EXHIBIT B

FEHR & PEERS

MEMORANDUM

Date:	February 16, 2016
To:	Greg Thurman, Terrasset Management Group
From:	Kathrin Tellez, Fehr & Peers
Subject:	**Workday Pleasanton Campus Transportation Assessment**

WC15-3217

This memorandum presents the results of a transportation assessment for the Workday Campus in Pleasanton (project), including project description, analysis and conclusions. The project is entitled to develop up to 430,000 square feet of office uses on the site. Potential transportation impacts of the project were identified in a Transportation Impact Assessment (TIA) prepared for the project by Hexagon Transportation Consultants dated March 14, 2014 (March TIA). The purpose of this assessment is determine if the currently proposed project generates similar levels of vehicle traffic assumed in the March TIA and to review operations of the site access intersections on Stoneridge Mall Road.

PROJECT DESCRIPTION

The project site is located on the northeast side of Stoneridge Mall Road, east of the West Pleasanton BART parking structure, south of Interstate 580 (I-580) and north of existing office development in Pleasanton, as shown on **Figure 1** (all figures are attached at the end of this memorandum). The project is currently vacant and would be developed with an approximately 410,000 square foot office building with the capacity for 2,200 employees. Two parking structures would be constructed as part of the project; one parking structure would be located between I-580 and the proposed office building with shared access from the BART parking structure driveway.

The second parking structure would be located beneath the new office building, with access from the location of an existing driveway on Stoneridge Mall Road. Access to a drop-off/pick-up zone would also be provided from the Workday Driveway. Access to both parking structures would also be provided from Embarcadero Court and the existing parking area circulation. A conceptual project site plan is shown on **Figure 2**.

Fehr & Peers worked with the project team and City staff to identify the necessary off-site improvements to provide site access for all modes of travel. As part of the project, the BART driveway that would be shared with Workday would be relocated, with the resulting intersection signalized. The bus shelter that is currently located on the southeast corner the BART driveway at Stoneridge Mall Road would be relocated to the northeast side of the intersection, improving access to the BART station for bus transit riders. The crosswalk on the south leg of the intersection would be relocated to the north leg, and a pedestrian signal provided across Stoneridge Mall Road and the BART access driveway. A new pedestrian path on west side of Stoneridge Mall Road would be constructed, connecting to the Workday Driveway. A pedestrian bridge connecting to the Workday campus would also be constructed.

The Workday Driveway would be designed to provide full signalized access, with modifications on the west side of Stoneridge Mall Road to channelize traffic and reduce conflict areas within the intersection influence areas and driveway aisles connecting to Stoneridge Mall Road. Crosswalks would also be provided.

ANALYSIS

Operations of the two site access intersections were evaluated during weekday morning (7 to 9 AM) and evening (4 to 6 PM) peak periods to coincide with the time periods when adjacent street traffic demands are greatest and the project generates the most traffic. Existing and cumulative conditions with the project at typical and maximum occupancy were evaluated based on existing traffic counts and cumulative traffic forecasts presented in the March TIA. A supplemental assessment of select off-site intersections reflecting the trip generating potential under maximum occupancy conditions was also conducted.

The operations of roadway facilities for vehicles are typically described with the term level of service (LOS). LOS is a qualitative description of traffic flow based on such factors as speed, travel time, delay, and freedom to maneuver. Six levels are defined from LOS A, representing free flow conditions with minimal delay, to LOS F, representing over-capacity conditions. LOS E represents "at-capacity" operations. Operations are designated as LOS F when volumes exceed capacity, resulting in stop-and-go conditions. **Appendix A** describes the LOS analysis method for vehicles. Pleasanton strives to maintain Level of Service D operations at most intersections, although designated Gateway intersections may be exempt from the LOS D standard.

Project Trip Generation

Trip generation refers to the process of estimating the amount of vehicular traffic a project might add to the local roadway network. In addition to estimates of daily traffic, estimates are also created for the peak one-hour periods during the morning (AM) and evening (PM) commute hours, when traffic volumes on adjacent streets are typically at their highest.

Table 1 shows the estimated trip generation for the project, based on trip generation rates used in the March TIA. As shown in Table 1, the currently contemplated project is expected to generate approximately 3,840 daily trips, with 590 morning and 540 evening peak hour trips. The project as approved and analyzed in the March TIA was estimated to generate slightly more traffic on a daily and peak hour basis that the proposed project.

Although the proposed project is slightly smaller than the approved project, details regarding the potential number of employees within the building were not know at the time the TIA was prepared. Therefore, trip generation per employee was calculated, as presented in **Table 2,** and compared to the trip generation estimates in the March TIA. As shown in Table 2, if the project was fully occupied with the maximum potential number of employees, it could generate more than 330 additional morning and 310 additional evening peak hour trips than considered in the March TIA.

TABLE 1

TRIP GENERATION ESTIMATES PER SQUARE FOOT

Scenario	Size	Daily	AM Peak Hour			PM Peak Hour		
			In	Out	Total	In	Out	Total
Approved Project	430,000 square feet	3,980	541	74	615	95	465	560
Less 3 percent Transit discount		(120)	(16)	(2)	(18)	(3)	(14)	(17)
Net-New Trips		3,860	525	72	597	92	451	543
Proposed Project	410,000 square feet	3,840	521	71	592	91	447	538
Less 3 percent Transit discount		(120)	(16)	(2)	(18)	(3)	(13)	(16)
Net-New Trips		3,720	505	69	574	89	433	522
Difference		***(140)***	***(20)***	***(3)***	***(23)***	***(4)***	***(18)***	***(22)***

1. Based on *Trip Generation Manual* (9th Edition), Institute of Transportation Engineers (ITE) trip generation rates for Land Use 710, General Office Building

Source: Fehr & Peers, February 2016

TABLE 2

TRIP GENERATION ESTIMATES PER EMPLOYEE

Scenario	Size	Daily	AM Peak Hour			PM Peak Hour		
			In	Out	Total	In	Out	Total
Approved Project	430,000 square feet	3,980	541	74	615	95	465	560
Less 3 percent Transit discount		(120)	(16)	(2)	(18)	(3)	(14)	(17)

TABLE 2
TRIP GENERATION ESTIMATES PER EMPLOYEE

Scenario	Size	Daily	AM Peak Hour			PM Peak Hour		
			In	Out	Total	In	Out	Total
Net-New Trips		3,860	525	72	597	92	451	543
Proposed Project	2,200 Employees	5,970	838	114	952	149	725	874
Less 3 percent Transit discount		(180)	(25)	(3)	(29)	(4)	(22)	(26)
Net-New Trips		5,790	813	111	924	145	704	848
Difference		**1,930**	**288**	**39**	**327**	**53**	**252**	**305**

1. Based on *Trip Generation Manual* (9th Edition), Institute of Transportation Engineers (ITE) trip generation rates for Land Use 710, General Office Building, per square feet and per employee.

Source: Fehr & Peers, February 2016

The trip generation estimates shown in Tables 1 and 2 consider a 3 percent transit reduction for proximity to the West Pleasanton BART station. It is likely that the actual transit mode share would be higher due to proximity to BART, but the 3 percent reduction was assumed for consistency with the March TIA.

If the proposed project reaches maximum occupancy levels, it could affect operations of off-site intersection to a greater extent than previously identified, especially those in close proximity to the project or those operating near capacity. Therefore, a supplemental analysis was conducted for intersections in close proximity to the project site, or those projected to operate at Level of Service D or worse, as identified in the March TIA.

A more focused assessment, including a queuing analysis, was conducted for the two project access intersections to inform site access design.

Project Trip Distribution and Assignment – Site Access Intersections

Project trip distribution refers to the directions of approach and departure that vehicles would access the site. Based on the parameters presented in the March TIA, vehicle trips that are expected to be generated by the proposed project as shown in Tables 1 and 2 were added to the existing traffic volumes at the following two intersections, as shown on **Figure 3:**

- Stoneridge Mall Road/Shared BART and Workday Driveway
- Stoneridge Mall Road/Workday Driveway

Buildout traffic forecasts contained in the March TIA were used as the basis to estimate future traffic volumes at the study intersections with the project. The Cumulative without Project forecasts contained in the March TIA were adjusted as they reflect development on the site consistent with the General Plan at the time the analysis was conducted. The traffic expected to be generated from these uses was subtracted from the base forecasts to develop Cumulative without Project forecasts as shown on **Figure 4**. Project traffic under typical (Table 1) and maximum occupancy (Table 2) conditions were then added to develop Cumulative with Project forecasts, as shown on Figure 4.

Intersection Operations – Site Access Intersections

Site access intersection operations were evaluated using the methods outlined in Attachment A for the weekday AM and PM peak hours based on the volumes presented on Figures 3 and 4 with the results presented in **Table 3** for the Existing condition and **Table 4** for the Cumulative condition. Consistent with the March TIA, signalization of the BART driveway on Stoneridge Mall Road was assumed. Separate left and right-turn exit lanes from the driveway to Stoneridge Mall Road were also assumed. Preliminary site plans included additional lane capacity on the shared BART/Workday Driveway; results of earlier analyses indicated that the additional roadway capacity was not necessary to serve vehicle demand and the cross-sections were narrowed to reduce pedestrian crossing distances at intersections and better balance the needs of all roadway users. The analysis results consider the construction of a pedestrian bridge connecting the Workday Campus. Should this pedestrian bridge not be constructed, there is an increased potential for

vehicle/pedestrian conflicts on the shared BART/Workday Driveway that could affect the analysis results. Level of service and vehicle queue worksheets are provided in **Attachment B**.

Operations of the Workday Driveway were initially evaluated assuming the current side-street stop-control under existing and cumulative conditions. Preliminary operations analysis indicated that the northbound vehicle queue at the shared BART driveway intersection could periodically spillback and block the Workday Driveway, and vehicles making the left-turn movement from the Workday Driveway to Stoneridge Mall Road could experience poor operations during the weekday PM peak hour; similar to the conclusions of the March TIA, peak hour signal warrants would be satisfied at the intersection. Based on these considerations, the analysis was then conducted assuming that the Workday Driveway was signalized and operated as a single intersection with the shared BART/Workday driveway given the close intersection spacing of approximately 225 feet. This presents a worst case assessment of intersection operations and vehicle queues.

As shown in Tables 3 and 4, the resulting intersections are projected to operate acceptably with traffic signal installation. Although the intersections are projected to operate at acceptable levels, they do not operate as efficiently as a standalone intersection resulting in potential vehicle queue spillback as vehicles enter the combined intersection influence area, particularly the southbound left-turn from Stoneridge Mall Road to the shared BART driveway, and from the northbound through movement at the Workday Driveway.

TABLE 3
EXISTING CONDITIONS
INTERSECTION LEVEL OF SERVICE RESULTS

Intersection	Peak Hour	Existing (from March TIA)		Existing Plus Typical Occupancy (signalized)		Existing Plus Maximum Occupancy (signalized)	
		Delay[1]	LOS[2]	Delay[1]	LOS[2]	Delay[1]	LOS[2]
1. Shared BART Driveway at Stoneridge Mall Road	AM	1 (13)	A (B)	16	B	19	B
	PM	3(24)	A (C)	20	B	23	C
2. Workday Driveway at Stoneridge Mall Road	AM	2 (13)	A (B)	24	C	26	C
	PM	4 (19)	A (C)	26	C	28	C

Notes:
1. Delay presented in seconds per vehicle; delay presented as intersection average (worst approach) for unsignalized intersections and as the intersection average for signalized intersections.
2. LOS = Level of Service.

Source: Fehr & Peers, February 2016.

TABLE 4
CUMULATIVE CONDITIONS
INTERSECTION LEVEL OF SERVICE RESULTS

Intersection	Peak Hour	Cumulative No Project (from March TIA)		Cumulative Plus Typical Occupancy (signalized)		Cumulative Plus Maximum Occupancy (signalized)	
		Delay[1]	LOS[2]	Delay[1]	LOS[2]	Delay[1]	LOS[2]
1. Shared BART Driveway at Stoneridge Mall Road	AM	6	A	15	B	19	B
	PM	8	A	21	C	24	C
2. Workday Driveway at Stoneridge Mall Road	AM	6 (36)	A (E)	26	C	28	C
	PM	7 (39)	A (E)	25	C	28	C

Notes:
1. Delay presented in seconds per vehicle; delay presented as intersection average (worst approach) for unsignalized intersections and as the intersection average for signalized intersections.
2. LOS = Level of Service.

Source: Fehr & Peers, February 2016.

Stoneridge Mall Road Queue Assessment

The 50th and 95th percentile vehicle queues were estimated using Synchro 8.0 for the southbound left-turn movement from Stoneridge Mall Road to the shared BART driveway, and for the northbound through movement at the Workday Driveway. Results of this assessment indicate that in the cumulative condition during the morning peak hour, average vehicle queues for the southbound left-turn are expected to range between 190 (typical occupancy) and 290 (maximum occupancy) feet and 95th percentile queues are expect to range between 260 (typical occupancy) and 390 feet (maximum occupancy).

The proposed design provides approximately 350 feet of vehicle storage for the southbound left-turn movement, which would generally accommodate the expected vehicle queues, although there may be 1 to 2 times during the morning peak hour when vehicle queues could spillback to the adjacent travel lane if the Workday building is fully occupied. Extending the turn pocket is not feasible as it would restrict access to an adjacent parcel, and providing a dual left-turn lane is not recommended due to lane utilization issues as vehicles position themselves to access either the BART garage or the Workday garage. Vehicles queues could be managed through signal timing, including signal phasing options that could extend the left-turn green time when vehicle queues reach a certain length, as measured by the vehicle detection system, or could serve the left-turn phase twice during some cycles in the morning peak hour.

The amount of green-time required to serve the BART/Workday Driveway southbound left-turn movement results in some vehicle queue buildup for the northbound through movement at the Workday Driveway. However, the 95th percentile vehicle queue under maximum occupancy conditions is not projected to extend past Embarcadero Court. Vehicle queues are expected to be contained within the available vehicle storage for the other travel movements during the remaining analysis time periods.

The southbound left-turn vehicle queue into the Workday Driveway is expected to be maintained within the available vehicle storage. Southbound/northbound through movement queues are not expected to form between the shared BART and Workday Driveway intersections as the traffic

signal would be timed to provide a clearance interval to prevent vehicle queues forming between the intersections.

BART/Workday Driveway Queue Assessment

The potential for vehicle queues to form along the BART/Workday shared driveway, extending to Stoneridge Mall Road was assessed. For vehicles entering the BART garage from the shared driveway, vehicle queues are not expected to form as the conflicting through movement is proposed to be stop controlled. Also, during the times of day when inbound activity to the garage is highest (morning peak hour), there would be minimal outbound activity to conflict with the inbound movements. The BART garage driveway is also being designed to allow the installation of a controlled pedestrian/bicycle crossing, if necessary, to reduce conflicts between vehicles and pedestrians/bicyclists. This would reduce the potential for platoons of bicyclists/pedestrians to impede vehicular travel into the garage, and provide a protected crossing for bicyclists and pedestrians, if actual conditions warrant.

Vehicle queues at the Workday garage entry were estimated by Watry Design, Inc. based on the service rate of the proposed garage entry gate system. Based on the typical day trip generation (Table 1) and a service rate of 600 vehicles per hour with two access lanes, average vehicle queues are expected to be less than one vehicle, and the maximum vehicle queue expected to form at the parking garage access is 2 vehicles. With maximum occupancy conditions (Table 2), average vehicle queues are expected to be less than two vehicles, with a maximum queue of five vehicles. As there is capacity for approximately ten vehicles to queue prior to the BART garage entrance, vehicle queues that could form at the Workday garage entrance are not expected to impede access to the BART garage, and are not expected to spillback to Stoneridge Mall Road.

Based on the shared driveway queueing assessment, vehicle queues from either the BART or Workday garage entrances are not expected to spillback to Stoneridge Mall Road.

Off-Site Intersection Operations

Operations of off-site intersections that were projected to operate at LOS D or worse in the March TIA, or intersections where project traffic would be concentrated were analyzed under maximum occupancy trip generation conditions. Analyzed intersections include:

- Foothill Road at Canyon Way/Dublin Canyon Road (intersection 3)
- Foothill Road at Stoneridge Drive (intersection 4)
- Stoneridge Mall Road at Embarcadero Court (intersection 8)
- Stoneridge Mall Road at Stoneridge Drive (intersection 10)
- Stoneridge Drive at Interstate 680 Northbound Ramps (intersection 12)
- Stoneridge Drive at Johnson Drive (intersection 13)
- Hopyard Road at Stoneridge Drive (intersection 14)
- San Ramon Road at Dublin Boulevard (intersection 15)

For this assessment, the incremental difference in vehicle trips analyzed in the March 2014 and the trip generation estimates under maximum occupancy (Table 2) were added to the forecasts presented in the March TIA for the following scenarios:

- Existing Plus Project
- Existing Plus Approved Plus Project
- Cumulative Buildout Plus Project

Intersection levels of service were evaluated using the same methods as the March TIA, as presented in **Table 5.** The City's Synchro networks were used to conduct the analysis, with traffic signal timings optimized for the future year analyses. Although the addition of the incremental trip generation under maximum occupancy conditions (Table 2) would increase vehicle delay at some intersections, the additional traffic would not degrade intersections projected to operate at LOS D or better to LOS E or F.

The intersection of Foothill Road at Canyon Way/Dublin Canyon Road was projected to operate at LOS E in the March TIA. With the addition of traffic under maximum occupancy conditions, the intersection is projected to continue operating at level of service E. This intersection is a designated gateway intersection, and is not required to maintain level of service D. Additionally, there are planned improvements at this intersection that the project would contribute to through the payment of the City's transportation impact fee.

Based on the result of the intersection analysis under maximum occupancy conditions, the overall conclusions presented in the March TIA do not change.

TABLE 5
INTERSECTION LEVEL OF SERVICE RESULTS

	Intersection	Peak Hour	Existing with Project (from March TIA)		Existing with Maximum Occupancy		EPAP with Project (from March TIA)		EPAP with Maximum Occupancy		Cumulative with Project (from March TIA)		Cumulative with Maximum Occupancy	
			Delay[1]	LOS[2]	Delay[1]	LOS[2]	Delay[1]	LOS[2]	Delay[1]	LOS[2]	Delay[1]	LOS[2]	Delay[1]	LOS[2]
1.	Foothill Road at Canyon Way/Dublin Canyon Road	AM	27	C	34	C	40	D	44	D	36	D[3]	36	C[3]
		PM	**58**	**E**	**61**	**E**	**72**	**E**	**76**	**E**	**67**	**E**[3]	**74**	**E**[3]
2.	Foothill Road at Stoneridge Drive	AM	19	B	20	B	24	C	25	C	40	D	46	D
		PM	24	C	24	C	49	D	49	D	29	C	29	C
3.	Stoneridge Mall Road at Embarcadero Court	AM	19	B	25	C	22	C	25	C	21	C	23	C
		PM	24	C	34	C	26	C	34	C	23	C	30	C
4.	Stoneridge Mall Road at Stoneridge Drive	AM	8	A	9	A	10	A	11	B	11	B	12	B
		PM	17	B	17	B	40	D	40	D	24	C	24	C
5.	Stoneridge Drive at Interstate 680 Northbound Ramps	AM	14	B	18	B	18	B	18	B	21	C	21	C
		PM	13	B	13	B	13	B	13	B	11	B	11	B
6.	Stoneridge Drive at Johnson Drive	AM	19	B	19	B	15	B	15	B	17	B	17	B
		PM	22	C	30	C	23	C	30	C	23	C	30	C
7.	Hopyard Road at Stoneridge Drive	AM	29	C	34	C	30	C	34	C	32	C	36	D
		PM	35	C	38	D	41	D	41	D	52	D	52	D
8.	San Ramon Road at Dublin Boulevard	AM	34	C	40	D	32	C	41	D	32	C	51	D
		PM	37	D	39	D	38	D	51	D	38	D	41	D

Notes:
1. Delay presented in seconds per vehicle based on *2000 HCM*.
2. LOS = Level of Service.
3. Reflects construction of a third southbound left-turn lane and associated receiving lanes.

Source: Fehr & Peers, February 2016.

Other Considerations

A drop-off/pick-up zone is proposed with full access from the Workday Driveway. Approximately 5 parking spaces would be provided in this area, as well as capacity of 3 to 4 vehicles in the drop-off zone. Heavy use on a daily basis is not expected and all deliveries would need to occur through the service area.

CONCLUSIONS

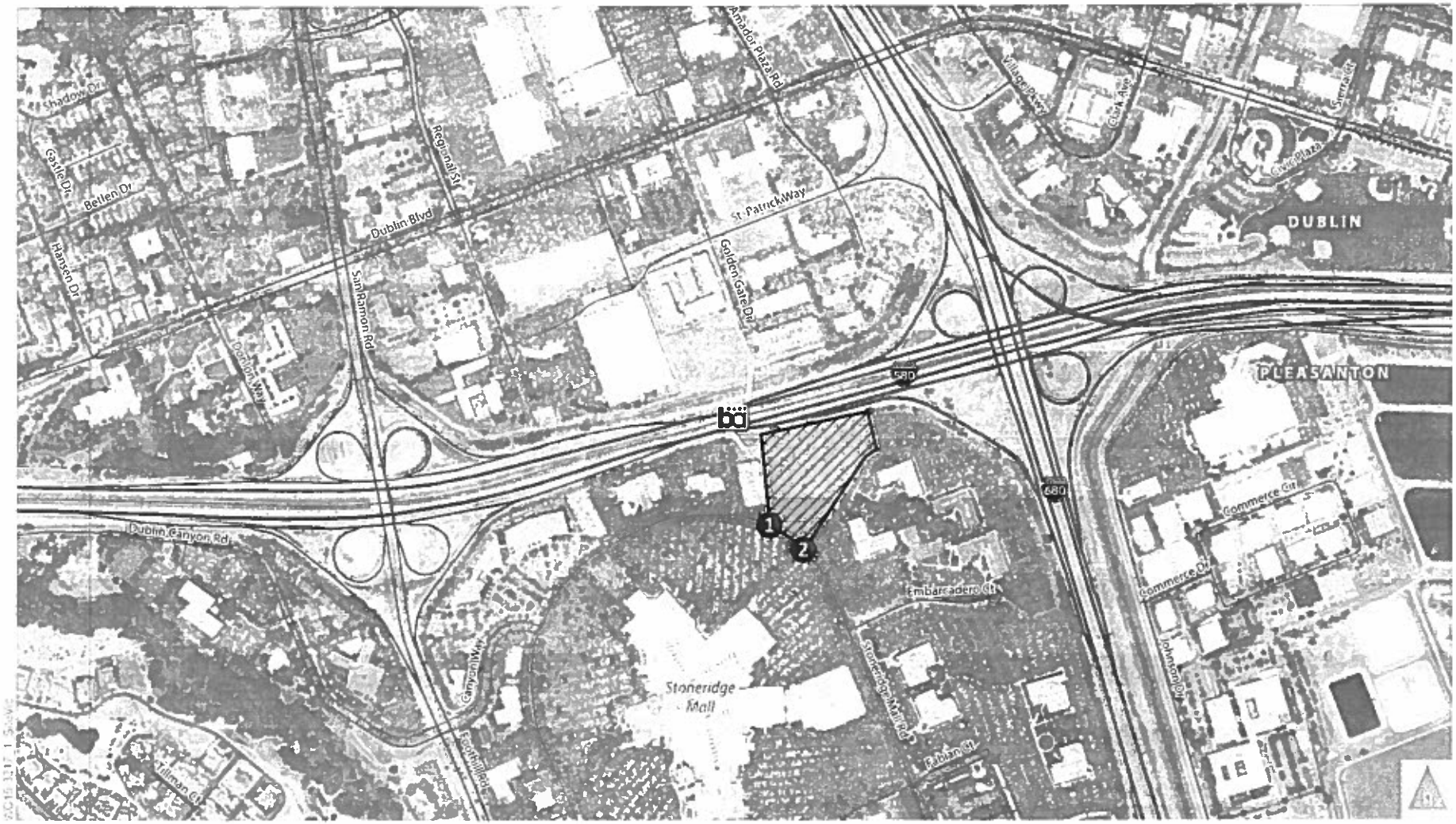
Results of this assessment indicate that on a typical day, the currently proposed Workday project would generate less traffic than the project analyzed in the March TIA; however, under maximum occupancy conditions, the level of trip generation could be higher. A supplemental analysis considering the additional vehicle trip generation indicates that the overall conclusions of the March TIA remain valid.

Results of the site access intersection operational analysis indicates that level of service C or better operations can be maintained at both intersections if signalized and operated with a single traffic controller to minimize vehicle queue spillback between the intersections. However, there may be some periods when vehicle queues at the shared BART driveway impede left-turn access to an adjacent driveway. These queues can be managed through signal operations.

This completes our site access assessment for the Workday development in Pleasanton. Please call Kathrin at 925-930-7100 if you have questions.

Attachments:

Figure 1	Site Vicinity
Figure 2	Conceptual Project Site Plan
Figure 3	Existing and Exiting Plus Project (Typical and Maximum Occupancy) Weekday AM and PM Peak Hour Intersection Turning Movement Volumes
Figure 4	Cumulative and Cumulative Plus Project (Typical and Maximum Occupancy) Weekday AM and PM Peak Hour Intersection Turning Movement Volumes
Attachment A	Level of Service Analysis Methods
Attachment B	Level of Service and Queue Worksheets

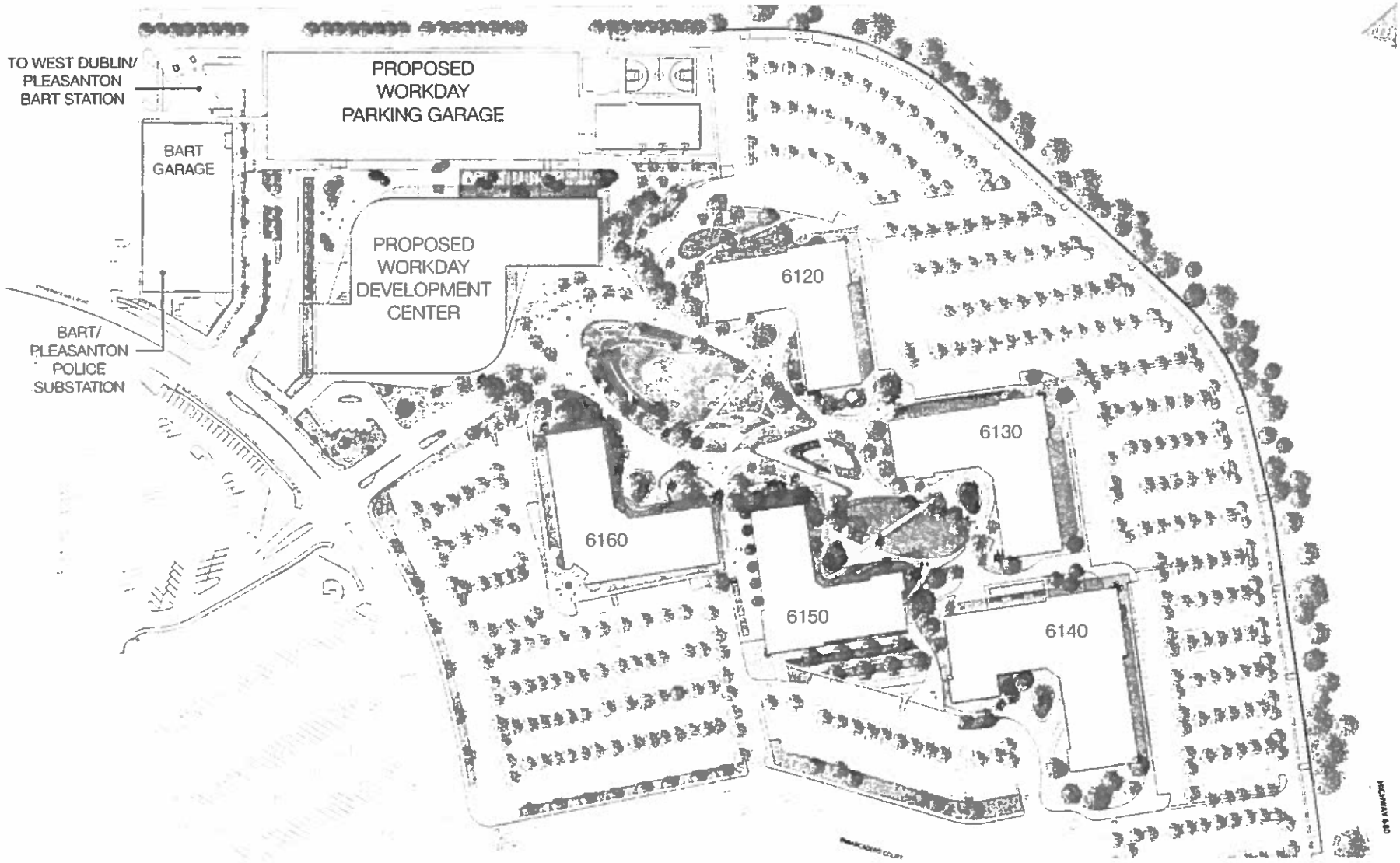


LEGEND

Project Site # Study Intersection

Figure 1

Project Site Vicinity Map and Study Intersection Locations

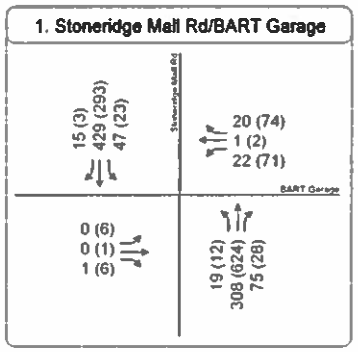


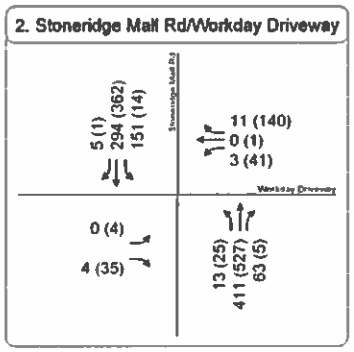
Site Plan Source: Gensler // s w a // Kier & Wright

Figure 2

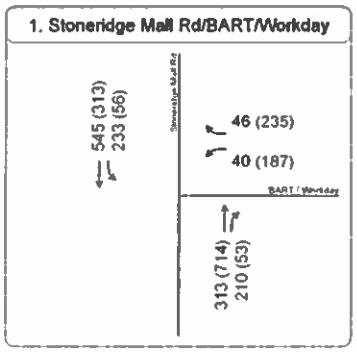
Conceptual Project Site Plan

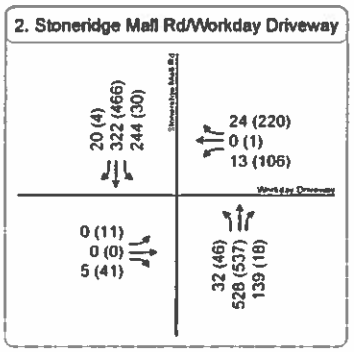
Existing



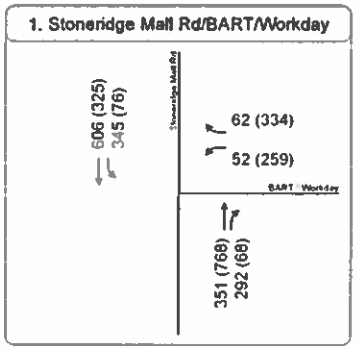


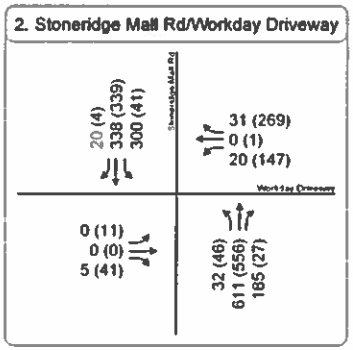
Existing Plus Typical Occupancy





Existing Plus Maximum Occupancy





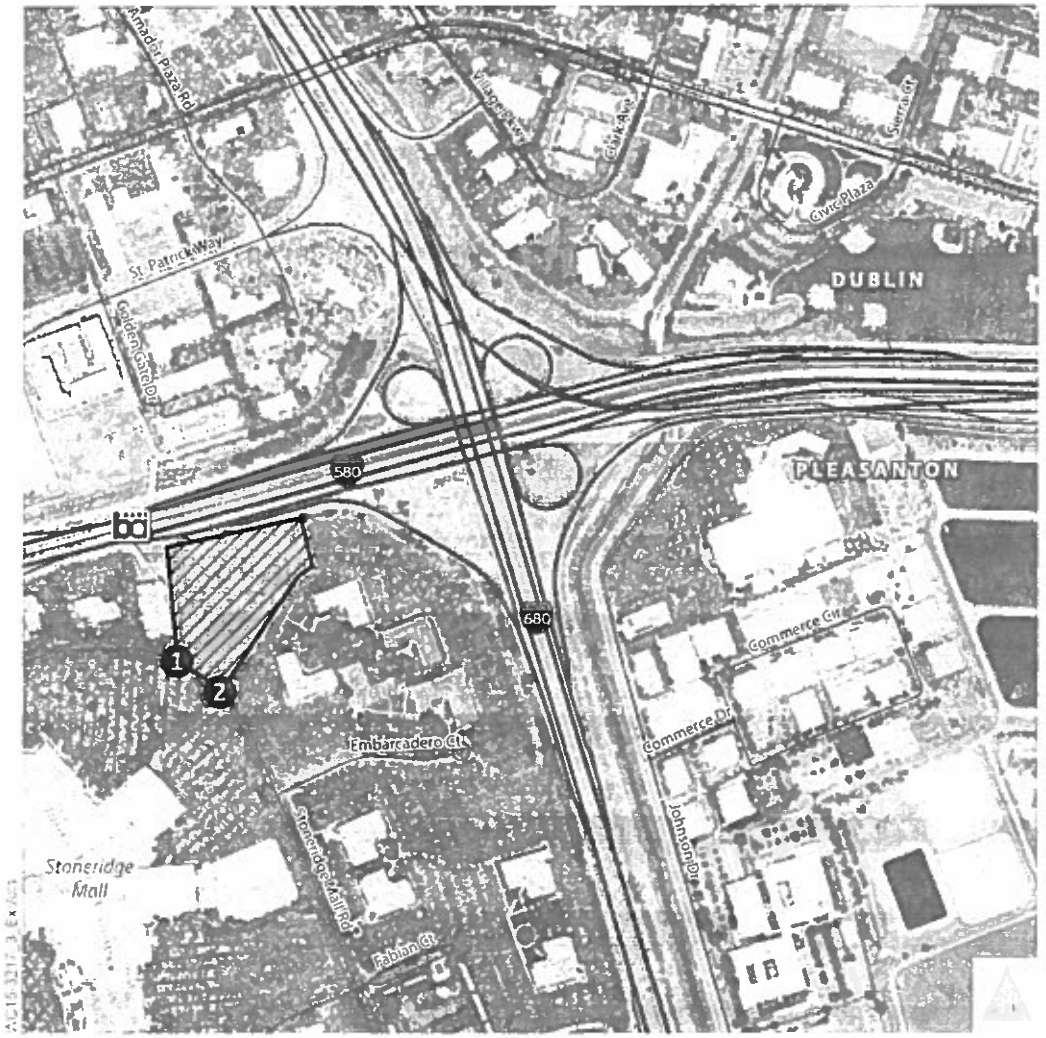
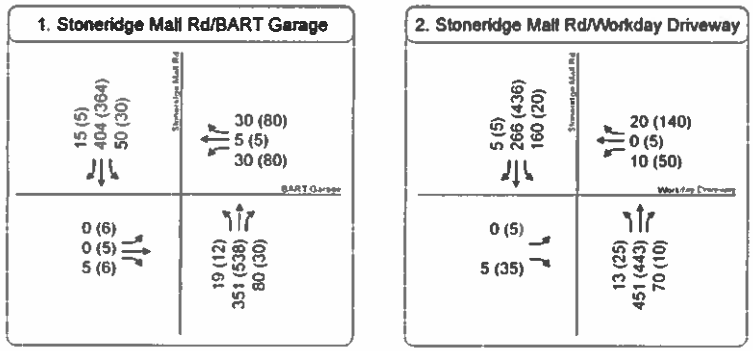


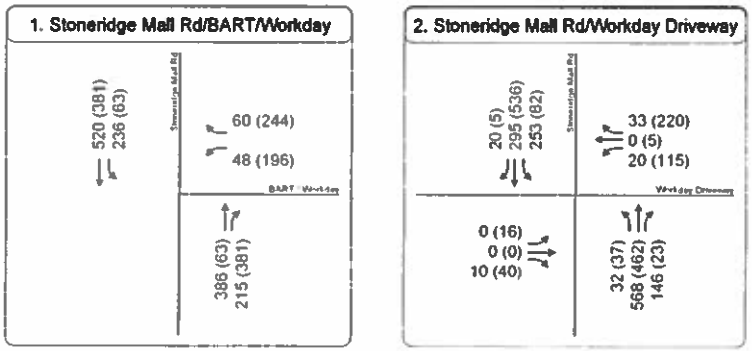
Figure 3

Existing and Existing Plus Project Peak Hour Intersection Traffic Volumes

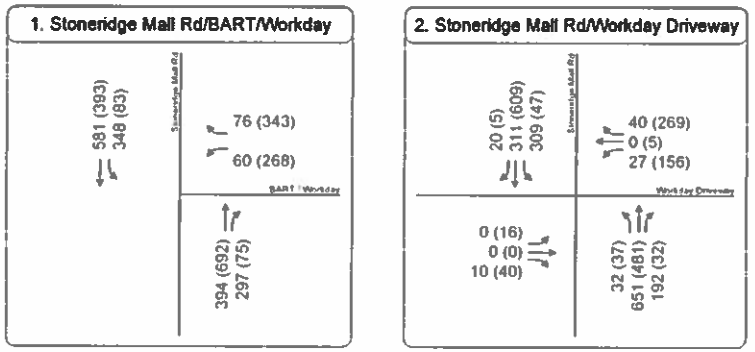
Cumulative No Build



Cumulative Plus Typical Occupancy



Cumulative Plus Maximum Occupancy



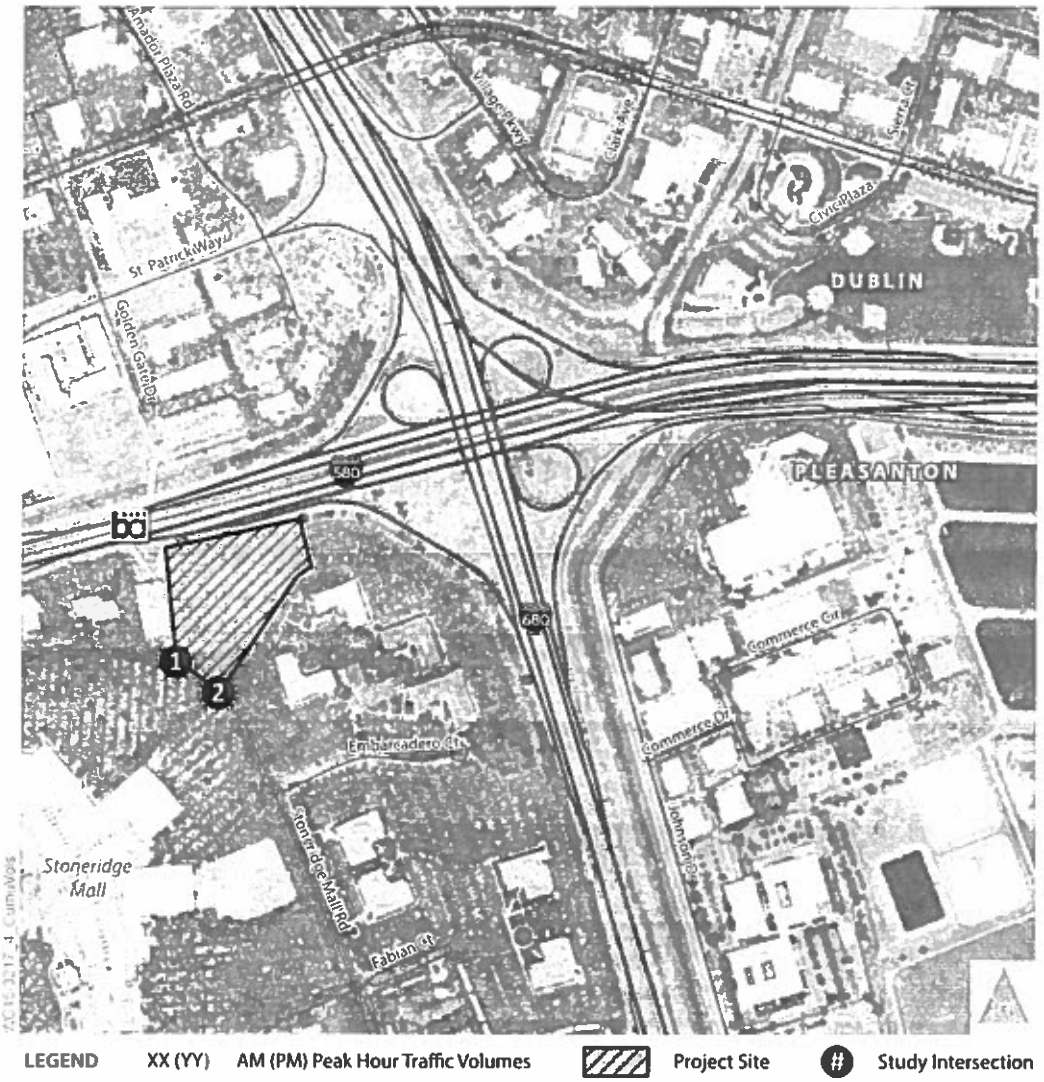


Figure 4

Cumulative and Cumulative Plus Project Peak Hour Intersection Traffic Volumes

ATTACHMENT A – INTERSECTION ANALYSIS METHODS

The operations of roadway facilities are for vehicles described with the term "level of service" (LOS). LOS is a qualitative description of traffic flow based on factors such as speed, travel time, delay, and freedom to maneuver. Six levels of service are defined ranging from LOS A (i.e., free-flow operating conditions) to LOS F (over capacity operating conditions). LOS E corresponds to operations "at capacity." When volumes exceed capacity, stop-and-go conditions result and operations are designated as LOS F. The City of Pleasanton strives to provide LOS D or better on a peak hour basis.

Signalized Intersections

Traffic conditions at signalized intersections were evaluated using the method from Chapter 16 of the Transportation Research Board's 2000 *Highway Capacity Manual*. This operations analysis method uses various intersection characteristics (such as traffic volumes, lane geometry, and signal phasing) to estimate the average control delay experienced by motorists traveling through an intersection. Control delay incorporates delay associated with deceleration, acceleration, stopping, and moving up in the queue. **Table A-1** summarizes the relationship between average delay per vehicle and LOS for signalized intersections.

Unsignalized Intersections

Traffic conditions at unsignalized intersections were evaluated using the method from Chapter 17 of the 2000 *Highway Capacity Manual*. With this method, operations are defined by the average control delay per vehicle (measured in seconds) for each movement that must yield the right-of-way. At two-way or side street-controlled intersections, the control delay (and LOS) is calculated for each controlled movement, as well as the left-turn movement from the major street, and the entire intersection. For controlled approaches composed of a single lane, the control delay is computed as the average of all movements in that lane. The delays for the entire intersection and for the movement or approach with the highest delay are reported. **Table A-2** summarizes the relationship between delay and LOS for unsignalized intersections.

TABLE A-1
SIGNALIZED INTERSECTION LOS CRITERIA

Level of Service	Description	Average Control Delay Per Vehicle (Seconds)
A	Operations with very low delay occurring with favorable progression and/or short cycle lengths.	≤ 10. 0
B	Operations with low delay occurring with good progression and/or short cycle lengths.	> 10. 0 to 20. 0
C	Operations with average delays resulting from fair progression and/or longer cycle lengths. Individual cycle failures begin to appear.	> 20. 0 to 35. 0
D	Operations with longer delays due to a combination of unfavorable progression, long cycle lengths, and/or high volume-to-capacity (V/C) ratios. Many vehicles stop and individual cycle failures are noticeable.	> 35. 0 to 55. 0
E	Operations with long delays indicating poor progression, long cycle lengths, and high V/C ratios. Individual cycle failures are frequent occurrences.	> 55. 0 to 80. 0
F	Operations with delays unacceptable to most drivers occurring due to over saturation, poor progression, or very long cycle lengths.	> 80. 0

Source: *Highway Capacity Manual* (Transportation Research Board, 2000).

TABLE A-2
UNSIGNALIZED INTERSECTION LOS CRITERIA

Level of Service	Description	Average Control Delay Per Vehicle (Seconds)
A	Little or no delays	≤ 10. 0
B	Short traffic delays	> 10. 0 to 15. 0
C	Average traffic delays	> 15. 0 to 25. 0
D	Long traffic delays	> 25. 0 to 35. 0
E	Very long traffic delays	> 35. 0 to 50. 0
F	Extreme traffic delays with intersection capacity exceeded	> 50. 0

Source: *Highway Capacity Manual* (Transportation Research Board, 2000)

ATTACHMENT B – LEVEL OF SERVICE AND QUEUE WORKSHEETS

Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	6	14	27	36	741	271	380
v/c Ratio	0.01	0.15	0.04	0.35	0.47	0.78	0.15
Control Delay	0.0	57.5	0.1	75.6	18.6	65.8	1.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	1.0	0.1
Total Delay	0.0	57.5	0.1	75.6	18.6	66.9	1.8
Queue Length 50th (ft)	0	11	0	29	123	185	10
Queue Length 95th (ft)	0	33	0	m65	331	181	13
Internal Link Dist (ft)	204		679		462		237
Turn Bay Length (ft)				100		90	
Base Capacity (vph)	764	105	729	108	1587	455	2595
Starvation Cap Reductn	0	0	0	0	0	55	945
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.13	0.04	0.33	0.47	0.68	0.23

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔		↰	↑↑		↰	↑↑		↰	↑↑	
Volume (vph)	0	0	5	13	0	24	32	528	139	244	322	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.1		4.1	4.1		4.1	4.1		4.1	4.1	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt		0.86		1.00	0.85		1.00	0.97		1.00	0.99	
Flt Protected		1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1665		1829	1636		1829	3543		1829	3625	
Flt Permitted		1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1665		1829	1636		1829	3543		1829	3625	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	6	14	0	27	36	587	154	271	358	22
RTOR Reduction (vph)	0	5	0	0	26	0	0	16	0	0	3	0
Lane Group Flow (vph)	0	1	0	14	1	0	36	725	0	271	377	0
Turn Type		NA		Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4		3	3		5	2		1	6 10	
Permitted Phases												
Actuated Green, G (s)		14.0		4.0	4.0		4.3	50.8		22.9	81.3	
Effective Green, g (s)		14.0		4.0	4.0		4.3	50.8		22.9	81.3	
Actuated g/C Ratio		0.12		0.03	0.03		0.04	0.42		0.19	0.68	
Clearance Time (s)		4.1		4.1	4.1		4.1	4.1		4.1		
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0		3.0		
Lane Grp Cap (vph)		194		60	54		65	1499		349	2455	
v/s Ratio Prot		c0.00		c0.01	0.00		0.02	c0.20		c0.15	c0.10	
v/s Ratio Perm												
v/c Ratio		0.00		0.23	0.02		0.55	0.48		0.78	0.15	
Uniform Delay, d1		46.8		56.5	56.1		56.9	25.1		46.1	7.0	
Progression Factor		1.00		1.00	1.00		1.22	0.65		1.11	0.18	
Incremental Delay, d2		0.0		2.0	0.1		9.6	1.1		10.2	0.0	
Delay (s)		46.8		58.5	56.2		78.8	17.5		61.3	1.3	
Level of Service		D		E	E		E	B		E	A	
Approach Delay (s)		46.8			57.0			20.3			26.3	
Approach LOS		D			E			C			C	

Intersection Summary			
HCM 2000 Control Delay	24.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.5
Intersection Capacity Utilization	50.2%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	44	51	614	259	606
v/c Ratio	0.13	0.14	0.31	0.71	0.27
Control Delay	35.9	10.5	0.4	55.1	14.3
Queue Delay	0.0	0.0	0.1	0.0	0.0
Total Delay	35.9	10.5	0.5	55.1	14.3
Queue Length 50th (ft)	26	0	0	188	155
Queue Length 95th (ft)	56	32	0	262	182
Internal Link Dist (ft)	792		237		1455
Turn Bay Length (ft)				100	
Base Capacity (vph)	504	460	1961	472	2318
Starvation Cap Reductn	0	0	340	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.09	0.11	0.38	0.55	0.26

Intersection Summary

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	40	46	343	210	233	545
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0
Lane Util. Factor	1.00	1.00	0.95		1.00	0.95
Frt	1.00	0.85	0.94		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1829	1636	3449		1829	3657
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1829	1636	3449		1829	3657
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	44	51	381	233	259	606
RTOR Reduction (vph)	0	41	59	0	0	0
Lane Group Flow (vph)	44	10	555	0	259	606
Turn Type	Perm	Over	NA		Prot	NA
Protected Phases		1	2 10		1	6
Permitted Phases	8					
Actuated Green, G (s)	22.1	22.9	62.7		22.9	69.4
Effective Green, g (s)	23.2	24.0	63.8		24.0	70.5
Actuated g/C Ratio	0.19	0.20	0.53		0.20	0.59
Clearance Time (s)	4.1	4.1			4.1	4.1
Vehicle Extension (s)	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	353	327	1833		365	2148
v/s Ratio Prot		0.01	c0.16		c0.14	0.17
v/s Ratio Perm	c0.02					
v/c Ratio	0.12	0.03	0.30		0.71	0.28
Uniform Delay, d1	40.0	38.6	15.7		44.8	12.2
Progression Factor	1.00	1.00	0.00		1.00	1.00
Incremental Delay, d2	0.2	0.0	0.1		6.2	0.3
Delay (s)	40.2	38.7	0.1		51.0	12.6
Level of Service	D	D	A		D	B
Approach Delay (s)	39.4		0.1			24.1
Approach LOS	D		A			C

Intersection Summary			
HCM 2000 Control Delay	15.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.3
Intersection Capacity Utilization	43.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	6	22	34	36	885	333	398
v/c Ratio	0.01	0.21	0.05	0.38	0.62	0.75	0.15
Control Delay	0.0	59.1	0.1	65.4	26.7	43.0	2.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	1.5	0.1
Total Delay	0.0	59.1	0.1	65.4	26.7	44.4	2.1
Queue Length 50th (ft)	0	17	0	28	182	134	12
Queue Length 95th (ft)	0	45	0	m65	#455	176	16
Internal Link Dist (ft)	204		679		462		237
Turn Bay Length (ft)				100		90	
Base Capacity (vph)	740	107	756	100	1424	516	2612
Starvation Cap Reductn	0	0	0	0	0	67	935
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.21	0.04	0.36	0.62	0.74	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.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↑↑↔			↑↑↔	
Volume (vph)	0	0	5	20	0	31	32	611	185	300	338	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.1		4.1	4.1		4.1	4.1		4.1	4.1	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt		0.86		1.00	0.85		1.00	0.97		1.00	0.99	
Flt Protected		1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1665		1829	1636		1829	3529		1829	3627	
Flt Permitted		1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1665		1829	1636		1829	3529		1829	3627	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	6	22	0	34	36	679	206	333	376	22
RTOR Reduction (vph)	0	5	0	0	32	0	0	21	0	0	3	0
Lane Group Flow (vph)	0	1	0	22	2	0	36	864	0	333	395	0
Turn Type		NA		Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4		3	3		5	2		1	6 10	
Permitted Phases												
Actuated Green, G (s)		12.6		5.7	5.7		3.9	45.3		29.2	81.4	
Effective Green, g (s)		12.6		5.7	5.7		3.9	45.3		29.2	81.4	
Actuated g/C Ratio		0.10		0.05	0.05		0.03	0.38		0.24	0.68	
Clearance Time (s)		4.1		4.1	4.1		4.1	4.1		4.1		
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0		3.0		
Lane Grp Cap (vph)		174		86	77		59	1332		445	2460	
v/s Ratio Prot		c0.00		c0.01	0.00		0.02	c0.24		c0.18	c0.11	
v/s Ratio Perm												
v/c Ratio		0.00		0.26	0.02		0.61	0.65		0.75	0.16	
Uniform Delay, d1		48.1		55.1	54.5		57.3	30.8		42.0	7.0	
Progression Factor		1.00		1.00	1.00		0.99	0.75		0.77	0.22	
Incremental Delay, d2		0.0		1.6	0.1		16.9	2.4		6.6	0.0	
Delay (s)		48.1		56.7	54.6		73.7	25.7		39.1	1.5	
Level of Service		D		E	D		E	C		D	A	
Approach Delay (s)		48.1			55.4			27.5			18.6	
Approach LOS		D			E			C			B	

Intersection Summary			
HCM 2000 Control Delay	24.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.5
Intersection Capacity Utilization	57.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	58	69	714	383	673
v/c Ratio	0.17	0.15	0.40	0.83	0.29
Control Delay	36.8	8.1	0.5	57.9	13.6
Queue Delay	0.0	0.0	0.1	0.0	0.0
Total Delay	36.8	8.1	0.7	57.9	13.6
Queue Length 50th (ft)	34	0	0	278	159
Queue Length 95th (ft)	68	35	0	381	202
Internal Link Dist (ft)	792		237		1455
Turn Bay Length (ft)				100	
Base Capacity (vph)	504	526	1793	533	2309
Starvation Cap Reductn	0	0	272	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.12	0.13	0.47	0.72	0.29

Intersection Summary

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	52	62	351	292	345	606
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0
Lane Util. Factor	1.00	1.00	0.95		1.00	0.95
Frt	1.00	0.85	0.93		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1829	1636	3408		1829	3657
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1829	1636	3408		1829	3657
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	58	69	390	324	383	673
RTOR Reduction (vph)	0	52	102	0	0	0
Lane Group Flow (vph)	58	17	612	0	383	673
Turn Type	Perm	Over	NA		Prot	NA
Protected Phases		1	2 10		1	6
Permitted Phases	8					
Actuated Green, G (s)	22.4	29.2	56.1		29.2	70.6
Effective Green, g (s)	23.5	30.3	57.2		30.3	71.7
Actuated g/C Ratio	0.20	0.25	0.48		0.25	0.60
Clearance Time (s)	4.1	4.1			4.1	4.1
Vehicle Extension (s)	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	358	413	1624		461	2185
v/s Ratio Prot		0.01	c0.18		c0.21	0.18
v/s Ratio Perm	c0.03					
v/c Ratio	0.16	0.04	0.38		0.83	0.31
Uniform Delay, d1	40.1	33.9	20.0		42.4	11.9
Progression Factor	1.00	1.00	0.00		1.00	1.00
Incremental Delay, d2	0.2	0.0	0.1		12.1	0.4
Delay (s)	40.3	33.9	0.1		54.5	12.3
Level of Service	D	C	A		D	B
Approach Delay (s)	36.8		0.1			27.6
Approach LOS	D		A			C

Intersection Summary			
HCM 2000 Control Delay	17.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.3
Intersection Capacity Utilization	52.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	58	118	123	122	51	617	33	522
v/c Ratio	0.17	0.57	0.43	0.38	0.40	0.38	0.22	0.24
Control Delay	1.0	60.9	13.3	6.5	85.6	15.7	68.7	13.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Total Delay	1.0	60.9	13.3	6.5	85.6	15.7	68.7	13.7
Queue Length 50th (ft)	0	89	1	0	41	81	27	85
Queue Length 95th (ft)	0	146	58	29	86	263	63	107
Internal Link Dist (ft)	204		679			462		237
Turn Bay Length (ft)					100		90	
Base Capacity (vph)	432	258	324	356	151	1622	318	2137
Starvation Cap Reductn	0	0	0	0	0	0	0	764
Spillback Cap Reductn	0	0	0	0	0	6	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.46	0.38	0.34	0.34	0.38	0.10	0.38

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	11	0	41	106	1	220	46	537	18	30	466	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.1		4.1	4.1	4.1	4.1	4.1		4.1	4.1	
Lane Util. Factor		1.00		1.00	0.95	0.95	1.00	0.95		1.00	0.95	
Frt		0.89		1.00	0.85	0.85	1.00	1.00		1.00	1.00	
Flt Protected		0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1701		1829	1557	1554	1829	3639		1829	3653	
Flt Permitted		0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1701		1829	1557	1554	1829	3639		1829	3653	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	12	0	46	118	1	244	51	597	20	33	518	4
RTOR Reduction (vph)	0	51	0	0	108	108	0	2	0	0	0	0
Lane Group Flow (vph)	0	7	0	118	15	14	51	615	0	33	522	0
Turn Type	Split	NA		Split	NA	Perm	Prot	NA		Prot	NA	
Protected Phases	4	4		3	3		5	2		1	6 10	
Permitted Phases						3						
Actuated Green, G (s)		13.7		13.7	13.7	13.7	7.2	52.6		9.9	69.0	
Effective Green, g (s)		13.7		13.7	13.7	13.7	7.2	52.6		9.9	69.0	
Actuated g/C Ratio		0.11		0.11	0.11	0.11	0.06	0.44		0.08	0.58	
Clearance Time (s)		4.1		4.1	4.1	4.1	4.1	4.1		4.1		
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0		3.0		
Lane Grp Cap (vph)		194		208	177	177	109	1595		150	2100	
v/s Ratio Prot		c0.00		c0.06	0.01		c0.03	c0.17		0.02	c0.14	
v/s Ratio Perm						0.01						
v/c Ratio		0.03		0.57	0.08	0.08	0.47	0.39		0.22	0.25	
Uniform Delay, d1		47.3		50.3	47.5	47.5	54.5	22.8		51.4	12.6	
Progression Factor		1.00		1.00	1.00	1.00	1.44	0.61		1.31	0.89	
Incremental Delay, d2		0.1		3.5	0.2	0.2	3.1	0.7		0.7	0.1	
Delay (s)		47.3		53.9	47.7	47.7	81.6	14.6		68.1	11.3	
Level of Service		D		D	D	D	F	B		E	B	
Approach Delay (s)		47.3			49.7			19.7			14.7	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	25.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.35		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.5
Intersection Capacity Utilization	42.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	208	261	852	62	348
v/c Ratio	0.43	0.68	0.41	0.37	0.20
Control Delay	37.1	15.1	5.3	56.5	20.8
Queue Delay	0.0	0.0	0.1	0.0	0.0
Total Delay	37.1	15.1	5.4	56.5	20.8
Queue Length 50th (ft)	122	0	52	46	96
Queue Length 95th (ft)	179	78	91	87	128
Internal Link Dist (ft)	792		237		1455
Turn Bay Length (ft)				100	
Base Capacity (vph)	661	513	2062	335	1780
Starvation Cap Reductn	0	0	253	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.31	0.51	0.47	0.19	0.20

Intersection Summary

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	187	235	714	53	56	313
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0
Lane Util. Factor	1.00	1.00	0.95		1.00	0.95
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1829	1636	3619		1829	3657
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1829	1636	3619		1829	3657
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	208	261	793	59	62	348
RTOR Reduction (vph)	0	237	3	0	0	0
Lane Group Flow (vph)	208	24	849	0	62	348
Turn Type	Perm	Over	NA		Prot	NA
Protected Phases		1	2 10		1	6
Permitted Phases	8					
Actuated Green, G (s)	31.5	9.9	66.3		9.9	55.3
Effective Green, g (s)	32.6	11.0	67.4		11.0	56.4
Actuated g/C Ratio	0.27	0.09	0.56		0.09	0.47
Clearance Time (s)	4.1	4.1			4.1	4.1
Vehicle Extension (s)	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	496	149	2032		167	1718
v/s Ratio Prot		0.01	c0.23		c0.03	c0.10
v/s Ratio Perm	c0.11					
v/c Ratio	0.42	0.16	0.42		0.37	0.20
Uniform Delay, d1	35.9	50.2	15.1		51.2	18.6
Progression Factor	1.00	1.00	0.27		1.00	1.00
Incremental Delay, d2	0.6	0.5	0.1		1.4	0.3
Delay (s)	36.5	50.8	4.2		52.6	18.9
Level of Service	D	D	A		D	B
Approach Delay (s)	44.4		4.2			24.0
Approach LOS	D		A			C

Intersection Summary			
HCM 2000 Control Delay	19.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.3
Intersection Capacity Utilization	46.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	58	163	151	149	51	648	46	603
v/c Ratio	0.17	0.66	0.44	0.43	0.43	0.42	0.26	0.29
Control Delay	1.0	62.3	11.6	10.0	89.5	17.7	65.1	17.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Total Delay	1.0	62.3	11.7	10.0	89.5	17.7	65.1	17.2
Queue Length 50th (ft)	0	122	1	0	41	152	37	117
Queue Length 95th (ft)	0	193	64	54	86	289	79	144
Internal Link Dist (ft)	204		679			462		237
Turn Bay Length (ft)					100		90	
Base Capacity (vph)	429	272	359	367	134	1550	362	2085
Starvation Cap Reductn	0	0	0	0	0	0	0	688
Spillback Cap Reductn	1	0	1	1	0	25	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.60	0.42	0.41	0.38	0.42	0.13	0.43

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↑↑			↑↑			↑↑	
Volume (vph)	11	0	41	147	1	269	46	556	27	41	539	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.1		4.1	4.1	4.1	4.1	4.1		4.1	4.1	
Lane Util. Factor		1.00		1.00	0.95	0.95	1.00	0.95		1.00	0.95	
Frt		0.89		1.00	0.85	0.85	1.00	0.99		1.00	1.00	
Flt Protected		0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1701		1829	1556	1554	1829	3632		1829	3654	
Flt Permitted		0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1701		1829	1556	1554	1829	3632		1829	3654	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	12	0	46	163	1	299	51	618	30	46	599	4
RTOR Reduction (vph)	0	51	0	0	130	129	0	2	0	0	0	0
Lane Group Flow (vph)	0	7	0	163	21	20	51	646	0	46	603	0
Turn Type	Split	NA		Split	NA	Perm	Prot	NA		Prot	NA	
Protected Phases	4	4		3	3		5	2		1	6 10	
Permitted Phases						3						
Actuated Green, G (s)		13.7		16.3	16.3	16.3	6.7	50.3		11.5	66.9	
Effective Green, g (s)		13.7		16.3	16.3	16.3	6.7	50.3		11.5	66.9	
Actuated g/C Ratio		0.11		0.14	0.14	0.14	0.06	0.42		0.10	0.56	
Clearance Time (s)		4.1		4.1	4.1	4.1	4.1	4.1		4.1		
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0		3.0		
Lane Grp Cap (vph)		194		248	211	211	102	1522		175	2037	
v/s Ratio Prot		c0.00		c0.09	0.01		c0.03	c0.18		c0.03	c0.16	
v/s Ratio Perm						0.01						
v/c Ratio		0.03		0.66	0.10	0.10	0.50	0.42		0.26	0.30	
Uniform Delay, d1		47.3		49.2	45.4	45.4	55.0	24.6		50.3	14.1	
Progression Factor		1.00		1.00	1.00	1.00	1.47	0.64		1.27	1.04	
Incremental Delay, d2		0.1		6.2	0.2	0.2	3.7	0.8		0.8	0.1	
Delay (s)		47.3		55.4	45.6	45.6	84.4	16.6		64.5	14.6	
Level of Service		D		E	D	D	F	B		E	B	
Approach Delay (s)		47.3			49.0			21.5			18.2	
Approach LOS		D			D			C			B	

Intersection Summary			
HCM 2000 Control Delay	28.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.5
Intersection Capacity Utilization	45.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	288	371	929	84	361
v/c Ratio	0.55	0.74	0.48	0.44	0.20
Control Delay	38.7	14.2	7.4	56.5	20.6
Queue Delay	0.0	0.0	0.1	0.0	0.0
Total Delay	38.7	14.2	7.4	56.5	20.6
Queue Length 50th (ft)	171	0	70	62	93
Queue Length 95th (ft)	246	91	118	108	133
Internal Link Dist (ft)	792		237		1455
Turn Bay Length (ft)				100	
Base Capacity (vph)	672	633	1931	379	1761
Starvation Cap Reductn	0	0	121	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.43	0.59	0.51	0.22	0.20

Intersection Summary

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	259	334	768	68	76	325
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0
Lane Util. Factor	1.00	1.00	0.95		1.00	0.95
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1829	1636	3612		1829	3657
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1829	1636	3612		1829	3657
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	288	371	853	76	84	361
RTOR Reduction (vph)	0	332	4	0	0	0
Lane Group Flow (vph)	288	39	925	0	84	361
Turn Type	Perm	Over	NA		Prot	NA
Protected Phases		1	2 10		1	6
Permitted Phases	8					
Actuated Green, G (s)	34.1	11.5	62.1		11.5	55.1
Effective Green, g (s)	35.2	12.6	63.2		12.6	56.2
Actuated g/C Ratio	0.29	0.10	0.53		0.10	0.47
Clearance Time (s)	4.1	4.1			4.1	4.1
Vehicle Extension (s)	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	536	171	1902		192	1712
v/s Ratio Prot		0.02	c0.26		c0.05	0.10
v/s Ratio Perm	c0.16					
v/c Ratio	0.54	0.23	0.49		0.44	0.21
Uniform Delay, d1	35.6	49.2	18.1		50.4	18.8
Progression Factor	1.00	1.00	0.32		1.00	1.00
Incremental Delay, d2	1.0	0.7	0.2		1.6	0.3
Delay (s)	36.6	49.9	6.0		52.0	19.1
Level of Service	D	D	A		D	B
Approach Delay (s)	44.1		6.0			25.3
Approach LOS	D		A			C

Intersection Summary			
HCM 2000 Control Delay	22.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.3
Intersection Capacity Utilization	52.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	11	22	37	36	793	281	350
v/c Ratio	0.02	0.15	0.05	0.30	0.43	0.78	0.12
Control Delay	0.0	53.1	0.1	59.3	20.4	61.7	1.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	2.5	0.1
Total Delay	0.0	53.1	0.1	59.3	20.4	64.2	1.5
Queue Length 50th (ft)	0	16	0	27	193	183	12
Queue Length 95th (ft)	0	44	0	61	294	213	16
Internal Link Dist (ft)	204		679		462		237
Turn Bay Length (ft)				100		90	
Base Capacity (vph)	777	146	740	123	1849	452	2883
Starvation Cap Reductn	0	0	0	0	0	82	1526
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.15	0.05	0.29	0.43	0.76	0.26

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	10	20	0	33	32	568	146	253	295	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.1		4.1	4.1		4.1	4.1		4.1	4.1	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt		0.86		1.00	0.85		1.00	0.97		1.00	0.99	
Flt Protected		1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1665		1829	1636		1829	3545		1829	3623	
Flt Permitted		1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1665		1829	1636		1829	3545		1829	3623	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	11	22	0	37	36	631	162	281	328	22
RTOR Reduction (vph)	0	11	0	0	34	0	0	14	0	0	3	0
Lane Group Flow (vph)	0	0	0	22	3	0	36	779	0	281	347	0
Turn Type		NA		Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4		3	3		5	2		1	6 10	
Permitted Phases												
Actuated Green, G (s)		1.1		8.2	8.2		5.4	58.1		23.5	88.9	
Effective Green, g (s)		1.1		8.2	8.2		5.4	58.1		23.5	88.9	
Actuated g/C Ratio		0.01		0.07	0.07		0.05	0.48		0.20	0.74	
Clearance Time (s)		4.1		4.1	4.1		4.1	4.1		4.1		
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0		3.0		
Lane Grp Cap (vph)		15		124	111		82	1716		358	2684	
v/s Ratio Prot		c0.00		c0.01	0.00		0.02	c0.22		c0.15	c0.10	
v/s Ratio Perm												
v/c Ratio		0.01		0.18	0.02		0.44	0.45		0.78	0.13	
Uniform Delay, d1		58.9		52.7	52.2		55.8	20.5		45.8	4.5	
Progression Factor		1.00		1.00	1.00		1.00	1.00		1.02	0.30	
Incremental Delay, d2		0.2		0.7	0.1		3.7	0.9		10.6	0.0	
Delay (s)		59.1		53.4	52.2		59.5	21.3		57.6	1.3	
Level of Service		E		D	D		E	C		E	A	
Approach Delay (s)		59.1			52.7			23.0			26.4	
Approach LOS		E			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	25.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.5
Intersection Capacity Utilization	52.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	53	67	668	262	578
v/c Ratio	0.28	0.17	0.30	0.70	0.23
Control Delay	51.1	9.2	0.3	53.8	8.9
Queue Delay	0.0	0.0	0.1	0.0	0.0
Total Delay	51.1	9.2	0.4	53.8	8.9
Queue Length 50th (ft)	39	0	0	190	92
Queue Length 95th (ft)	74	35	0	261	141
Internal Link Dist (ft)	792		237		1455
Turn Bay Length (ft)				100	
Base Capacity (vph)	504	469	2227	469	2530
Starvation Cap Reductn	0	0	507	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.11	0.14	0.39	0.56	0.23

Intersection Summary

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	48	60	386	215	236	520
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0
Lane Util. Factor	1.00	1.00	0.95		1.00	0.95
Frt	1.00	0.85	0.95		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1829	1636	3461		1829	3657
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1829	1636	3461		1829	3657
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	53	67	429	239	262	578
RTOR Reduction (vph)	0	53	42	0	0	0
Lane Group Flow (vph)	53	14	626	0	262	578
Turn Type	Perm	Over	NA		Prot	NA
Protected Phases		1	2 10		1	6
Permitted Phases	8					
Actuated Green, G (s)	13.4	23.5	70.8		23.5	76.2
Effective Green, g (s)	14.5	24.6	71.9		24.6	77.3
Actuated g/C Ratio	0.12	0.21	0.60		0.21	0.64
Clearance Time (s)	4.1	4.1			4.1	4.1
Vehicle Extension (s)	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	221	335	2073		374	2355
v/s Ratio Prot		0.01	c0.18		c0.14	0.16
v/s Ratio Perm	c0.03					
v/c Ratio	0.24	0.04	0.30		0.70	0.25
Uniform Delay, d1	47.8	38.2	11.8		44.3	9.0
Progression Factor	1.00	1.00	0.00		1.00	1.00
Incremental Delay, d2	0.6	0.1	0.1		5.8	0.2
Delay (s)	48.3	38.3	0.1		50.1	9.3
Level of Service	D	D	A		D	A
Approach Delay (s)	42.7		0.1			22.0
Approach LOS	D		A			C

Intersection Summary			
HCM 2000 Control Delay	14.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.3
Intersection Capacity Utilization	44.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	11	30	44	36	936	343	368
v/c Ratio	0.02	0.29	0.06	0.38	0.65	0.80	0.14
Control Delay	0.0	61.5	0.2	75.6	26.8	50.8	2.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	4.1	0.1
Total Delay	0.0	61.5	0.2	75.6	26.8	54.9	2.4
Queue Length 50th (ft)	0	23	0	29	347	133	13
Queue Length 95th (ft)	0	55	0	m66	#440	224	18
Internal Link Dist (ft)	204		679		462		237
Turn Bay Length (ft)				100		90	
Base Capacity (vph)	754	109	719	100	1446	461	2607
Starvation Cap Reductn	0	0	0	0	0	62	987
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.28	0.06	0.36	0.65	0.86	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.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	10	27	0	40	32	651	192	309	311	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.1		4.1	4.1		4.1	4.1		4.1	4.1	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt		0.86		1.00	0.85		1.00	0.97		1.00	0.99	
Flt Protected		1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1665		1829	1636		1829	3532		1829	3624	
Flt Permitted		1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1665		1829	1636		1829	3532		1829	3624	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	11	30	0	44	36	723	213	343	346	22
RTOR Reduction (vph)	0	10	0	0	42	0	0	20	0	0	3	0
Lane Group Flow (vph)	0	1	0	30	2	0	36	916	0	343	365	0
Turn Type		NA		Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4		3	3		5	2		1	6 10	
Permitted Phases												
Actuated Green, G (s)		12.6		5.8	5.8		3.9	45.9		28.2	81.3	
Effective Green, g (s)		12.6		5.8	5.8		3.9	45.9		28.2	81.3	
Actuated g/C Ratio		0.10		0.05	0.05		0.03	0.38		0.23	0.68	
Clearance Time (s)		4.1		4.1	4.1		4.1	4.1		4.1		
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0		3.0		
Lane Grp Cap (vph)		174		88	79		59	1350		429	2455	
v/s Ratio Prot		c0.00		c0.02	0.00		0.02	c0.26		c0.19	c0.10	
v/s Ratio Perm												
v/c Ratio		0.01		0.34	0.03		0.61	0.68		0.80	0.15	
Uniform Delay, d1		48.1		55.3	54.4		57.3	30.9		43.2	6.9	
Progression Factor		1.00		1.00	1.00		1.18	0.77		0.84	0.26	
Incremental Delay, d2		0.0		2.3	0.1		17.0	2.7		9.8	0.0	
Delay (s)		48.1		57.6	54.5		84.3	26.5		46.3	1.8	
Level of Service		D		E	D		F	C		D	A	
Approach Delay (s)		48.1			55.8			28.7			23.3	
Approach LOS		D			E			C			C	

Intersection Summary			
HCM 2000 Control Delay	27.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.5
Intersection Capacity Utilization	59.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	67	84	768	387	646
v/c Ratio	0.19	0.18	0.42	0.87	0.28
Control Delay	37.5	8.1	0.6	63.6	13.5
Queue Delay	0.0	0.0	0.1	0.0	0.0
Total Delay	37.6	8.1	0.7	63.6	13.5
Queue Length 50th (ft)	39	0	0	282	151
Queue Length 95th (ft)	77	39	0	#433	194
Internal Link Dist (ft)	792		237		1455
Turn Bay Length (ft)				100	
Base Capacity (vph)	504	490	1821	478	2299
Starvation Cap Reductn	0	0	257	0	0
Spillback Cap Reductn	36	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.14	0.17	0.49	0.81	0.28

Intersection Summary

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	60	76	394	297	348	581
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0
Lane Util. Factor	1.00	1.00	0.95		1.00	0.95
Frt	1.00	0.85	0.94		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1829	1636	3421		1829	3657
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1829	1636	3421		1829	3657
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	67	84	438	330	387	646
RTOR Reduction (vph)	0	63	96	0	0	0
Lane Group Flow (vph)	67	21	672	0	387	646
Turn Type	Perm	Over	NA		Prot	NA
Protected Phases		1	2 10		1	6
Permitted Phases	8					
Actuated Green, G (s)	22.5	28.2	57.0		28.2	70.2
Effective Green, g (s)	23.6	29.3	58.1		29.3	71.3
Actuated g/C Ratio	0.20	0.24	0.48		0.24	0.59
Clearance Time (s)	4.1	4.1			4.1	4.1
Vehicle Extension (s)	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	359	399	1656		446	2172
v/s Ratio Prot		0.01	c0.20		c0.21	0.18
v/s Ratio Perm	c0.04					
v/c Ratio	0.19	0.05	0.41		0.87	0.30
Uniform Delay, d1	40.2	34.7	19.9		43.5	12.0
Progression Factor	1.00	1.00	0.00		1.00	1.00
Incremental Delay, d2	0.3	0.1	0.1		16.2	0.4
Delay (s)	40.4	34.8	0.1		59.6	12.4
Level of Service	D	C	A		E	B
Approach Delay (s)	37.3		0.1			30.1
Approach LOS	D		A			C

Intersection Summary			
HCM 2000 Control Delay	18.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.3
Intersection Capacity Utilization	53.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	62	128	250	41	539	40	602
v/c Ratio	0.18	0.58	0.61	0.35	0.34	0.26	0.28
Control Delay	1.1	60.3	13.0	84.4	15.6	72.0	12.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Total Delay	1.1	60.3	13.0	84.4	15.6	72.0	12.5
Queue Length 50th (ft)	0	96	4	34	70	33	90
Queue Length 95th (ft)	0	155	79	m73	202	72	110
Internal Link Dist (ft)	204		679		462		237
Turn Bay Length (ft)				100		90	
Base Capacity (vph)	432	318	487	123	1595	318	2121
Starvation Cap Reductn	0	0	0	0	0	0	644
Spillback Cap Reductn	0	0	0	0	8	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.40	0.51	0.33	0.34	0.13	0.41

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↑			↑↑			↑↑	
Volume (vph)	16	0	40	115	5	220	37	462	23	36	536	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.1		4.1	4.1		4.1	4.1		4.1	4.1	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt		0.90		1.00	0.85		1.00	0.99		1.00	1.00	
Flt Protected		0.99		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1716		1829	1643		1829	3631		1829	3652	
Flt Permitted		0.99		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1716		1829	1643		1829	3631		1829	3652	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	18	0	44	128	6	244	41	513	26	40	596	6
RTOR Reduction (vph)	0	55	0	0	215	0	0	2	0	0	0	0
Lane Group Flow (vph)	0	7	0	128	35	0	41	537	0	40	602	0
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4		3	3		5	2		1	6 10	
Permitted Phases												
Actuated Green, G (s)		13.7		14.5	14.5		6.7	51.8		10.3	68.7	
Effective Green, g (s)		13.7		14.5	14.5		6.7	51.8		10.3	68.7	
Actuated g/C Ratio		0.11		0.12	0.12		0.06	0.43		0.09	0.57	
Clearance Time (s)		4.1		4.1	4.1		4.1	4.1		4.1		
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0		3.0		
Lane Grp Cap (vph)		195		221	198		102	1567		156	2090	
v/s Ratio Prot		c0.00		c0.07	0.02		c0.02	c0.15		0.02	c0.16	
v/s Ratio Perm												
v/c Ratio		0.04		0.58	0.18		0.40	0.34		0.26	0.29	
Uniform Delay, d1		47.3		49.9	47.4		54.7	22.7		51.3	13.1	
Progression Factor		1.00		1.00	1.00		1.44	0.61		1.37	0.78	
Incremental Delay, d2		0.1		3.7	0.4		2.5	0.6		0.9	0.1	
Delay (s)		47.4		53.5	47.8		81.2	14.4		71.0	10.4	
Level of Service		D		D	D		F	B		E	B	
Approach Delay (s)		47.4			49.8			19.1			14.1	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	25.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.33		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.5
Intersection Capacity Utilization	47.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	218	271	776	70	423
v/c Ratio	0.44	0.68	0.38	0.40	0.24
Control Delay	36.7	14.8	6.1	57.0	21.3
Queue Delay	0.0	0.0	0.1	0.0	0.0
Total Delay	36.7	14.8	6.2	57.0	21.3
Queue Length 50th (ft)	127	0	56	52	118
Queue Length 95th (ft)	183	79	97	96	158
Internal Link Dist (ft)	792		237		1455
Turn Bay Length (ft)				100	
Base Capacity (vph)	719	521	2020	335	1775
Starvation Cap Reductn	0	0	332	0	0
Spillback Cap Reductn	0	0	0	0	4
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.30	0.52	0.46	0.21	0.24

Intersection Summary

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	196	244	638	60	63	381
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0
Lane Util. Factor	1.00	1.00	0.95		1.00	0.95
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1829	1636	3610		1829	3657
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1829	1636	3610		1829	3657
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	218	271	709	67	70	423
RTOR Reduction (vph)	0	245	4	0	0	0
Lane Group Flow (vph)	218	26	772	0	70	423
Turn Type	Perm	Over	NA		Prot	NA
Protected Phases		1	2 10		1	6
Permitted Phases	8					
Actuated Green, G (s)	32.3	10.3	65.1		10.3	55.4
Effective Green, g (s)	33.4	11.4	66.2		11.4	56.5
Actuated g/C Ratio	0.28	0.10	0.55		0.10	0.47
Clearance Time (s)	4.1	4.1			4.1	4.1
Vehicle Extension (s)	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	509	155	1991		173	1721
v/s Ratio Prot		0.02	c0.21		c0.04	0.12
v/s Ratio Perm	c0.12					
v/c Ratio	0.43	0.17	0.39		0.40	0.25
Uniform Delay, d1	35.5	49.9	15.3		51.1	19.0
Progression Factor	1.00	1.00	0.31		1.00	1.00
Incremental Delay, d2	0.6	0.5	0.1		1.5	0.3
Delay (s)	36.1	50.4	4.9		52.7	19.3
Level of Service	D	D	A		D	B
Approach Delay (s)	44.0		4.9			24.1
Approach LOS	D		A			C

Intersection Summary			
HCM 2000 Control Delay	21.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.3
Intersection Capacity Utilization	44.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	62	173	305	41	570	52	683
v/c Ratio	0.18	0.66	0.62	0.38	0.38	0.29	0.33
Control Delay	1.1	60.8	11.5	87.9	18.2	68.4	15.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Total Delay	1.1	60.8	11.5	87.9	18.2	68.4	15.8
Queue Length 50th (ft)	0	129	4	34	68	42	121
Queue Length 95th (ft)	0	201	86	m73	258	86	146
Internal Link Dist (ft)	204		679		462		237
Turn Bay Length (ft)				100		90	
Base Capacity (vph)	431	303	521	111	1493	367	2079
Starvation Cap Reductn	0	0	0	0	0	0	578
Spillback Cap Reductn	1	0	2	0	27	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.57	0.59	0.37	0.39	0.14	0.46

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	16	0	40	156	5	269	37	481	32	47	609	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.1		4.1	4.1		4.1	4.1		4.1	4.1	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt		0.90		1.00	0.85		1.00	0.99		1.00	1.00	
Flt Protected		0.99		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1716		1829	1642		1829	3623		1829	3652	
Flt Permitted		0.99		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1716		1829	1642		1829	3623		1829	3652	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	18	0	44	173	6	299	41	534	36	52	677	6
RTOR Reduction (vph)	0	55	0	0	256	0	0	3	0	0	0	0
Lane Group Flow (vph)	0	7	0	173	49	0	41	567	0	52	683	0
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4		3	3		5	2		1	6 10	
Permitted Phases												
Actuated Green, G (s)		13.7		17.3	17.3		5.9	48.6		11.9	66.7	
Effective Green, g (s)		13.7		17.3	17.3		5.9	48.6		11.9	66.7	
Actuated g/C Ratio		0.11		0.14	0.14		0.05	0.41		0.10	0.56	
Clearance Time (s)		4.1		4.1	4.1		4.1	4.1		4.1		
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0		3.0		
Lane Grp Cap (vph)		195		263	236		89	1467		181	2029	
v/s Ratio Prot		c0.00		c0.09	0.03		c0.02	c0.16		c0.03	c0.19	
v/s Ratio Perm												
v/c Ratio		0.04		0.66	0.21		0.46	0.39		0.29	0.34	
Uniform Delay, d1		47.3		48.6	45.3		55.5	25.2		50.1	14.6	
Progression Factor		1.00		1.00	1.00		1.43	0.64		1.33	0.92	
Incremental Delay, d2		0.1		5.8	0.4		3.6	0.7		0.8	0.1	
Delay (s)		47.4		54.4	45.7		82.9	16.9		67.7	13.5	
Level of Service		D		D	D		F	B		E	B	
Approach Delay (s)		47.4			48.9			21.3			17.4	
Approach LOS		D			D			C			B	

Intersection Summary			
HCM 2000 Control Delay	27.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.5
Intersection Capacity Utilization	49.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	298	381	852	92	437
v/c Ratio	0.55	0.74	0.45	0.46	0.25
Control Delay	38.0	13.9	8.2	56.8	21.4
Queue Delay	0.0	0.0	0.1	0.0	0.0
Total Delay	38.0	13.9	8.3	56.8	21.4
Queue Length 50th (ft)	176	0	74	68	119
Queue Length 95th (ft)	248	91	121	115	161
Internal Link Dist (ft)	792		237		1455
Turn Bay Length (ft)				100	
Base Capacity (vph)	702	644	1883	384	1744
Starvation Cap Reductn	0	0	187	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.42	0.59	0.50	0.24	0.25

Intersection Summary

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	268	343	692	75	83	393
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0
Lane Util. Factor	1.00	1.00	0.95		1.00	0.95
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1829	1636	3604		1829	3657
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1829	1636	3604		1829	3657
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	298	381	769	83	92	437
RTOR Reduction (vph)	0	340	5	0	0	0
Lane Group Flow (vph)	298	41	847	0	92	437
Turn Type	Perm	Over	NA		Prot	NA
Protected Phases		1	2 10		1	6
Permitted Phases	8					
Actuated Green, G (s)	35.1	11.9	60.7		11.9	54.6
Effective Green, g (s)	36.2	13.0	61.8		13.0	55.7
Actuated g/C Ratio	0.30	0.11	0.51		0.11	0.46
Clearance Time (s)	4.1	4.1			4.1	4.1
Vehicle Extension (s)	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	551	177	1856		198	1697
v/s Ratio Prot		0.03	c0.24		c0.05	0.12
v/s Ratio Perm	c0.16					
v/c Ratio	0.54	0.23	0.46		0.46	0.26
Uniform Delay, d1	35.0	48.9	18.5		50.2	19.6
Progression Factor	1.00	1.00	0.36		1.00	1.00
Incremental Delay, d2	1.1	0.7	0.2		1.7	0.4
Delay (s)	36.1	49.6	6.7		52.0	19.9
Level of Service	D	D	A		D	B
Approach Delay (s)	43.7		6.7			25.5
Approach LOS	D		A			C

Intersection Summary			
HCM 2000 Control Delay	23.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.3
Intersection Capacity Utilization	51.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group