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Sent: Thursday, October 11, 2018 8:35 AM
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Subject: 10/11/18 PC Agenda Item Revision
Attachments: Attachment VI_Traffic Study_Revised.pdf

Follow Up Flag: Follow up
Flag Status: Completed

Good morning Planning Commissioners,

Please see below message from Jay Lee regarding tonight's regular meeting agenda item for "Round One." This email will be published to the City website as "Items Received After Published Agenda", as well as briefly mentioned in Jay's presentation.

Planning Commissioners,

Please be advised that the traffic study (Attachment VI) for the October 11, 2018, 7PM Planning Commission public hearing agenda item no. 2, for Round One Entertainment, has been revised since the publishing of the agenda. The revised traffic study (Attachment VI) is attached to this email. The revisions are clerical in nature and do not impact the traffic analysis and its conclusions. A summary of the revisions is below:

- Pages 9-10: Formatting errors and typos were fixed.
- Pages 10-13: Traffic data was slightly adjusted for consistency with previous traffic studies and traffic counts.

Respectfully,

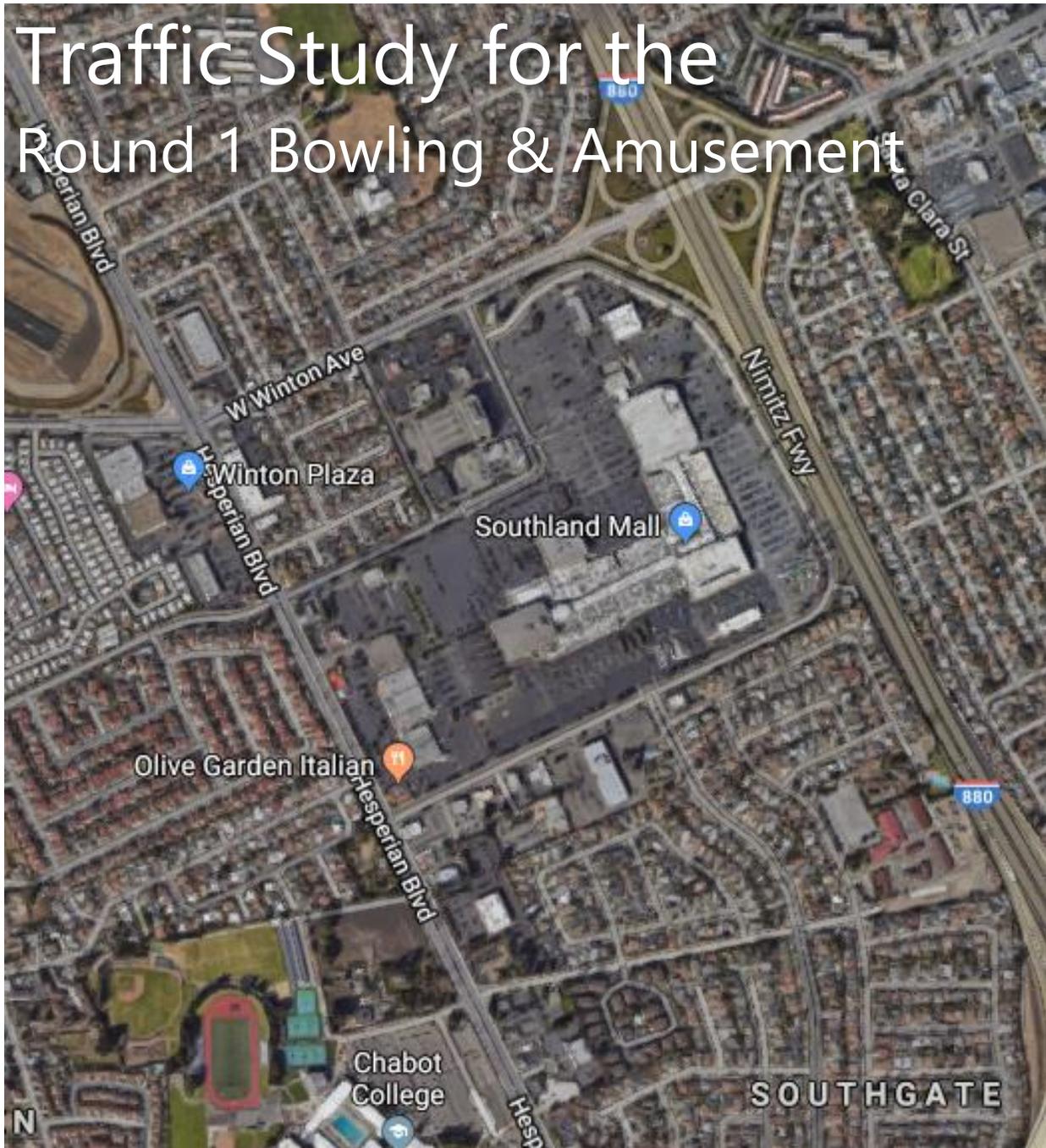
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Regards,

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Traffic Study for the Round 1 Bowling & Amusement



Draft Report

Prepared for the
City of Hayward



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1.0 INTRODUCTION

1.1 INTRODUCTION

This report presents the results of a traffic impact analysis for the proposed Round 1 Bowling & Amusement development to be located at Southland Mall in the City of Hayward.

The proposed project is planned to be built at the location of an existing sporting goods store and it would consist of a facility with eight bowling lanes, arcade games area, billiards, and dining and party rooms for its patrons. The total tenant space area of the proposed development is 45,506 square feet (sq. ft), with the first-floor area at 3,567 sq. ft. and the second-floor area at 41,939 sq. ft.

In addition, this traffic study also utilizes traffic impact analysis results conducted for a previously approved development – Southland Mall Cinema. This approved project would replace an existing shopping center land use and the resulting net trips were used as part of background study scenario.

Regional access to the Project site, which is located in Southland Mall, will be via I-880 Ramps at Winton Avenue and via Southland Drive.

1.2 SUMMARY

All the study intersections currently operate at an acceptable LOS D or better during the weekday p.m. peak hour, except for the unsignalized intersection of Southland Drive/La Playa Drive. This intersection operates with an average delay of 37.4 seconds/vehicle (LOS E) for the stop-controlled westbound left-turn movement of La Playa Drive at Southland Drive.

The proposed project is expected to generate 1,517 daily trips with 61 trips during p.m. peak hour (40 inbound and 21 outbound trips).

All of the study intersections are expected to operate at an acceptable LOS D or better during the weekday p.m. peak hour, except for the unsignalized intersection with an average delay of 68.6 seconds/vehicle (LOS F) for the westbound left-turn movement of La Playa Drive.

All of the study intersections are expected to continue to operate at an acceptable LOS D or better during the weekday p.m. peak hour, except for the unsignalized intersection with an average delay of 72.5 seconds/vehicle (LOS F) for the westbound left-turn movement of La Playa Drive at Southland Drive.

2.0 STUDY APPROACH

2.1 STUDY SCOPE

This study includes the following five study intersections of which four are signalized intersections and one two-way stop-controlled intersection:

1. Winton Avenue and Southland Drive (signalized intersection)
2. Winton Avenue and Southland Place (signalized intersection)
3. Southland Drive and La Playa Drive (unsignalized intersection)
4. Hesperian Boulevard and Southland Drive (signalized intersection)
5. Hesperian Boulevard and La Playa Drive (signalized intersection)

Per the City's direction, peak hour traffic counts at the study intersections were conducted during a weekday (Friday) p.m. peak period (see Appendix A) to account for the highest peak condition during a weekday at the project vicinity. It should be noted that the unsignalized intersection of Southland Drive and La Playa Drive is a private intersection within the Southland Mall property limits.

Figure 1 illustrates the study intersections and proposed Project vicinity. **Figure 2** shows the Project site plan.

The following three (3) study scenarios are covered as part of this traffic study:

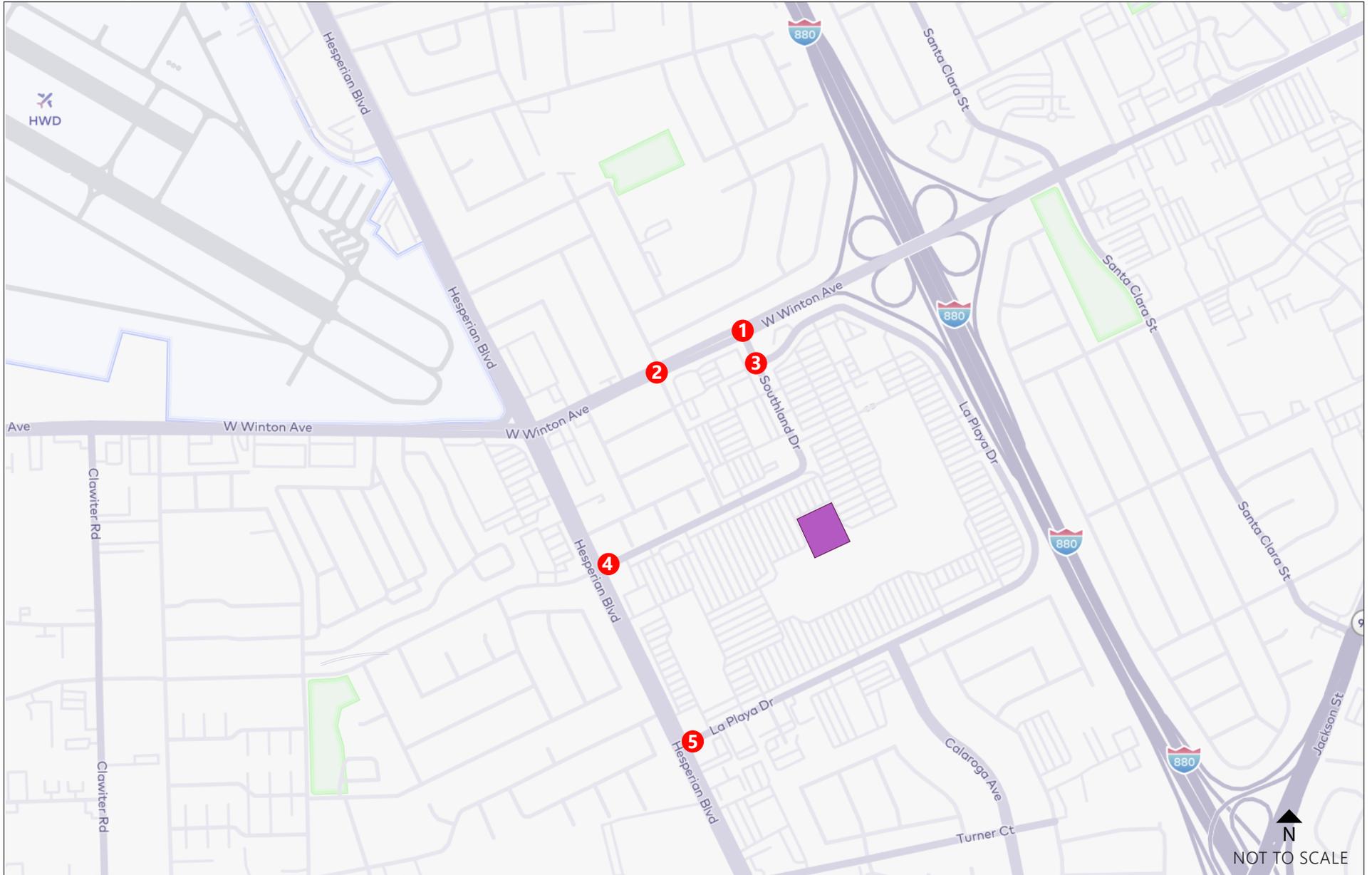
- Existing Conditions
- Background (Existing plus Approved) Conditions – the same as the previous scenario, with the addition of an approved project – Southland Mall Cinema
- Background plus Project Conditions – the same as the previous scenario, with the addition of the proposed project – Round 1 Bowling & Amusement facility

2.2 ANALYSIS METHODS AND SIGNIFICANCE CRITERIA

Per the City of Hayward Traffic Study Guidelines (March 2017), the acceptable level of service is LOS E for signalized intersections during the peak commute periods except when a LOS F may be acceptable due to costs of migration or when there would be other unacceptable impacts. The City's standard is not applied to the Southland Drive/La Playa Drive unsignalized intersection because it lies within Southland Mall's private property. The intersection level of service (LOS) was calculated in Synchro 9 software based on HCM 2000 methodology.

FIGURE 1

Location of Project Site and Study Intersections



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-  Project Site
-  Study Intersection

3.0 Existing Setting

3.1 EXISTING TRAFFIC VOLUMES

The intersection turning movement counts were collected at each study intersection during a weekday p.m. peak period on Friday, September 14, 2018. The detailed traffic counts are included in Appendix A. **Figure 3** illustrates the existing lane geometry, traffic controls and the existing peak hour (4:00 p.m. – 5:00 p.m.) turning movement volumes at the study intersections.

3.2 INTERSECTION OPERATING CONDITIONS – EXISTING CONDITIONS

Table 1 below shows the LOS for each study intersection under Existing Conditions during p.m. peak hour. LOS worksheets are provided in Appendix B. As shown, all the study intersections currently operate at an acceptable LOS D or better during the weekday p.m. peak hour, except for the unsignalized intersection - Southland Drive/La Playa Drive. This intersection operates with an average delay of 37.4 seconds/vehicle (LOS E) for the stop-controlled westbound left-turn movement of La Playa Drive.

Table 1: Intersection Level of Service – Existing Conditions

ID	Intersection Name	PM Peak Hour	
		Delay (s/veh)	LOS
1	Winton Avenue and Southland Drive	49.3	D
2	Winton Avenue and Southland Place	32.7	C
3	Southland Drive and La Playa Drive (Unsignalized)*	37.4	E
4	Hesperian Boulevard and Southland Drive	31.3	C
5	Hesperian Boulevard and La Playa Drive	10.1	B

Source: AMG, 2018

LOS – Level of Service; Delay – Average intersection delay (seconds/vehicle) for signalized intersections and worst stop-controlled approach delay (seconds/vehicle) for two-way stop-controlled intersections.

*Note: Unsignalized delay shown is for the Stop control movement of westbound left-turn from La Playa Drive to Southland Drive

Traffic conditions at the study intersections were performed using Highway Capacity Manual (HCM) 2000 methodology that's available with Synchro 9 software. Level of service is a qualitative measure of traffic operations, ranging from LOS A (free-flow conditions) to LOS F (congested traffic flow). HCM methodology evaluates intersection operations on the basis of average control delay time (seconds/vehicle) for all vehicles passing through an intersection. Thus, the measured average delay is scaled along LOS A through LOS F. The existing signal timing info and phasing info for some of the study

intersections were obtained from a recently conducted traffic study and they were used accordingly with the traffic analysis software.

3.3 EXISTING TRAFFIC OPERATIONS AND QUEUE CONDITIONS

The signalized intersection Winton Avenue/Southland Drive located to the north of the unsignalized study intersection Southland Drive/La Playa Drive are closely spaced intersections with a vehicle storage length of approximately 150 feet between the curb lines for these intersections.

As mentioned previously, Southland Drive/La Playa Drive intersection has stop-control for the westbound and the northbound movements only. The southbound movement, which feeds traffic from Winton Avenue into the mall is an uncontrolled free-flow movement. This unsignalized intersection operation is non-standard and HCM based analysis doesn't provide a LOS for such atypical intersection operation.

As a workaround to calculate worst movement approach delay at this intersection, the intersection is modeled with a stop control for the eastbound and westbound approaches and uncontrolled southbound left-turn movement to calculate the delay for the northbound Southland Drive and the westbound La Playa Drive. Similarly, to assess the delay for the southbound and westbound left-turn and through movements, this intersection is modeled with a stop control on La Playa Drive. The northbound movement was modeled as uncontrolled with a fifth of the existing volumes to simulate stop-controlled traffic operation for this movement. This afore-mentioned methodology was adopted based on a similar traffic study conducted for a land use at Southland Mall which was approved by the City.

The nexus of traffic signal operation at the intersection of Winton Avenue/Southland Drive and unsignalized intersection (two-way stop control) operation at Southland Drive/La Playa Drive were field verified and the following are the observations at this study segment.

The northbound and westbound traffic movements at the intersection of Southland Drive/Winton Avenue occur during the same phase of the signalized traffic operation. A maximum queue of 15 vehicles with an average of approximately 12 vehicles were observed at the westbound turn lanes along Winton Avenue at Southland Drive. At the same time during the p.m. peak, the northbound right turn only lanes were at capacity for most of the commute peak period. In addition, the queued vehicle blocking the intersection would cause some queuing along the free-flowing southbound left turn from Southland Drive onto La Playa Drive.

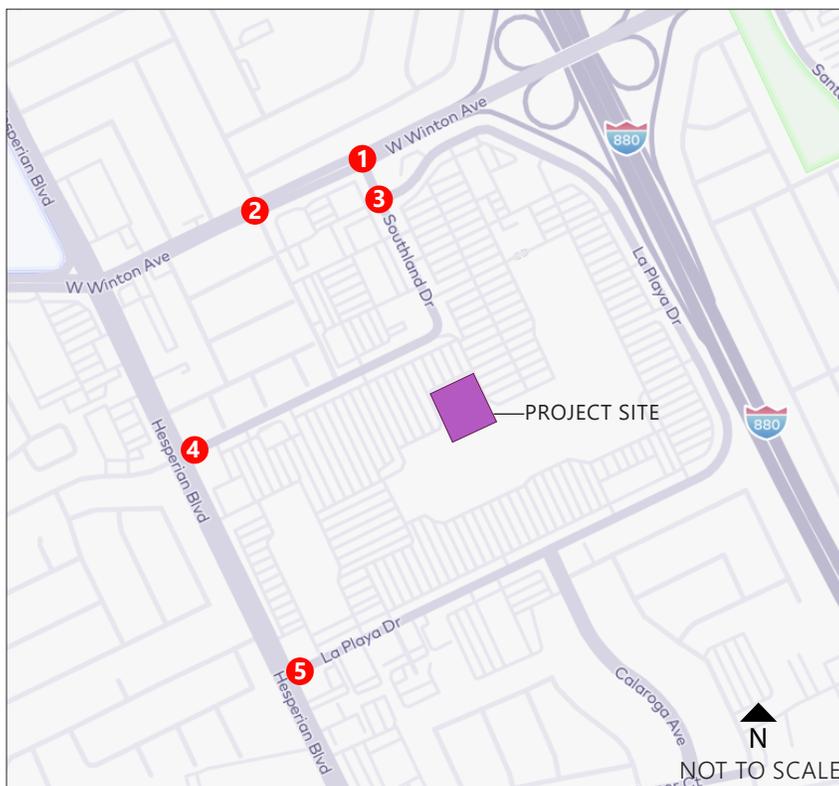
At the intersection of Southland Drive/La Playa Drive, the westbound and northbound movements are stop controlled movements and the southbound left-turn and thru movements are uncontrolled. However, some of the southbound left-turning traffic along Southland Drive stops either incorrectly assuming that the movement is stop controlled or slowly drives through the intersection causing some queue delays. The maximum queue observed for the stop controlled northbound movement was

approximately 14 vehicles and for the westbound stop control along La Playa Drive a maximum queue of 9 right-turning vehicles were observed.

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FIGURE 3
Existing PM Peak Turning Movement Volumes

Intersection #1 Winton Ave at Southland Dr	Intersection #2 Winton Ave at Southland Pl	Intersection #3 La Playa Dr at Southland Dr	Intersection #4 Southland Dr at Hesperian Blvd
<p>Diagram of Intersection #1 (Winton Ave at Southland Dr) showing traffic flow and turning movement volumes. Winton Ave (top) has 941 vehicles turning left, 711 turning right, and 1870 going straight. Southland Dr (bottom) has 55 vehicles turning left, 950 turning right, and 1870 going straight.</p>	<p>Diagram of Intersection #2 (Winton Ave at Southland Pl) showing traffic flow and turning movement volumes. Winton Ave (top) has 23 vehicles turning left, 75 turning right, and 59 going straight. Southland Pl (bottom) has 16 vehicles turning left, 1547 turning right, and 65 going straight.</p>	<p>Diagram of Intersection #3 (La Playa Dr at Southland Dr) showing traffic flow and turning movement volumes. La Playa Dr (top) has 54 vehicles turning left, 513 turning right, and 190 going straight. Southland Dr (bottom) has 370 vehicles turning left, 10 turning right, and 569 going straight.</p>	<p>Diagram of Intersection #4 (Southland Dr at Hesperian Blvd) showing traffic flow and turning movement volumes. Southland Dr (top) has 138 vehicles turning left, 961 turning right, and 195 going straight. Hesperian Blvd (bottom) has 156 vehicles turning left, 344 turning right, and 45 going straight.</p>
<p>Intersection #5 La Playa Dr at Hesperian Blvd</p>			
<p>Diagram of Intersection #5 (La Playa Dr at Hesperian Blvd) showing traffic flow and turning movement volumes. La Playa Dr (top) has 1052 vehicles turning left, 155 turning right, and 193 going straight. Hesperian Blvd (bottom) has 1303 vehicles turning left, 145 turning right, and 164 going straight.</p>			



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- Study Intersection
- Signal Control
- Stop Control
- xx Friday PM Peak Hour Turning Movement Volumes

STUDY INTERSECTIONS

1. Winton Ave. at Southland Dr.
2. Winton Ave. at Southland Pl.
3. La Playa Dr. at Southland Dr.
4. Southland Dr. at Hesperian Blvd.
5. La Playa Dr. at Hesperian Blvd.

4.0 Background (Existing + Approved) Conditions

This scenario is identical to Existing Conditions, but with the addition of traffic from a previously approved project – Southland Mall Cinema which is located within the project vicinity.

4.1 APPROVED PROJECT LOCATION AND DESCRIPTION

Per the information provided by the City and a traffic study conducted by Hexagon Transportation Consultants for Southland Mall Cinema, this project includes replacing 40,384 square feet of existing mall with 22,500 square feet of cinemas space with five screens and 552-seating capacity.

4.2 APPROVED PROJECT TRIP GENERATION AND DISTRIBUTION

Table 2 shows the net trip generation estimation results for the approved project. As shown below, the approved project would generate a total of 140 p.m. peak hour trips on a Friday with 88 inbound trips and 52 outbound trips.

Table 2: Approved Project Trip Generation – Southland Mall Cinema

Land Use	Size	Units	PM Peak Hour (Mon. - Thu.)						PM Peak Hour (Fri.)								
			Pk-Hr Rate	Splits		In			Out			Pk-Hr Rate	Splits		In		
Proposed Use																	
Cinema ¹	5	screens	20.22	40%	60%	40	61	101	45.91	55%	45%	127	103	230			
Existing Use																	
Mall ²	29.19	ksf	2.57	48%	52%	-36	-39	-75				-36	-39	-75			
Offices ³	8.12	ksf	1.49	17%	83%	-2	-10	-12				-2	-10	-12			
Storage & Maintenance ⁴	2.19	ksf	0.32	25%	75%	0	-1	-1				0	-1	-1			
Senior Center ⁵	0.82	ksf	2.74	49%	51%	-1	-1	-2				-1	-1	-2			
Net New Trips Generated						1	10	11				88	52	140			

Notes:
 All trip rates are based on Institute of Traffic Engineers (ITE) Trip Generation Manual, 9th Edition, 2012.
 ksf = 1,000 square feet gross leasable area.
¹ Movie Theater with Matinee (Land Use 444), average trip rates for typical weekdays and Friday are used.
² Shopping Center (Land Use 820), fitted curve equation is used to calculate the average trip rate based on total ksf of the mall.
³ General Office Building (Land Use 710), average trip rate for typical weekdays is used.
⁴ Warehousing (Land Use 150), average trip rate for typical weekdays is used.
⁵ Recreational Community Center (Land Use 495), average trip rate for typical weekdays is used.

Source: Southland Mall Cinema Traffic Impact Study, June 30, 2015, Hexagon Transportation Consultants

These approved project trips were assigned to the roadway networks based on the distribution pattern as mentioned in the Southland Mall Cinema traffic study.

Figure 4 shows the turning movement volumes under the Background (Existing Plus Approved) Project Conditions resulting from Approved Project (Southland Mall Cinema) trip assignment. **Table 3** below shows the approved project trip distribution percentages from the Southland Mall Cinema traffic study.

Table 3: Approved Project Trip Distribution

Direction	Trip Distribution Percentage (%)
I-880 East	65
Winton Avenue West	5
Middle Lane	5
Hesperian Boulevard	25

Source: Traffic Study for Proposed Cinema at Southland Mall, June 30, 2015

4.3 INTERSECTION OPERATING CONDITIONS – BACKGROUND (EXISTING PLUS APPROVED) CONDITIONS

Table 4 below shows the LOS for each study intersection under Background Project Conditions during p.m. peak hour. LOS worksheets are provided in Appendix C. As shown, all of the study intersections are expected to operate at an acceptable LOS D or better during the weekday p.m. peak hour, except for the unsignalized intersection with an average delay of 68.6 seconds/vehicle (LOS F) for the westbound left-turn movement of La Playa Drive.

Table 4: Intersection Level of Service – Background Project Conditions

ID	Intersection Name	Existing PM Peak Hour		Background (Existing + Approved) PM Peak Hour	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Winton Avenue and Southland Drive	49.3	D	51.5	D
2	Winton Avenue and Southland Place	32.7	C	32.7	C
3	Southland Drive and La Playa Drive (Unsignalized)*	37.4	E	68.6	F
4	Hesperian Boulevard and Southland Drive	31.3	C	31.5	C
5	Hesperian Boulevard and La Playa Drive	10.1	B	10.4	B

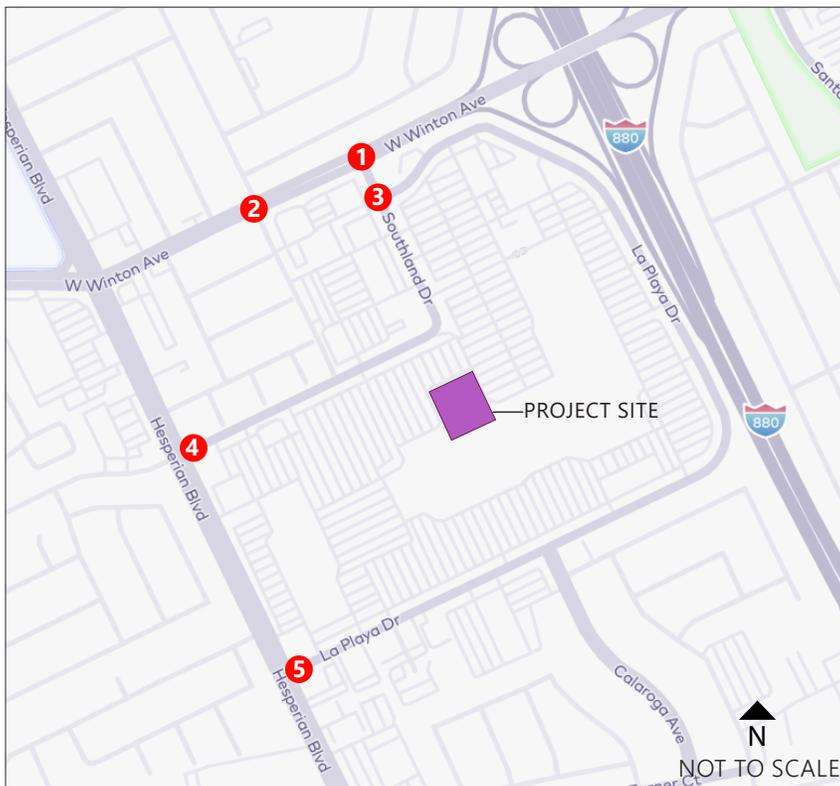
Source: AMG, 2018

LOS – Level of Service; Delay – Average intersection delay (seconds/vehicle) for signalized intersections and worst stop-controlled approach delay (seconds/vehicle) for two-way stop-controlled intersections.

*Note: Unsignalized delay shown is for the Stop control movement of westbound left-turn from La Playa Drive to Southland Drive

FIGURE 4
Existing + Approved Project Traffic Volumes

Intersection #1 Winton Ave at Southland Dr	Intersection #2 Winton Ave at Southland Pl	Intersection #3 La Playa Dr at Southland Dr	Intersection #4 Southland Dr at Hesperian Blvd
<p>Northbound (Winton Ave): 941 (left), 764 (through)</p> <p>Southbound (Winton Ave): 1870 (through), 59 (left)</p> <p>Eastbound (Southland Dr): 986 (left)</p>	<p>Northbound (Winton Ave): 23 (left), 75 (through), 59 (right)</p> <p>Southbound (Winton Ave): 107 (left), 670 (through), 124 (right)</p> <p>Eastbound (Southland Pl): 16 (left), 1551 (through), 65 (right)</p> <p>Westbound (Southland Pl): 75 (left), 112 (through), 381 (right)</p>	<p>Northbound (La Playa Dr): 54 (left), 530 (through), 230 (right)</p> <p>Southbound (La Playa Dr): 394 (left), 16 (right)</p> <p>Eastbound (Southland Dr): 579 (left), 9 (right)</p>	<p>Northbound (Southland Dr): 138 (left), 966 (through), 195 (right)</p> <p>Southbound (Southland Dr): 130 (left), 99 (through), 158 (right)</p> <p>Eastbound (Hesperian Blvd): 156 (left), 351 (through), 45 (right)</p> <p>Westbound (Hesperian Blvd): 70 (left), 1229 (through), 149 (right)</p>
<p>Intersection #5 La Playa Dr at Hesperian Blvd</p>			
<p>Northbound (La Playa Dr): 1052 (left), 160 (right)</p> <p>Southbound (La Playa Dr): 196 (left), 182 (right)</p> <p>Eastbound (Hesperian Blvd): 1303 (left), 167 (right)</p>			



LEGEND

- Study Intersection
- Signal Control
- Stop Control
- xx Friday PM Peak Hour Turning Movement Volumes

STUDY INTERSECTIONS

1. Winton Ave. at Southland Dr.
2. Winton Ave. at Southland Pl.
3. La Playa Dr. at Southland Dr.
4. Southland Dr. at Hesperian Blvd.
5. La Playa Dr. at Hesperian Blvd.

5.0 Background Plus Project Conditions

This scenario is identical to Background Conditions, but with the addition of traffic from the proposed project Round 1 Bowling & Amusement development.

5.1 PROPOSED PROJECT LOCATION AND DESCRIPTION

The proposed project is planned to be built at the location of an existing sporting goods store and it consists of a facility with eight bowling lanes, arcade games area, billiards, dining and party rooms for its patrons. The total tenant space area of the proposed development is 45,506 square feet (sq. ft), with the first-floor area at 3,567 sq. ft. and the second-floor area at 41,939 sq. ft.

The project site can be accessed via Winton Avenue/Southland Drive, Hesperian Boulevard/Southland Drive and via various other driveways surrounded by Southland Mall property.

The proposed project facilities' hours of operation are from 10:00 a.m. to 2:00 a.m. that provides entertainment for all age groups with on-premise food and beverages sale. The project components are very typical of an Institute of Transportation Engineers (ITE) land use Bowling Alley (ITE land use code 437). ITE Trip generation manual describes the land use as follows: *A bowling alley is a recreational facility that includes bowling lanes. A small lounge, restaurant and/or snack bar, video games, and pool tables may also be available.*

5.2 TRIP GENERATION AND TRIP DISTRIBUTION

AMG estimated the potential trips to be generated by the proposed development, using ITE Trip Generation, 10th Edition. The trip generation rates for the land use category Bowling Alley (Land Use 437) was applied. The internal capture between various land uses and Pass-by trips for the retail land use were not considered with the traffic impact analysis.

Table 5 shows the trip generation estimation results. As shown, the proposed project is expected to generate 1,517 daily trips with 61 trips during p.m. peak hour (40 inbound and 21 outbound trips).

Table 5: Project Trip Generation – Round 1 Bowling and Amusement

Land Use	Size (ksf)	Daily Rate	Daily Trips	PM Peak Hour					
				Rate	Total Trips	In %	Out %	In Trips	Out Trips
Bowling Alleys	45.506	33.33	1,517	1.34	61	65	35	40	21

Notes: ksf = 1,000 square feet

Source: ITE Trip General Manual, 10th Edition, 2017; ITE Trip General Handbook, 3rd Edition, 2017; AMG, 2018

These project trips were assigned to the roadway networks based on the distribution pattern shown in **Table 6**. **Figure 5** shows the turning movement volumes under the Background (Existing + Approved) Plus Project Conditions.

Table 6: Project Trip Distribution

Direction	Trip Distribution Percentage
I-880 East	65
Winton Avenue West	5
Middle Lane	5
Hesperian Boulevard	25

Source: Traffic Study for Proposed Cinema at Southland Mall, June 30, 2015

5.3 INTERSECTION OPERATING CONDITIONS – BACKGROUND PLUS PROJECT CONDITIONS

Table 7 summarizes peak hour levels of service at the study intersections under the Background Plus Project Conditions. LOS worksheets are provided in Appendix D.

As shown, all of the study intersections are expected to continue to operate at an acceptable LOS D or better during the weekday p.m. peak hour, except for the unsignalized intersection with an average delay of 72.5 seconds/vehicle (LOS F) for the westbound left-turn movement of La Playa Drive at Southland Drive.

Table 7: Intersection Level of Service – Background Project Conditions

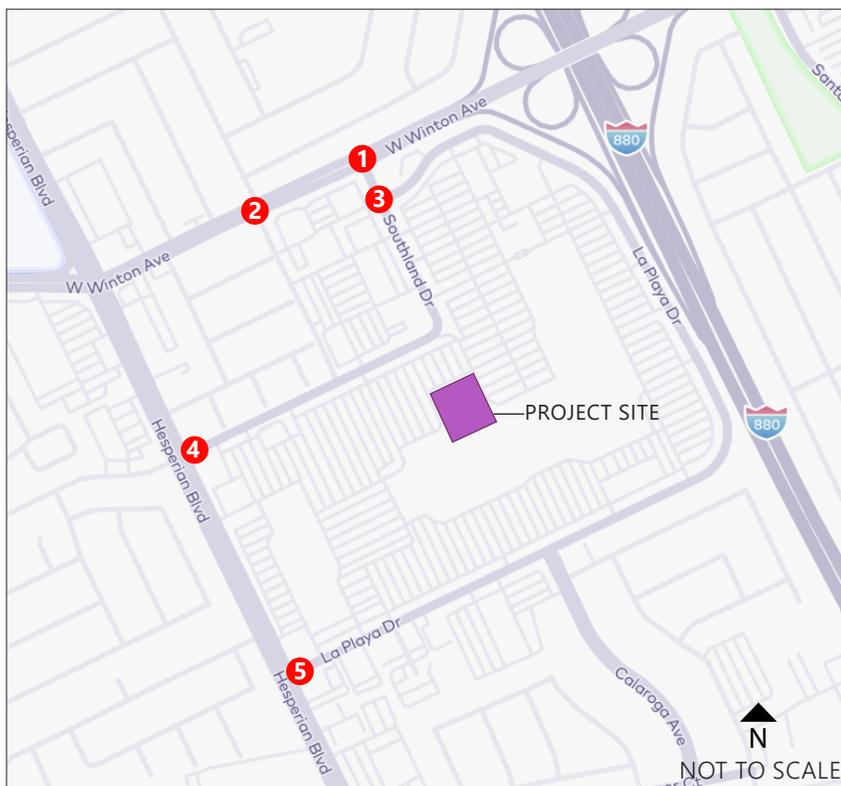
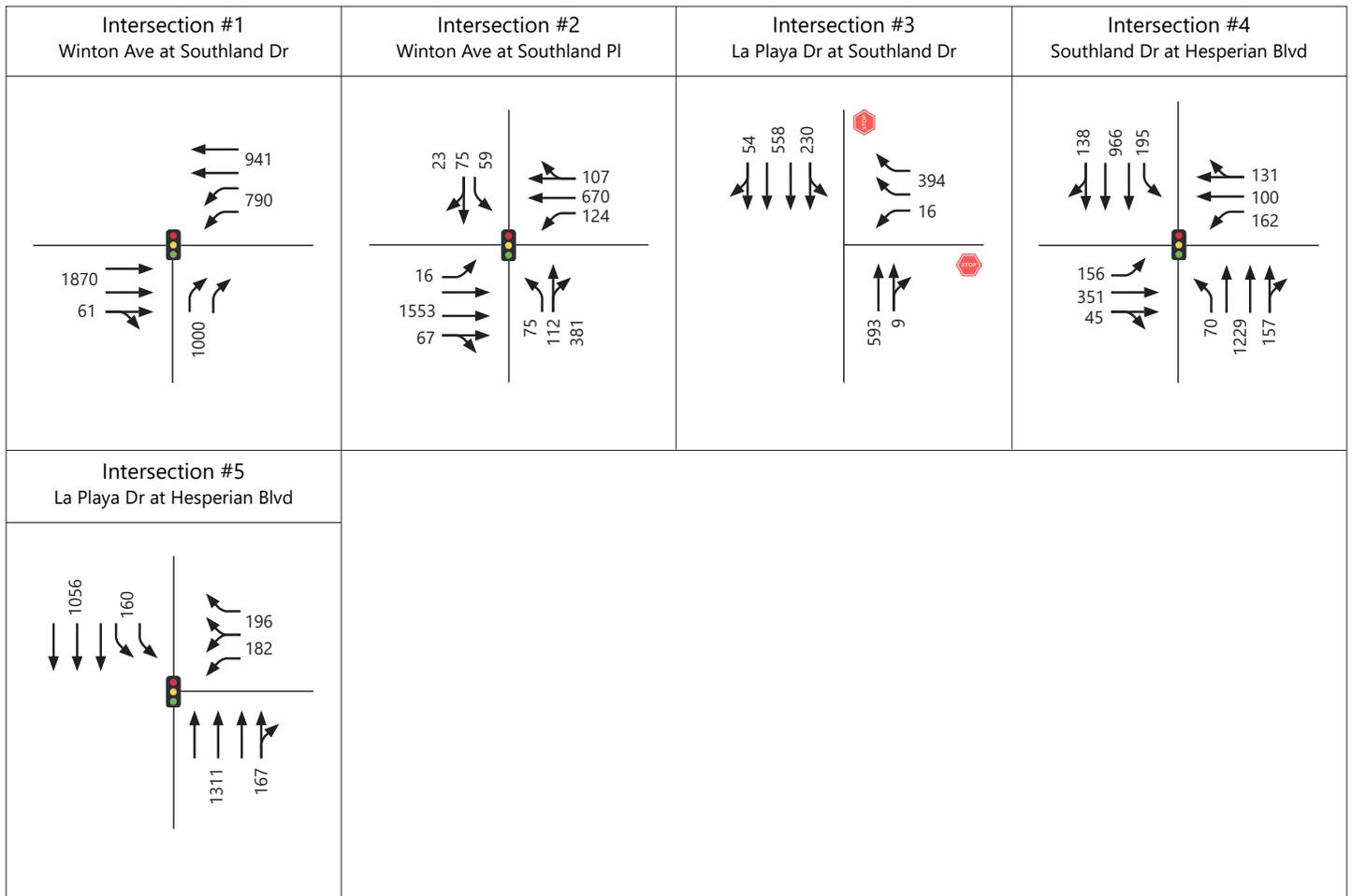
ID	Intersection Name	Existing PM Peak Hour		Background (Existing + Approved) PM Peak Hour		Background + Project PM Peak Hour	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Winton Avenue and Southland Drive	49.3	D	51.5	D	52.9	D
2	Winton Avenue and Southland Place	32.7	C	32.7	C	32.7	C
3	Southland Drive and La Playa Drive (Unsignalized)*	37.4	E	68.6	F	72.5	F
4	Hesperian Boulevard and Southland Drive	31.3	C	31.5	C	31.8	C
5	Hesperian Boulevard and La Playa Drive	10.1	B	10.4	B	10.5	B

Source: AMG, 2018

LOS – Level of Service; Delay – Average intersection delay (seconds/vehicle) for signalized intersections and worst stop-controlled approach delay (seconds/vehicle) for two-way stop-controlled intersections.

*Note: Unsignalized delay shown is for the Stop control movement of westbound left-turn from La Playa Drive to Southland Drive

FIGURE 5
Background + Project Traffic Volumes



LEGEND

- Study Intersection
- Signal Control
- Stop Control
- xx Friday PM Peak Hour Turning Movement Volumes

STUDY INTERSECTIONS

1. Winton Ave. at Southland Dr.
2. Winton Ave. at Southland Pl.
3. La Playa Dr. at Southland Dr.
4. Southland Dr. at Hesperian Blvd.
5. La Playa Dr. at Hesperian Blvd.

The addition of proposed project trips does not trigger any significant intersection delay, turn movement delay or queuing conditions. Improvements recommended as part of the previously approved project Southland Mall Cinema are expected to continue to alleviate queue conditions from the proposed project trips.

The approved project (Southland Mall Cinema) traffic study recommended the following improvements:

- 1) At the Unsignalized two-way stop-controlled intersection of Southland Drive/La Playa Drive intersection, restripe the southbound approach lanes between Winton Avenue and La Playa Drive to provide a left-turn only lane (currently it's a shared thru-left turn lane) and channelize the westbound left-turn lane traffic into southbound lanes on Southland Drive.
- 2) City should consider revising the signal phasing and timing at the intersection of Southland Drive/Winton Avenue intersection to reduce the intersection cycle length and increase the green time for northbound right-turn movement. This signal operational improvement would reduce the queue conditions and spillage between the Winton Avenue and La Playa Drive along Southland Drive.

6.0 Conclusion

Based on the results of the analysis, the following is a summary of our findings:

All the study intersections currently operate at an acceptable LOS D or better during the weekday p.m. peak hour, except for the unsignalized intersection Southland Drive/La Playa Drive. This intersection operates with an average delay of 37.4 seconds/vehicle (LOS E) for the stop-controlled westbound left-turn movement of La Playa Drive at Southland Drive.

The proposed project is expected to generate 1,517 daily trips with 61 trips during p.m. peak hour (40 inbound and 21 outbound trips).

All of the study intersections are expected to operate at an acceptable LOS D or better during the weekday p.m. peak hour, except for the unsignalized intersection with an average delay of 68.6 seconds/vehicle (LOS F) for the westbound left-turn movement of La Playa Drive.

All of the study intersections are expected to continue to operate at an acceptable LOS D or better during the weekday p.m. peak hour, except for the unsignalized intersection with an average delay of 72.5 seconds/vehicle (LOS F) for the westbound left-turn movement of La Playa Drive at Southland Drive.

Appendix A INTERSECTION TURNING MOVEMENT COUNTS

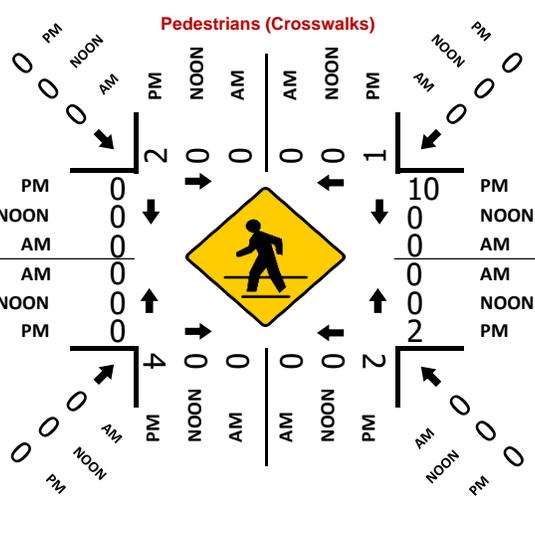
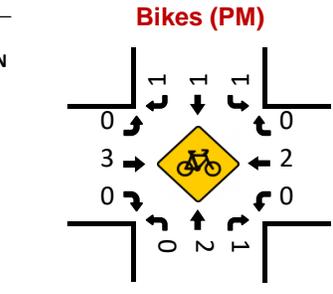
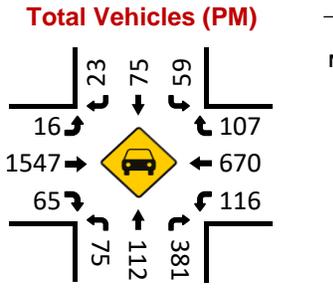
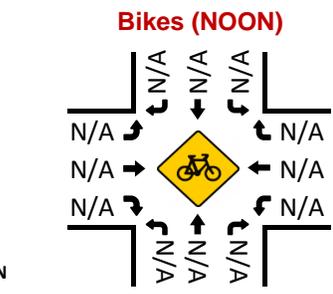
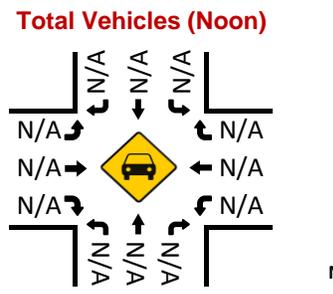
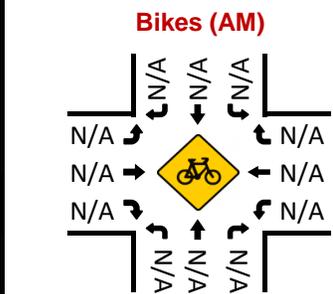
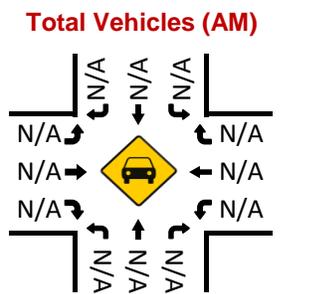
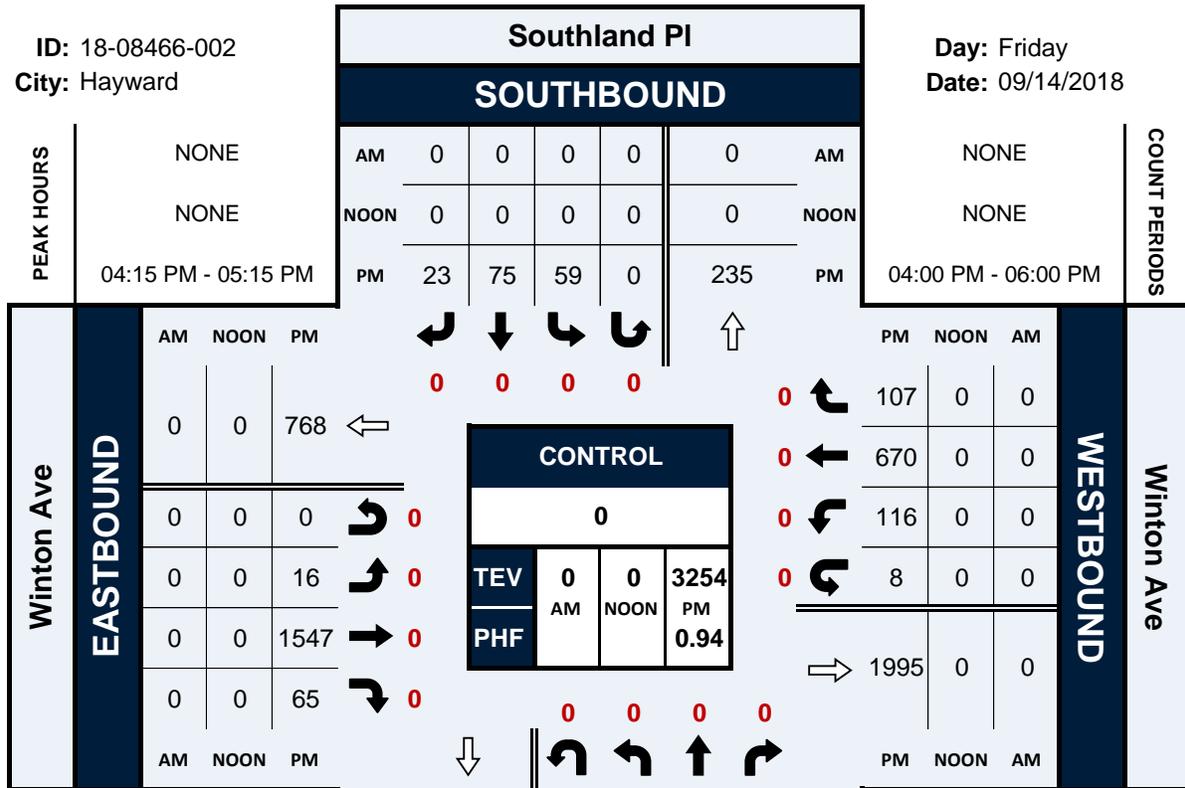
DRAFT

Southland Pl & Winton Ave

Peak Hour Turning Movement Count

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City: Hayward

Day: Friday
Date: 09/14/2018

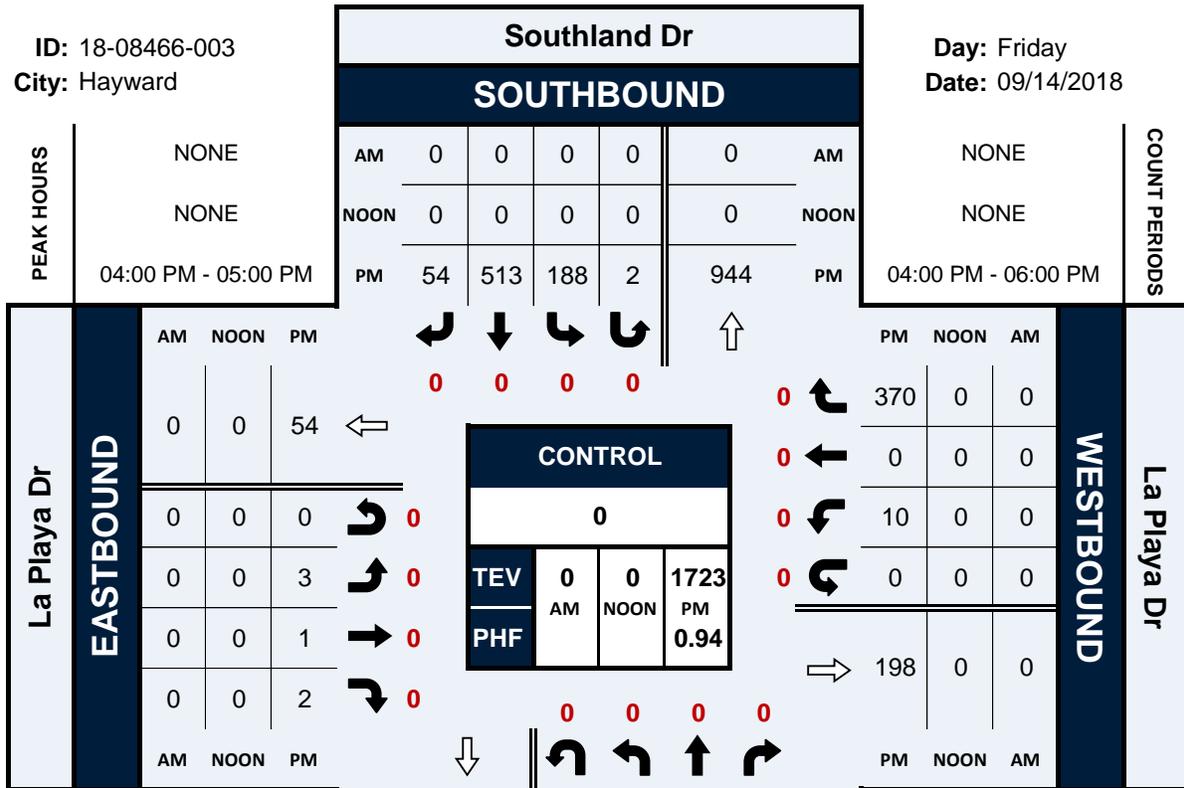


Southland Dr & La Playa Dr

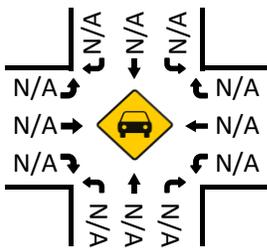
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ID: 18-08466-003
City: Hayward

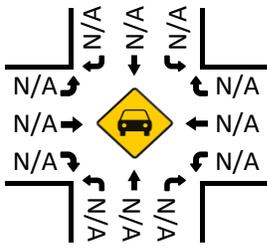
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Date: 09/14/2018



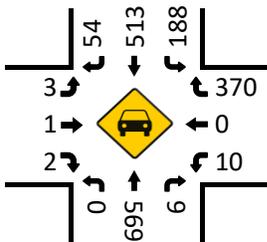
Total Vehicles (AM)



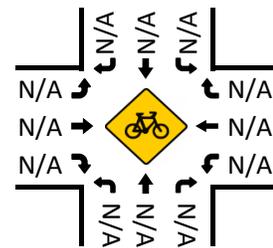
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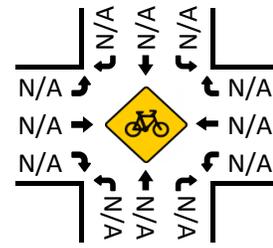
Total Vehicles (PM)



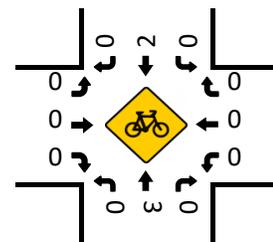
Bikes (AM)



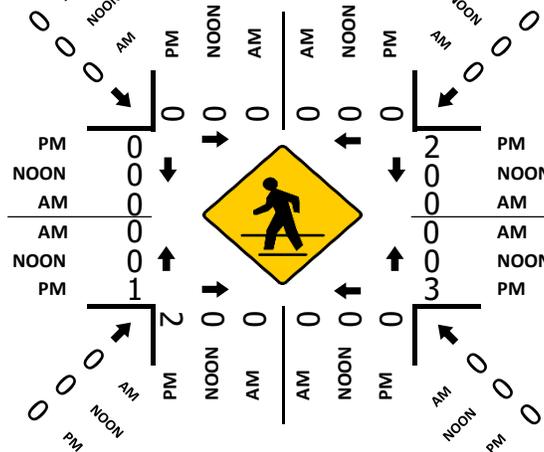
Bikes (NOON)



Bikes (PM)



Pedestrians (Crosswalks)

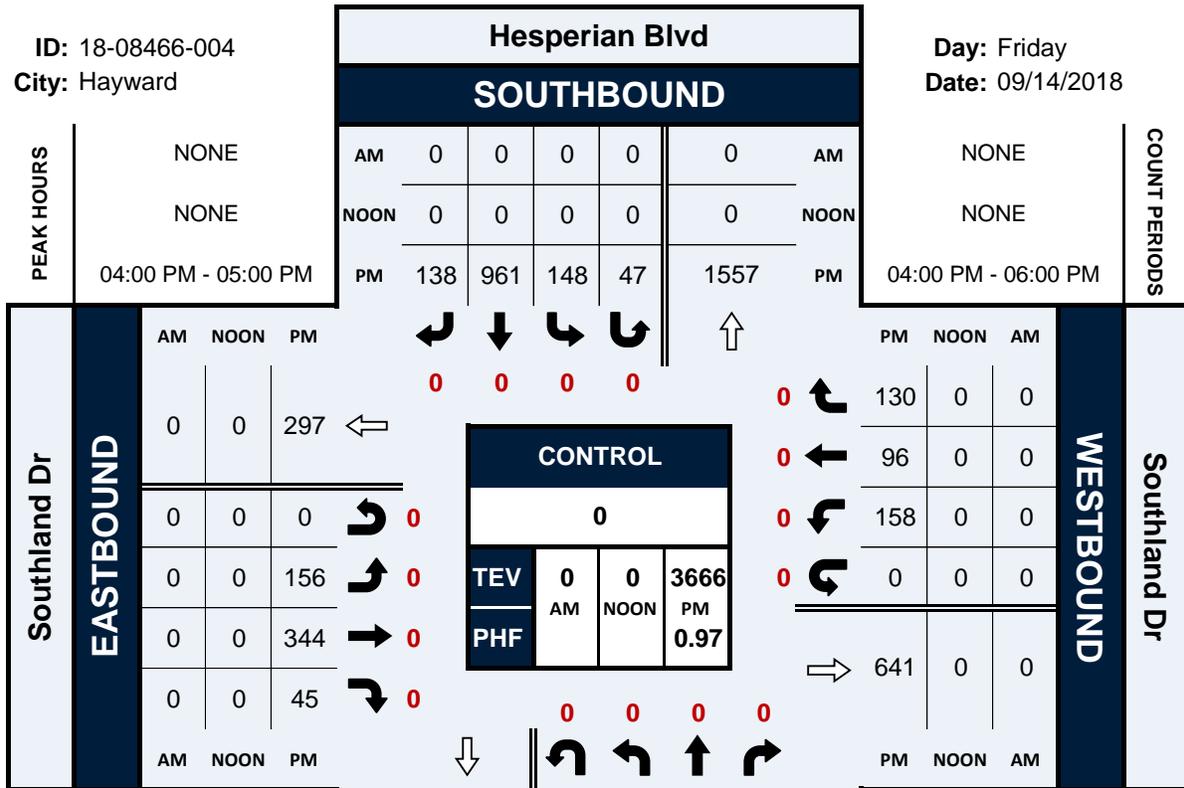


Hesperian Blvd & Southland Dr

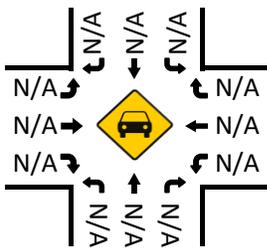
Peak Hour Turning Movement Count

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City: Hayward

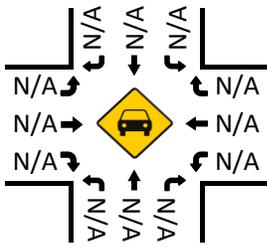
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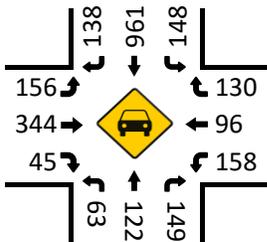
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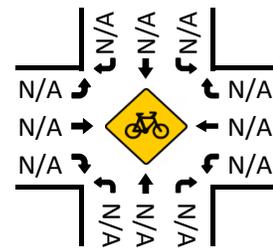
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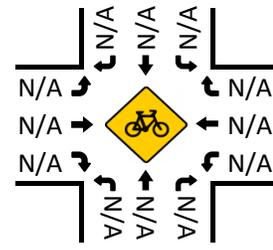
Total Vehicles (PM)



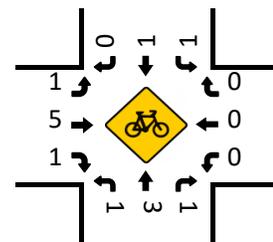
Bikes (AM)



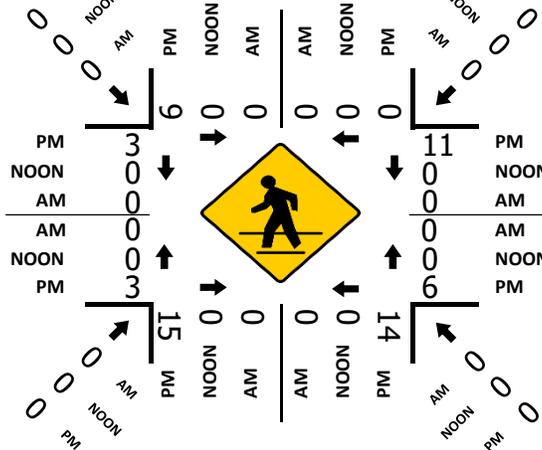
Bikes (NOON)



Bikes (PM)



Pedestrians (Crosswalks)

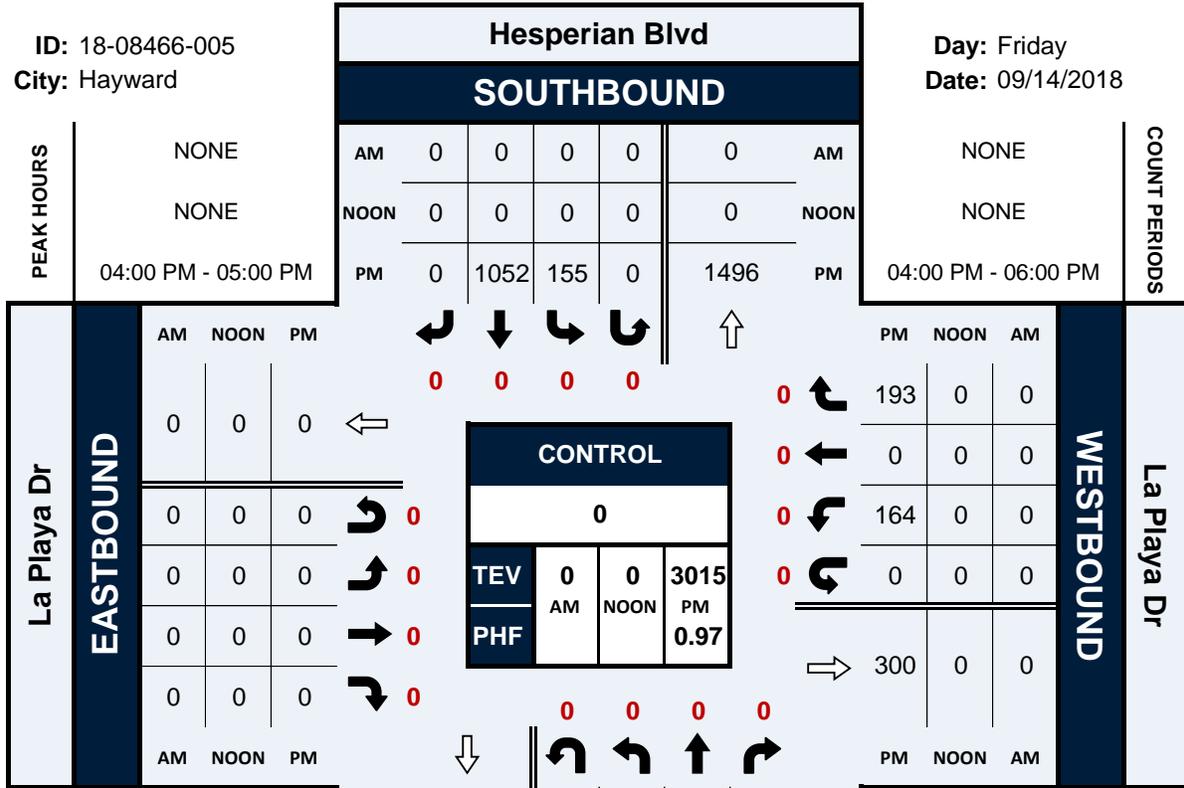


Hesperian Blvd & La Playa Dr

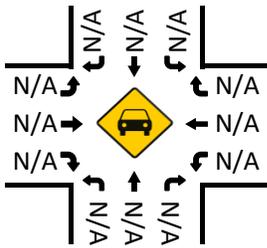
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City: Hayward

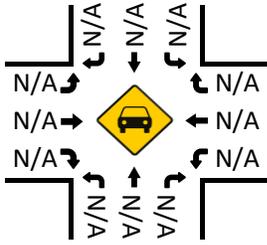
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Date: 09/14/2018



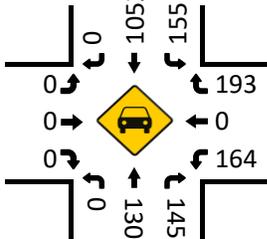
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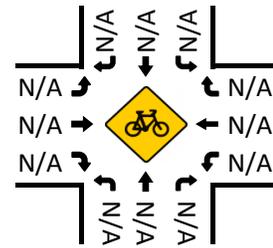
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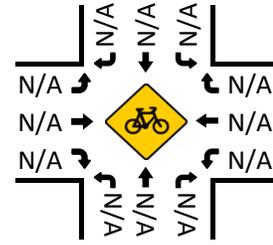
Total Vehicles (PM)



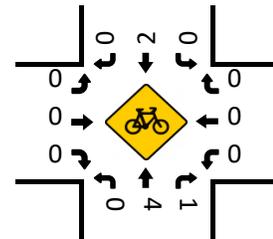
Bikes (AM)



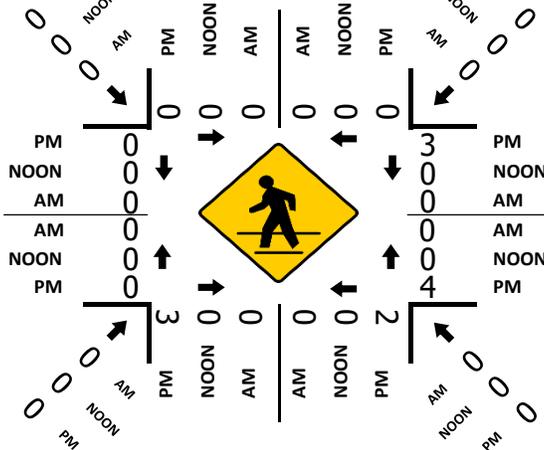
Bikes (NOON)



Bikes (PM)



Pedestrians (Crosswalks)



Appendix B LEVEL OF SERVICE WORKSHEETS: EXISTING CONDITIONS

DRAFT

Queues

1: Southland Drive & W. Winton Avenue

Existing PM Peak



Lane Group	EBT	WBL	WBT	NBR
Lane Group Flow (vph)	2093	773	1023	1033
v/c Ratio	0.97	0.84	0.40	0.88
Control Delay	60.4	58.0	8.0	24.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	60.4	58.0	8.0	24.3
Queue Length 50th (ft)	735	344	171	161
Queue Length 95th (ft)	#814	424	205	273
Internal Link Dist (ft)	1		1818	
Turn Bay Length (ft)		340		
Base Capacity (vph)	2154	919	2565	1174
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.97	0.84	0.40	0.88

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

1: Southland Drive & W. Winton Avenue

Existing PM Peak



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑		↔	↑↑		↔
Traffic Volume (vph)	1870	55	711	941	0	950
Future Volume (vph)	1870	55	711	941	0	950
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5	4.5		4.5
Lane Util. Factor	0.91		0.97	0.95		0.88
Frt	1.00		1.00	1.00		0.85
Flt Protected	1.00		0.95	1.00		1.00
Satd. Flow (prot)	5063		3433	3539		2787
Flt Permitted	1.00		0.95	1.00		1.00
Satd. Flow (perm)	5063		3433	3539		2787
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2033	60	773	1023	0	1033
RTOR Reduction (vph)	2	0	0	0	0	587
Lane Group Flow (vph)	2091	0	773	1023	0	446
Turn Type	NA		Prot	NA		Perm
Protected Phases	4		3	8		
Permitted Phases						2
Actuated Green, G (s)	59.5		37.5	101.5		29.5
Effective Green, g (s)	59.5		37.5	101.5		29.5
Actuated g/C Ratio	0.42		0.27	0.72		0.21
Clearance Time (s)	4.5		4.5	4.5		4.5
Vehicle Extension (s)	3.0		3.0	3.0		3.0
Lane Grp Cap (vph)	2151		919	2565		587
v/s Ratio Prot	c0.41		c0.23	0.29		
v/s Ratio Perm						c0.16
v/c Ratio	0.97		0.84	0.40		0.76
Uniform Delay, d1	39.4		48.4	7.4		51.9
Progression Factor	1.28		1.00	1.00		1.00
Incremental Delay, d2	10.2		9.2	0.5		8.9
Delay (s)	60.7		57.6	7.9		60.9
Level of Service	E		E	A		E
Approach Delay (s)	60.7			29.3	60.9	
Approach LOS	E			C	E	

Intersection Summary

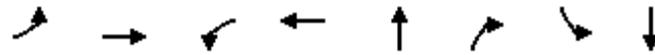
HCM 2000 Control Delay	49.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	78.1%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Queues

2: Southland Place/Stonewall Avenue & W. Winton Avenue

Existing PM Peak



Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	17	1753	135	844	204	414	64	107
v/c Ratio	0.23	0.80	0.69	0.45	0.36	0.58	0.18	0.16
Control Delay	72.1	37.8	77.3	18.7	36.6	20.4	34.4	29.3
Queue Delay	0.0	61.0	0.0	0.2	0.0	0.6	0.0	0.0
Total Delay	72.1	98.9	77.3	18.9	36.6	21.0	34.4	29.3
Queue Length 50th (ft)	15	473	127	193	143	145	42	61
Queue Length 95th (ft)	42	563	203	224	218	262	82	109
Internal Link Dist (ft)		815		533	215			198
Turn Bay Length (ft)	70		420				60	
Base Capacity (vph)	77	2225	249	1914	562	714	360	657
Starvation Cap Reductn	0	0	0	340	0	0	0	0
Spillback Cap Reductn	0	1970	0	0	0	86	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	6.87	0.54	0.54	0.36	0.66	0.18	0.16

Intersection Summary

HCM Signalized Intersection Capacity Analysis

2: Southland Place/Stonewall Avenue & W. Winton Avenue

Existing PM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↗	↑↑↑		↖	↑↑			↑	↗	↖	↑	↘
Traffic Volume (vph)	16	1547	65	124	670	107	75	112	381	59	75	23
Future Volume (vph)	16	1547	65	124	670	107	75	112	381	59	75	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5			4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.95			1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	0.98			1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00			0.98	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5054		1770	3466			1826	1583	1770	1797	
Flt Permitted	0.95	1.00		0.95	1.00			0.83	1.00	0.53	1.00	
Satd. Flow (perm)	1770	5054		1770	3466			1555	1583	996	1797	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	17	1682	71	135	728	116	82	122	414	64	82	25
RTOR Reduction (vph)	0	3	0	0	9	0	0	0	147	0	8	0
Lane Group Flow (vph)	17	1750	0	135	835	0	0	204	267	64	99	0
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	
Protected Phases	7	4		3	8			2				6
Permitted Phases							2		2	6		
Actuated Green, G (s)	2.4	63.0		15.5	76.1			48.0	48.0	48.0	48.0	
Effective Green, g (s)	2.4	63.0		15.5	76.1			48.0	48.0	48.0	48.0	
Actuated g/C Ratio	0.02	0.45		0.11	0.54			0.34	0.34	0.34	0.34	
Clearance Time (s)	4.5	4.5		4.5	4.5			4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	30	2274		195	1884			533	542	341	616	
v/s Ratio Prot	0.01	c0.35		c0.08	0.24							0.06
v/s Ratio Perm								0.13	c0.17	0.06		
v/c Ratio	0.57	0.77		0.69	0.44			0.38	0.49	0.19	0.16	
Uniform Delay, d1	68.3	32.4		60.0	19.2			34.8	36.4	32.3	32.0	
Progression Factor	1.00	1.00		1.01	0.95			1.00	1.00	1.00	1.00	
Incremental Delay, d2	22.3	1.6		9.5	0.2			2.1	3.2	1.2	0.6	
Delay (s)	90.5	34.0		70.3	18.4			36.9	39.6	33.5	32.6	
Level of Service	F	C		E	B			D	D	C	C	
Approach Delay (s)		34.6			25.5			38.7			32.9	
Approach LOS		C			C			D			C	

Intersection Summary

HCM 2000 Control Delay	32.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	71.5%	ICU Level of Service	C
Analysis Period (min)	15		

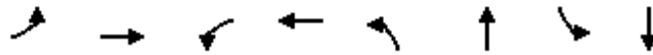
c Critical Lane Group

Intersection Sign configuration not allowed in HCM analysis.

Queues

4: Hesperian Boulevard & Middle Lane/Southland Drive

Existing PM Peak



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	170	423	172	245	76	1492	212	1195
v/c Ratio	0.81	0.68	0.81	0.36	0.45	0.85	0.80	0.56
Control Delay	66.8	38.3	67.5	15.2	46.8	32.3	59.9	20.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	66.8	38.3	67.5	15.2	46.8	32.3	59.9	20.6
Queue Length 50th (ft)	93	112	94	25	40	272	113	182
Queue Length 95th (ft)	#205	161	#208	58	85	#359	#232	241
Internal Link Dist (ft)		121		1356		1171		913
Turn Bay Length (ft)	205		140		210		260	
Base Capacity (vph)	216	743	216	792	193	1757	277	2146
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.79	0.57	0.80	0.31	0.39	0.85	0.77	0.56

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

4: Hesperian Boulevard & Middle Lane/Southland Drive

Existing PM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	156	344	45	158	96	130	70	1224	149	195	961	138
Future Volume (vph)	156	344	45	158	96	130	70	1224	149	195	961	138
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.91		1.00	0.91	
Frt	1.00	0.98		1.00	0.91		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3478		1770	3234		1770	5002		1770	4990	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3478		1770	3234		1770	5002		1770	4990	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	170	374	49	172	104	141	76	1330	162	212	1045	150
RTOR Reduction (vph)	0	12	0	0	116	0	0	16	0	0	19	0
Lane Group Flow (vph)	170	411	0	172	129	0	76	1476	0	212	1176	0
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	10.3	15.1		10.4	15.2		6.9	30.7		12.9	36.7	
Effective Green, g (s)	10.3	15.1		10.4	15.2		6.9	30.7		12.9	36.7	
Actuated g/C Ratio	0.12	0.17		0.12	0.17		0.08	0.35		0.15	0.42	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	209	602		211	564		140	1763		262	2102	
v/s Ratio Prot	0.10	c0.12		c0.10	0.04		0.04	c0.30		c0.12	0.24	
v/s Ratio Perm												
v/c Ratio	0.81	0.68		0.82	0.23		0.54	0.84		0.81	0.56	
Uniform Delay, d1	37.5	33.8		37.4	30.9		38.6	25.9		35.9	19.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	20.9	3.2		20.9	0.2		4.2	3.6		16.6	0.3	
Delay (s)	58.4	37.0		58.3	31.1		42.8	29.5		52.5	19.4	
Level of Service	E	D		E	C		D	C		D	B	
Approach Delay (s)		43.1			42.3			30.2			24.4	
Approach LOS		D			D			C			C	

Intersection Summary

HCM 2000 Control Delay	31.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	87.1	Sum of lost time (s)	18.0
Intersection Capacity Utilization	72.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Queues

5: Hesperian Boulevard & La Playa Drive

Existing PM Peak



Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	264	124	1574	168	1143
v/c Ratio	0.44	0.37	0.62	0.45	0.34
Control Delay	14.9	8.1	11.2	25.7	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	14.9	8.1	11.2	25.7	4.2
Queue Length 50th (ft)	24	0	119	24	41
Queue Length 95th (ft)	50	37	179	50	69
Internal Link Dist (ft)	2218		469		1171
Turn Bay Length (ft)				80	
Base Capacity (vph)	1235	591	2556	370	3381
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.21	0.21	0.62	0.45	0.34

Intersection Summary

HCM Signalized Intersection Capacity Analysis

5: Hesperian Boulevard & La Playa Drive

Existing PM Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔↔↔	↔	↔↔↔		↔↔↔	↔↔↔
Traffic Volume (vph)	164	193	1303	145	155	1052
Future Volume (vph)	164	193	1303	145	155	1052
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5		4.5	4.5
Lane Util. Factor	0.97	0.91	0.91		0.97	0.91
Frt	0.95	0.85	0.98		1.00	1.00
Flt Protected	0.97	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3325	1441	5009		3433	5085
Flt Permitted	0.97	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3325	1441	5009		3433	5085
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	178	210	1416	158	168	1143
RTOR Reduction (vph)	73	105	19	0	0	0
Lane Group Flow (vph)	191	19	1555	0	168	1143
Turn Type	Prot	Perm	NA		Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	8.1	8.1	25.8		4.4	34.7
Effective Green, g (s)	8.1	8.1	25.8		4.4	34.7
Actuated g/C Ratio	0.16	0.16	0.50		0.08	0.67
Clearance Time (s)	4.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	519	225	2494		291	3406
v/s Ratio Prot	c0.06		c0.31		c0.05	0.22
v/s Ratio Perm		0.01				
v/c Ratio	0.37	0.09	0.62		0.58	0.34
Uniform Delay, d1	19.6	18.7	9.5		22.8	3.6
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.4	0.2	1.2		2.8	0.3
Delay (s)	20.0	18.9	10.7		25.6	3.9
Level of Service	C	B	B		C	A
Approach Delay (s)	19.6		10.7			6.7
Approach LOS	B		B			A

Intersection Summary

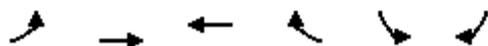
HCM 2000 Control Delay	10.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	51.8	Sum of lost time (s)	13.5
Intersection Capacity Utilization	50.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

31: Southland Drive NB/La Playa Drive WB & Southland Drive SBLT

Existing PM Peak



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↘	
Traffic Volume (veh/h)	0	578	380	0	190	0
Future Volume (Veh/h)	0	578	380	0	190	0
Sign Control		Stop	Stop		Free	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	628	413	0	207	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type						
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	620	414	414	0	0	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	620	414	414	0	0	
tC, single (s)	7.1	6.5	6.5	6.2	4.1	
tC, 2 stage (s)						
tF (s)	3.5	4.0	4.0	3.3	2.2	
p0 queue free %	100	0	10	100	87	
cM capacity (veh/h)	84	461	461	1085	1623	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	314	314	206	206	207	
Volume Left	0	0	0	0	207	
Volume Right	0	0	0	0	0	
cSH	461	461	461	461	1623	
Volume to Capacity	0.68	0.68	0.45	0.45	0.13	
Queue Length 95th (ft)	126	126	57	57	11	
Control Delay (s)	27.9	27.9	19.0	19.0	7.5	
Lane LOS	D	D	C	C	A	
Approach Delay (s)	27.9		19.0		7.5	
Approach LOS	D		C			
Intersection Summary						
Average Delay			21.6			
Intersection Capacity Utilization			33.2%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

32: Southland Drive NB/Southland Drive SB & La Playa Drive WBLT

Existing PM Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	10	0	0	0	569	9	190	513	54
Future Volume (Veh/h)	0	0	0	10	0	0	0	569	9	190	513	54
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
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
Hourly flow rate (vph)	0	0	0	11	0	0	0	618	10	207	558	59
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1310	1630	169	1176	1654	314	617			628		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1310	1630	169	1176	1654	314	617			628		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	91	100	100	100			78		
cM capacity (veh/h)	97	79	845	122	76	682	959			950		
Direction, Lane #	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2	SB 3	SB 4			
Volume Total	11	0	0	309	319	300	186	186	152			
Volume Left	11	0	0	0	0	207	0	0	0			
Volume Right	0	0	0	0	10	0	0	0	59			
cSH	122	1700	1700	959	1700	950	1700	1700	1700			
Volume to Capacity	0.09	0.00	0.00	0.00	0.19	0.22	0.11	0.11	0.09			
Queue Length 95th (ft)	7	0	0	0	0	21	0	0	0			
Control Delay (s)	37.4	0.0	0.0	0.0	0.0	7.5	0.0	0.0	0.0			
Lane LOS	E	A	A			A						
Approach Delay (s)	37.4			0.0		2.7						
Approach LOS	E											
Intersection Summary												
Average Delay			1.8									
Intersection Capacity Utilization			40.6%	ICU Level of Service	A							
Analysis Period (min)			15									

Appendix C LEVEL OF SERVICE WORKSHEETS: BACKGROUND CONDITIONS

DRAFT

Queues

1: Southland Drive & W. Winton Avenue

Existing+Approved PM Peak



Lane Group	EBT	WBL	WBT	NBR
Lane Group Flow (vph)	2097	830	1023	1072
v/c Ratio	0.97	0.90	0.40	0.91
Control Delay	60.8	63.5	8.0	28.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	60.8	63.5	8.0	28.6
Queue Length 50th (ft)	737	377	171	191
Queue Length 95th (ft)	#817	#490	205	#346
Internal Link Dist (ft)	1		1818	
Turn Bay Length (ft)		340		
Base Capacity (vph)	2152	919	2565	1174
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.97	0.90	0.40	0.91

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

1: Southland Drive & W. Winton Avenue

Existing+Approved PM Peak



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑		↔	↑↑		↔
Traffic Volume (vph)	1870	59	764	941	0	986
Future Volume (vph)	1870	59	764	941	0	986
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5	4.5		4.5
Lane Util. Factor	0.91		0.97	0.95		0.88
Frt	1.00		1.00	1.00		0.85
Flt Protected	1.00		0.95	1.00		1.00
Satd. Flow (prot)	5062		3433	3539		2787
Flt Permitted	1.00		0.95	1.00		1.00
Satd. Flow (perm)	5062		3433	3539		2787
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2033	64	830	1023	0	1072
RTOR Reduction (vph)	2	0	0	0	0	587
Lane Group Flow (vph)	2095	0	830	1023	0	485
Turn Type	NA		Prot	NA		Perm
Protected Phases	4		3	8		
Permitted Phases						2
Actuated Green, G (s)	59.5		37.5	101.5		29.5
Effective Green, g (s)	59.5		37.5	101.5		29.5
Actuated g/C Ratio	0.42		0.27	0.72		0.21
Clearance Time (s)	4.5		4.5	4.5		4.5
Vehicle Extension (s)	3.0		3.0	3.0		3.0
Lane Grp Cap (vph)	2151		919	2565		587
v/s Ratio Prot	c0.41		c0.24	0.29		
v/s Ratio Perm						c0.17
v/c Ratio	0.97		0.90	0.40		0.83
Uniform Delay, d1	39.5		49.5	7.4		52.8
Progression Factor	1.28		1.00	1.00		1.00
Incremental Delay, d2	10.4		13.9	0.5		12.5
Delay (s)	61.0		63.4	7.9		65.3
Level of Service	E		E	A		E
Approach Delay (s)	61.0			32.7	65.3	
Approach LOS	E			C	E	

Intersection Summary

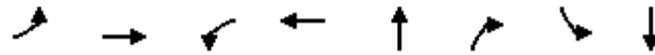
HCM 2000 Control Delay	51.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	79.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Queues

2: Southland Place/Stonewall Avenue & W. Winton Avenue

Existing+Approved PM Peak



Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	17	1757	135	844	204	414	64	107
v/c Ratio	0.23	0.80	0.69	0.45	0.36	0.58	0.18	0.16
Control Delay	72.1	37.9	77.3	18.7	36.7	20.4	34.4	29.3
Queue Delay	0.0	61.0	0.0	0.2	0.0	0.6	0.0	0.0
Total Delay	72.1	98.9	77.3	18.8	36.7	21.0	34.4	29.3
Queue Length 50th (ft)	15	475	127	193	143	145	42	61
Queue Length 95th (ft)	42	565	203	224	218	262	82	109
Internal Link Dist (ft)		815		533	215			198
Turn Bay Length (ft)	70		420				60	
Base Capacity (vph)	77	2225	249	1914	562	714	359	657
Starvation Cap Reductn	0	0	0	340	0	0	0	0
Spillback Cap Reductn	0	1970	0	0	0	86	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	6.89	0.54	0.54	0.36	0.66	0.18	0.16

Intersection Summary

HCM Signalized Intersection Capacity Analysis

2: Southland Place/Stonewall Avenue & W. Winton Avenue

Existing+Approved PM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↗	↑↑↑		↖	↑↑			↑	↗	↖	↓	↘
Traffic Volume (vph)	16	1551	65	124	670	107	75	112	381	59	75	23
Future Volume (vph)	16	1551	65	124	670	107	75	112	381	59	75	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5			4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.95			1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	0.98			1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00			0.98	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5054		1770	3466			1826	1583	1770	1797	
Flt Permitted	0.95	1.00		0.95	1.00			0.83	1.00	0.53	1.00	
Satd. Flow (perm)	1770	5054		1770	3466			1555	1583	995	1797	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	17	1686	71	135	728	116	82	122	414	64	82	25
RTOR Reduction (vph)	0	3	0	0	9	0	0	0	147	0	8	0
Lane Group Flow (vph)	17	1754	0	135	835	0	0	204	267	64	99	0
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2		2	6		
Actuated Green, G (s)	2.4	63.1		15.5	76.2			47.9	47.9	47.9	47.9	
Effective Green, g (s)	2.4	63.1		15.5	76.2			47.9	47.9	47.9	47.9	
Actuated g/C Ratio	0.02	0.45		0.11	0.54			0.34	0.34	0.34	0.34	
Clearance Time (s)	4.5	4.5		4.5	4.5			4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	30	2277		195	1886			532	541	340	614	
v/s Ratio Prot	0.01	c0.35		c0.08	0.24							0.06
v/s Ratio Perm								0.13	c0.17	0.06		
v/c Ratio	0.57	0.77		0.69	0.44			0.38	0.49	0.19	0.16	
Uniform Delay, d1	68.3	32.3		60.0	19.2			34.9	36.5	32.4	32.1	
Progression Factor	1.00	1.00		1.01	0.95			1.00	1.00	1.00	1.00	
Incremental Delay, d2	22.3	1.7		9.5	0.2			2.1	3.2	1.2	0.6	
Delay (s)	90.5	34.0		70.3	18.3			37.0	39.7	33.6	32.6	
Level of Service	F	C		E	B			D	D	C	C	
Approach Delay (s)		34.6			25.5			38.8			33.0	
Approach LOS		C			C			D			C	

Intersection Summary

HCM 2000 Control Delay	32.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	71.6%	ICU Level of Service	C
Analysis Period (min)	15		

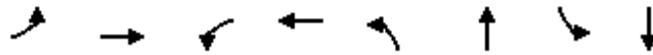
c Critical Lane Group

Intersection Sign configuration not allowed in HCM analysis.

Queues

4: Hesperian Boulevard & Middle Lane/Southland Drive

Existing+Approved PM Peak



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	170	431	172	249	76	1498	212	1200
v/c Ratio	0.81	0.69	0.81	0.36	0.46	0.84	0.84	0.56
Control Delay	67.1	38.6	67.8	15.3	46.9	31.3	65.6	20.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	67.1	38.6	67.8	15.3	46.9	31.3	65.6	20.7
Queue Length 50th (ft)	93	114	94	26	40	271	115	183
Queue Length 95th (ft)	#205	163	#208	60	85	346	#242	242
Internal Link Dist (ft)		121		1356		1171		913
Turn Bay Length (ft)	205		140		210		260	
Base Capacity (vph)	215	740	215	790	192	1795	260	2145
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.79	0.58	0.80	0.32	0.40	0.83	0.82	0.56

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

4: Hesperian Boulevard & Middle Lane/Southland Drive

Existing+Approved PM Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			  			 	
Traffic Volume (vph)	156	351	45	158	99	130	70	1229	149	195	966	138
Future Volume (vph)	156	351	45	158	99	130	70	1229	149	195	966	138
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.91		1.00	0.91	
Frt	1.00	0.98		1.00	0.92		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3479		1770	3239		1770	5003		1770	4990	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3479		1770	3239		1770	5003		1770	4990	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	170	382	49	172	108	141	76	1336	162	212	1050	150
RTOR Reduction (vph)	0	12	0	0	116	0	0	16	0	0	19	0
Lane Group Flow (vph)	170	419	0	172	133	0	76	1482	0	212	1181	0
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	10.3	15.3		10.4	15.4		6.9	31.4		12.4	36.9	
Effective Green, g (s)	10.3	15.3		10.4	15.4		6.9	31.4		12.4	36.9	
Actuated g/C Ratio	0.12	0.17		0.12	0.18		0.08	0.36		0.14	0.42	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	208	608		210	570		139	1795		250	2104	
v/s Ratio Prot	0.10	c0.12		c0.10	0.04		0.04	c0.30		c0.12	0.24	
v/s Ratio Perm												
v/c Ratio	0.82	0.69		0.82	0.23		0.55	0.83		0.85	0.56	
Uniform Delay, d1	37.7	33.9		37.6	31.0		38.8	25.6		36.6	19.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	21.4	3.3		21.4	0.2		4.3	3.2		22.5	0.3	
Delay (s)	59.1	37.1		59.0	31.2		43.1	28.8		59.1	19.5	
Level of Service	E	D		E	C		D	C		E	B	
Approach Delay (s)		43.3			42.6			29.5			25.5	
Approach LOS		D			D			C			C	
Intersection Summary												
HCM 2000 Control Delay			31.5				HCM 2000 Level of Service				C	
HCM 2000 Volume to Capacity ratio			0.80									
Actuated Cycle Length (s)			87.5				Sum of lost time (s)			18.0		
Intersection Capacity Utilization			72.8%				ICU Level of Service			C		
Analysis Period (min)			15									

c Critical Lane Group

Queues

5: Hesperian Boulevard & La Playa Drive

Existing+Approved PM Peak



Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	281	130	1598	174	1143
v/c Ratio	0.46	0.38	0.63	0.49	0.34
Control Delay	15.6	7.9	11.3	26.8	4.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	15.6	7.9	11.3	26.8	4.4
Queue Length 50th (ft)	27	0	121	25	42
Queue Length 95th (ft)	54	38	184	52	71
Internal Link Dist (ft)	2218		469		1171
Turn Bay Length (ft)				80	
Base Capacity (vph)	1240	596	2546	357	3351
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.23	0.22	0.63	0.49	0.34

Intersection Summary

HCM Signalized Intersection Capacity Analysis

5: Hesperian Boulevard & La Playa Drive

Existing+Approved PM Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	182	196	1303	167	160	1052
Future Volume (vph)	182	196	1303	167	160	1052
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5		4.5	4.5
Lane Util. Factor	0.97	0.91	0.91		0.97	0.91
Frt	0.96	0.85	0.98		1.00	1.00
Flt Protected	0.97	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3336	1441	4998		3433	5085
Flt Permitted	0.97	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3336	1441	4998		3433	5085
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	198	213	1416	182	174	1143
RTOR Reduction (vph)	70	109	22	0	0	0
Lane Group Flow (vph)	211	21	1576	0	174	1143
Turn Type	Prot	Perm	NA		Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	8.4	8.4	25.7		4.2	34.4
Effective Green, g (s)	8.4	8.4	25.7		4.2	34.4
Actuated g/C Ratio	0.16	0.16	0.50		0.08	0.66
Clearance Time (s)	4.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	540	233	2479		278	3376
v/s Ratio Prot	c0.06		c0.32		c0.05	0.22
v/s Ratio Perm		0.01				
v/c Ratio	0.39	0.09	0.64		0.63	0.34
Uniform Delay, d1	19.4	18.5	9.6		23.0	3.8
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.5	0.2	1.3		4.4	0.3
Delay (s)	19.9	18.6	10.9		27.4	4.0
Level of Service	B	B	B		C	A
Approach Delay (s)	19.5		10.9			7.1
Approach LOS	B		B			A

Intersection Summary

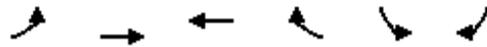
HCM 2000 Control Delay	10.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	51.8	Sum of lost time (s)	13.5
Intersection Capacity Utilization	52.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

31: Southland Drive NB/La Playa Drive WB & Southland Drive SBLT

Existing+Approved PM Peak



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↘	
Traffic Volume (veh/h)	0	588	394	0	230	0
Future Volume (Veh/h)	0	588	394	0	230	0
Sign Control		Stop	Stop		Free	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	639	428	0	250	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type						
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	714	500	500	0	0	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	714	500	500	0	0	
tC, single (s)	7.1	6.5	6.5	6.2	4.1	
tC, 2 stage (s)						
tF (s)	3.5	4.0	4.0	3.3	2.2	
p0 queue free %	0	0	0	100	85	
cM capacity (veh/h)	0	400	400	1085	1623	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	320	320	214	214	250	
Volume Left	0	0	0	0	250	
Volume Right	0	0	0	0	0	
cSH	400	400	400	400	1623	
Volume to Capacity	0.80	0.80	0.54	0.54	0.15	
Queue Length 95th (ft)	175	175	76	76	14	
Control Delay (s)	41.5	41.5	23.9	23.9	7.6	
Lane LOS	E	E	C	C	A	
Approach Delay (s)	41.5		23.9		7.6	
Approach LOS	E		C			
Intersection Summary						
Average Delay			29.3			
Intersection Capacity Utilization			35.7%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

32: Southland Drive NB/Southland Drive SB & La Playa Drive WBLT

Existing+Approved PM Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	16	0	0	0	579	9	290	530	54
Future Volume (Veh/h)	0	0	0	16	0	0	0	579	9	290	530	54
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
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
Hourly flow rate (vph)	0	0	0	17	0	0	0	629	10	315	576	59
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1550	1874	174	1408	1899	320	635			639		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1550	1874	174	1408	1899	320	635			639		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	77	100	100	100			67		
cM capacity (veh/h)	57	47	840	73	46	676	944			941		
Direction, Lane #	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2	SB 3	SB 4			
Volume Total	17	0	0	314	324	411	192	192	155			
Volume Left	17	0	0	0	0	315	0	0	0			
Volume Right	0	0	0	0	10	0	0	0	59			
cSH	73	1700	1700	944	1700	941	1700	1700	1700			
Volume to Capacity	0.23	0.00	0.00	0.00	0.19	0.33	0.11	0.11	0.09			
Queue Length 95th (ft)	20	0	0	0	0	37	0	0	0			
Control Delay (s)	68.6	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0			
Lane LOS	F	A	A			A						
Approach Delay (s)	68.6			0.0		3.9						
Approach LOS	F											
Intersection Summary												
Average Delay			3.1									
Intersection Capacity Utilization			45.7%		ICU Level of Service				A			
Analysis Period (min)			15									

Appendix D LEVEL OF SERVICE WORKSHEETS: BACKGROUND PLUS PROJECT CONDITIONS

DRAFT

Queues

1: Southland Drive & W. Winton Avenue

Existing+Approved+Project PM Peak



Lane Group	EBT	WBL	WBT	NBR
Lane Group Flow (vph)	2099	859	1023	1087
v/c Ratio	0.98	0.93	0.40	0.93
Control Delay	61.0	67.6	8.0	30.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	61.0	67.6	8.0	30.5
Queue Length 50th (ft)	737	395	171	202
Queue Length 95th (ft)	#818	#519	205	#361
Internal Link Dist (ft)	1		1818	
Turn Bay Length (ft)		340		
Base Capacity (vph)	2152	919	2565	1174
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.98	0.93	0.40	0.93

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

1: Southland Drive & W. Winton Avenue

Existing+Approved+Project PM Peak



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑		↔	↑↑		↔
Traffic Volume (vph)	1870	61	790	941	0	1000
Future Volume (vph)	1870	61	790	941	0	1000
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5	4.5		4.5
Lane Util. Factor	0.91		0.97	0.95		0.88
Frt	1.00		1.00	1.00		0.85
Flt Protected	1.00		0.95	1.00		1.00
Satd. Flow (prot)	5061		3433	3539		2787
Flt Permitted	1.00		0.95	1.00		1.00
Satd. Flow (perm)	5061		3433	3539		2787
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2033	66	859	1023	0	1087
RTOR Reduction (vph)	2	0	0	0	0	587
Lane Group Flow (vph)	2097	0	859	1023	0	500
Turn Type	NA		Prot	NA		Perm
Protected Phases	4		3	8		
Permitted Phases						2
Actuated Green, G (s)	59.5		37.5	101.5		29.5
Effective Green, g (s)	59.5		37.5	101.5		29.5
Actuated g/C Ratio	0.42		0.27	0.72		0.21
Clearance Time (s)	4.5		4.5	4.5		4.5
Vehicle Extension (s)	3.0		3.0	3.0		3.0
Lane Grp Cap (vph)	2150		919	2565		587
v/s Ratio Prot	c0.41		c0.25	0.29		
v/s Ratio Perm						c0.18
v/c Ratio	0.98		0.93	0.40		0.85
Uniform Delay, d1	39.5		50.1	7.4		53.1
Progression Factor	1.28		1.00	1.00		1.00
Incremental Delay, d2	10.6		17.6	0.5		14.4
Delay (s)	61.2		67.6	7.9		67.6
Level of Service	E		E	A		E
Approach Delay (s)	61.2			35.2	67.6	
Approach LOS	E			D	E	

Intersection Summary

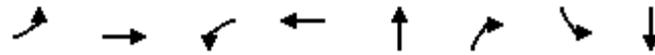
HCM 2000 Control Delay	52.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	80.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Queues

2: Southland Place/Stonewall Avenue & W. Winton Avenue

Existing+Approved+Project PM Peak



Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	17	1761	135	844	204	414	64	107
v/c Ratio	0.23	0.80	0.69	0.45	0.36	0.58	0.18	0.16
Control Delay	72.1	37.8	77.3	18.6	36.7	20.4	34.5	29.3
Queue Delay	0.0	60.9	0.0	0.2	0.0	0.6	0.0	0.0
Total Delay	72.1	98.7	77.3	18.8	36.7	21.0	34.5	29.3
Queue Length 50th (ft)	15	477	127	193	143	145	42	61
Queue Length 95th (ft)	42	567	203	224	218	262	82	109
Internal Link Dist (ft)		815		533	215			198
Turn Bay Length (ft)	70		420				60	
Base Capacity (vph)	77	2227	249	1917	560	713	358	655
Starvation Cap Reductn	0	0	0	340	0	0	0	0
Spillback Cap Reductn	0	1970	0	0	0	86	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	6.85	0.54	0.54	0.36	0.66	0.18	0.16

Intersection Summary

HCM Signalized Intersection Capacity Analysis

2: Southland Place/Stonewall Avenue & W. Winton Avenue

Existing+Approved+Project PM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↙	↑↑↑		↙	↑↑			↑	↗	↙	↘	
Traffic Volume (vph)	16	1553	67	124	670	107	75	112	381	59	75	23
Future Volume (vph)	16	1553	67	124	670	107	75	112	381	59	75	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5			4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.95			1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	0.98			1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00			0.98	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5054		1770	3466			1826	1583	1770	1797	
Flt Permitted	0.95	1.00		0.95	1.00			0.83	1.00	0.53	1.00	
Satd. Flow (perm)	1770	5054		1770	3466			1555	1583	995	1797	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	17	1688	73	135	728	116	82	122	414	64	82	25
RTOR Reduction (vph)	0	3	0	0	9	0	0	0	147	0	8	0
Lane Group Flow (vph)	17	1758	0	135	835	0	0	204	267	64	99	0
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2		2	6		
Actuated Green, G (s)	2.4	63.2		15.5	76.3			47.8	47.8	47.8	47.8	
Effective Green, g (s)	2.4	63.2		15.5	76.3			47.8	47.8	47.8	47.8	
Actuated g/C Ratio	0.02	0.45		0.11	0.54			0.34	0.34	0.34	0.34	
Clearance Time (s)	4.5	4.5		4.5	4.5			4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	30	2281		195	1888			530	540	339	613	
v/s Ratio Prot	0.01	c0.35		c0.08	0.24							0.06
v/s Ratio Perm								0.13	c0.17	0.06		
v/c Ratio	0.57	0.77		0.69	0.44			0.38	0.49	0.19	0.16	
Uniform Delay, d1	68.3	32.3		60.0	19.1			35.0	36.5	32.5	32.1	
Progression Factor	1.00	1.00		1.01	0.95			1.00	1.00	1.00	1.00	
Incremental Delay, d2	22.3	1.7		9.5	0.2			2.1	3.2	1.2	0.6	
Delay (s)	90.5	34.0		70.3	18.3			37.1	39.7	33.7	32.7	
Level of Service	F	C		E	B			D	D	C	C	
Approach Delay (s)		34.5			25.4			38.9			33.1	
Approach LOS		C			C			D			C	

Intersection Summary

HCM 2000 Control Delay	32.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	71.7%	ICU Level of Service	C
Analysis Period (min)	15		

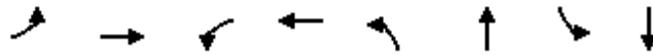
c Critical Lane Group

Intersection Sign configuration not allowed in HCM analysis.

Queues

4: Hesperian Boulevard & Middle Lane/Southland Drive

Existing+Approved+Project PM Peak



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	170	431	176	251	76	1507	212	1200
v/c Ratio	0.81	0.69	0.83	0.36	0.46	0.84	0.85	0.56
Control Delay	67.3	38.7	69.7	15.4	46.9	31.2	67.4	20.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	67.3	38.7	69.7	15.4	46.9	31.2	67.4	20.7
Queue Length 50th (ft)	93	114	96	27	40	271	116	183
Queue Length 95th (ft)	#205	163	#215	60	85	348	#244	242
Internal Link Dist (ft)		121		1356		1171		913
Turn Bay Length (ft)	205		140		210		260	
Base Capacity (vph)	214	739	214	790	192	1804	255	2145
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.79	0.58	0.82	0.32	0.40	0.84	0.83	0.56

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

4: Hesperian Boulevard & Middle Lane/Southland Drive

Existing+Approved+Project PM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	156	351	45	162	100	131	70	1229	157	195	966	138
Future Volume (vph)	156	351	45	162	100	131	70	1229	157	195	966	138
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.91		1.00	0.91	
Frt	1.00	0.98		1.00	0.92		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3479		1770	3239		1770	4999		1770	4990	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3479		1770	3239		1770	4999		1770	4990	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	170	382	49	176	109	142	76	1336	171	212	1050	150
RTOR Reduction (vph)	0	12	0	0	117	0	0	17	0	0	19	0
Lane Group Flow (vph)	170	419	0	176	134	0	76	1490	0	212	1181	0
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	10.3	15.3		10.4	15.4		7.0	31.6		12.3	36.9	
Effective Green, g (s)	10.3	15.3		10.4	15.4		7.0	31.6		12.3	36.9	
Actuated g/C Ratio	0.12	0.17		0.12	0.18		0.08	0.36		0.14	0.42	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	208	607		210	569		141	1803		248	2101	
v/s Ratio Prot	0.10	c0.12		c0.10	0.04		0.04	c0.30		c0.12	0.24	
v/s Ratio Perm												
v/c Ratio	0.82	0.69		0.84	0.24		0.54	0.83		0.85	0.56	
Uniform Delay, d1	37.7	33.9		37.8	31.0		38.7	25.5		36.8	19.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	21.4	3.4		24.2	0.2		3.9	3.2		23.8	0.3	
Delay (s)	59.1	37.3		62.0	31.3		42.7	28.7		60.6	19.6	
Level of Service	E	D		E	C		D	C		E	B	
Approach Delay (s)		43.5			43.9			29.4			25.7	
Approach LOS		D			D			C			C	

Intersection Summary

HCM 2000 Control Delay	31.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	87.6	Sum of lost time (s)	18.0
Intersection Capacity Utilization	73.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Queues

5: Hesperian Boulevard & La Playa Drive

Existing+Approved+Project PM Peak



Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	281	130	1607	174	1148
v/c Ratio	0.46	0.38	0.63	0.49	0.34
Control Delay	15.6	7.9	11.4	26.8	4.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	15.6	7.9	11.4	26.8	4.4
Queue Length 50th (ft)	27	0	122	25	42
Queue Length 95th (ft)	54	38	186	52	72
Internal Link Dist (ft)	2218		469		1171
Turn Bay Length (ft)				80	
Base Capacity (vph)	1240	596	2546	357	3351
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.23	0.22	0.63	0.49	0.34

Intersection Summary

HCM Signalized Intersection Capacity Analysis

5: Hesperian Boulevard & La Playa Drive

Existing+Approved+Project PM Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↶↷	↶	↶↶↶↷		↶↷	↶↶↶
Traffic Volume (vph)	182	196	1311	167	160	1056
Future Volume (vph)	182	196	1311	167	160	1056
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5		4.5	4.5
Lane Util. Factor	0.97	0.91	0.91		0.97	0.91
Frt	0.96	0.85	0.98		1.00	1.00
Flt Protected	0.97	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3336	1441	4999		3433	5085
Flt Permitted	0.97	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3336	1441	4999		3433	5085
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	198	213	1425	182	174	1148
RTOR Reduction (vph)	70	109	22	0	0	0
Lane Group Flow (vph)	211	21	1585	0	174	1148
Turn Type	Prot	Perm	NA		Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	8.4	8.4	25.7		4.2	34.4
Effective Green, g (s)	8.4	8.4	25.7		4.2	34.4
Actuated g/C Ratio	0.16	0.16	0.50		0.08	0.66
Clearance Time (s)	4.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	540	233	2480		278	3376
v/s Ratio Prot	c0.06		c0.32		c0.05	0.23
v/s Ratio Perm		0.01				
v/c Ratio	0.39	0.09	0.64		0.63	0.34
Uniform Delay, d1	19.4	18.5	9.6		23.0	3.8
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.5	0.2	1.3		4.4	0.3
Delay (s)	19.9	18.6	10.9		27.4	4.0
Level of Service	B	B	B		C	A
Approach Delay (s)	19.5		10.9			7.1
Approach LOS	B		B			A

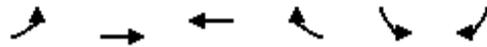
Intersection Summary

HCM 2000 Control Delay	10.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	51.8	Sum of lost time (s)	13.5
Intersection Capacity Utilization	52.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

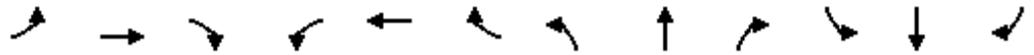
31: Southbound Drive NB/La Playa Drive WB & Southland Drive SBL Existing+Approved+Project PM Peak



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↵	
Traffic Volume (veh/h)	0	602	394	0	230	0
Future Volume (Veh/h)	0	602	394	0	230	0
Sign Control		Stop	Stop		Free	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	654	428	0	250	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type						
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	714	500	500	0	0	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	714	500	500	0	0	
tC, single (s)	7.1	6.5	6.5	6.2	4.1	
tC, 2 stage (s)						
tF (s)	3.5	4.0	4.0	3.3	2.2	
p0 queue free %	0	0	0	100	85	
cM capacity (veh/h)	0	400	400	1085	1623	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	327	327	214	214	250	
Volume Left	0	0	0	0	250	
Volume Right	0	0	0	0	0	
cSH	400	400	400	400	1623	
Volume to Capacity	0.82	0.82	0.54	0.54	0.15	
Queue Length 95th (ft)	185	185	76	76	14	
Control Delay (s)	43.7	43.7	23.9	23.9	7.6	
Lane LOS	E	E	C	C	A	
Approach Delay (s)	43.7		23.9		7.6	
Approach LOS	E		C			
Intersection Summary						
Average Delay			30.5			
Intersection Capacity Utilization			36.0%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

32: Southland Drive NB/Southland Drive SB & La Playa Drive WBLT Existing+Approved+Project PM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations				↵		↵↵		↵↵			↵↵↵	
Traffic Volume (veh/h)	0	0	0	16	0	0	0	593	9	290	558	54
Future Volume (Veh/h)	0	0	0	16	0	0	0	593	9	290	558	54
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
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
Hourly flow rate (vph)	0	0	0	17	0	0	0	645	10	315	607	59
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type												
Median storage veh												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1589	1922	181	1432	1946	328	666			655		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1589	1922	181	1432	1946	328	666			655		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	76	100	100	100			66		
cM capacity (veh/h)	53	44	830	70	42	668	919			928		
Direction, Lane #	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2	SB 3	SB 4			
Volume Total	17	0	0	322	332	416	202	202	160			
Volume Left	17	0	0	0	0	315	0	0	0			
Volume Right	0	0	0	0	10	0	0	0	59			
cSH	70	1700	1700	919	1700	928	1700	1700	1700			
Volume to Capacity	0.24	0.00	0.00	0.00	0.20	0.34	0.12	0.12	0.09			
Queue Length 95th (ft)	21	0	0	0	0	38	0	0	0			
Control Delay (s)	72.5	0.0	0.0	0.0	0.0	9.2	0.0	0.0	0.0			
Lane LOS	F	A	A			A						
Approach Delay (s)	72.5			0.0		3.9						
Approach LOS	F											
Intersection Summary												
Average Delay			3.1									
Intersection Capacity Utilization			46.1%		ICU Level of Service					A		
Analysis Period (min)			15									