Appendix F:
Traffic Sensitivity Analysis – April 2018

Technical Memorandum

TO:	Abdelmoez Abdalla, Federal Highway Administration	**DATE:**	April 20, 2018
FROM:	John Karachepone P.E., Jacobs		
SUBJECT:	Pyramid Highway/US 395 Connection, Year 2040 Sensitivity Analysis - Traffic		
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1. BACKGROUND

The Federal Highway Administration (FHWA), in cooperation with the Nevada Department of Transportation (NDOT) and the Regional Transportation Commission of Washoe County (RTC), issued a Draft Environmental Impact Statement (Draft EIS) in August 2013 that identified and evaluated transportation improvements along the Pyramid Highway corridor and a proposed connection between Pyramid Highway and US 395. The Draft EIS evaluated a No-Action Alternative, and four Build Alternatives (referred to as Alternatives 1, 2, 3, and 4). The *Pyramid Highway/US 395 Connector Traffic Report* (December 2011)[1] was prepared in support of the Draft EIS. Based on the Draft EIS findings and public and agency comments received on the Draft EIS, Alternative 3 was identified as the Preferred Alternative.

While the Preferred Alternative was being identified and vetted by elected officials after the Draft EIS, RTC was in the process of adopting a new regional traffic model. This new model used updated population and employment projections from a new Consensus Forecast from the Truckee Meadows Regional Planning Agency that replaced the Interim Consensus Forecast (ICF) used for the Draft EIS traffic analysis. In general, the projected population and employment in the region are forecasted to be lower, and the areas of population and employment growth have changed to be more consolidated than the prior ICF estimates. As a result, the forecasted volumes from the updated travel demand models were also generally lower than the previously forecasted volumes documented in the Draft EIS.

The reduction in traffic forecasts was significant enough for the Study team to revisit the identification and design of the freeway-type build alternatives evaluated in the Draft EIS. This warranted a review of prior decisions made as part of the Draft EIS process. First, the Study team verified that the Purpose and Need for the project had not changed based on the new

[1] The “Pyramid Highway/US 395 Connector Traffic Report” was submitted to NDOT on December 16, 2011 and approved on February 23, 2012.

traffic data, and then rescreened the alternatives to make sure that the best performing alternatives were carried forward for full evaluation in the Draft EIS.

Based on the reduced forecasted traffic, the Study team completed a detailed reevaluation of the four freeway-type build alternatives evaluated in the Draft EIS. The reduced traffic demand changed the type of highway facility needed; the Study team concluded that an arterial facility instead of a freeway facility could provide adequate capacity for the projected traffic volumes. Because the design criteria for an arterial facility are different from those required for a freeway facility, the Study team modified the design criteria for the build alternatives to those of an arterial facility, including the cross-section width, design speed, access control, and acceptable grades. This effort resulted in a cumulative reduction in the facility design footprint of the build ("freeway") alternatives that were fully evaluated in the Draft EIS. The build alternatives were redesigned as arterial facilities, and traffic operations analyses were completed. A memorandum was prepared on May 28, 2015, as an update to the *Update to Pyramid Highway/US 395 Connector Traffic Report* (December 2011)[2] technical report prepared for the Draft EIS.

Between fall 2015 and spring 2016, several meetings occurred between the RTC, FHWA, and NDOT to resolve how to proceed with the Final EIS (FEIS). One of several discussion items was the new 2040 traffic model that the RTC was in the process of developing. During a May 2016 meeting, it was agreed to proceed with the 2035 model for FEIS purposes. This approach was documented in subsequent methods memoranda (a June 2016 memorandum was sent, which was later updated in December 2016 when FHWA requested additional traffic analysis). The December 13, 2016 methods memorandum addresses the issue of the new 2040 model in some detail. The memorandum states: "*As discussed in Section 2.5.1 in the FHWA Interim Guidance on the Application of Travel and Land Use Forecasting in NEPA, a sensitivity test can be conducted to determine if the changes caused by the introduction of the new data or model version would change the conclusions made from the previous analysis. If there is no change, then the study team would simply document the change and the sensitivity analysis in the project administrative record and move on instead of re-doing the analysis*."

In late 2017, FHWA Legal Counsel raised this issue again as part of its review of the November 2017 Administrative Draft FEIS, questioning whether the arterial-type alternatives evaluated in the Final EIS could accommodate the year 2040 traffic volumes.

Consistent with the December 13, 2016 memorandum, this memorandum documents the sensitivity analysis conducted to determine if the changes caused by the new year 2040 horizon model would change the conclusions made from the previous analysis.

[2] The "Update to Pyramid Highway/US 395 Connector Traffic Report (December 2011), Pyramid Highway/US 395 Connection Environmental Impact Statement, Alternative 3 (Preferred Alternative) Modified Design" was submitted to NDOT on May 28, 2015 and approved on June 4, 2015.

2. PURPOSE OF THIS MEMORANDUM

The purpose of this memorandum is to document the traffic sensitivity analyses completed to:

1. Test if the new 2040 travel demand model and associated traffic projections would change the conclusions made from the previous analysis documented in the FEIS.
2. Determine if the Preferred Alternative (Arterial Alternative 3) documented in the FEIS can be expected to operate with an acceptable level of service with the estimated year 2040 traffic volumes.

3. METHODOLOGY

The methodology to complete this sensitivity test is based on comparing models from RTC that represent the year 2035 and 2040, determining the expected growth in traffic volumes between 2035 and 2040 for key signalized intersections along the Preferred Arterial Alternative 3, then examining the associated impacts. The specific methodology is described in the following steps:

- Obtain traffic volume plots from RTC representing the year 2040 and year 2035 conditions.
- Determine the differences in raw[3] model 2035 and 2040 volumes as percentage growth.
- Apply the growth percentage to the year 2035 volumes previously approved by NDOT Traffic Information to develop an estimate of the year 2040 volumes at selected signalized intersections along the Preferred Alternative (those signalized intersections projected to operate at the poorest LOS in the year 2035). All such intersections are located along Pyramid Highway.
- Conduct an operational analysis at those select signalized intersections that exhibited the poorest LOS in the year 2035 and evaluate operations.
- Revisit the qualitative evaluations for air quality - CO hotspot included in the administrative draft FEIS based on the year 2040 traffic analysis above.

4. OBSERVATIONS FROM MODEL COMPARISON

The RTC provided model results (direct model output representing raw model volumes) from the current adopted RTP (the horizon year 2040) model and the previous adopted RTP model (the horizon year 2035). The previous adopted RTP model (the horizon year 2035) was the basis for the previous analysis documented in the FEIS. Table 1 summarizes the raw model volumes as output from the models at four key intersections along Pyramid Highway.

[3] Volumes obtained directly from the model are described as "raw" model volumes and are not suitable for use directly in analysis. The NDOT Traffic Information Division has a specific and detailed procedure by which model volumes are processed for use in operational analysis. For this sensitivity test, the model-to-model growth percentage is ascertained and this growth percentage is applied to previously approved traffic forecasts for the year 2035 to estimate the year 2040 conditions.

Table 1 – Percentage difference between 2035 and 2040 daily volumes directly from the model at key intersections along Pyramid Highway

Intersection	Year 2035 Daily Volume	Year 2040 Daily Volume	Difference as a Percentage
Pyramid at Disc Drive	139,054	80,474	-42.13%
Pyramid at Sparks Boulevard	133,656	129,070	-3.43%
Pyramid at Lazy 5 Parkway	119,993	125,656	4.72%
Pyramid at Eagle Canyon/La Posada	86,598	83,273	-3.84%

Source: RTC Models reflecting the year 2035 horizon year and 2040 RTP horizon year

As summarized in Table 1, traffic remains about the same between Years 2035 and 2040, except for a notable decrease in volumes at the intersection of Pyramid Highway at Disc Drive. A review of the roadway network of the two models indicates that some of the difference may be attributed to differences between the two model networks and associated provided connectivity. For example, the RTC year 2040 model shows the US 395 Connector (Connector) with an intersection at West Sun Valley Boulevard, while the 2035 model shows the Connector with an interchange at Sun Valley Boulevard. An interchange (with free flow for through movements) is attractive to traffic and attracts more traffic to the Connector. Similarly, a direct connection at Sun Valley Boulevard (instead of West Sun Valley Boulevard) attracts more traffic to the Connector because users can then use Sun Valley Boulevard to access US 395 through interchanges at Sutro Drive and Clear Acre Lane. A check was then conducted on the expected volumes on the mainline link of the Connector west of Disc Drive and east of Sun Valley Boulevard. The 2035 raw model volume is 58,635 vehicles per day while the corresponding 2040 raw model volume is 51,036 vehicles per day (a reduction of about 13 percent). Therefore, it is reasonable that the Connector mainline conditions and the interchange configuration evaluated in the FEIS (based on the 2035 RTP model) will be sufficient to provide for acceptable operations in the year 2040.

With regards to the other intersections, Table 1 indicates that the volumes vary by about five percent. Such a variation in traffic can occur due to daily and seasonal variations in traffic demand. Nevertheless, the intersection of Pyramid Highway at Lazy 5 Parkway shows a marginal increase in total traffic, while all the other intersections show decreases between the year 2035 and 2040.

As shown in Table 2, at the Lazy 5 intersection, the increased traffic is in the east-west direction rather than the north-south (Pyramid Highway) direction. An examination of the roadway network in the area shows a new roadway link at Eagle Canyon Drive, connecting to the west, provides an option for traffic destined to/from the northwest. From Lazy 5 Parkway traffic can proceed west to West Sun Valley Boulevard and then to the new extension of Eagle Canyon Drive to the west. Because the east-west traffic increases at the Lazy 5 Parkway intersection are significant, this intersection is selected for operational traffic analysis under 2040 conditions as a sensitivity test.

Table 2– Detail of Raw Model Traffic Demand at the Signalized Intersection of Lazy 5 Parkway

Intersection	Direction of Travel	Year 2035 Daily Volume	Year 2040 Daily Volume	Difference as a Percentage
Pyramid at Lazy 5 Parkway	From West	8,244	11,479	39.23%
	From North	42,331	38,037	-10.14%
	From East	11,377	20,248	77.97%
	From South	58,040	55,892	-3.70%
	Totals	**119,993**	**125,656**	**4.72%**

Source: RTC Models reflecting the year 2035 horizon year and 2040 RTP horizon year

Consistent with Table 2, the east-west through volumes are increased by 39 percent from the west, and 78 percent from the east to estimate the year 2040 conditions at the Lazy 5 intersection. All other traffic volumes are held constant at the intersection.

5. SIGNALIZED INTERSECTION OPERATIONS ANALYSIS OF 2040 CONDITIONS

A Synchro operational analysis was completed to determine if the previously analyzed 2035 geometric conditions at the Lazy 5 Parkway intersection of Pyramid Highway would be sufficient for the projected year 2040 conditions. First, the analysis at the intersection was updated to the current Highway Capacity Manual (HCM), 6th Edition, methodologies. Table 3 summarizes the results.

Table 3 – Summary Results from 2040 Analysis of Signalized Intersection of Lazy 5 Parkway

Pyramid Highway at Lazy 5 Parkway	AM Peak Hour		PM Peak Hour	
	HCM 6th Ed Control Delay (seconds)	HCM 6th Ed Level of Service	HCM 6th Ed Control Delay (seconds)	HCM 6th Ed Level of Service
Year 2035	36.0	D	42.3	D
Year 2040	37.1	D	44.2	D

As is evident in Table 3, the intersection of Pyramid Highway at Lazy 5 Parkway can be expected to operate at LOS D or better in the year 2040. The results shown above reflect network signal timing favoring Pyramid Highway and include some movements and approaches operating at LOS F. The signal timing for the year 2040 conditions were then optimized to confirm that the intersection can operate acceptably with all movements and approaches operating at LOS E or better. The overall intersection continues to operate at LOS D, confirming that the Preferred Arterial Alternative 3 documented in the FEIS can be expected to operate with an acceptable level of service with the estimated year 2040 traffic volumes. Appendix 1 contains the analysis sheets.

6. AIR QUALITY

Because use of the latest planning assumptions for traffic forecasting relates to air quality conformity, the FEIS air quality analysis was reviewed to determine whether the 2040 traffic model would change or affect the analysis and conclusions reached.

The Carbon Monoxide (CO) hot spot analysis prepared for the Draft EIS (based on 2035 traffic volumes) concluded that no exceedances of the CO standard would occur. Based on the updated year 2035 traffic data for the Final EIS, emissions are anticipated to be lower than those estimated for the Draft EIS because of lower traffic volumes. The FEIS concludes that no exceedances of the CO standard would occur as a result of the Arterial Alternatives.

A review of the differences between the 2035 model used for the FEIS and the current 2040 traffic model indicates that the 2040 model would not change this conclusion. Under the 2040 traffic model, none of the Arterial Alternatives would result in exceedances of the CO standard because:

- Even if traffic volumes were to slightly increase with the year 2040 traffic data (compared to the year 2035 traffic volumes), any related increases in emissions would be offset by lower emission factors for the year 2040; and
- The Draft EIS used higher traffic volumes and emission factors but still concluded no exceedances would occur.

A review of Mobile Source Air Toxics (MSAT) evaluation was also conducted. Potential impacts from MSATs are greatest near highly developed residential areas and congested intersections. The intersection of Pyramid Highway and Disc Drive is anticipated to have the highest traffic volumes based on 2035 traffic data. However, traffic volumes would decrease at this intersection based on the 2040 traffic data. As Table 1 shows, traffic volumes at other major intersections are very similar. Therefore, the 2040 traffic model would not result in material changes to the FEIS MSAT analysis.

7. CONCLUSIONS

The analysis completed and documented within this memorandum confirms that the Preferred Arterial Alternative 3 documented in the FEIS can be expected to operate with an acceptable level of service with the estimated year 2040 traffic volumes.

This memorandum also confirms that the new 2040 travel demand model and associated traffic projections would NOT change the conclusions made from the previous analysis documented in the FEIS

Appendix 1

Results Sheets from the Signalized Intersection Analysis

(see separate file)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	130	180	340	430	150	170	200	1390	290	190	2430	150
Future Volume (veh/h)	130	180	340	430	150	170	200	1390	290	190	2430	150
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826
Adj Flow Rate, veh/h	141	196	278	467	163	139	217	1511	283	207	2641	147
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	198	229	285	525	374	167	400	2538	788	272	2961	729
Arrive On Green	0.11	0.07	0.07	0.16	0.11	0.11	0.12	0.51	0.51	0.08	0.47	0.47
Sat Flow, veh/h	1739	3469	1547	3374	3469	1547	3374	4985	1547	3374	6281	1547
Grp Volume(v), veh/h	141	196	278	467	163	139	217	1511	283	207	2641	147
Grp Sat Flow(s),veh/h/ln	1739	1735	1547	1687	1735	1547	1687	1662	1547	1687	1570	1547
Q Serve(g_s), s	8.3	5.9	6.4	14.4	4.7	9.3	6.4	22.7	11.7	6.4	40.7	5.9
Cycle Q Clear(g_c), s	8.3	5.9	6.4	14.4	4.7	9.3	6.4	22.7	11.7	6.4	40.7	5.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	198	229	285	525	374	167	400	2538	788	272	2961	729
V/C Ratio(X)	0.71	0.86	0.97	0.89	0.44	0.83	0.54	0.60	0.36	0.76	0.89	0.20
Avail Cap(c_a), veh/h	198	229	285	541	392	175	509	2538	788	382	2961	729
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	45.3	49.0	43.0	43.9	44.3	46.4	44.1	18.3	15.6	47.8	25.6	16.4
Incr Delay (d2), s/veh	11.3	25.9	46.0	16.3	0.8	26.9	1.2	1.0	1.3	5.6	4.6	0.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.0	3.3	10.5	6.9	2.0	4.7	2.6	7.8	4.0	2.8	14.1	2.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	56.6	74.9	89.0	60.2	45.1	73.3	45.2	19.4	16.9	53.4	30.2	17.0
LnGrp LOS	E	E	F	E	D	E	D	B	B	D	C	B
Approach Vol, veh/h		615			769			2011			2995	
Approach Delay, s/veh		77.1			59.4			21.8			31.1	
Approach LOS		E			E			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	13.6	59.0	21.5	12.0	17.6	55.0	17.1	16.4
Change Period (Y+Rc), s	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max Green Setting (Gmax), s	12.0	54.0	17.0	7.0	16.0	50.0	12.0	12.0
Max Q Clear Time (g_c+I1), s	8.4	24.7	16.4	8.4	8.4	42.7	10.3	11.3
Green Ext Time (p_c), s	0.2	13.2	0.1	0.0	0.4	6.8	0.1	0.1

Intersection Summary	
HCM 6th Ctrl Delay	36.0
HCM 6th LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	140	160	140	270	160	230	270	2510	360	230	1600	160
Future Volume (veh/h)	140	160	140	270	160	230	270	2510	360	230	1600	160
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826
Adj Flow Rate, veh/h	152	174	114	293	174	188	293	2728	352	250	1739	157
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	161	230	317	399	320	143	467	2914	1088	260	3285	952
Arrive On Green	0.09	0.07	0.07	0.12	0.09	0.09	0.14	0.58	0.58	0.08	0.52	0.52
Sat Flow, veh/h	1739	3469	1547	3374	3469	1547	3374	4985	1547	3374	6281	1547
Grp Volume(v), veh/h	152	174	114	293	174	188	293	2728	352	250	1739	157
Grp Sat Flow(s),veh/h/ln	1739	1735	1547	1687	1735	1547	1687	1662	1547	1687	1570	1547
Q Serve(g_s), s	11.3	6.4	0.0	10.9	6.2	12.0	10.7	65.3	0.0	9.6	23.7	0.0
Cycle Q Clear(g_c), s	11.3	6.4	0.0	10.9	6.2	12.0	10.7	65.3	0.0	9.6	23.7	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	161	230	317	399	320	143	467	2914	1088	260	3285	952
V/C Ratio(X)	0.95	0.76	0.36	0.73	0.54	1.32	0.63	0.94	0.32	0.96	0.53	0.16
Avail Cap(c_a), veh/h	161	267	333	399	320	143	467	2914	1088	260	3285	952
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	58.7	59.7	44.4	55.3	56.4	59.0	52.8	24.8	7.4	59.8	20.4	10.7
Incr Delay (d2), s/veh	55.3	10.1	0.7	6.9	1.9	183.1	2.7	7.2	0.8	45.6	0.6	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.3	3.1	3.1	4.9	2.7	11.8	4.5	24.0	3.4	5.6	8.1	1.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	114.0	69.8	45.1	62.2	58.3	242.1	55.5	32.0	8.2	105.4	21.1	11.1
LnGrp LOS	F	E	D	E	E	F	E	C	A	F	C	B
Approach Vol, veh/h		440			655			3373			2146	
Approach Delay, s/veh		78.7			112.8			31.6			30.2	
Approach LOS		E			F			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	15.0	81.0	20.4	13.6	23.0	73.0	17.0	17.0
Change Period (Y+Rc), s	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max Green Setting (Gmax), s	10.0	76.0	14.0	10.0	18.0	68.0	12.0	12.0
Max Q Clear Time (g_c+I1), s	11.6	67.3	12.9	8.4	12.7	25.7	13.3	14.0
Green Ext Time (p_c), s	0.0	8.2	0.1	0.2	0.5	17.5	0.0	0.0

Intersection Summary		
HCM 6th Ctrl Delay		42.3
HCM 6th LOS		D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	130	250	340	430	270	170	200	1390	290	190	2430	150
Future Volume (veh/h)	130	250	340	430	270	170	200	1390	290	190	2430	150
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826
Adj Flow Rate, veh/h	141	272	278	467	293	139	217	1511	283	207	2641	147
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	217	293	270	506	382	170	304	2478	769	272	3064	755
Arrive On Green	0.12	0.08	0.08	0.15	0.11	0.11	0.09	0.50	0.50	0.08	0.49	0.49
Sat Flow, veh/h	1739	3469	1547	3374	3469	1547	3374	4985	1547	3374	6281	1547
Grp Volume(v), veh/h	141	272	278	467	293	139	217	1511	283	207	2641	147
Grp Sat Flow(s),veh/h/ln	1739	1735	1547	1687	1735	1547	1687	1662	1547	1687	1570	1547
Q Serve(g_s), s	8.2	8.3	9.0	14.6	8.8	9.4	6.7	23.3	12.0	6.4	39.6	5.7
Cycle Q Clear(g_c), s	8.2	8.3	9.0	14.6	8.8	9.4	6.7	23.3	12.0	6.4	39.6	5.7
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	217	293	270	506	382	170	304	2478	769	272	3064	755
V/C Ratio(X)	0.65	0.93	1.03	0.92	0.77	0.82	0.71	0.61	0.37	0.76	0.86	0.19
Avail Cap(c_a), veh/h	217	293	270	506	423	189	411	2478	769	380	3064	755
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	44.5	48.5	44.0	44.7	46.1	46.4	47.2	19.3	16.5	48.0	24.1	15.4
Incr Delay (d2), s/veh	6.7	34.3	62.8	22.5	7.5	21.8	3.7	1.1	1.4	5.7	3.5	0.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.8	4.8	11.5	7.4	4.0	4.5	2.8	8.1	4.1	2.8	13.4	2.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	51.2	82.8	106.8	67.2	53.6	68.2	50.9	20.5	17.8	53.7	27.6	16.0
LnGrp LOS	D	F	F	E	D	E	D	C	B	D	C	B
Approach Vol, veh/h		691			899			2011			2995	
Approach Delay, s/veh		86.0			62.9			23.4			28.8	
Approach LOS		F			E			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	13.6	58.0	21.0	14.0	14.6	57.0	18.3	16.7
Change Period (Y+Rc), s	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max Green Setting (Gmax), s	12.0	53.0	16.0	9.0	13.0	52.0	12.0	13.0
Max Q Clear Time (g_c+I1), s	8.4	25.3	16.6	11.0	8.7	41.6	10.2	11.4
Green Ext Time (p_c), s	0.2	12.8	0.0	0.0	0.3	9.5	0.1	0.4

Intersection Summary	
HCM 6th Ctrl Delay	37.8
HCM 6th LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	140	220	140	270	280	230	270	2510	360	230	1600	160
Future Volume (veh/h)	140	220	140	270	280	230	270	2510	360	230	1600	160
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826
Adj Flow Rate, veh/h	152	239	114	293	304	188	293	2728	352	250	1739	157
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	161	290	343	367	347	155	467	2876	1061	260	3237	940
Arrive On Green	0.09	0.08	0.08	0.11	0.10	0.10	0.14	0.58	0.58	0.08	0.52	0.52
Sat Flow, veh/h	1739	3469	1547	3374	3469	1547	3374	4985	1547	3374	6281	1547
Grp Volume(v), veh/h	152	239	114	293	304	188	293	2728	352	250	1739	157
Grp Sat Flow(s),veh/h/ln	1739	1735	1547	1687	1735	1547	1687	1662	1547	1687	1570	1547
Q Serve(g_s), s	11.3	8.8	0.0	11.0	11.2	13.0	10.7	66.5	0.0	9.6	24.1	0.0
Cycle Q Clear(g_c), s	11.3	8.8	0.0	11.0	11.2	13.0	10.7	66.5	0.0	9.6	24.1	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	161	290	343	367	347	155	467	2876	1061	260	3237	940
V/C Ratio(X)	0.95	0.83	0.33	0.80	0.88	1.21	0.63	0.95	0.33	0.96	0.54	0.17
Avail Cap(c_a), veh/h	161	294	345	367	347	155	467	2876	1061	260	3237	940
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	58.7	58.6	42.5	56.5	57.7	58.5	52.8	25.7	8.3	59.8	21.1	11.1
Incr Delay (d2), s/veh	55.3	17.1	0.6	11.7	21.4	141.6	2.7	8.5	0.8	45.6	0.6	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.3	4.5	3.0	5.2	5.8	11.0	4.5	24.9	3.7	5.6	8.2	1.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	114.0	75.7	43.0	68.2	79.1	200.1	55.5	34.2	9.1	105.4	21.8	11.5
LnGrp LOS	F	E	D	E	E	F	E	C	A	F	C	B
Approach Vol, veh/h		505			785			3373			2146	
Approach Delay, s/veh		79.9			104.0			33.4			30.8	
Approach LOS		E			F			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	15.0	80.0	19.1	15.9	23.0	72.0	17.0	18.0
Change Period (Y+Rc), s	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max Green Setting (Gmax), s	10.0	75.0	14.0	11.0	18.0	67.0	12.0	13.0
Max Q Clear Time (g_c+I1), s	11.6	68.5	13.0	10.8	12.7	26.1	13.3	15.0
Green Ext Time (p_c), s	0.0	6.2	0.1	0.0	0.5	17.3	0.0	0.0

Intersection Summary	
HCM 6th Ctrl Delay	44.2
HCM 6th LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	130	250	340	430	270	170	200	1390	290	190	2430	150
Future Volume (veh/h)	130	250	340	430	270	170	200	1390	290	190	2430	150
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826
Adj Flow Rate, veh/h	141	272	278	467	293	139	217	1511	283	207	2641	147
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	220	329	302	479	383	171	338	2455	762	274	2975	733
Arrive On Green	0.13	0.09	0.09	0.14	0.11	0.11	0.10	0.49	0.49	0.08	0.47	0.47
Sat Flow, veh/h	1739	3469	1547	3374	3469	1547	3374	4985	1547	3374	6281	1547
Grp Volume(v), veh/h	141	272	278	467	293	139	217	1511	283	207	2641	147
Grp Sat Flow(s),veh/h/ln	1739	1735	1547	1687	1735	1547	1687	1662	1547	1687	1570	1547
Q Serve(g_s), s	8.1	8.1	8.0	14.6	8.7	9.3	6.5	23.3	12.0	6.3	40.3	5.8
Cycle Q Clear(g_c), s	8.1	8.1	8.0	14.6	8.7	9.3	6.5	23.3	12.0	6.3	40.3	5.8
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	220	329	302	479	383	171	338	2455	762	274	2975	733
V/C Ratio(X)	0.64	0.83	0.92	0.97	0.77	0.81	0.64	0.62	0.37	0.76	0.89	0.20
Avail Cap(c_a), veh/h	220	329	302	479	427	191	479	2455	762	415	2975	733
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	43.8	46.9	41.7	45.1	45.6	45.9	45.7	19.5	16.6	47.5	25.2	16.2
Incr Delay (d2), s/veh	6.2	15.9	32.2	34.4	7.3	21.2	2.0	1.2	1.4	4.2	4.4	0.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.7	4.1	9.4	8.1	4.0	4.4	2.7	8.1	4.1	2.7	13.9	2.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	50.0	62.9	74.0	79.5	52.9	67.1	47.7	20.7	18.0	51.7	29.6	16.8
LnGrp LOS	D	E	E	E	D	E	D	C	B	D	C	B
Approach Vol, veh/h		691			899			2011			2995	
Approach Delay, s/veh		64.7			68.9			23.2			30.5	
Approach LOS		E			E			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	13.6	57.0	20.0	15.0	15.6	55.0	18.3	16.7
Change Period (Y+Rc), s	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max Green Setting (Gmax), s	13.0	52.0	15.0	10.0	15.0	50.0	12.0	13.0
Max Q Clear Time (g_c+I1), s	8.3	25.3	16.6	10.1	8.5	42.3	10.1	11.3
Green Ext Time (p_c), s	0.3	12.6	0.0	0.0	0.3	7.1	0.1	0.4

Intersection Summary	
HCM 6th Ctrl Delay	37.1
HCM 6th LOS	D

HCM 6th Signalized Intersection Summary
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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	140	220	140	270	280	230	270	2510	360	230	1600	160
Future Volume (veh/h)	140	220	140	270	280	230	270	2510	360	230	1600	160
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826	1826
Adj Flow Rate, veh/h	152	239	114	293	304	188	293	2728	352	250	1739	157
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	178	308	300	391	355	297	355	2729	1026	301	3339	981
Arrive On Green	0.10	0.09	0.09	0.12	0.10	0.10	0.11	0.55	0.55	0.09	0.53	0.53
Sat Flow, veh/h	1739	3469	1547	3374	3469	1547	3374	4985	1547	3374	6281	1547
Grp Volume(v), veh/h	152	239	114	293	304	188	293	2728	352	250	1739	157
Grp Sat Flow(s),veh/h/ln	1739	1735	1547	1687	1735	1547	1687	1662	1547	1687	1570	1547
Q Serve(g_s), s	10.8	8.5	0.0	10.6	10.9	2.8	10.7	68.9	0.0	9.2	22.6	0.0
Cycle Q Clear(g_c), s	10.8	8.5	0.0	10.6	10.9	2.8	10.7	68.9	0.0	9.2	22.6	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	178	308	300	391	355	297	355	2729	1026	301	3339	981
V/C Ratio(X)	0.86	0.78	0.38	0.75	0.86	0.63	0.83	1.00	0.34	0.83	0.52	0.16
Avail Cap(c_a), veh/h	221	413	347	391	358	298	375	2729	1026	321	3339	981
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	55.7	56.2	44.2	53.9	55.7	46.9	55.3	28.5	9.2	56.4	19.1	9.4
Incr Delay (d2), s/veh	22.7	6.5	0.8	7.8	18.0	4.3	13.5	17.1	0.9	15.8	0.6	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.7	3.9	3.1	4.8	5.5	5.6	5.0	28.1	3.9	4.4	7.6	1.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	78.4	62.7	45.0	61.8	73.7	51.2	68.8	45.6	10.2	72.2	19.7	9.8
LnGrp LOS	E	E	D	E	E	D	E	D	B	E	B	A
Approach Vol, veh/h		505			785			3373			2146	
Approach Delay, s/veh		63.4			63.8			44.0			25.1	
Approach LOS		E			E			D			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	16.3	74.0	19.6	16.2	18.3	72.0	17.9	17.9
Change Period (Y+Rc), s	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max Green Setting (Gmax), s	12.0	69.0	14.0	15.0	14.0	67.0	16.0	13.0
Max Q Clear Time (g_c+I1), s	11.2	70.9	12.6	10.5	12.7	24.6	12.8	12.9
Green Ext Time (p_c), s	0.1	0.0	0.1	0.7	0.1	17.5	0.1	0.0

Intersection Summary	
HCM 6th Ctrl Delay	41.7
HCM 6th LOS	D

Notes

User approved changes to right turn type.