix Asphalt (Grading S) (75) (PG 58-28)	TON	1,151	$ 110.00	$ 126,619.08
411-10255	Emulsified Asphalt (Slow-Setting)	GAL	592	$ 3.00	$ 1,774.60
412-00600	Concrete Pavement (6 Inch)	SY	88,965	$ 60.00	$ 5,337,900.00
601	Wall	SF	59,600	$ 125.00	$ 7,450,000.00
603-01365	36 Inch Reinforced Concrete Pipe (CIP)	LF	2,050	$ 120.00	$ 246,000.00
603	Prefabricated Pedestrian Bridge	SF	1,750	$ 175.00	$ 306,250.00
603	Conventional Urban Roadway Bridge	SF	25,630	$ 225.00	$ 5,766,750.00
604-19110	Inlet Type R L 5 (10 Foot)	EACH	4	$ 6,000.00	$ 24,000.00
604-19210	Inlet Type R L 10 (10 Foot)	EACH		$ 8,000.00	$ -
604-19310	Inlet Type R L 15 (10 Foot)	EACH	3	$ 10,000.00	$ 30,000.00
604-30015	Manhole Slab Base (15 foot)	EACH	5	$ 5,000.00	$ 25,000.00
606-00301	Guardrail Type 3	LF	1,200	$ 40.00	$ 48,000.00
608-00006	Concrete Sidewalk (6 Inch)	SY	2,710	$ 55.00	$ 149,050.00
608-00010	Concrete Curb Ramp	SY	350	$ 180.00	$ 63,000.00
609-21010	Curb and Gutter Type 2 (Section I-B)	LF	5,555	$ 18.00	$ 99,990.00
609-21020	Curb and Gutter Type 2 (Section II-B)	LF	4,292	$ 24.00	$ 103,008.00
612-00001	Delineator (Type I)	EACH	50	$ 20.00	$ 1,000.00
612-00001	Delineator (Type II)	EACH	50	$ 20.00	$ 1,000.00
614-00011	Sign Panel (Class I)	SF	150	$ 22.00	$ 3,300.00
614-00012	Sign Panel (Class II)	SF	150	$ 30.00	$ 4,500.00
614-00013	Sign Panel (Class III)	SF	150	$ 35.00	$ 5,250.00
614-01503	Steel Sign Support (2-Inch Round)(Post & Socket)	EACH	60	$ 250.00	$ 15,000.00
614-10160	Signal Head Backplates	EACH		$ 130.00	$ -
614-70324	Traffic Signal Face (12-12-12)	EACH		$ 700.00	$ -
614-70432	Traffic Signal Face (12-12-12-12)	EACH		$ 860.00	$ -
614-81000	Traffic Signal-Light Pole	EACH		$ 16,000.00	$ -
614	Traffic Signal	LS	7	$ 350,000.00	$ 2,450,000.00
614	Sign Bridge	each	4	$ 5,000.00	$ 20,000.00
625-00000	Construction Surveying	LS	1	$ 50,000.00	$ 50,000.00
625-00001	Construction Surveying (Hourly)	HOUR	40	$ 180.00	$ 7,200.00
626-00000	Mobilization	L S	1.00	$ 2,000,000.00	$ 2,000,000.00
626-01000	Public Information Services	L S	1.00	$ 80,000.00	$ 80,000.00
627-00008	Epoxy Pavement Marking	GAL	203	$ 250.00	$ 50,769.44
627-30410	Preformed Thermoplastic Pavement Marking	SF	3,344	$ 16.00	$ 53,504.00
	PROJECT TOTAL				$ 31,136,220.30

Construction Est	$	40,477,086.40	includes 30% contengency
ROW	$	3,113,622.03	10% of project total
Utilities	$	3,113,622.03	10% of project total
MOT	$	3,113,622.03	10% of project total - traffic control devices
Erosion Control	$	2,179,535.42	7% of project total
Envrio Clearance	$	1,556,811.02	5% of project total
Design Est	$	3,736,346.44	12% of project total
Constr. Eng. & Insp	$	5,915,881.86	19% of project total
Total	$	63,206,527.22	
Rounded Total	**$**	**63,206,530.00**	

Single Point Urban Interchange

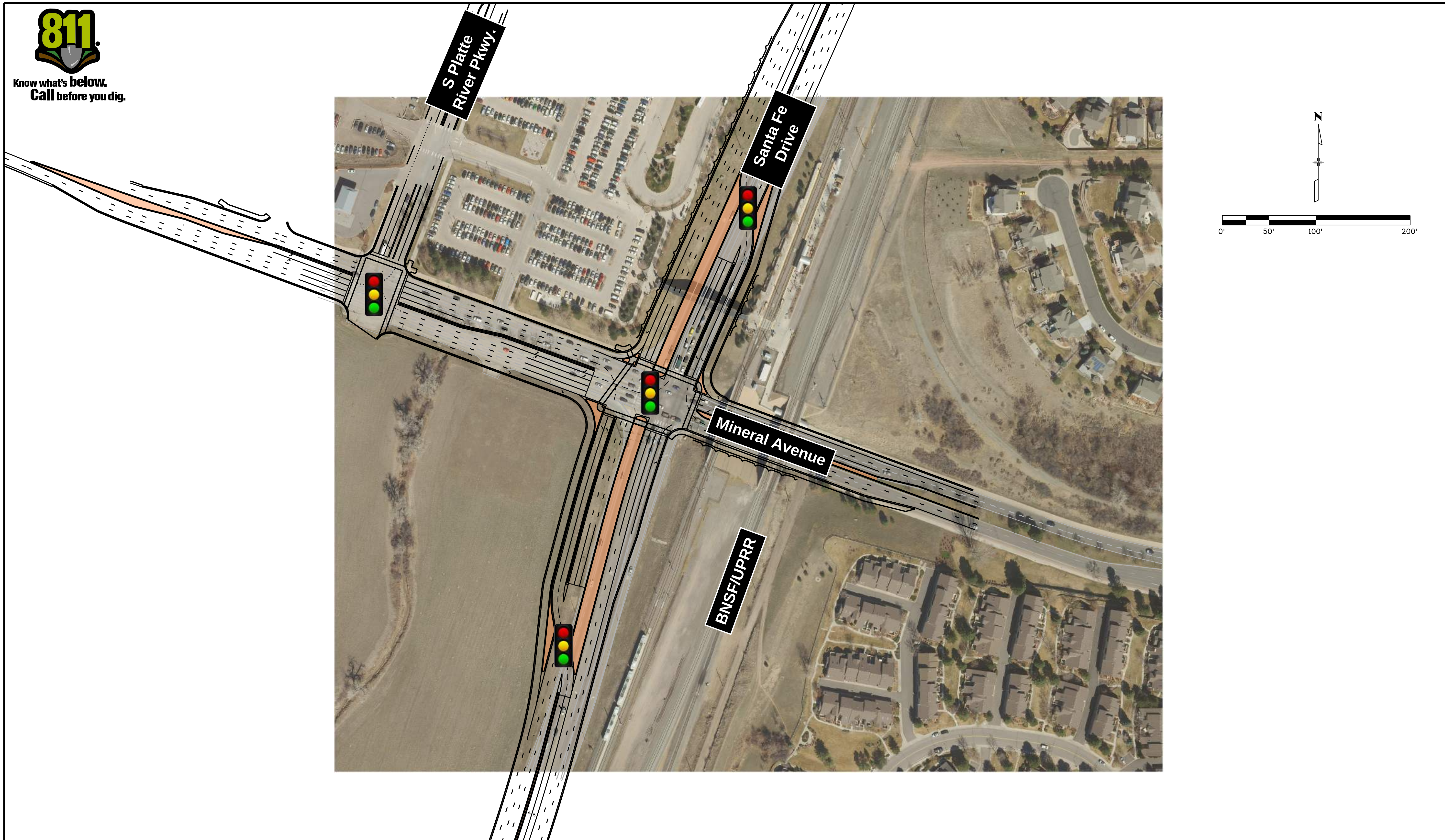
ITEM NO.	DESCRIPTION	UNIT	QUANTITY	BID PRICE	COST
	PAY ITEMS				
	CDOT Staff Signal Timing Testing	L S	7	$ 250.00	$ 1,750.00
	CDOT Staff Signal Timing Implementation	LS	7	$ 250.00	$ 1,750.00
202-00010	Removal of Tree	EACH	10	$ 500.00	$ 5,000.00
202-00019	Removal of Inlet	EACH	12	$ 800.00	$ 9,600.00
202-00021	Removal of Manhole	EACH	5	$ 1,000.00	$ 5,000.00
202-00090	Removal of Delineator	EACH	50	$ 8.00	$ 400.00
202-00200	Removal of Sidewalk	SY	1,480	$ 15.00	$ 22,200.00
202-00201	Removal of Curb	LF	10,270	$ 5.00	$ 51,350.00
202-00210	Removal of Concrete Pavement	SY	144,034	$ 15.00	$ 2,160,510.00
202-00220	Removal of Asphalt Mat	SY	424,960	$ 5.00	$ 2,124,800.00
202-00240	Removal of Asphalt Mat (Planing)	SY	39,860	$ 2.00	$ 79,720.00
202-00250	Removal of Pavement Marking	SF		$ 1.00	$ -
202-00810	Removal of Ground Sign	EACH	30	$ 90.00	$ 2,700.00
202-00400	Removal of Bridge	EACH	1	$ 100,000.00	$ 100,000.00
202-00035	Removal of Pipe	LF	2,050	$ 20.00	$ 41,000.00
202-05006	Sawing Concrete (6 Inch)	LF	220	$ 10.00	$ 2,200.00
202-05026	Sawing Asphalt Material (6 Inch)	LF	630	$ 5.00	$ 3,150.00
203-00060	Embankment Material (Complete In Place)	CY	60,000	$ 20.00	$ 1,200,000.00
203-01597	Potholing	HOUR	40	$ 200.00	$ 8,000.00
203-02330	Laborer	HOUR	40	$ 45.00	$ 1,800.00
207-00205	Topsoil	CY	2,000	$ 15.00	$ 30,000.00
210	Reset Power Pole	EACH	1	$ 2,000.00	$ 2,000.00
210-00755	Reset Light Standard Steel High Mast	EACH	32	$ 2,000.00	$ 64,000.00
210-00760	Reset Luminaire	EACH	10	$ 200.00	$ 2,000.00
210-00810	Reset Ground Sign	EACH		$ 300.00	$ -
210-00840	Reset Traffic Signal Pole	EACH		$ 2,510.00	$ -
210-04010	Adjust Manhole	EACH	1	$ 500.00	$ 500.00
212-00858	Reset Pedestrian Pole	EACH	1	$ 1,500.00	$ 1,500.00
214-00230	Deciduous Tree (3 inch Caliper)	EACH	10	$ 600.00	$ 6,000.00
304-06007	Aggregate Base Course (Class 6)	CY	14,457	$ 40.00	$ 578,297.78
306-01000	Reconditioning	SY	25,567	$ 4.00	$ 102,268.00
403-34721	Hot Mix Asphalt (Grading S) (75) (PG 58-28)	TON	1,044	$ 110.00	$ 114,802.78
411-10255	Emulsified Asphalt (Slow-Setting)	GAL	568	$ 3.00	$ 1,703.17
412-00600	Concrete Pavement (6 Inch)	SY	89,191	$ 60.00	$ 5,351,473.33
601	Wall	SF	57,550	$ 125.00	$ 7,193,750.00
603-01365	36 Inch Reinforced Concrete Pipe (CIP)	LF	2,050	$ 120.00	$ 246,000.00
603	Prefabricated Pedestrian Bridge	SF	1,750	$ 175.00	$ 306,250.00
603	Conventional Urban Roadway Bridge	SF	35,530	$ 225.00	$ 7,994,250.00
604-19110	Inlet Type R L 5 (10 Foot)	EACH	4	$ 6,000.00	$ 24,000.00
604-19210	Inlet Type R L 10 (10 Foot)	EACH		$ 8,000.00	$ -
604-19310	Inlet Type R L 15 (10 Foot)	EACH	3	$ 10,000.00	$ 30,000.00
604-30015	Manhole Slab Base (15 foot)	EACH	5	$ 5,000.00	$ 25,000.00
606-00301	Guardrail Type 3	LF	1,200	$ 40.00	$ 48,000.00
608-00006	Concrete Sidewalk (6 Inch)	SY	2,600	$ 55.00	$ 143,000.00
608-00010	Concrete Curb Ramp	SY	530	$ 180.00	$ 95,400.00
609-21010	Curb and Gutter Type 2 (Section I-B)	LF	5,745	$ 18.00	$ 103,410.00
609-21020	Curb and Gutter Type 2 (Section II-B)	LF	4,375	$ 24.00	$ 105,000.00
612-00001	Delineator (Type I)	EACH	50	$ 20.00	$ 1,000.00
612-00001	Delineator (Type II)	EACH	50	$ 20.00	$ 1,000.00
614-00011	Sign Panel (Class I)	SF	150	$ 22.00	$ 3,300.00
614-00012	Sign Panel (Class II)	SF	150	$ 30.00	$ 4,500.00
614-00013	Sign Panel (Class III)	SF	150	$ 35.00	$ 5,250.00
614-01503	Steel Sign Support (2-Inch Round)(Post & Socket)	EACH	60	$ 250.00	$ 15,000.00
614-10160	Signal Head Backplates	EACH		$ 130.00	$ -
614-70324	Traffic Signal Face (12-12-12)	EACH		$ 700.00	$ -
614-70432	Traffic Signal Face (12-12-12-12)	EACH		$ 860.00	$ -
614-81000	Traffic Signal-Light Pole	EACH		$ 16,000.00	$ -
614	Traffic Signal	LS	7	$ 350,000.00	$ 2,450,000.00
614	Sign Bridge	each	4	$ 5,000.00	$ 20,000.00
625-00000	Construction Surveying	LS	1	$ 50,000.00	$ 50,000.00
625-00001	Construction Surveying (Hourly)	HOUR	40	$ 180.00	$ 7,200.00
626-00000	Mobilization	L S	1.00	$ 200,000.00	$ 2,000,000.00
626-01000	Public Information Services	L S	1.00	$ 80,000.00	$ 80,000.00
627-00008	Epoxy Pavement Marking	GAL	202	$ 250.00	$ 50,477.78
627-30410	Preformed Thermoplastic Pavement Marking	SF	2,812	$ 16.00	$ 44,992.00
	PROJECT TOTAL				$ 33,122,254.84

Construction Est	$ 43,058,931.29	includes 30% contengency
ROW	$ 3,312,225.48	10% of project total
Utilities	$ 3,312,225.48	10% of project total
MOT	$ 3,312,225.48	10% of project total - traffic control devices
Erosion Control	$ 2,318,557.84	7% of project total
Enviro Clearance	$ 1,656,112.74	5% of project total
Design Est	$ 3,974,670.58	12% of project total
Constr. Eng. & Insp	$ 6,293,228.42	19% of project total
Total	$ 67,238,177.32	
Rounded Total	**$ 67,238,180.00**	

Attachment E

Preliminary Concept Designs

Know what's **below.**
Call before you dig.



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Print Date: Thursday, July 25, 2019 11:14:23 AM
File Name: US85_NEPA_TRAF_Alt2.dgn
Horiz. Scale: 1:200 Vert. Scale: As Noted

HDR 1670 BROADWAY, SUITE 3400 DENVER, COLORADO 80202
Phone: 303-764-1520 FAX: 303-860-7139

R-X

Sheet Revisions		
Date:	Comments	Init.

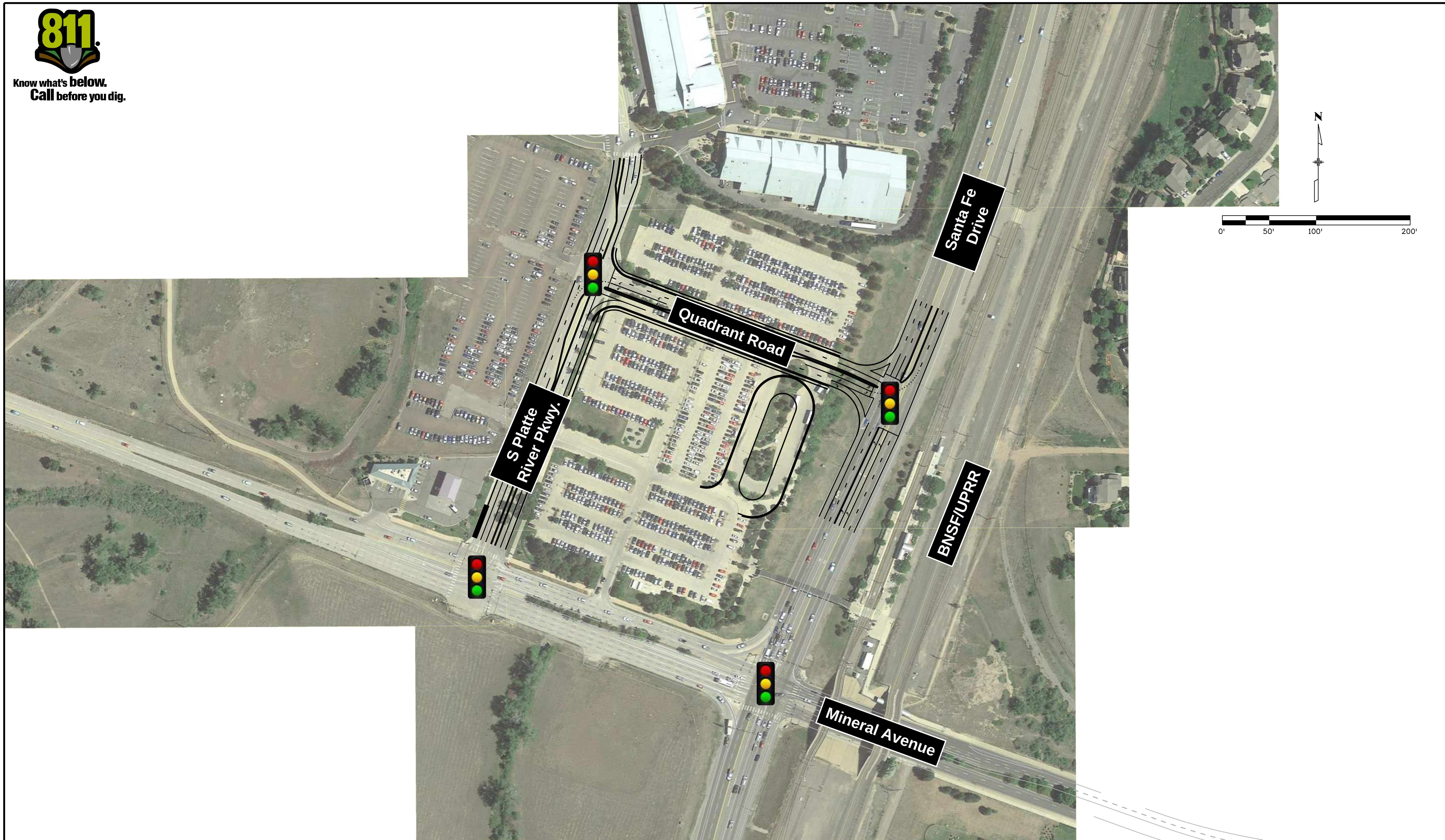
Colorado Department of Transportation
CDOT CO Region 1
Arapahoe Residency
7328 South Revere Parkway, Suite 204A
Centennial, CO 80112
Phone: 303-365-7255
Fax: 303-790-1037
RYJ

As Constructed
No Revisions:
Revised:
Void:

US 85 & MINERAL AVENUE
INTERCHANGE STUDY
ALTERNATIVE 2

Designer: J. SEYER
Detailer: J. SEYER
Structure Numbers
Sheet Subset:
Subset Sheets: of

Project No./Code
0852-114
21557
Sheet Number



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Horiz. Scale: 1:200	Vert. Scale: As Noted

HDR 1670 BROADWAY, SUITE 3400 DENVER, COLORADO 80202 Phone: 303-764-1520 FAX: 303-860-7139

R-X

Sheet Revisions

Date:	Comments	Init.

Colorado Department of Transportation

CDOT CO Region 1

Arapahoe Residency
7328 South Revere Parkway, Suite 204A
Centennial, CO 80112
Phone: 303-365-7255
Fax: 303-790-1037

RYJ

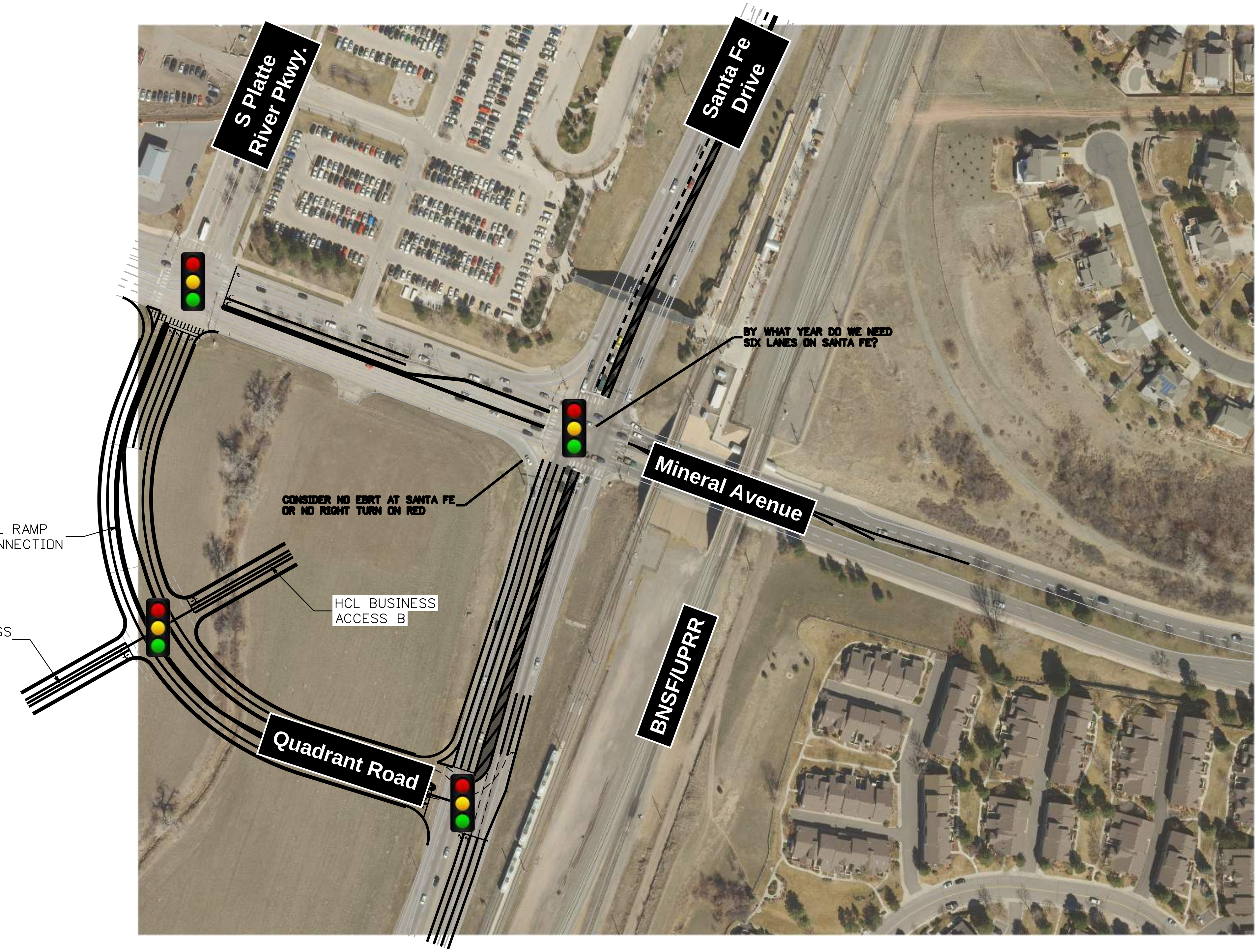
As Constructed
No Revisions:
Revised:
Void:

US 85 & MINERAL AVENUE INTERCHANGE STUDY NW QUADRANT OPTION 2

Designer:	D. HYMAS	Structure Numbers	
Detailer:	D. HYMAS		
Sheet Subset:		Subset Sheets:	of

Project No./Code
0852-114
21557
Sheet Number

Know what's **below.**
Call before you dig.



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0' 50' 100' 200'

Print Date: Thursday, July 25, 2019 11:15:41 AM	Sheet Revisions			Colorado Department of Transportation	As Constructed	US 85 & MINERAL AVENUE INTERCHANGE STUDY ALTERNATIVE 3	Project No./Code
File Name: US85_NEPA_TRAF_Alt3.dgn	Date:	Comments	Init.	Arapahoe Residency 7328 South Revere Parkway, Suite 204A Centennial, CO 80112 Phone: 303-365-7255 Fax: 303-790-1037	No Revisions:	Designer: J. SEYER / Structure Numbers	0852-114
Horiz. Scale: 1:200 Vert. Scale: As Noted				Region 1	Revised:	Detailer: J. SEYER	21557
HDR 1670 BROADWAY, SUITE 3400 DENVER, COLORADO 80202 Phone: 303-764-1520 FAX: 303-860-7139				RYJ	Void:	Sheet Subset: / Subset Sheets: of	Sheet Number

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Attachment F

Synchro Queuing Outputs

2019 Existing

AM Peak Hour

Lane Group	EBL	EBT	WBU	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	175	2010	5	660	180	98	62
v/c Ratio	0.13	0.46	0.04	0.23	0.14	0.49	0.41
Control Delay	1.4	2.6	1.2	0.8	0.2	76.6	23.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	1.4	2.6	1.2	0.8	0.2	76.6	23.0
Queue Length 50th (ft)	7	116	0	11	0	48	0
Queue Length 95th (ft)	13	153	m1	18	m0	79	49
Internal Link Dist (ft)		383		182		584	
Turn Bay Length (ft)	175		150			225	
Base Capacity (vph)	1376	4417	141	2851	1310	801	416
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.46	0.04	0.23	0.14	0.12	0.15

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	194	1138	760	148	515	260	291	1628	204	367	1444	112
v/c Ratio	0.66	1.27	0.48	0.91	0.56	0.38	0.80	1.11	0.26	1.07	1.00	0.07
Control Delay	74.6	174.1	1.2	107.1	41.6	14.6	98.5	113.5	20.2	118.9	58.7	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	74.6	174.1	1.2	107.1	41.6	14.6	98.5	113.5	20.2	118.9	58.7	0.1
Queue Length 50th (ft)	96	~741	9	147	157	43	154	~978	85	~205	~746	0
Queue Length 95th (ft)	137	#884	21	#286	200	105	m171	m#1073	m113	#311	#916	m0
Internal Link Dist (ft)		317			1265			750			749	
Turn Bay Length (ft)	250			400		350	200		650	550		
Base Capacity (vph)	617	896	1583	165	917	677	366	1468	775	343	1445	1583
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	1.27	0.48	0.90	0.56	0.38	0.80	1.11	0.26	1.07	1.00	0.07

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

2019 Existing

PM Peak Hour

Lane Group	EBL	EBT	WBU	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	191	1176	69	2176	176	436	319
v/c Ratio	0.73	0.30	0.23	0.88	0.15	0.78	0.91
Control Delay	53.8	6.4	4.3	15.1	0.1	81.9	76.9
Queue Delay	0.0	0.0	0.0	12.5	0.0	0.0	0.0
Total Delay	53.8	6.4	4.3	27.7	0.1	81.9	76.9
Queue Length 50th (ft)	63	138	8	233	0	256	254
Queue Length 95th (ft)	111	175	m12	m162	m0	312	#393
Internal Link Dist (ft)		383		182		584	
Turn Bay Length (ft)	175		150			225	
Base Capacity (vph)	309	3944	298	2482	1139	667	397
Starvation Cap Reductn	0	0	0	334	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.62	0.30	0.23	1.01	0.15	0.65	0.80

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	117	699	796	112	1219	163	546	1566	173	235	1811	418
v/c Ratio	0.66	0.87	0.50	0.55	1.19	0.24	1.10	0.98	0.21	0.76	1.29	0.26
Control Delay	93.5	79.6	2.0	69.9	137.1	15.5	139.1	65.4	4.3	77.3	169.5	0.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0
Total Delay	93.5	79.6	2.0	69.9	137.1	15.5	139.9	65.4	4.3	77.3	169.5	0.2
Queue Length 50th (ft)	71	434	65	104	~888	65	~375	961	0	137	~1458	0
Queue Length 95th (ft)	111	495	112	m139	m#948	m76	#501	#1163	49	m154	#1593	m0
Internal Link Dist (ft)		317			1265			750			749	
Turn Bay Length (ft)	250			400		350	200		650	550		
Base Capacity (vph)	190	924	1583	202	1022	712	495	1602	811	362	1409	1583
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	44	0	0	0	0	37
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.62	0.76	0.50	0.55	1.19	0.23	1.21	0.98	0.21	0.65	1.29	0.27

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

2030 CFI

AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	196	2196	233	244	706	201	228	17	339	108	17	67
v/c Ratio	0.70	0.75	0.24	1.03	0.22	0.19	1.48	0.08	0.89	0.79	0.08	0.15
Control Delay	80.4	27.5	5.6	101.4	2.5	0.5	287.9	54.7	46.5	106.3	54.7	2.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	80.4	27.5	5.6	101.4	2.5	0.5	287.9	54.7	46.5	106.3	54.7	2.4
Queue Length 50th (ft)	97	568	23	~247	5	0	~330	15	114	55	15	0
Queue Length 95th (ft)	140	764	78	#431	26	1	#435	37	219	#109	37	12
Internal Link Dist (ft)		383			218			432			584	
Turn Bay Length (ft)	175		325	150					225	300		325
Base Capacity (vph)	320	2918	984	236	3180	1065	154	434	543	137	434	487
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.61	0.75	0.24	1.03	0.22	0.19	1.48	0.04	0.62	0.79	0.04	0.14

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	327	1434	209	730	2296	255	2173	163
v/c Ratio	0.62	1.15	0.76	0.44	1.09	0.16	1.03	0.10
Control Delay	68.3	95.5	43.8	18.5	95.9	0.2	75.0	0.1
Queue Delay	61.9	0.5	60.6	1.1	3.7	0.3	27.2	0.0
Total Delay	130.2	96.0	104.4	19.6	99.6	0.4	102.2	0.1
Queue Length 50th (ft)	102	~867	71	152	~924	0	~854	0
Queue Length 95th (ft)	181	#992	#92	256	#1013	0	#946	0
Internal Link Dist (ft)		56		56	483		482	
Turn Bay Length (ft)	250		400			200		150
Base Capacity (vph)	526	1250	274	1661	2101	1583	2101	1583
Starvation Cap Reductn	299	47	88	649	125	0	105	0
Spillback Cap Reductn	0	143	0	0	440	783	410	21
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.44	1.30	1.12	0.72	1.38	0.32	1.29	0.10

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	EBR	WBT	NBL
Lane Group Flow (vph)	1917	911	972	350
v/c Ratio	0.66	0.58	0.43	0.46
Control Delay	13.3	4.0	10.7	36.5
Queue Delay	2.5	0.0	0.2	0.0
Total Delay	15.7	4.0	10.9	36.5
Queue Length 50th (ft)	159	1	50	170
Queue Length 95th (ft)	157	105	54	228
Internal Link Dist (ft)	144		56	328
Turn Bay Length (ft)				
Base Capacity (vph)	2904	1583	2264	755
Starvation Cap Reductn	192	0	559	0
Spillback Cap Reductn	823	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.92	0.58	0.57	0.46

Intersection Summary

Lane Group	EBT	WBT	WBR	SBL
Lane Group Flow (vph)	1839	1022	311	439
v/c Ratio	1.11	0.31	0.33	0.58
Control Delay	69.3	23.6	6.4	35.3
Queue Delay	0.6	0.1	0.0	0.0
Total Delay	69.9	23.7	6.4	35.3
Queue Length 50th (ft)	~725	145	0	219
Queue Length 95th (ft)	m#399	245	102	287
Internal Link Dist (ft)	56	274		323
Turn Bay Length (ft)			125	
Base Capacity (vph)	1661	3246	953	755
Starvation Cap Reductn	277	0	0	0
Spillback Cap Reductn	0	799	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	1.33	0.42	0.33	0.58

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	311	2856	439	2544
v/c Ratio	0.19	1.05	0.32	0.50
Control Delay	0.3	40.9	25.0	0.1
Queue Delay	0.0	20.0	0.0	0.2
Total Delay	0.3	60.9	25.0	0.4
Queue Length 50th (ft)	0	~1129	123	0
Queue Length 95th (ft)	0	m930	m126	m0
Internal Link Dist (ft)		482		187
Turn Bay Length (ft)			175	
Base Capacity (vph)	1611	2712	1373	5085
Starvation Cap Reductn	0	348	0	0
Spillback Cap Reductn	0	0	0	1467
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.19	1.21	0.32	0.70

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	911	350	2778	2594
v/c Ratio	0.57	0.24	0.55	1.01
Control Delay	1.2	21.7	0.1	26.3
Queue Delay	0.0	0.0	0.7	36.2
Total Delay	1.2	21.7	0.8	62.5
Queue Length 50th (ft)	0	100	0	~956
Queue Length 95th (ft)	0	m104	m0	m930
Internal Link Dist (ft)			497	483
Turn Bay Length (ft)		325		
Base Capacity (vph)	1611	1464	5085	2576
Starvation Cap Reductn	0	0	0	420
Spillback Cap Reductn	0	0	1770	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.57	0.24	0.84	1.20

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

2030 CFI

PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	206	1237	278	361	2314	186	211	17	311	464	22	340
v/c Ratio	0.99	0.58	0.34	0.87	0.76	0.19	1.09	0.10	0.89	0.97	0.08	0.87
Control Delay	140.1	42.1	7.1	41.4	10.1	0.9	160.8	71.4	48.9	110.9	62.6	66.0
Queue Delay	0.0	0.0	0.0	19.4	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	140.1	42.1	7.1	60.9	11.4	0.9	160.8	71.4	48.9	110.9	62.6	66.0
Queue Length 50th (ft)	127	404	19	425	109	6	~322	19	101	286	23	250
Queue Length 95th (ft)	#222	515	96	m393	m121	m8	341	43	214	#405	49	319
Internal Link Dist (ft)		383			218			432			584	
Turn Bay Length (ft)	175		325	150					225	300		325
Base Capacity (vph)	209	2151	814	413	3027	984	194	362	492	476	465	551
Starvation Cap Reductn	0	0	0	54	463	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.99	0.58	0.34	1.01	0.90	0.19	1.09	0.05	0.63	0.97	0.05	0.62

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	235	934	189	1541	2235	219	2709	520
v/c Ratio	0.47	0.90	0.62	1.01	0.94	0.14	1.14	0.33
Control Delay	73.2	36.8	47.6	42.3	57.3	0.2	96.5	0.4
Queue Delay	62.7	0.9	65.3	24.6	21.3	0.1	0.5	5.1
Total Delay	135.9	37.7	112.9	66.9	78.6	0.3	97.0	5.5
Queue Length 50th (ft)	80	580	73	~505	893	0	~1359	0
Queue Length 95th (ft)	137	#611	171	#768	965	0	#1425	0
Internal Link Dist (ft)		56		56	483		482	
Turn Bay Length (ft)	250		400			200		150
Base Capacity (vph)	495	1042	306	1525	2373	1583	2373	1583
Starvation Cap Reductn	281	0	136	0	198	0	279	0
Spillback Cap Reductn	0	21	0	96	232	607	427	981
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.10	0.91	1.11	1.08	1.04	0.22	1.39	0.86

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	EBR	WBT	NBL
Lane Group Flow (vph)	1272	956	2244	656
v/c Ratio	0.44	0.60	1.19	0.63
Control Delay	13.3	6.6	114.8	42.9
Queue Delay	0.2	0.0	0.1	0.3
Total Delay	13.5	6.6	114.9	43.2
Queue Length 50th (ft)	154	261	~898	423
Queue Length 95th (ft)	m102	m291	m#906	490
Internal Link Dist (ft)	144		56	328
Turn Bay Length (ft)				
Base Capacity (vph)	2883	1583	1886	1048
Starvation Cap Reductn	289	0	44	0
Spillback Cap Reductn	668	0	13	69
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.57	0.60	1.22	0.67

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBT	WBT	WBR	SBL
Lane Group Flow (vph)	1256	1883	194	283
v/c Ratio	0.82	0.67	0.26	0.27
Control Delay	17.8	24.2	9.8	35.8
Queue Delay	16.9	1.1	0.0	0.0
Total Delay	34.7	25.3	9.8	35.8
Queue Length 50th (ft)	105	383	84	165
Queue Length 95th (ft)	169	m315	m71	222
Internal Link Dist (ft)	56	274		323
Turn Bay Length (ft)			125	
Base Capacity (vph)	1525	2812	737	1048
Starvation Cap Reductn	290	0	0	0
Spillback Cap Reductn	0	622	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	1.02	0.86	0.26	0.27

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	194	2689	283	3517
v/c Ratio	0.12	0.91	0.23	0.69
Control Delay	0.1	12.2	44.2	0.3
Queue Delay	0.0	14.4	0.0	0.8
Total Delay	0.1	26.6	44.2	1.0
Queue Length 50th (ft)	0	1100	100	0
Queue Length 95th (ft)	0	1150	m85	m0
Internal Link Dist (ft)		482		187
Turn Bay Length (ft)			175	
Base Capacity (vph)	1611	2966	1239	5085
Starvation Cap Reductn	0	337	0	0
Spillback Cap Reductn	0	0	0	1095
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.12	1.02	0.23	0.88

Intersection Summary
m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	956	656	2672	3156
v/c Ratio	0.59	0.54	0.53	1.05
Control Delay	1.3	40.5	0.0	42.1
Queue Delay	0.0	0.0	0.4	19.8
Total Delay	1.3	40.5	0.4	61.9
Queue Length 50th (ft)	0	306	0	~1510
Queue Length 95th (ft)	0	m298	m0	m1238
Internal Link Dist (ft)			497	483
Turn Bay Length (ft)		325		
Base Capacity (vph)	1611	1220	5085	2994
Starvation Cap Reductn	0	0	0	487
Spillback Cap Reductn	0	0	1576	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.59	0.54	0.76	1.26

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

2030 Northwest Quadrant

AM Peak Hour

Queues
100: Platte River Parkway & Mineral Avenue

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	392	2000	233	244	479	345	228	139	217	495	158	153
v/c Ratio	0.81	0.74	0.15	1.03	0.20	0.37	0.80	0.72	0.60	1.03	0.46	0.26
Control Delay	76.5	34.0	0.2	116.5	9.8	4.0	67.4	84.8	14.5	101.8	20.8	15.3
Queue Delay	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Total Delay	76.5	35.2	0.2	116.5	9.8	4.0	67.4	84.8	14.6	101.8	20.8	15.3
Queue Length 50th (ft)	188	516	0	~262	63	111	186	134	0	~269	40	36
Queue Length 95th (ft)	241	615	0	#447	124	163	257	202	78	#371	110	95
Internal Link Dist (ft)		383			218			432			637	
Turn Bay Length (ft)	325		325	150		500			225	275		325
Base Capacity (vph)	566	2697	1583	236	2438	938	289	434	535	480	521	611
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	445	0	0	0	0	0	0	16	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.89	0.15	1.03	0.20	0.37	0.79	0.32	0.42	1.03	0.30	0.25

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	EBR	WBT	WBR	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	1837	837	939	286	2617	255	2383	163
v/c Ratio	1.06	0.53	0.36	0.38	1.05	0.35	1.05	0.10
Control Delay	59.3	2.5	22.0	20.6	67.7	28.3	59.3	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	8.6	0.0
Total Delay	59.3	2.5	22.0	20.6	67.7	28.3	68.0	0.1
Queue Length 50th (ft)	~987	41	139	110	~924	146	~924	0
Queue Length 95th (ft)	m#1088	m42	178	176	m#972	m162	#1002	m0
Internal Link Dist (ft)	281		410		559		615	
Turn Bay Length (ft)				325		250		250
Base Capacity (vph)	1738	1583	2607	754	2495	719	2271	1583
Starvation Cap Reductn	0	0	0	0	0	0	45	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.06	0.53	0.36	0.38	1.05	0.35	1.07	0.10

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	333	214	328	2635	2385	411
v/c Ratio	0.78	0.45	0.65	0.65	0.75	0.37
Control Delay	54.3	24.3	62.3	3.0	8.7	1.6
Queue Delay	0.0	0.0	0.0	1.0	1.0	0.0
Total Delay	54.3	24.3	62.3	4.0	9.7	1.6
Queue Length 50th (ft)	168	91	174	47	359	30
Queue Length 95th (ft)	188	130	m174	m37	m403	m31
Internal Link Dist (ft)	625			615	536	
Turn Bay Length (ft)		275	350			250
Base Capacity (vph)	526	474	503	4078	3196	1110
Starvation Cap Reductn	0	0	0	1061	0	0
Spillback Cap Reductn	0	0	0	0	508	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.63	0.45	0.65	0.87	0.89	0.37

Intersection Summary
m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	WBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	739	52	536	10	161
v/c Ratio	0.30	0.19	0.34	0.05	0.59
Control Delay	2.5	35.1	2.2	25.8	38.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	2.5	35.1	2.2	25.8	38.5
Queue Length 50th (ft)	33	37	74	4	71
Queue Length 95th (ft)	55	m62	282	16	120
Internal Link Dist (ft)	625	637			278
Turn Bay Length (ft)				100	
Base Capacity (vph)	2479	695	1583	502	695
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.30	0.07	0.34	0.02	0.23

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

2030 Northwest Quadrant

PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	268	1175	278	351	1716	340	211	133	194	670	482	478
v/c Ratio	0.80	0.65	0.18	0.87	0.74	0.41	1.04	0.75	0.59	0.83	0.95	0.85
Control Delay	97.9	55.5	0.2	66.3	27.2	11.4	148.8	102.8	16.1	54.5	45.2	42.9
Queue Delay	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.1	2.0
Total Delay	97.9	55.5	0.2	66.3	27.3	11.6	148.8	102.8	16.1	54.5	45.3	44.9
Queue Length 50th (ft)	157	400	0	369	422	124	~263	156	0	298	100	511
Queue Length 95th (ft)	208	497	0	#581	493	171	#447	229	81	348	251	515
Internal Link Dist (ft)		383			218			432			637	
Turn Bay Length (ft)	325		325	150		500			225	275		325
Base Capacity (vph)	373	1816	1583	403	2330	828	206	362	464	822	599	580
Starvation Cap Reductn	0	0	0	0	69	87	0	0	0	0	2	33
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.72	0.65	0.18	0.87	0.76	0.46	1.02	0.37	0.42	0.82	0.81	0.87

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
200: US 85 & Mineral Avenue

04/23/2019

Lane Group	EBT	EBR	WBT	WBR	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	1194	878	1730	179	2837	219	2898	520
v/c Ratio	0.85	0.55	0.82	0.29	1.06	0.28	1.19	0.33
Control Delay	37.1	5.5	10.7	1.5	51.5	11.6	110.4	0.2
Queue Delay	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Total Delay	37.1	5.5	10.8	1.5	51.5	11.6	110.4	0.2
Queue Length 50th (ft)	452	225	287	9	~707	65	~959	0
Queue Length 95th (ft)	515	217	m119	m8	m#832	m67	m#1253	m0
Internal Link Dist (ft)	281		410		559		615	
Turn Bay Length (ft)				325		250		250
Base Capacity (vph)	1531	1583	2297	679	2683	778	2441	1583
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	52	0	0	0	0	14
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.78	0.55	0.77	0.26	1.06	0.28	1.19	0.33

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	240	193	615	2464	3297	266
v/c Ratio	0.97	0.44	0.98	0.56	0.98	0.24
Control Delay	121.1	47.1	75.8	5.0	11.5	0.5
Queue Delay	0.0	0.0	0.0	0.6	0.0	0.0
Total Delay	121.1	47.1	75.8	5.6	11.5	0.5
Queue Length 50th (ft)	145	174	351	213	942	15
Queue Length 95th (ft)	#243	259	m327	m214	m223	m3
Internal Link Dist (ft)	625			615	536	
Turn Bay Length (ft)		275	350			250
Base Capacity (vph)	247	440	629	4407	3361	1095
Starvation Cap Reductn	0	0	0	1388	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.97	0.44	0.98	0.82	0.98	0.24

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	WBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	880	276	422	10	115
v/c Ratio	0.37	0.75	0.27	0.08	0.31
Control Delay	4.9	47.1	1.3	28.0	31.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	4.9	47.1	1.3	28.0	31.5
Queue Length 50th (ft)	29	132	43	5	56
Queue Length 95th (ft)	m454	284	39	17	95
Internal Link Dist (ft)	625	637			278
Turn Bay Length (ft)				100	
Base Capacity (vph)	2367	662	1583	214	662
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	17	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.37	0.42	0.27	0.05	0.17

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

2030 Southwest Quadrant

AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	196	1567	845	397	454	129	464	356	340	98	26	67
v/c Ratio	0.67	0.65	0.67	0.90	0.25	0.15	0.57	0.86	0.69	0.57	0.13	0.16
Control Delay	78.6	33.4	4.7	70.8	7.8	0.5	40.7	51.4	19.2	82.8	57.4	0.8
Queue Delay	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
Total Delay	78.6	33.8	4.7	70.8	7.8	0.5	40.7	51.4	19.3	82.8	57.4	0.8
Queue Length 50th (ft)	94	426	31	206	34	0	170	185	86	48	23	0
Queue Length 95th (ft)	137	562	87	#291	59	0	189	232	137	81	50	0
Internal Link Dist (ft)		383			182			544			584	
Turn Bay Length (ft)	250		325	400			325		175	375		300
Base Capacity (vph)	306	2411	1275	457	1842	886	827	617	669	183	434	600
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	380	0	0	0	0	0	8	16	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.64	0.77	0.66	0.87	0.25	0.15	0.56	0.58	0.52	0.54	0.06	0.11

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	EBR	WBT	WBR	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	1832	418	939	286	2622	260	2617	122
v/c Ratio	1.10	0.59	0.41	0.40	1.01	0.35	1.10	0.16
Control Delay	79.7	19.1	22.8	23.9	53.9	20.4	76.7	5.1
Queue Delay	0.0	0.4	0.0	0.0	20.3	0.0	0.0	0.0
Total Delay	79.7	19.5	22.8	23.9	74.2	20.4	76.7	5.1
Queue Length 50th (ft)	~1021	145	150	125	~869	146	~1058	25
Queue Length 95th (ft)	#1121	218	182	178	#970	196	m#1114	m23
Internal Link Dist (ft)	317		410		652		471	
Turn Bay Length (ft)				350		225		225
Base Capacity (vph)	1663	707	2271	707	2607	750	2373	769
Starvation Cap Reductn	0	58	0	0	139	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.10	0.64	0.41	0.40	1.06	0.35	1.10	0.16

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	339	594	328	2604	2531	563
v/c Ratio	0.79	0.38	0.79	0.64	0.76	0.43
Control Delay	70.8	2.4	78.7	7.2	4.5	0.6
Queue Delay	0.0	0.0	0.0	0.8	1.2	0.7
Total Delay	70.8	2.4	78.7	8.0	5.7	1.3
Queue Length 50th (ft)	177	70	158	327	116	16
Queue Length 95th (ft)	228	77	209	400	m112	m19
Internal Link Dist (ft)	523			588	652	
Turn Bay Length (ft)		175	375			225
Base Capacity (vph)	503	1583	471	4072	3341	1352
Starvation Cap Reductn	0	0	0	0	528	450
Spillback Cap Reductn	0	0	0	1013	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.67	0.38	0.70	0.85	0.90	0.62

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	541	149	732	809	459
v/c Ratio	0.70	0.32	0.31	0.46	0.45
Control Delay	29.3	5.3	3.4	16.8	6.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	29.3	5.3	3.4	16.8	6.6
Queue Length 50th (ft)	109	21	63	166	70
Queue Length 95th (ft)	145	m43	104	235	m117
Internal Link Dist (ft)	210		523	544	
Turn Bay Length (ft)	175	100			125
Base Capacity (vph)	1020	633	2336	1773	1012
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.53	0.24	0.31	0.46	0.45

Intersection Summary
m Volume for 95th percentile queue is metered by upstream signal.

2030 Southwest Quadrant

PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	206	701	794	469	1753	139	758	257	248	428	57	340
v/c Ratio	0.95	0.32	0.73	0.75	0.90	0.15	0.94	0.88	0.58	0.98	0.21	0.87
Control Delay	132.0	35.5	12.0	51.5	19.8	1.6	72.8	75.5	22.2	114.1	67.4	64.6
Queue Delay	0.0	0.2	0.0	0.0	2.9	0.0	0.0	0.4	0.3	0.0	0.0	0.0
Total Delay	132.0	35.7	12.0	51.5	22.7	1.6	72.8	75.9	22.5	114.1	67.4	64.6
Queue Length 50th (ft)	124	200	147	281	271	2	431	200	97	264	60	230
Queue Length 95th (ft)	#211	258	316	m302	m300	m3	479	350	148	#381	104	305
Internal Link Dist (ft)		383			182			544			584	
Turn Bay Length (ft)	250		325	400			325		175	375		300
Base Capacity (vph)	216	2183	1082	629	1951	906	809	367	492	438	362	467
Starvation Cap Reductn	0	0	0	0	121	0	0	0	0	0	0	0
Spillback Cap Reductn	0	707	0	0	0	0	0	10	34	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.95	0.47	0.73	0.75	0.96	0.15	0.94	0.72	0.54	0.98	0.16	0.73

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBT	EBR	WBT	WBR	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	1158	403	1730	179	2469	255	3031	459
v/c Ratio	0.93	0.76	1.02	0.34	0.74	0.27	1.00	0.48
Control Delay	63.9	56.4	51.6	32.1	26.0	15.8	21.9	5.6
Queue Delay	12.5	1.0	5.9	0.0	0.4	0.0	10.2	0.0
Total Delay	76.4	57.4	57.4	32.1	26.4	15.8	32.1	5.6
Queue Length 50th (ft)	690	460	~492	127	692	120	~1158	156
Queue Length 95th (ft)	m#765	m563	m379	m113	735	m130	m443	m86
Internal Link Dist (ft)	317		410		652		471	
Turn Bay Length (ft)				350		225		225
Base Capacity (vph)	1241	527	1695	527	3321	948	3022	948
Starvation Cap Reductn	97	27	0	0	337	0	0	0
Spillback Cap Reductn	0	0	28	0	0	0	92	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.01	0.81	1.04	0.34	0.83	0.27	1.03	0.48

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	276	609	615	2505	3026	479
v/c Ratio	0.82	0.38	0.92	0.59	0.94	0.39
Control Delay	113.4	2.1	69.8	1.6	10.6	2.3
Queue Delay	0.0	0.0	0.0	0.1	8.5	0.6
Total Delay	113.4	2.1	69.8	1.7	19.1	2.9
Queue Length 50th (ft)	152	66	367	105	288	55
Queue Length 95th (ft)	#241	157	m358	m99	m291	m42
Internal Link Dist (ft)	523			588	652	
Turn Bay Length (ft)		175	375			225
Base Capacity (vph)	343	1583	668	4276	3203	1212
Starvation Cap Reductn	0	0	0	0	202	381
Spillback Cap Reductn	0	112	0	371	88	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.80	0.41	0.92	0.64	1.01	0.58

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	500	211	871	768	552
v/c Ratio	0.73	0.41	0.35	0.39	0.49
Control Delay	37.5	6.2	7.0	11.6	3.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	37.5	6.2	7.0	11.6	3.2
Queue Length 50th (ft)	127	33	226	116	11
Queue Length 95th (ft)	170	m80	m383	192	68
Internal Link Dist (ft)	210		523	544	
Turn Bay Length (ft)	175	100			125
Base Capacity (vph)	851	633	2493	1975	1127
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.59	0.33	0.35	0.39	0.49

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

2030 Dual Quadrants

AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	392	1577	639	387	438	196	479	366	392	82
v/c Ratio	0.72	0.71	0.73	0.88	0.30	0.26	0.70	0.91	0.89	0.20
Control Delay	68.3	38.7	23.2	67.9	21.9	3.4	37.4	51.4	77.6	11.7
Queue Delay	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0
Total Delay	68.3	39.2	23.2	67.9	21.9	3.4	37.4	51.8	77.6	11.7
Queue Length 50th (ft)	183	471	267	196	60	0	173	201	176	3
Queue Length 95th (ft)	241	588	486	#275	213	45	201	220	#255	29
Internal Link Dist (ft)		383			182			544		637
Turn Bay Length (ft)	300		175	400					375	
Base Capacity (vph)	566	2207	875	457	1442	761	682	497	457	526
Starvation Cap Reductn	0	0	0	0	0	0	0	12	0	0
Spillback Cap Reductn	0	252	0	0	0	0	0	7	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.81	0.73	0.85	0.30	0.26	0.70	0.75	0.86	0.16

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	EBR	WBT	WBR	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	1832	418	939	286	2418	260	2327	163
v/c Ratio	1.04	0.56	0.39	0.38	0.98	0.37	1.04	0.22
Control Delay	52.8	16.9	20.9	21.9	52.0	25.6	56.4	8.3
Queue Delay	0.0	0.4	0.0	1.5	12.6	0.0	7.7	0.0
Total Delay	52.8	17.3	20.9	23.4	64.6	25.6	64.0	8.3
Queue Length 50th (ft)	~971	147	146	122	760	162	~900	50
Queue Length 95th (ft)	#1071	m212	178	174	#881	226	#982	m80
Internal Link Dist (ft)	317		410		652		615	
Turn Bay Length (ft)				350		225		275
Base Capacity (vph)	1763	749	2406	749	2458	708	2237	740
Starvation Cap Reductn	0	78	0	0	113	0	41	0
Spillback Cap Reductn	0	0	0	293	5	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.04	0.62	0.39	0.63	1.03	0.37	1.06	0.22

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	271	10	2750	2484	307
v/c Ratio	0.89	0.16	0.92	0.60	0.23
Control Delay	91.6	44.8	31.6	2.7	0.2
Queue Delay	0.0	0.0	7.2	0.2	0.0
Total Delay	91.6	44.8	38.8	2.9	0.2
Queue Length 50th (ft)	132	9	635	131	4
Queue Length 95th (ft)	#214	m12	m653	m25	m0
Internal Link Dist (ft)	625		615	1589	
Turn Bay Length (ft)	225	300			225
Base Capacity (vph)	306	70	2975	4140	1345
Starvation Cap Reductn	0	0	224	0	0
Spillback Cap Reductn	0	0	0	661	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.89	0.14	1.00	0.71	0.23

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	120	542	318	2615	2583	214
v/c Ratio	0.73	0.34	0.78	0.62	0.74	0.16
Control Delay	87.3	0.6	66.6	5.1	4.2	0.4
Queue Delay	0.0	0.0	0.0	0.2	0.8	0.0
Total Delay	87.3	0.6	66.6	5.4	5.0	0.4
Queue Length 50th (ft)	115	0	158	281	104	4
Queue Length 95th (ft)	192	0	m163	m308	m111	m4
Internal Link Dist (ft)	523			588	652	
Turn Bay Length (ft)		175	350			225
Base Capacity (vph)	212	1583	471	4236	3514	1364
Starvation Cap Reductn	0	0	0	0	563	0
Spillback Cap Reductn	0	34	0	671	111	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.57	0.35	0.68	0.73	0.88	0.16

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	WBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	317	52	260	10	161
v/c Ratio	0.13	0.19	0.16	0.05	0.59
Control Delay	3.1	39.7	0.2	25.7	38.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	3.1	39.7	0.2	25.7	38.2
Queue Length 50th (ft)	23	34	0	4	71
Queue Length 95th (ft)	43	m46	0	16	119
Internal Link Dist (ft)	625	637			278
Turn Bay Length (ft)	150			100	
Base Capacity (vph)	2472	794	1583	574	794
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.13	0.07	0.16	0.02	0.20

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	541	108	418	541	500
v/c Ratio	0.70	0.21	0.34	0.54	0.46
Control Delay	29.3	4.5	5.5	16.6	4.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	29.3	4.5	5.5	16.6	4.1
Queue Length 50th (ft)	109	11	90	161	26
Queue Length 95th (ft)	145	m23	97	m583	m89
Internal Link Dist (ft)	210		523	544	
Turn Bay Length (ft)	175				
Base Capacity (vph)	1020	674	1230	999	1080
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.53	0.16	0.34	0.54	0.46

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

2030 Dual Quadrants

PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	278	722	701	485	1747	191	763	273	603	361
v/c Ratio	1.18	0.41	0.72	0.77	1.06	0.24	1.14	0.57	1.02	0.95
Control Delay	184.1	45.7	10.4	54.1	56.9	4.5	113.4	24.1	112.9	84.1
Queue Delay	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
Total Delay	184.1	46.1	10.4	54.1	56.9	4.5	113.4	24.3	112.9	84.1
Queue Length 50th (ft)	~195	243	53	298	~1205	8	~474	126	~372	305
Queue Length 95th (ft)	#297	286	219	m330	m#1313	m19	#602	173	#522	#498
Internal Link Dist (ft)		383			182			544		637
Turn Bay Length (ft)	300		175	400					375	
Base Capacity (vph)	235	1778	967	629	1650	782	672	502	591	403
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	500	0	0	0	0	0	22	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.18	0.56	0.72	0.77	1.06	0.24	1.14	0.57	1.02	0.90

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBT	EBR	WBT	WBR	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	1158	403	1730	179	2372	255	2821	520
v/c Ratio	0.88	0.72	0.97	0.32	0.74	0.28	0.96	0.57
Control Delay	54.9	49.9	40.1	30.5	28.3	17.4	28.0	13.6
Queue Delay	1.6	0.6	11.4	0.0	3.0	0.0	23.7	1.3
Total Delay	56.5	50.6	51.5	30.6	31.3	17.4	51.7	14.8
Queue Length 50th (ft)	680	454	460	126	656	166	1002	234
Queue Length 95th (ft)	m728	m535	m375	m112	699	m223	1039	275
Internal Link Dist (ft)	317		410		652		615	
Turn Bay Length (ft)				350		225		275
Base Capacity (vph)	1324	562	1808	562	3216	918	2927	918
Starvation Cap Reductn	62	28	0	0	318	0	250	209
Spillback Cap Reductn	0	0	108	20	715	0	39	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.92	0.75	1.02	0.33	0.95	0.28	1.05	0.73

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	177	31	2573	3365	198
v/c Ratio	0.70	0.45	0.84	0.81	0.15
Control Delay	90.1	107.4	22.8	0.9	0.0
Queue Delay	0.0	0.0	0.3	1.1	0.0
Total Delay	90.1	107.4	23.1	2.0	0.0
Queue Length 50th (ft)	98	39	900	24	1
Queue Length 95th (ft)	138	m54	784	m33	m0
Internal Link Dist (ft)	625		615	1589	
Turn Bay Length (ft)	225	300			225
Base Capacity (vph)	318	80	3076	4155	1320
Starvation Cap Reductn	0	0	106	0	0
Spillback Cap Reductn	1	0	0	499	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.56	0.39	0.87	0.92	0.15

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	146	563	583	2536	3073	219
v/c Ratio	0.87	0.36	0.94	0.59	0.93	0.18
Control Delay	121.0	0.5	70.3	5.4	10.5	2.0
Queue Delay	0.0	0.0	0.0	0.2	6.5	0.0
Total Delay	121.0	0.6	70.3	5.6	17.0	2.0
Queue Length 50th (ft)	178	0	342	361	219	20
Queue Length 95th (ft)	#305	0	m334	m341	237	m21
Internal Link Dist (ft)	523			588	652	
Turn Bay Length (ft)		175	350			225
Base Capacity (vph)	177	1583	631	4294	3293	1247
Starvation Cap Reductn	0	0	0	649	92	0
Spillback Cap Reductn	0	72	0	335	216	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.82	0.37	0.92	0.70	1.00	0.18

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	WBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	229	276	167	10	115
v/c Ratio	0.10	0.72	0.11	0.08	0.30
Control Delay	5.7	41.2	0.5	27.1	30.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	5.7	41.2	0.5	27.1	30.8
Queue Length 50th (ft)	20	129	0	5	56
Queue Length 95th (ft)	39	m97	m0	17	93
Internal Link Dist (ft)	625	637			278
Turn Bay Length (ft)	150			100	
Base Capacity (vph)	2330	952	1583	317	952
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.10	0.29	0.11	0.03	0.12

Intersection Summary
m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	500	149	644	593	613
v/c Ratio	0.73	0.30	0.49	0.56	0.53
Control Delay	37.5	6.1	10.0	14.1	6.8
Queue Delay	0.0	0.0	0.7	0.0	0.1
Total Delay	37.5	6.1	10.7	14.1	6.9
Queue Length 50th (ft)	127	18	228	163	119
Queue Length 95th (ft)	170	m32	m258	m249	m167
Internal Link Dist (ft)	210		523	544	
Turn Bay Length (ft)	175				
Base Capacity (vph)	851	640	1312	1064	1167
Starvation Cap Reductn	0	0	339	0	66
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.59	0.23	0.66	0.56	0.56

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Attachment G

Public Comment Report

Public Comment Report

Santa Fe and Mineral Intersection Project

A summary of comments received from the first public open house and online survey.

City of Littleton
October 2018

Contents

Open Littleton Survey Results

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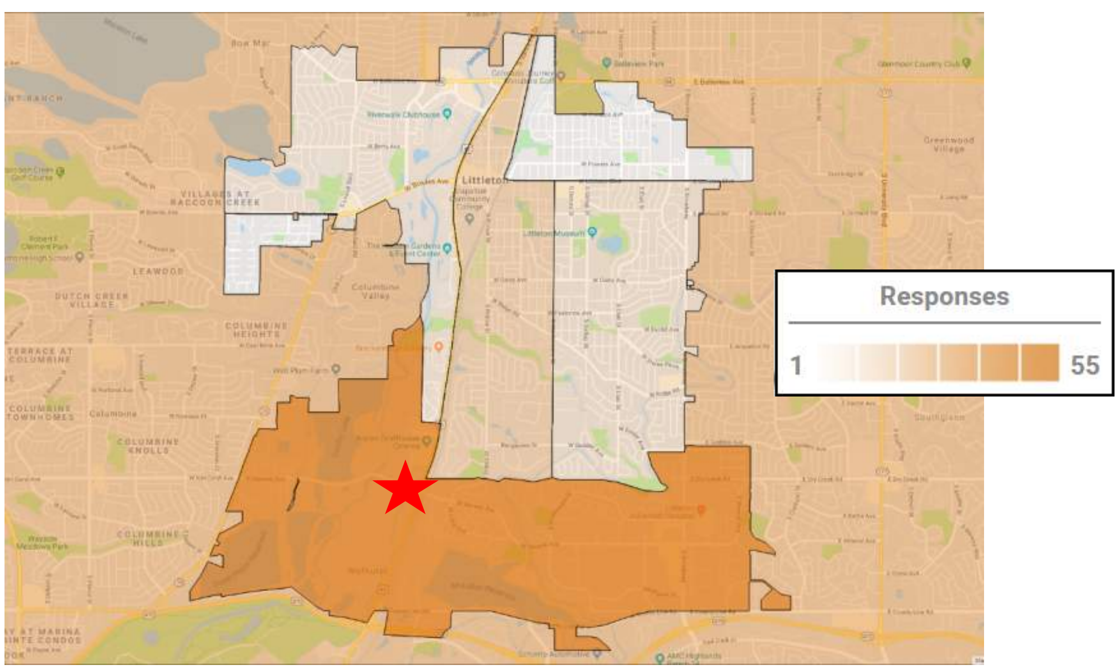
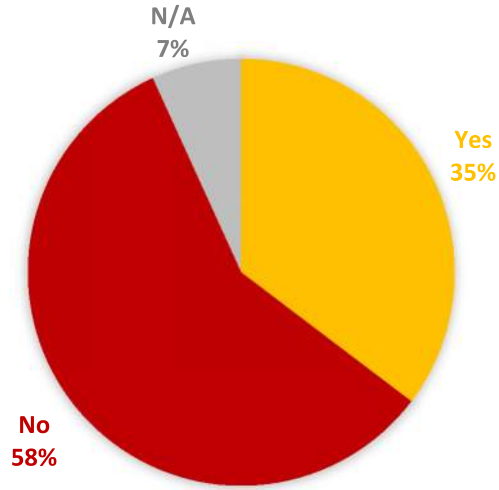
Responses



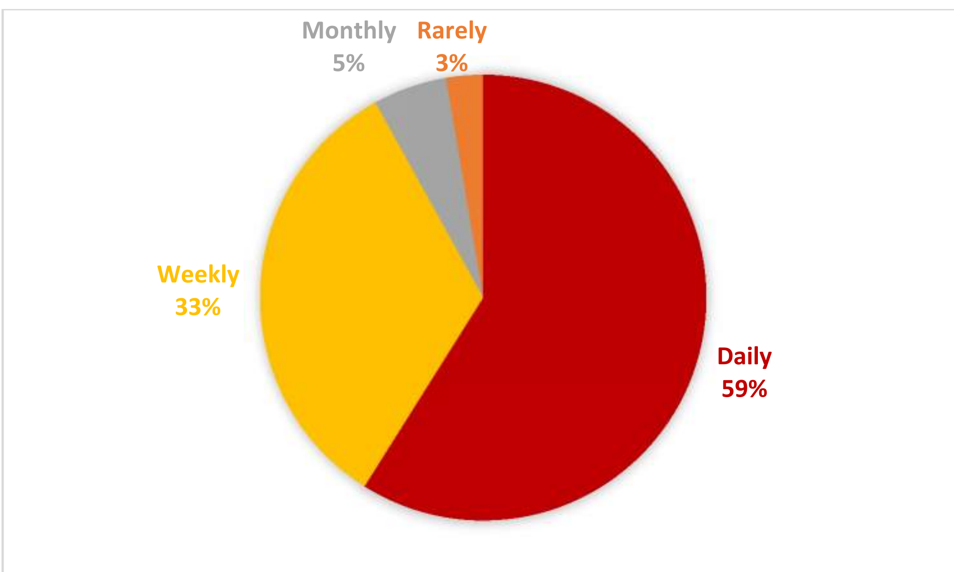
Q1: Do you consider this a safe intersection?



Comment Snapshot

- No. I've seen multiple rear end crashes here due to everyone speeding up and then hitting their brakes again when the light turns red.
- No. I have personally witnessed an accident on the east side of mineral because of the buildup of traffic.
- For automobiles, Yes. For bicyclists or pedestrians, absolutely not.
- Yes. I haven't seen any unsafe situations as I travel through it.

Q2: How often do you travel through this intersection?



Comment Snapshot

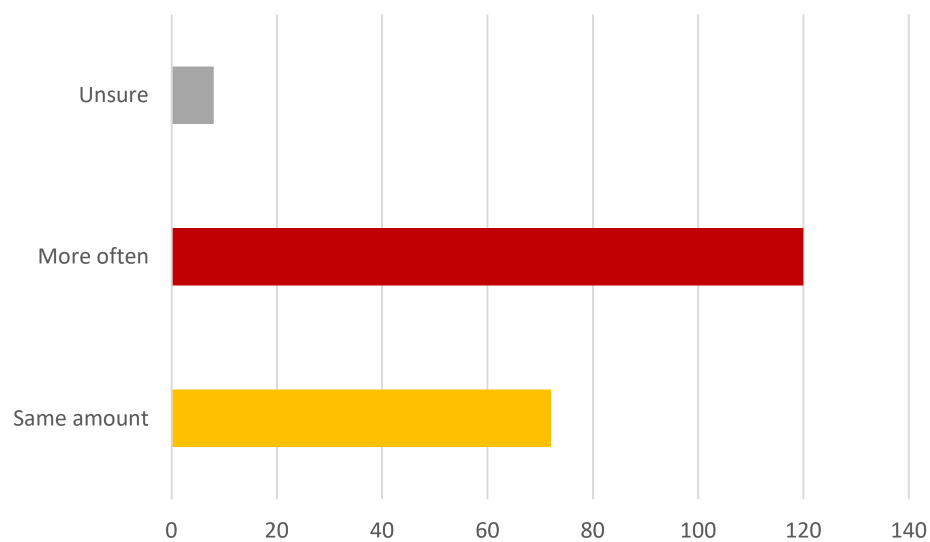
- I travel through this intersection at least 5 times a week for work and 1-2 times during the weekend for social activity.
- Not often. I avoid it when possible. If I do, it's for shopping or to go south towards Castle Rock. I used to travel there daily but changed daycares to not have to do that anymore. It was a nightmare.
- I could use this intersection at least 2x per day to commute to work downtown. I avoid it, though, during rush hour. I only use it after about 7 pm or on weekends.
- Daily for access to light rail, frequently for access to Santa Fe, C-470, and Aspen Grove.

Q3: How often do you avoid this intersection? What alternate routes do you use?

Comment Snapshot

- Whenever I can and since I am east of Santa Fe and south of Mineral, I take Jackass Hill to Prince Street or Mineral to Broadway to head north. I take Mineral to South Park Lane to County Line or Mineral to Broadway to head south.
- I avoid Mineral going West in the afternoon at all costs. I use Broadway or Platte Canyon to get to Belleview.
- I never avoid this intersection as it is the direct route from my place of employment into my residence in South Park. The alternative is to travel southbound Santa Fe, which is still part of the problem intersection. Almost daily. Prince St to Jackass Hill - Broadway or University to County Line.

Q4: How much more often would you use this intersection if traffic operations were improved?



Comment Snapshot

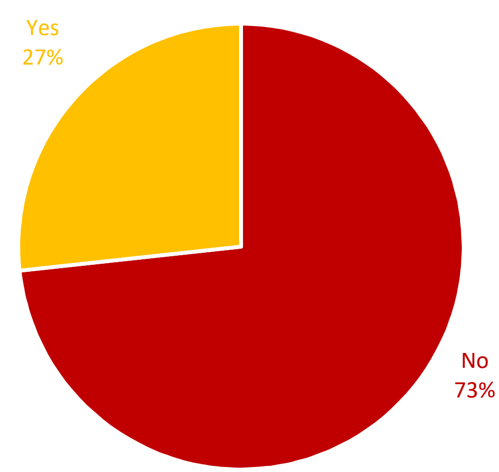
- Probably the same, but hopefully less frustration.
- Much, much more. And we would spend money more locally too. You're missing my tax dollars due to this intersection, and the terrible light timing.
- I have to use this intersection so any improvement would be better then what we see every day.
- We'd bike down to the Mary Carter Greenway trail much more often. I'd also be more likely to use it during rush hour.

Q5: In your opinion, what are the biggest challenges for the traffic at the intersection (left turns, through traffic, signal timing, too much traffic etc.)?

Comment Snapshot

- The left turn signal traveling on Mineral east to west could be longer. Few cars are able to move through the intersection using a left turn because the light is short and frequent travelers usually wait to make sure all cars are stopped before entering the intersection. Lots of red light runners!
- Too much traffic, right turns from Mineral to Santa Fe and the fact Santa Fe is not through traffic at the intersection. It needs to be set up like Santa Fe and Belleview with Santa Fe elevated and not stopping at Mineral.
- ALL OF THE ABOVE!!!! This is the perfect storm.
- Much is traffic flow, semi-trucks, construction vehicles, people using it as an alternate then C470 to get to Dry Creek.

Q6: Do you bike or walk through this intersection?



Comment Snapshot

- I'm alive, so therefore it proves I don't bike or walk near this intersection.
- Sometimes I walk when taking the light rail. Having a drop off on the east side of Santa Fe for the light rail would help.
- I use the light rail pedestrian bridge if I am walking or on my bike.
- I would never do either its too dangerous. I've used the light rail bridge. This intersection is not made for either bikes or pedestrians.

Q7: How often do you avoid this intersection when biking or walking? What alternate routes do you use?

Comment Snapshot

- All the time. If riding a bike we go up the ramp for the trains and across the bridge to get to the other side.
- Always. Use Carter greenway or Highline Canal instead.
- We almost always avoid it by going up and across the RTD light-rail platform.
- We always use the overpass. We would otherwise bike on the highline canal to the underpass to get to the routes along the Platte River.

Q8: Please provide additional comments.

Comment Snapshot

- I am amazed how congested this is, never saw it coming. Let's fix it.
- For those of us who live east of Santa Fe between the downtown and Mineral, the only routes to get to Santa Fe are via Mineral or via West Church Avenue near ACC or via streets which access Santa Fe north of Church in the downtown area. If there was any way to extend Ridge Road to Santa Fe, that would give people that additional route which would inevitably cut down on some usage of the Mineral/Santa Fe intersection.
- Why not do an overpass with exits underneath, you can turn right, wait at the light to turn left, or do a U-turn to go back the other way. Traffic on the upper pass going straight, never even have to stop. They do this in the southeast area of Texas, Harlingen is the experience I have with this type of road. It would solve a lot of problems. Very similar to Belleview and Santa Fe. Make Santa Fe more of an actual Highway.
- I think a classic Diamond Interchange is the proper investment. I think any smaller improvements will have their gains wiped out by future development and drawing in new commuter traffic.

Public Open House Comments (September 13, 2018)

The City of Littleton hosted the first public open house for the Santa Fe and Mineral Intersection study on September 13, 2018 from 5:30 to 7 p.m. at the Carson Nature Center. The event gave the public an opportunity to talk with the project team and provide their feedback on the project, presenting why this intersection study is necessary, existing conditions, future traffic congestion and possible long- and short-term solutions.

A total of 34 people signed in, however there were more than 60 attendees. Here's what we heard:

- About existing conditions:
  - Traffic is unpredictable at the intersection
  - Signal timing fixes can help, but will not solve the problem
  - Regional traffic from Douglas County, Highlands Ranch, and other nearby cities is the real issue
  - The intersection can be dangerous
  - WB bicycle lane is rarely used by bikes and impedes traffic flow
  - Mineral backups are just as bad as Santa Fe
  - East/West and North/South traffic flow are both important
- About the proposed solutions:
  - The at-grade solutions are a "band-aid" and the real need is to grade-separate this intersection
  - Some of the at-grade solutions show promise, particularly the Quadrant Roadway
  - Coordination with RTD or the Evergreen (SW quadrant developer) would be difficult for the Quadrant Roadway
  - The CFI and Median U-turn seem very confusing, and several people worried about how people new to the intersection would be able to find their way through it.
  - The grade-separated options create noise and visual impacts
  - The SPUI option works very well at Belleview
  - At-grade solutions don't appear to help east-west traffic on Mineral
  - Remove the WB bike lane and widen Mineral
  - Prefer the grade-separated options in an ideal world (where cost is not a consideration)
  - Signal timing on the rest of the corridor
  - The City should consider contacting Waze and/or Google to reduce re-routing traffic to parallel facilities as cut-through.

Attachment H

RTD Park-and-Ride Mitigation Technical Memorandum

Technical Memorandum

Date:	Thursday, September 19, 2019
Project:	City of Littleton, Santa Fe & Mineral Intersection Study
To:	Aaron Heumann, City of Littleton Brent Thompson, City of Littleton
From:	Tyler Hopkins, HDR David Millar, HDR Keith Borsheim, HDR Martin Droze, HDR
Subject:	RTD Park-and-Ride Mitigation

Introduction

In response to severe traffic congestion and safety issues at the US 85 (Santa Fe Drive)/Mineral Avenue intersection, the City of Littleton (the City) is conducting an evaluation of the intersection to identify and analyze potential solutions. Recognizing that the long-term solution may involve a grade-separated interchange that has a steep price tag, the City has endeavored to also identify solutions that can be implemented for a lower cost and in a shorter timeframe.

One alternative identified would include the construction of a quadrant roadway in the northwest quadrant of the study intersection, impacting the existing RTD Park-and-Ride (shown in **Figure 1**). Based on previous coordination, RTD has indicated that they would be amenable to this alternative only if all existing parking spaces (1,994 regular and 33 handicap) and bus bays (five) could be maintained.

Quadrant Roadway

The current design of the quadrant roadway would accommodate both left-turning traffic from the study intersection and all traffic accessing the Park-and-Ride lot. The roadway would connect to Santa Fe Drive approximately 750 feet north of the Santa Fe Drive/Mineral Avenue intersection and to Mineral Avenue at the existing Mineral Avenue/S Platte River Parkway intersection. Access to S Platte River Parkway would be provided at a signalized intersection along the new roadway.

The largest opportunity to regain lost spaces lies in paving and striping the existing gravel overflow lot west of S Platte River Parkway. Formalizing the layout of this lot, combined with other minor layout modifications in response to the placement of the quadrant roadway, results in not only the full replacement of all existing parking spaces, but nine additional spaces as well (**Table 1**). The full conceptual design of the quadrant roadway and reconfigured Park-and-Ride lot is provided in **Figure 2**.

Table 1: Number of Parking Spaces Summary

Type	Existing	Proposed
Regular	1,194	1,203
Handicap	33	33
Total	**1,227**	**1,236**

Figure 1: Existing Conditions

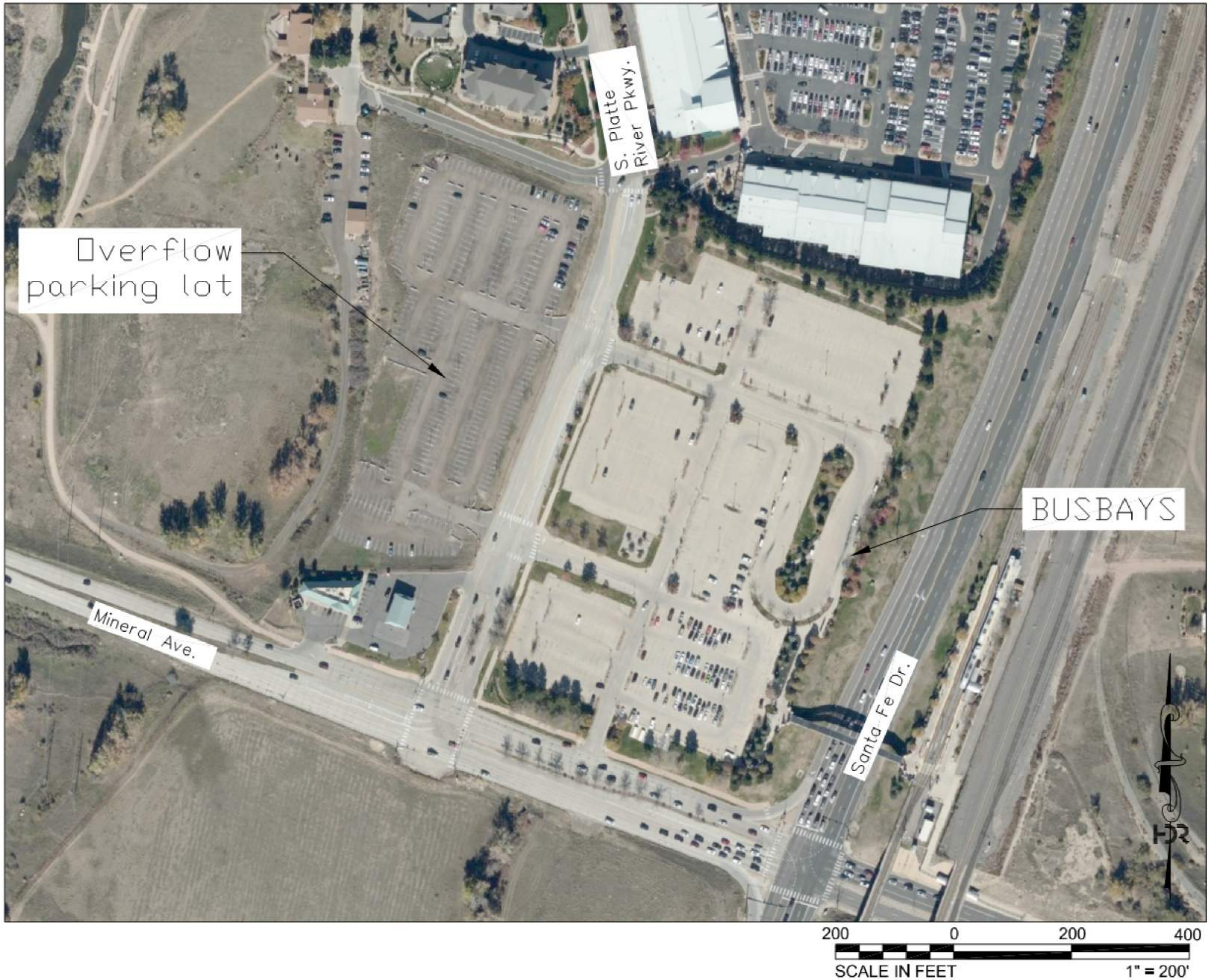
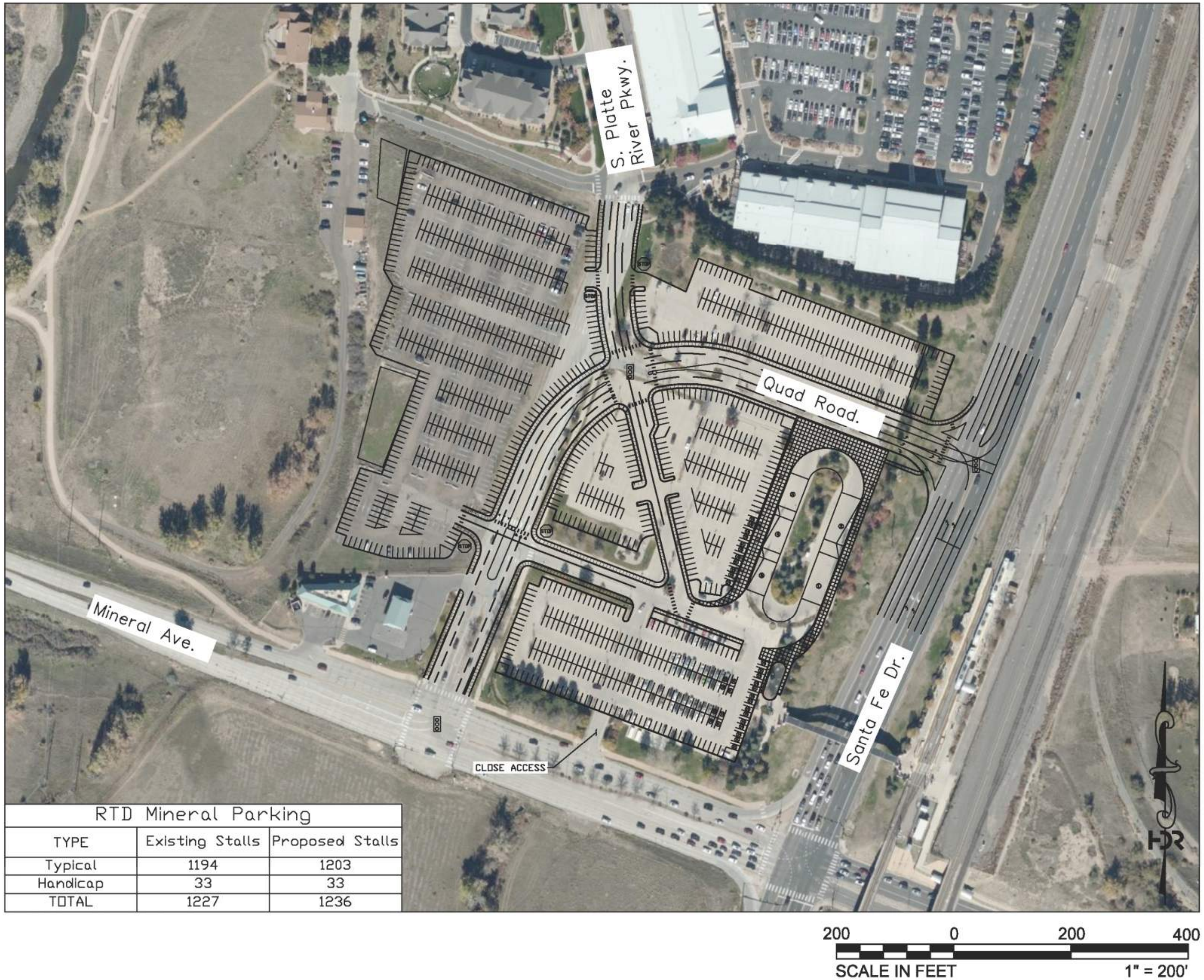


Figure 2: Surface Parking Layout



RTD Mineral Parking		
TYPE	Existing Stalls	Proposed Stalls
Typical	1194	1203
Handicap	33	33
TOTAL	1227	1236

Traffic Operations

Traffic operations at the Santa Fe Drive/Mineral Avenue intersection would be dramatically improved with construction of the quadrant roadway. In the future, delays at this intersection—which impact RTD operations—are expected to be reduced from 186.7 seconds to 49.8 seconds in the AM peak hour, and from 206.7 seconds to 50.3 seconds in the PM peak hour (**Table 2**), representing a nearly 50 percent reduction. Though RTD buses accessing the Park-and-Ride would be shifted to the quadrant roadway, based on the current routing of these buses no significant out-of-direction travel is expected.

Table 2: Delay Summary

Scenario	AM Peak Delay	PM Peak Delay
2019 Existing	92.5s	99.6s
2030 No Build	186.7s	206.7s
2030 Quadrant	49.8s	50.3s

This improvement in overall mobility for motorists and RTD buses alike would have significant benefits to the traveling public.

Structured Parking Option

Alternatively, as has been discussed previously between RTD and the City, a parking garage could be considered for the site. Using the dimensions of the structure at the I-25 and Lincoln Avenue station, **Figure 3** shows the approximate footprint of a parking garage (the Lincoln Avenue Park-and-Ride has approximately 1,700 spaces). There are many potential opportunities associated with a garage, such as:

- Covered bus bays on the first level;
- A second level connection directly to the pedestrian bridge;
- Elimination of the pedestrian crossings across the quadrant roadway;
- Land for TOD development or expanding Aspen Grove around the light rail station, the funds from which could help offset the cost of the parking structure; and
- Shared parking with future surrounding development.

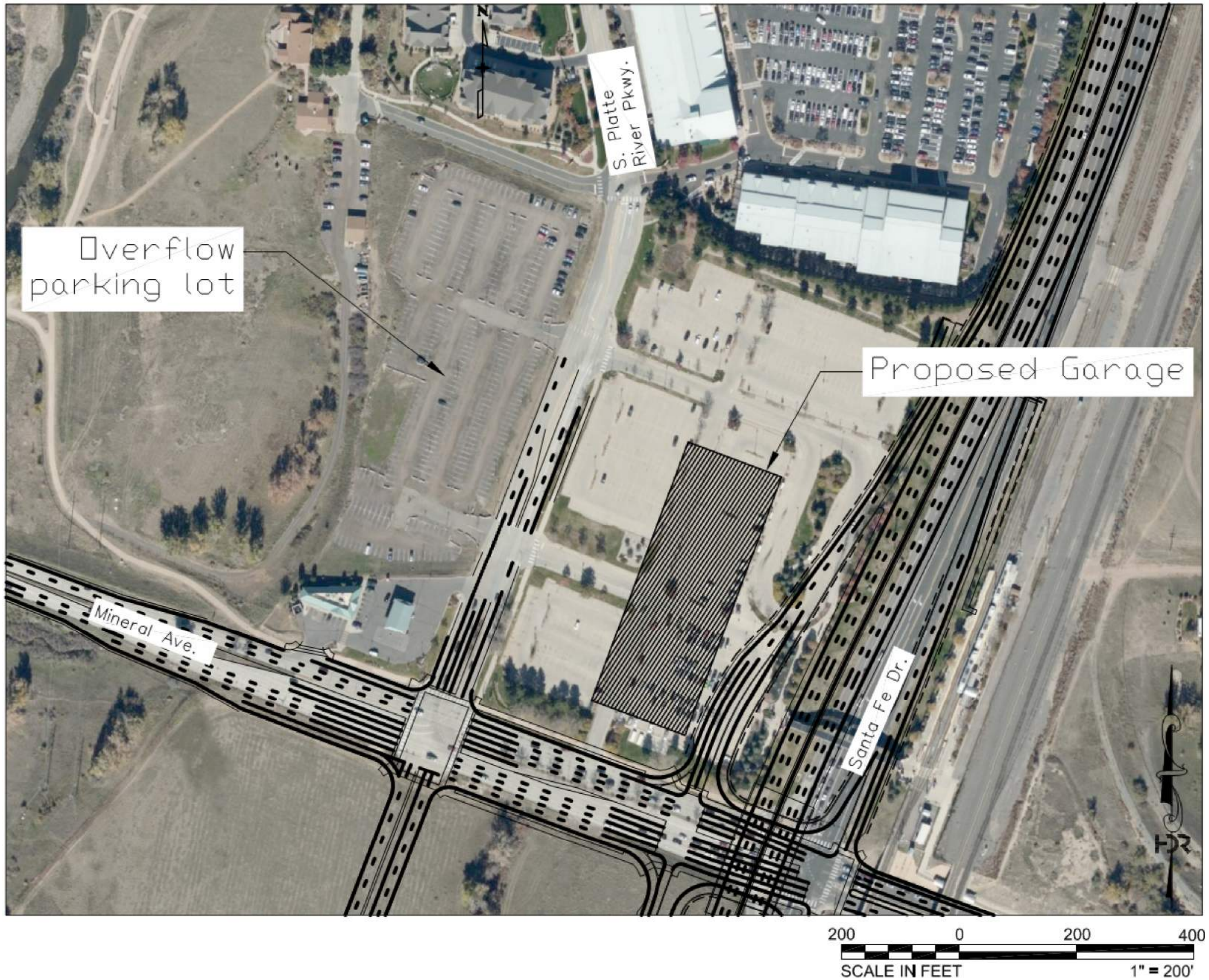
As both a parking garage and future grade separation of the Santa Fe Drive/Mineral Avenue intersection are potential long-term projects **Figure 3** shows that each can be designed to fit without interfering with the other. Note that the parking garage may also be constructed prior to grade separation, with access via the quadrant roadway.

Next Steps

At this stage of the design, additional coordination with RTD is required to obtain input on the final design of the Park-and-Ride lot. Of note, paving the overflow lot will result in a significant increase in impervious surface; the design of a stormwater detention system which abides by the UDFCD standards should be discussed as part of this coordination effort.

A conceptual cost estimate will be developed for the project as well—initial estimates put the reconfiguration and enhancement of the Park-and-Ride at an approximate cost of $1.5 to $2.0 million, in addition to the cost of the rest of the project (e.g. roadway construction and signals).

Figure 3: Structured Parking Option



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