Oak Springs Development

Project # 2013104463

Supplemental Report for

November 2013 Transportation Impact Analysis

Thurston County, WA

September 2016

3-8-2017

DKS
DKS ASSOCIATES, INC.

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CHAPTER 1: INTRODUCTION AND SUMMARY

This supplemental report is an update to a 2013 transportation impact analysis that was submitted for the Oak Springs development site in unincorporated Thurston County, Washington. The prior traffic impact study, prepared by Heath & Associates Inc. presented an assessment of the existing roadway conditions and future forecasts of newly generated project traffic. Since that study was submitted to Thurston County, another major development, Oak Tree Preserve, was reviewed and approved by the County.

The purpose of this study is to update the 2013 traffic analysis to include all phases of the approved Oak Tree Preserve and other subsequent approvals made by either the County or the City of Lacey. The Oak Springs project site proposal is unchanged from the 2013 submittal. As appropriate, new transportation mitigation measures are recommended to address the higher level of future background growth addressed in this update. Information regarding the general roadway information, road improvement information, sight distance data is referenced herein, based on the previous Heath & Associates Oaks Springs study.

The study area is shown in Figure 1, including the five study intersections, where traffic operations are analyzed:

- Pacific Avenue SE / Marvin Road SE
- Pacific Avenue SE / Union Mills Road SE
- Union Mills Road SE / Marvin Road SE
- 19th Avenue SE / Marvin Road SE
- Woodgrove Street SE / Marvin Road SE

This chapter provides an introduction to the project and the steps taken to analyze the associated impacts on the transportation network. It highlights important elements of the remaining chapters, including a description of the project site and a summary of the project site evaluation. Table 1 lists important characteristics of the study area and the proposed project.

Table 1: Key Study Area and Proposed Project Characteristics

Characteristics	Information
Study Area	
Number of Study Intersections	Five
Analysis Period	Weekday PM peak hour (one hour between 4pm and 6pm)
Project Development	
Size and Land Use	Single family housing (89 new units)
Proposed Vehicle Trips (In Addition to Existing Traffic)	98 vehicles (PM peak hour)
Vehicle Access Points	Woodgrove Street SE

LEGEND

- Study Intersection

DKS

No Scale

Figure 1

Study Area

Existing Intersection Operations

Existing traffic operations at the study intersections were analyzed for the PM peak hour based on 2010 Highway Capacity Manual methodology[1]. The estimated level-of-service (LOS) and delay for each study intersection is shown in Table 2. As shown, all study intersections currently meet Thurston County operating standards during the peak hours analyzed.

Table 2: Existing 2016 Study Intersection Operations (PM Peak Hour)

Intersection	Intersection Control	Operating Standard	Existing PM Peak	
			LOS	*Delay*
Pacific Avenue SE/Union Mills SE	Signalized	D	B	10.1
Marvin Road SE/Pacific Avenue SE	Roundabout	D	C	16.2
Marvin Road SE/Union Mills Road SE	Side-street Stop	D	C	20.8
Marvin Road SE/19th Avenue SE	Side-street Stop	D	B	14.7
Marvin Road SE/Woodgrove Street SE	Side-street Stop	D	B	13.5

Signalized/Roundabout:
LOS = Level of Service of Intersection
Delay= Average delay for all Vehicles

Two-Way or All-Way Stop Controlled:
LOS = Level of Service of movement with greatest delay

Source: DKS Associates

Project Traffic Impact

Consistent with Thurston County Code section 17.10[2], a transportation concurrency evaluation is required for a development that generates 25 or more vehicle trips in the PM peak hour. If LOS at transportation facilities falls below adopted standards, mitigation is necessary for a development to meet concurrency. Thurston County adopted LOS standards are LOS E along high density corridors, and LOS D along other urban roads. For those County intersections evaluated in this traffic study that fall below adopted LOS standards, improvements have been identified to mitigate transportation impacts.

Project traffic impacts were evaluated at the study intersections for the weekday PM peak hour during the 2016 project build year. Additional traffic was added to the existing roadway network based on trip generation estimates, trip distribution assumptions associated with the additional 89 housing units and pipeline trips (assumptions are documented in Chapter 3). As shown in Table 3, most of the study intersections did not meet the operation standards for the P peak hours in the future with additional traffic loadings associated with background growth and the proposed project.

[1] 2010 Highway Capacity Manual, Transportation Research Board, Washington DC, 2010.
[2] Oak Springs-Traffic Impact Analysis report, Heath & Associates, Inc.

Table 3: Future Intersection Operations (PM Peak Hour)

Intersection	Intersection Control	Operating Standard	2020 PM Peak (Baseline)		2020 PM Peak (with Oak Springs)		2022 PM Peak (Full Development)	
			LOS	*Delay*	*LOS*	*Delay*	*LOS*	*Delay*
Pacific Avenue SE/ Union Mills SE	Signalized	D	B	12.0	B	18.2	C	20.1
Marvin Road SE/ Pacific Avenue SE	Round-about	D	F	65.1	F	67.6	F	78.8
Marvin Road SE/ Union Mills Road SE	Two-Way Stop	D	F	>120	F	>120	F	>120
Marvin Road SE/ 19th Avenue SE	Two-Way Stop	D	F	>120	F	>120	F	>120
Marvin Road SE/ Woodgrove Street SE	Two-Way Stop	D	C	18.4	C	21.1	C	22.7

Signalized/Roundabout:
LOS = Level of Service of Intersection
Delay= Average delay for all Vehicles

Two-Way or All-Way Stop Controlled:
LOS = Level of Service of movement with greatest delay

Source: DKS Associates

Site Plan

The site plan provided by the project sponsor was reviewed to evaluate site access, intersection sight distance, pedestrian and bicycle access. The evaluation of these issues includes the identification of associated on-site project modifications or improvements, which are explained in detail in Chapter 3 of this report and summarized in the "Project Mitigation Summary" section below.

Project Mitigation Summary

Three intersections fail to meet mobility standards under 2020 baseline PM peak conditions, and perform slightly worse with the Oak Springs development and two additional years of background growth. The three intersections and recommended mitigations strategies are as follows:

- **Marvin Road SE/Pacific Avenue SE.** The eastbound and southbound approaches at this roundabout fail under 2020 Baseline PM conditions, which include background traffic growth and trips from nearby development projects such as Oak Tree Preserve. WSDOT currently has no plans for adding capacity to this two-lane roundabout. Should WSDOT identify a need for additional capacity, mitigation could include a proportionate share contribution based on Oak Springs development trips.
- **Marvin Road SE/Union Mills Road SE**. High delay for the stop-controlled eastbound approach is due to infrequent gaps in the heavy southbound traffic as well as conflicting northbound left turns. This deficiency occurs under 2020 Baseline PM Conditions, prior to addition of Oak

Springs trips. This intersection is identified for mitigation in the Oak Tree Preserve TIA, with access control that will prohibit eastbound left turns, which have the highest delays. To accommodate vehicles needing to make this movement, improvements at the Marvin Road SE/19th Avenue SE intersection are needed in order to enable u-turns.

- **Marvin Road SE/19th Avenue SE.** High delay for the stop-controlled eastbound and westbound approaches is due to infrequent gaps in the heavy southbound traffic on Marvin Road SE. This deficiency occurs under 2020 Baseline PM conditions, prior to addition of Oak Springs trips. New intersection control (signal or roundabout) is a required mitigation for the Oak Tree Preserve development. The Oak Springs development may be conditioned to contribute to this mitigation in proportion to the relative number of trips it is adding to the intersection. Under 2020 PM conditions, this proportion is 52 new trips out of a total of 1,003 new trips, or about 5% of the traffic volume growth at the intersection.The Marvin Road SE/19th Avenue SE intersection was analyzed as a signalized intersection in order to test the identified mitigation under 2020 and 2022 PM peak hour conditions. Results are shown in Table 4.

Table 4: Future Mitigated Intersection Operations

Intersection	Intersection Control	Operating Standard	2020 PM Peak (with Oak Springs)		2022 PM Peak (Full Development)	
			LOS	*Delay*	*LOS*	*Delay*
Marvin Road SE/ 19th Avenue SE	Signalized	D	C	31.8	D	35.0

Signalized:
LOS = Level of Service of Intersection
Delay= Average delay for all Vehicles

Two-Way or All-Way Stop Controlled:
LOS = Level of Service of movement with greatest delay

Source: DKS Associates

With a new signal, the intersection operated acceptably under both 2020 and 2022 PM peak conditions with the Oak Springs development traffic.

CHAPTER 2: EXISTING CONDITIONS

This chapter provides documentation of existing study area conditions, including study area roadway network, and existing traffic volumes and intersection operations. Supporting details are provided in the Appendix.

Study Area Roadway Network

Roadway serving the proposed site consists of multi-lane arterials and two–lane collector roads which vary in width, terrain, and posted speeds. As indicated by their specific arterial designations, these roadways also vary in their overall function as part of the general network. Key roadways in the study area are summarized in Table 5 along with their existing characteristics.

Table 5: Study Area Roadway Characteristics

Roadway	Functional Classification	Number of Lanes	Posted Speed
Woodgrove Street	Local Road	2	25 mph
19th Avenue SE	Collector	2	25 mph
Marvin Road SE	Major Arterial	4	35 mph
Union Mills Road SE	Minor Arterial	2	35 mph
Pacific Avenue SE	Urban Collector	2	45 mph

Source: DKS Associates

Existing Traffic Volumes and Operations

Existing PM peak hour traffic operations were analyzed at the following study intersections:

- Pacific Avenue SE / Marvin Road SE
- 19th Avenue SE / Marvin Road SE
- Woodgrove Street SE / Marvin Road SE
- Union Mills Road SE / Marvin Road SE
- Pacific Avenue SE / Union Mills Road SE

To perform the intersection analysis, traffic counts were collected during the PM (4:00 to 6:00) peak periods on Thursday March 3, 2016. The peak hour traffic volumes analyzed under existing conditions are shown in Figure 2, with the detailed traffic counts included in the Appendix.

The purpose of intersection analysis is to ensure that the transportation network remains within desired performance levels as required by County mobility targets. Intersections are the focus of the analysis because they are the controlling bottlenecks of traffic flow and the ability of a roadway system to carry traffic efficiently is nearly always diminished in their vicinity.

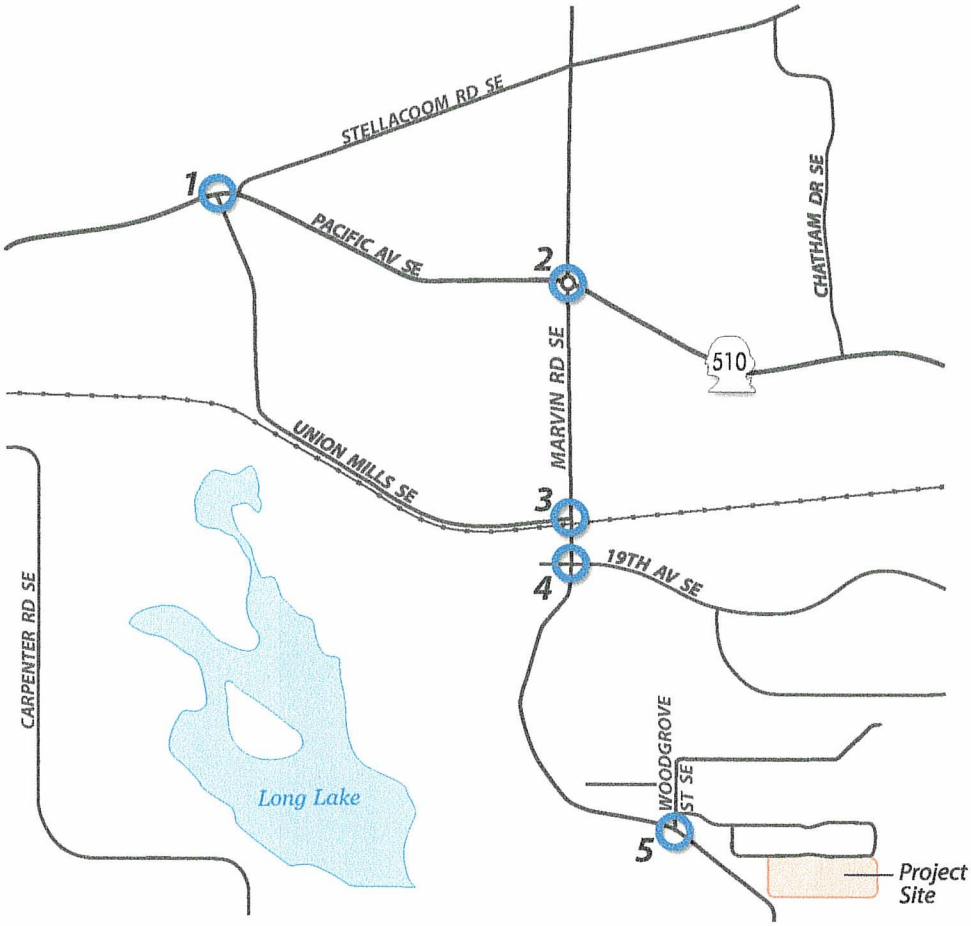
Before the analysis results of the study intersections are presented, discussion is provided for two important analysis topics: intersection performance measures (definitions of typical measures) and required operating standards (as specified by the agency with roadway jurisdiction).

Intersection Performance Measures

Level of service (LOS) ratings and volume-to-capacity (V/C) ratios are two commonly used performance measures that provide a good indication of intersection performance. In addition, they are often incorporated into agency mobility standards.

- **Level of service (LOS):** A "report card" rating (A through F) based on the average delay experienced by vehicles at the intersection[3]. LOS A, B, and C indicate conditions where traffic moves without significant delays over periods of peak hour travel demand. LOS D and E are progressively worse operating conditions. LOS F represents conditions where average vehicle delay has become excessive and demand has exceeded capacity.
- **Volume-to-capacity (V/C) ratio:** A decimal representation (typically between 0.00 and 1.00) of the proportion of capacity that is being used at a turn movement, approach leg, or intersection. It is determined by dividing the peak hour traffic volume by the hourly capacity of a given intersection, approach, or movement. A lower ratio indicates smooth operations and minimal delays. As the ratio approaches 1.00, congestion increases and performance is reduced. If the ratio is greater than 1.00, the turn movement, approach leg, or intersection is oversaturated and usually results in excessive queues and long delays.

[3] *A description of Level of Service (LOS) is provided in the appendix and includes a list of the delay values (in seconds) that correspond to each LOS designation.*



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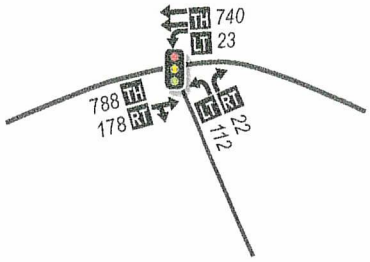

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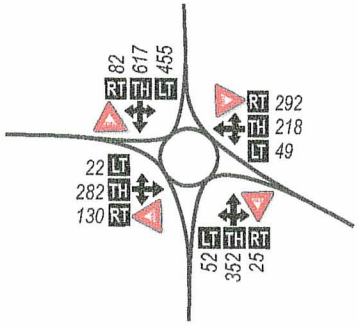
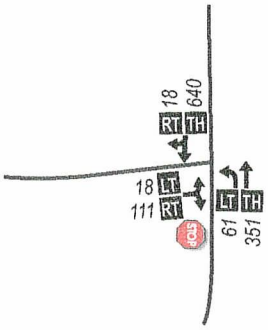


3. *Marvin Rd. SE @ Union Mills SE*



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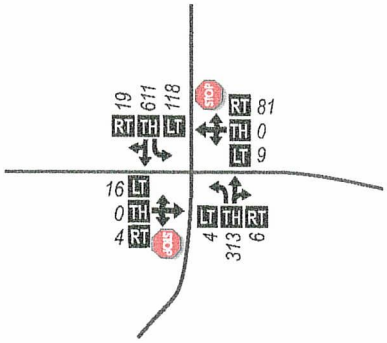
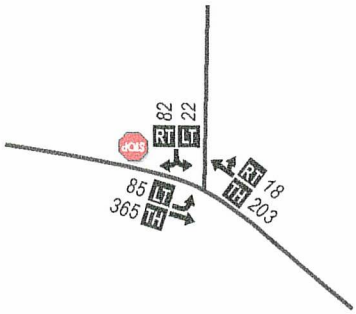


5. *Marvin Rd. SE @ Woodgrove St. SE*



LEGEND

- # - Study Intersection
- Traffic Signal
- Stop Sign
- Yield Sign
- Lane Configuration
- *000* - Peak Hour Traffic
- LT TH RT - Volume Turn Movement (Left • Thru • Right)

DKS

No Scale

Figure **2**

Existing Conditions PM Peak Hour Traffic Volumes

Required Operating Standards

Thurston County has a mobility target of LOS D for urban roads and LOS E for high density corridor[4].

Existing Operating Conditions

Existing traffic operations at the study intersections were analyzed for the PM peak hour based on the 2010 Highway Capacity Manual methodology for signalized and unsignalized intersections[5]. Results were compared with the County's minimum acceptable LOS mobility target as shown in Table 6. All existing study intersections currently meet operating standards during the PM peak period analyzed.

Table 6: Existing Study Intersection Operations (PM Peak Hour)

Intersection	Intersection Control	Operating Standard	Existing PM Peak	
			LOS	*Delay*
Pacific Avenue/Union Mills	Signalized	D	B	10.1
Marvin Road/Pacific Avenue	Roundabout	D	C	16.2
Marvin Road/Union Mills	Side-street Stop	D	C	20.8
Marvin Road/19th Avenue	Stop	D	B	14.7
Marvin Road/Woodgrove	Stop	D	B	13.5

Signalized:
LOS = Level of Service of Intersection
Delay= Average delay for all Vehicles

Two-Way or All-Way Stop Controlled:
LOS = Level of Service of movement with greatest delay

Source: DKS Associates

[4] *Thurston County Road Standards*
[5] *2010 Highway Capacity Manual, Transportation Research Board, Washington DC, 2010*

CHAPTER 3: IMPACTS

This chapter reviews the impacts that the Oak Springs project would have on the study area transportation system. This analysis includes future operating conditions with the proposed project. The focus of the impact analysis is on the study intersections, which have been previously documented.

Trip Distribution

Trip distribution provides an estimation of where the additional project trips would be coming from and going to. It is given as percentages at key gateways to the study area and is used to route project trips through the study area intersections. Trip distribution for the additional traffic generated by the proposed project was based on information provided by the City of Lacey for Thurston Regional Planning Council (TRPC) Zone 76 and extended to the study area based on location of anticipated trip origins and destinations. The trip distribution percentages and resulting project traffic volumes are shown in Figure 3.

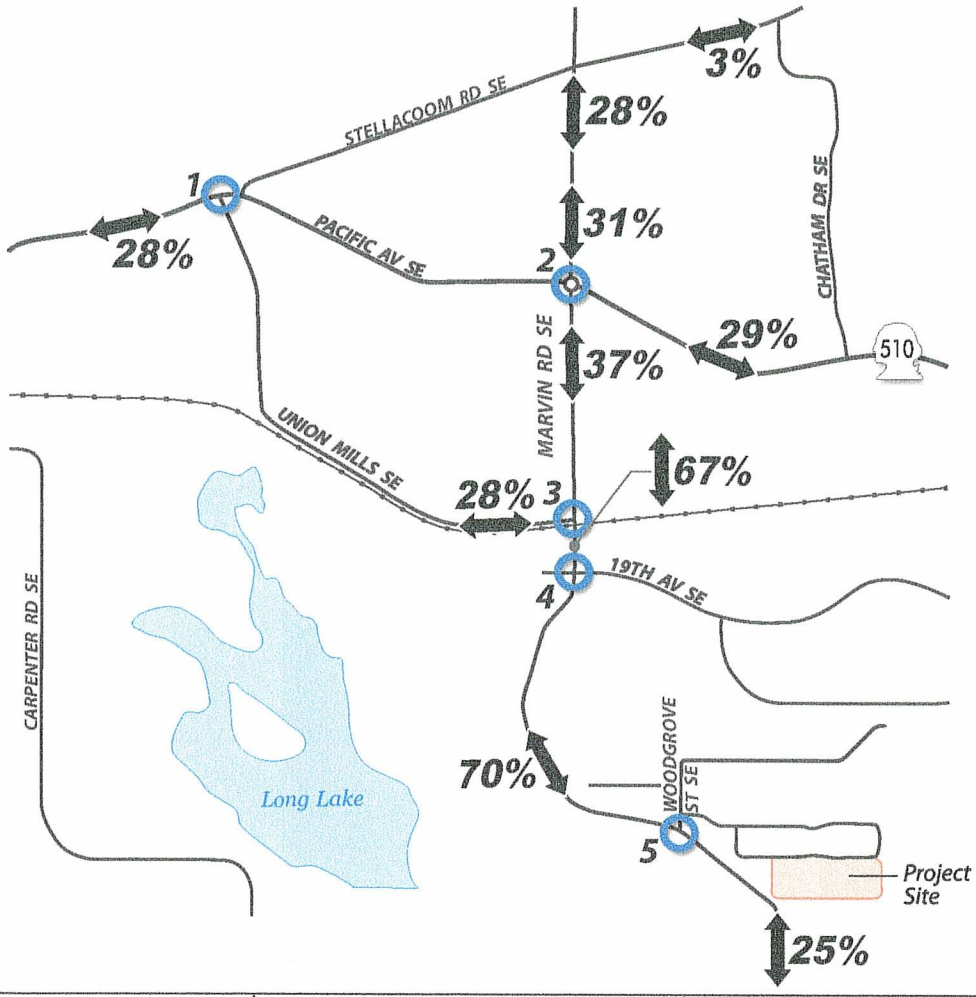
Future Traffic Volumes

This section summarizes the peak hour transportation operating conditions for the development buildout year of 2020 and 2022. Future traffic operating conditions were analyzed at the study intersections to determine if the transportation network can support traffic generated by the proposed Oak Springs project, in addition to background traffic and traffic from other developments. If intersection mobility standards are not met, then mitigations may be necessary to improve network performance.

Future weekday PM peak hour traffic volumes without the proposed Oak Tree Preserve residential project were estimated for buildout year 2020 conditions. Future traffic volumes at the study intersections were developed by (1) applying background annual growth rates to existing PM peak hour traffic counts, and (2) adding traffic from approved pipeline project developments.

For this study, base and future year TRPC model plots were used to estimate growth rates at study intersections approaches. For the key segments of Marvin Road SE, the growth rates varied between 1.7% and 3.3% for northbound volume, and between 3.0% and 4.6% for southbound volumes. The previous Oak Springs study used a 2.7% annual growth rate for all volumes. Future pipeline project traffic volumes were provided by the city for all five study intersections, and are shown in Figure 4. The weekday PM peak hour traffic volumes for year 2020 without the project are shown in Figure 5.

Adding the project-generated PM peak hour trips to the future PM peak hour volumes with background and pipeline growth results in the 2020 With Project traffic volumes shown in Figure 6. Traffic volumes with an additional two years of background growth, to 2022, are shown in Figure 7.



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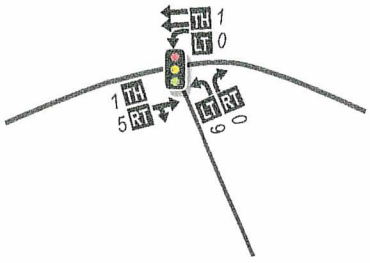
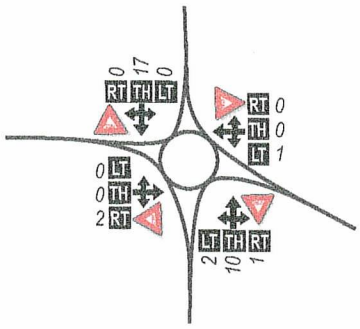
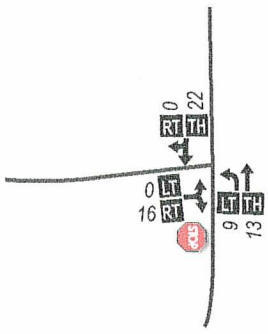


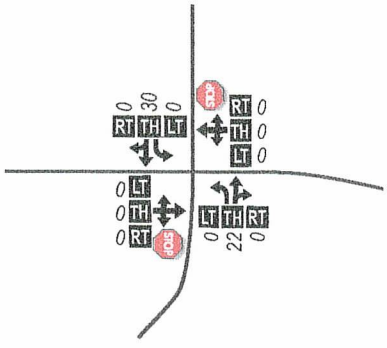
2. *Pacific Ave. SE @ Marvin Rd. SE*



3. *Marvin Rd. SE @ Union Mills SE*



4. *Marvin Rd. SE @ 19th Ave. SE*



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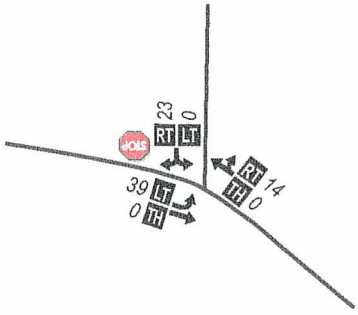


LEGEND

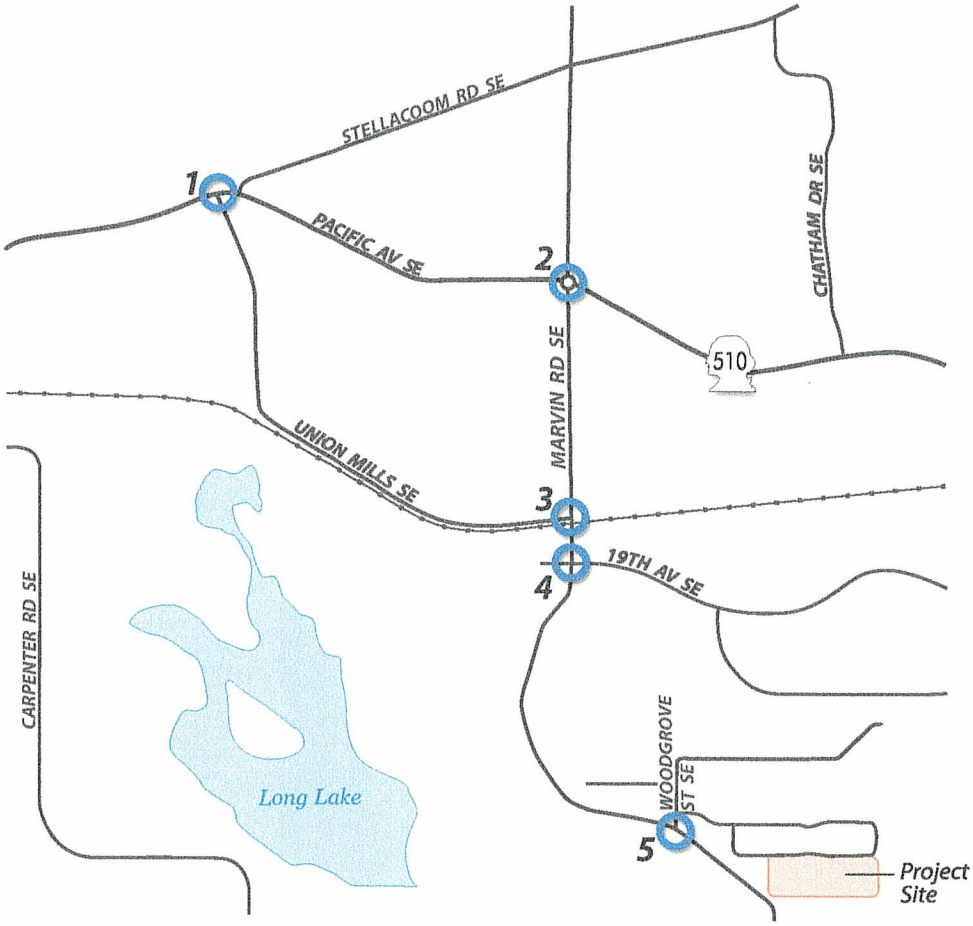
- # - Study Intersection
- Traffic Signal
- STOP - Stop Sign
- Yield Sign
- Lane Configuration
- 000 - Peak Hour Traffic
- LT TH RT - Volume Turn Movement (Left • Thru • Right)
- 00% - Trip Distribution Percentage

DKS

No Scale

Figure 3

Trip Distribution & Assignment



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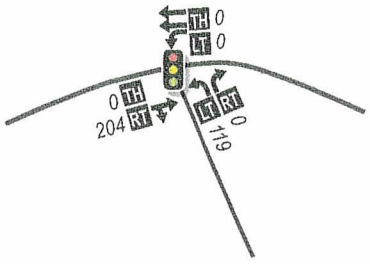

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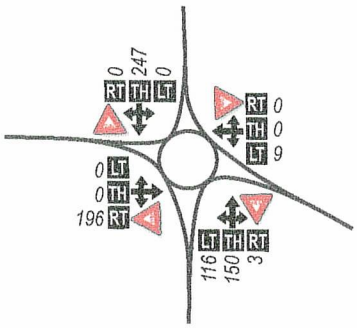

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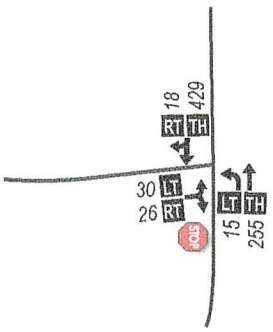

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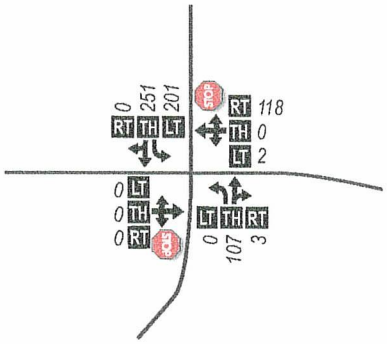

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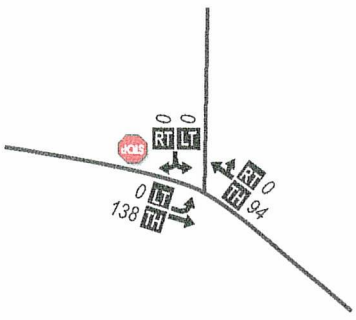


LEGEND

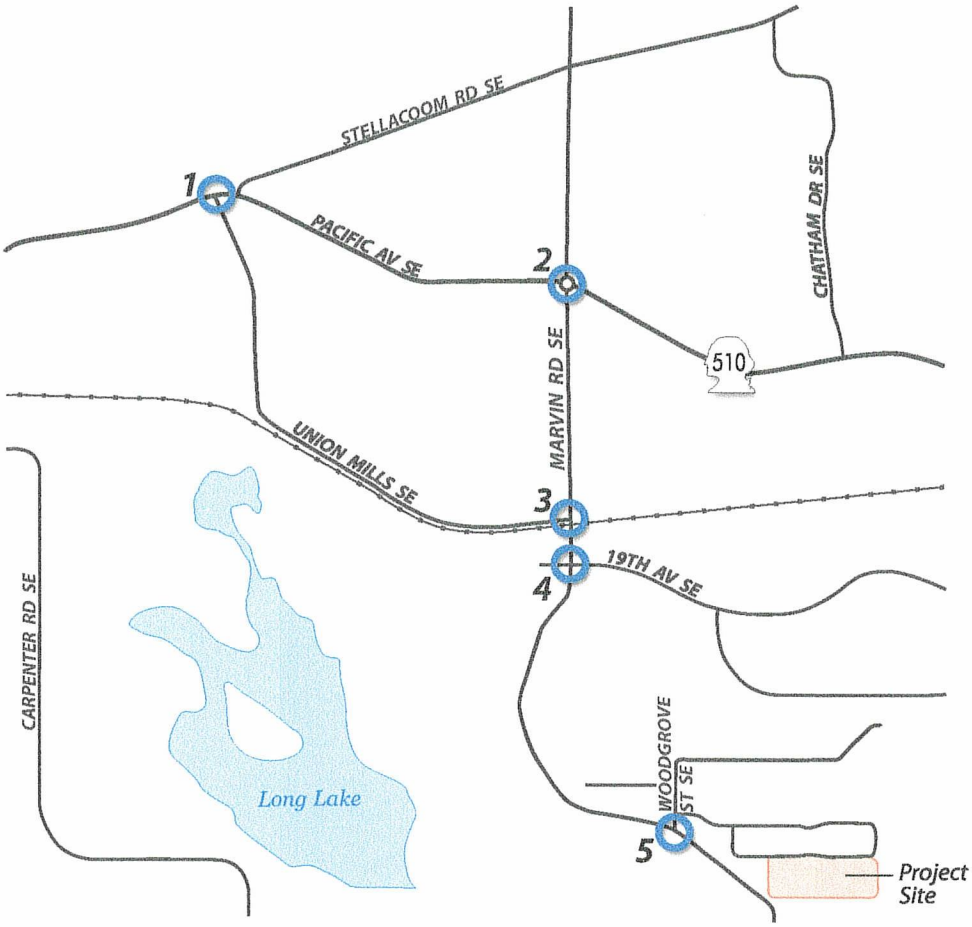
- # - Study Intersection
- Traffic Signal
- STOP - Stop Sign
- Yield Sign
- Lane Configuration
- *000* - Peak Hour Traffic
- LT TH RT - Volume Turn Movement (Left • Thru • Right)

DKS

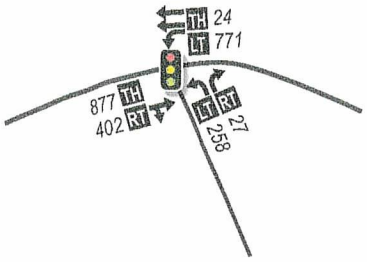
No Scale

Figure 4

Pipeline Volumes



1. *Pacific Ave. SE @ Union Mills SE*



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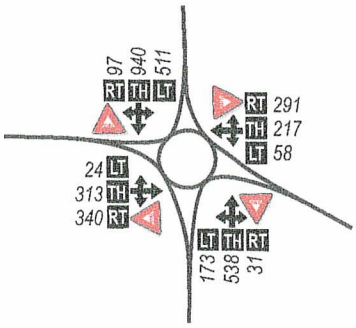

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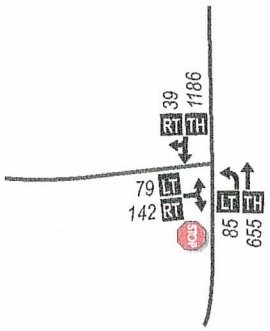

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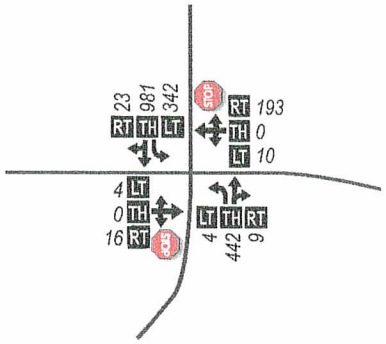

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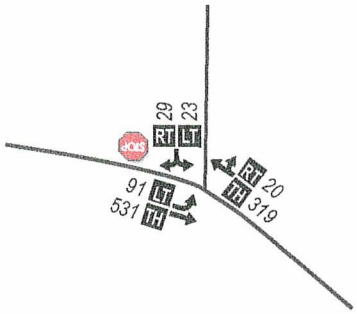


LEGEND

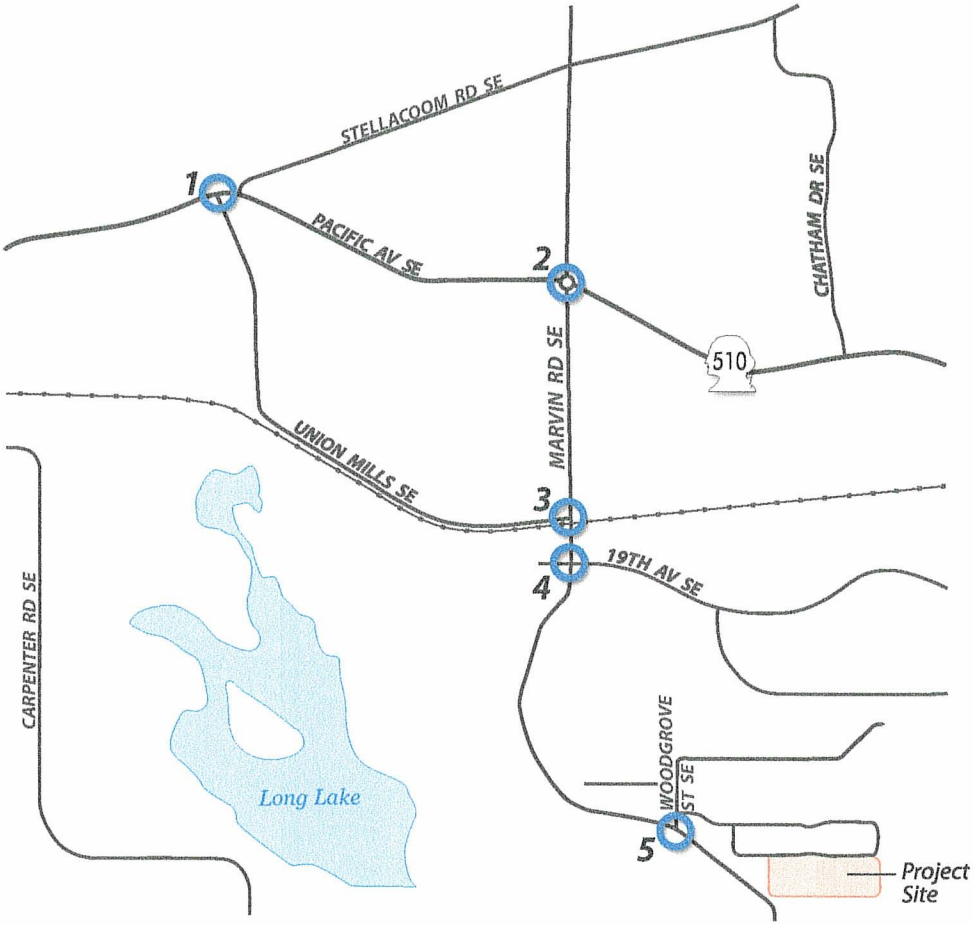
- Study Intersection
- Traffic Signal
- Stop Sign
- Yield Sign
- Lane Configuration
000 - Peak Hour Traffic
LT TH RT - Volume Turn Movement (Left • Thru • Right)

DKS

No Scale

Figure **5**

2020 Baseline



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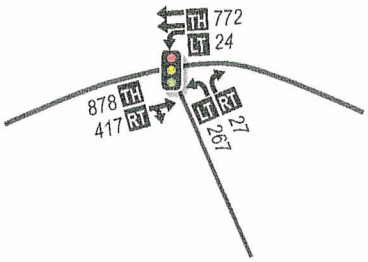

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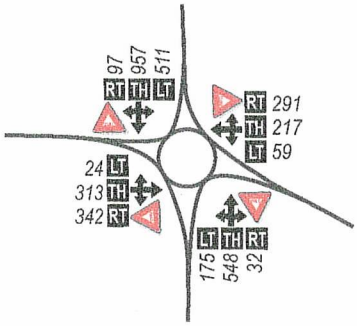

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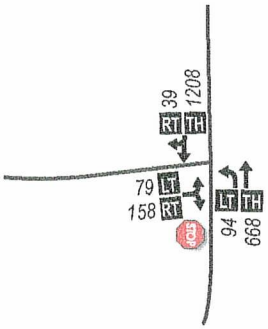
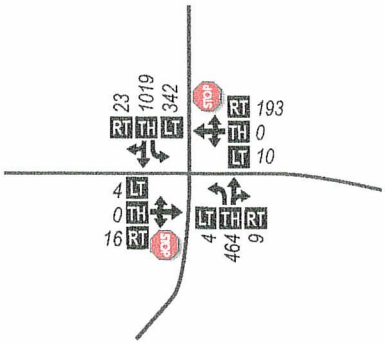
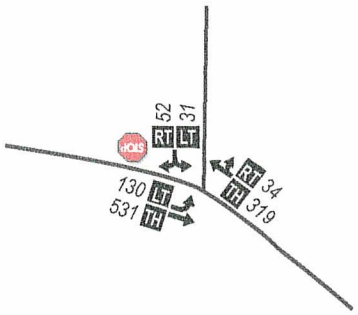


4. *Marvin Rd. SE @ 19th Ave. SE*



5. *Marvin Rd. SE @ Woodgrove St. SE*



LEGEND

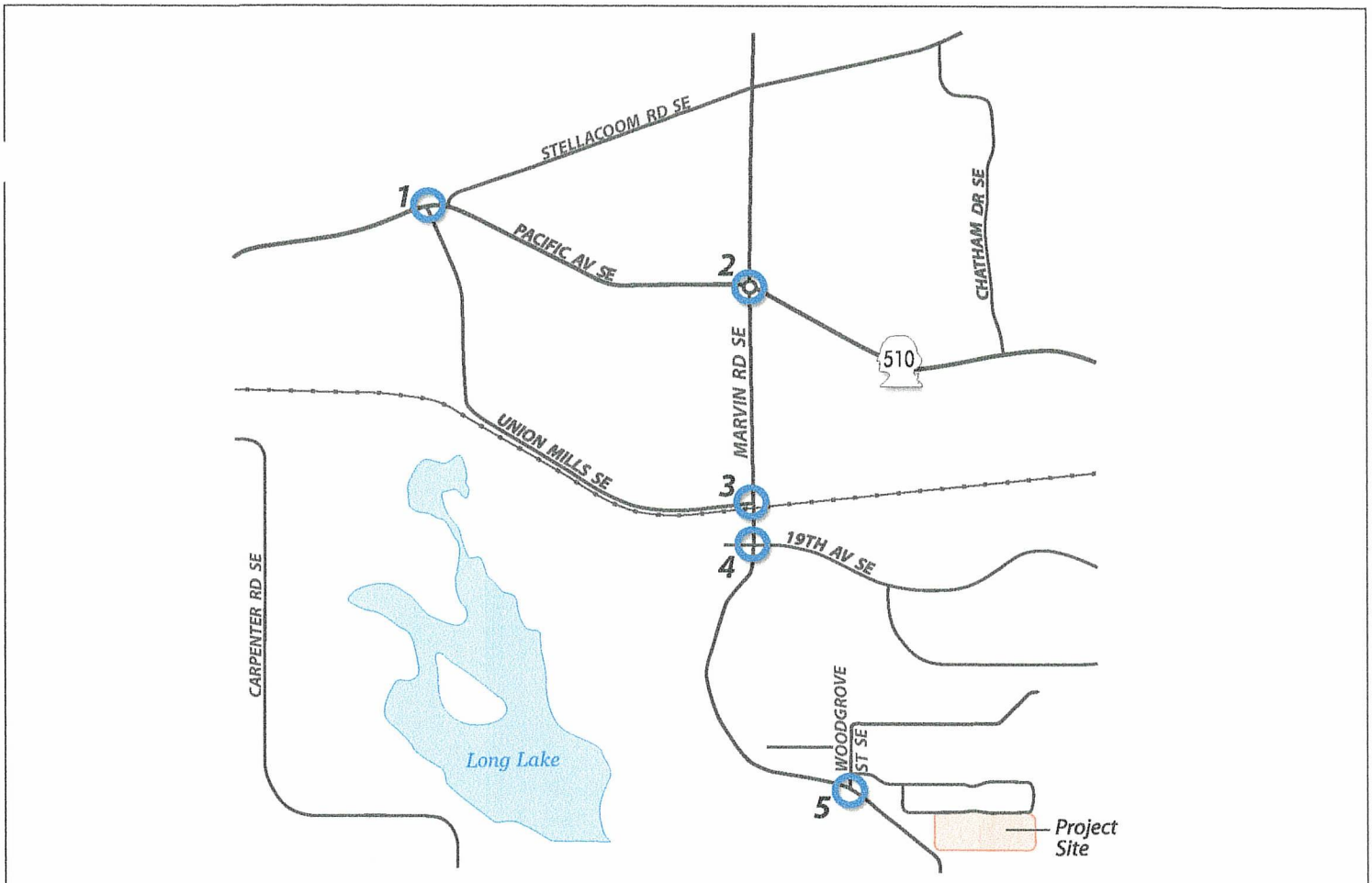
- Study Intersection
- Traffic Signal
- Stop Sign
- Yield Sign
- Lane Configuration
000 - Peak Hour Traffic
LT TH RT - Volume Turn Movement (Left • Thru • Right)

DKS

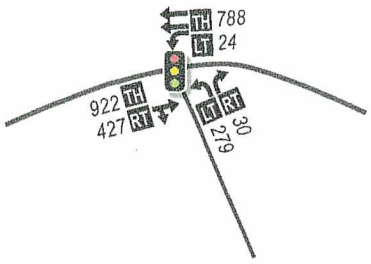
No Scale

Figure 6

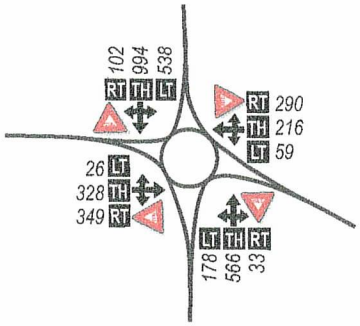
2020 Baseline Volumes with Oak Springs



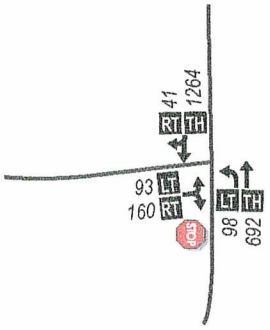
1. *Pacific Ave. SE @ Union Mills SE*



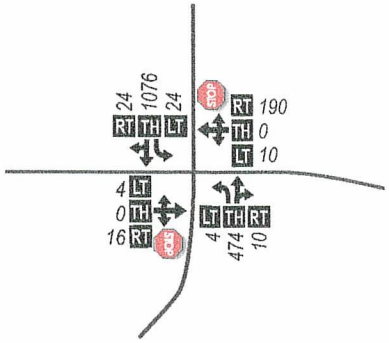
2. *Pacific Ave. SE @ Marvin Rd. SE*



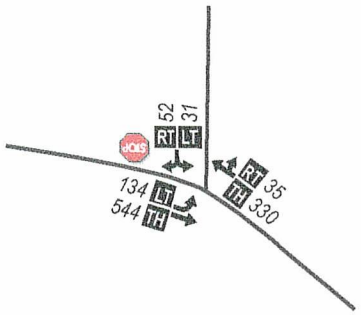
3. *Marvin Rd. SE @ Union Mills SE*



4. *Marvin Rd. SE @ 19th Ave. SE*



5. *Marvin Rd. SE @ Woodgrove St. SE*



LEGEND

- Study Intersection
- Traffic Signal
STOP - Stop Sign
- Yield Sign
- Lane Configuration
000 - Peak Hour Traffic
LT TH RT - Volume Turn Movement (Left • Thru • Right)

DKS

No Scale

Figure 7

2022 with Full Development

Intersection Operations

Operations were analyzed at the five intersections for three scenarios:

- 2020 PM Peak Hour Baseline (volumes shown in Figure 5)
- 2020 PM Peak Hour with Oak Springs Development (volumes shown in Figure 6)
- 2022 PM Peak Hour with Oak Springs Development (volumes shown in Figure 7)

The study intersection operating conditions, including level of service and delay, are shown in Table 7.

Table 7: Future Intersection Operations

Intersection	Intersection Control	Operating Standard	2020 PM Peak (Baseline)		2020 PM Peak (with Oak Springs)		2022 PM Peak (Full Development)		2022 PM Peak (Full Dev. With Mitigations)	
			LOS	*Delay*	*LOS*	*Delay*	*LOS*	*Delay*	*LOS*	*Delay*
Pacific Avenue SE/ Union Mills SE	Signalized	D	B	12.0	B	18.2	C	20.1	No change	
Marvin Road SE/ Pacific Avenue SE	Round-about	D	F	65.1	F	67.6	F	78.8	No change	
Marvin Road SE/ Union Mills Road SE	Two-Way Stop	D	F	>120	F	>120	F	>120	No change	
Marvin Road SE/ 19th Avenue SE	Two-Way Stop	D	F	>120	F	>120	F	>120	D	35.0
Marvin Road SE/ Woodgrove Street SE	Two-Way Stop	D	C	18.4	C	21.1	C	22.7	No change	

Signalized:
LOS = Level of Service of Intersection
Delay= Average delay for all Vehicles

Two-Way or All-Way Stop Controlled:
LOS = Level of Service of movement with greatest delay

Source: DKS Associates

2020 Baseline conditions include background traffic growth and pipeline developments, including Oak Tree Preserve. Analysis shows that with these baseline conditions and without the Oak Springs development trips, three intersections fail to meet the LOS D operating standard in the PM peak hour: Marvin Road SE/Pacific Avenue SE, Marvin Road SE/Union Mills SE, and Marvin Road SE/19th Avenue SE.

The Oak Springs development adds a relatively low number of trips to the study intersections compared to the 2020 background growth and pipeline development trips. Therefore, intersection operations under 2020 PM peak conditions with the Oak Springs development are only slightly worse than the baseline, with the same three intersections failing to meet standards and the other two (Pacific Avenue SE/Union Mills SE and Marvin Road SE/Woodgrove Street SE) continuing to operate better than standard.

2022 PM peak operations with full development include an additional two years of background growth. The additional growth has little relative impact on the operations of the five intersections. The three intersections that fail to meet standard due to 2020 background and pipeline growth continue to do so.

CHAPTER 4: PROJECT MITIGATION

This chapter summarizes the mitigations recommended to address deficiencies identified in the future year analysis. Previous impact studies for the Oak Tree Preserve development and Oak Springs development recommended mitigations based on impacts to the adjacent transportation system. These previous recommendations were reviewed as part of developing the following mitigation strategies.

Mitigation Recommendations for Oak Springs TIA

Three intersections fail to meet mobility standards under 2020 baseline PM peak conditions, and perform slightly worse with the Oak Springs development and two additional years of background growth. The three intersections and recommended mitigations strategies are as follows:

- **Marvin Road SE/Pacific Avenue SE.** The eastbound and southbound approaches at this roundabout fail under 2020 Baseline PM conditions, which include background traffic growth and trips from nearby development projects such as Oak Tree Preserve. The Oak Tree Preserve development proposed no mitigations at this intersection, and WSDOT currently has no plans for adding capacity to this two-lane roundabout. Should WSDOT identify a need for additional capacity, mitigation could include a proportionate share contribution based Oak Springs development trips.
- **Marvin Road SE/Union Mills Road SE.** High delay for the stop-controlled eastbound approach is due to infrequent gaps in the heavy southbound traffic as well as conflicting northbound left turns. This deficiency occurs under 2020 Baseline PM conditions, prior to addition of Oak Springs trips. This intersection is identified for mitigation in the Oak Tree Preserve TIA, with access control that will prohibit eastbound left turns, which have the highest delays. The Oak Springs development may be conditioned to contribute to this mitigation in proportion to the relative number of trips it is adding to the intersection. Under 2020 PM conditions, this proportion is 60 new trips out of a total of 1,047 new trips, or about 6% of the traffic growth at the intersection. The Oak Springs developer will coordinate with the Oak Tree Preserve developer to pay proportionate share of the improvement or construct the improvement if not completed before the issuance of building permits. To accommodate vehicles needing to make an eastbound left turn, improvements at the Marvin Road SE/19th Avenue SE intersection are needed in order to enable u-turns. A roundabout, as described below, will accommodate u-turns, or if a signal is installed, the intersection should be improved to the width needed to allow u-turns. The Oak Tree Preserve TIA defers decision on the specific type of improvement at Marvin Road SE/19th Avenue SE to the County Engineer.
- **Marvin Road SE/19th Avenue SE.** High delay for the stop-controlled eastbound and westbound approaches is due to infrequent gaps in the heavy southbound traffic on Marvin Road SE. This deficiency occurs under 2020 Baseline PM conditions, prior to addition of Oak Springs trips. New intersection control (signal or roundabout) is a required mitigation for the Oak Tree Preserve development, and is to be constructed with Phase 2 (year 2018)[6]. The Oak Springs development may be conditioned to contribute to this mitigation in proportion to the relative number of trips it is adding to the intersection. Under 2020 PM conditions, this proportion is 52 new trips out of a total of 1,003 new trips, or about 5% of the traffic volume growth at the intersection. The Oak Springs developer will coordinate with the Oak Tree Preserve developer to pay proportionate

[6] Oak Tree Preserve Traffic Impact Analysis, April 29, 2014.

share of the improvement or construct the improvement if not completed before the issuance of building permits.

The Marvin Road SE/19th Avenue SE intersection was analyzed as a signalized intersection in order to test the identified mitigation under 2020 and 2022 PM peak hour conditions. Results are shown in Table 8.

Table 8: Future Mitigated Intersection Operations

Intersection	Intersection Control	Operating Standard	2020 PM Peak (with Oak Springs)		2022 PM Peak (Full Development)	
			LOS	*Delay*	*LOS*	*Delay*
Marvin Road SE/ 19th Avenue SE	Signalized	D	C	31.8	D	35.0

Signalized:
LOS = Level of Service of Intersection
Delay= Average delay for all Vehicles

Two-Way or All-Way Stop Controlled:
LOS = Level of Service of movement with greatest delay

Source: DKS Associates

With a new signal, the intersection operates acceptably under both 2020 and 2022 PM peak conditions with the Oak Springs development traffic.

Additional mitigations beyond intersection improvements include:

- **Payment of Thurston County traffic impact fees**. The subject development is in the Urban Growth Area Transportation Service Area (TSA) of Thurston County's TIF program. The TIF rate for Single Family Detached units is $3,243 per unit. With 89 units, the total TIF responsibility would be $288,627. Note that Thurston County's current six-year Transportation Improvement Program (2016-2021) includes the Marvin Road (Pacific Avenue to Mullen Road) project, which includes construction of intersection improvements at multiple locations, including the intersections that have been identified for mitigation in this study.

- **Payment of City of Lacey traffic impact fees** as specified in City review of this TIA. Note that the City of Lacey considers Marvin Road a "strategic corridor" in its 2030 Transportation Plan, meaning it would be exempt from LOS requirements.

APPENDIX

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	788	178	23	740	112	22
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	0.95		1.00	0.95	1.00	1.00
Frpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.97		1.00	1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	3428		1769	3539	1770	1553
Flt Permitted	1.00		0.95	1.00	0.95	1.00
Satd. Flow (perm)	3428		1769	3539	1770	1553
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	821	185	24	771	117	23
RTOR Reduction (vph)	30	0	0	0	0	18
Lane Group Flow (vph)	976	0	24	771	117	5
Confl. Peds. (#/hr)		1	1		2	
Heavy Vehicles (%)	2%	2%	2%	2%	2%	4%
Turn Type	NA		Prot	NA	Prot	Perm
Protected Phases	4		3	8	2	
Permitted Phases						2
Actuated Green, G (s)	18.7		0.5	23.2	8.4	8.4
Effective Green, g (s)	18.7		0.5	23.2	8.4	8.4
Actuated g/C Ratio	0.47		0.01	0.59	0.21	0.21
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1618		22	2073	375	329
v/s Ratio Prot	c0.28		0.01	c0.22	c0.07	
v/s Ratio Perm						0.00
v/c Ratio	0.60		1.09	0.37	0.31	0.01
Uniform Delay, d1	7.7		19.6	4.3	13.2	12.3
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6		221.9	0.1	0.5	0.0
Delay (s)	8.4		241.5	4.5	13.6	12.3
Level of Service	A		F	A	B	B
Approach Delay (s)	8.4			11.6	13.4	
Approach LOS	A			B	B	

Intersection Summary			
HCM 2000 Control Delay	10.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	39.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	40.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

DELAY (CONTROL)

Average control delay per vehicle, or average pedestrian delay (seconds)

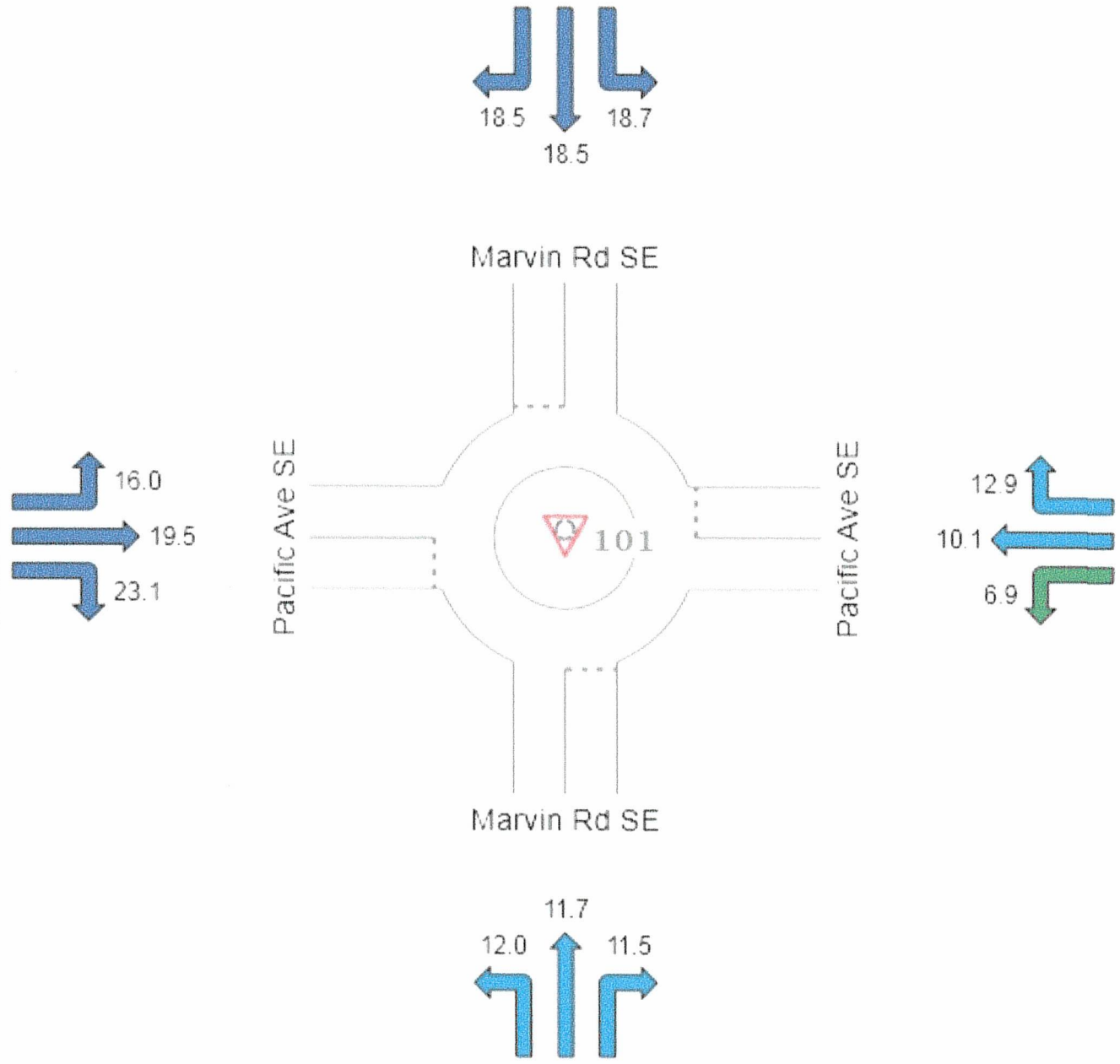
Site: 2016 Existing Conditions

Pacific avenue/Marvin Rd

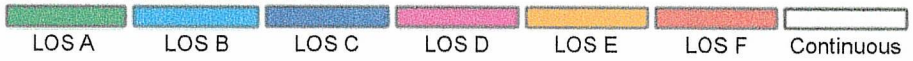
Roundabout

All Movement Classes

	South	East	North	West	Intersection
	11.7	11.3	18.6	20.4	16.2
LOS	B	B	C	C	C



Colour code based on Level of Service



Level of Service Method: Delay & v/c (HCM 2010)
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Roundabout Level of Service Method: Same as Sign Control
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.

Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	18	111	61	351	640	18
Conflicting Peds, #/hr	0	1	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	180	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	6
Mvmt Flow	20	121	66	382	696	20

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1220	706	716	0	-	0
Stage 1	706	-	-	-	-	-
Stage 2	514	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	199	436	885	-	-	-
Stage 1	489	-	-	-	-	-
Stage 2	600	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	184	436	885	-	-	-
Mov Cap-2 Maneuver	184	-	-	-	-	-
Stage 1	489	-	-	-	-	-
Stage 2	555	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	20.8	1.4	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	885	-	366	-	-
HCM Lane V/C Ratio	0.075	-	0.383	-	-
HCM Control Delay (s)	9.4	-	20.8	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0.2	-	1.8	-	-

Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	16	0	4	9	0	81	4	313	6	118	611	19
Conflicting Peds, #/hr	1	0	3	3	0	1	0	0	4	4	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	105	-	-	100	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	91	91	91	91	91	91	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	2	4	2	2	2	2	2	2
Mvmt Flow	18	0	4	10	0	89	4	344	7	130	671	21

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1348	1306	689	1305	1314	354	695	0	0	354	0	0
Stage 1	944	944	-	359	359	-	-	-	-	-	-	-
Stage 2	404	362	-	946	955	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.24	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.336	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	128	160	446	137	158	685	901	-	-	1205	-	-
Stage 1	315	341	-	659	627	-	-	-	-	-	-	-
Stage 2	623	625	-	314	337	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	101	141	443	123	140	681	898	-	-	1201	-	-
Mov Cap-2 Maneuver	101	141	-	123	140	-	-	-	-	-	-	-
Stage 1	313	303	-	654	623	-	-	-	-	-	-	-
Stage 2	537	621	-	276	300	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	42	14.7	0.1	1.3
HCM LOS	E	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	898	-	-	119	468	1201	-	-
HCM Lane V/C Ratio	0.005	-	-	0.185	0.211	0.108	-	-
HCM Control Delay (s)	9	-	-	42	14.7	8.4	-	-
HCM Lane LOS	A	-	-	E	B	A	-	-
HCM 95th %tile Q(veh)	0	-	-	0.6	0.8	0.4	-	-

Intersection	
Int Delay, s/veh	1.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	85	365	203	18	22	28
Conflicting Peds, #/hr	0	0	0	0	4	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	105	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	4	2
Mvmt Flow	93	401	223	20	24	31

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	247	0	-	0	825	237
Stage 1	-	-	-	-	237	-
Stage 2	-	-	-	-	588	-
Critical Hdwy	4.12	-	-	-	6.44	6.22
Critical Hdwy Stg 1	-	-	-	-	5.44	-
Critical Hdwy Stg 2	-	-	-	-	5.44	-
Follow-up Hdwy	2.218	-	-	-	3.536	3.318
Pot Cap-1 Maneuver	1319	-	-	-	340	802
Stage 1	-	-	-	-	798	-
Stage 2	-	-	-	-	551	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1319	-	-	-	314	799
Mov Cap-2 Maneuver	-	-	-	-	314	-
Stage 1	-	-	-	-	795	-
Stage 2	-	-	-	-	510	-

Approach	EB	WB	SB
HCM Control Delay, s	1.5	0	13.5
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1319	-	-	-	476
HCM Lane V/C Ratio	0.071	-	-	-	0.115
HCM Control Delay (s)	7.9	-	-	-	13.5
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0.2	-	-	-	0.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	877	402	24	771	258	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	0.95		1.00	0.95	1.00	1.00
Frpb, ped/bikes	0.99		1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.95		1.00	1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	3350		1769	3539	1770	1553
Flt Permitted	1.00		0.95	1.00	0.95	1.00
Satd. Flow (perm)	3350		1769	3539	1770	1553
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	914	419	25	803	269	28
RTOR Reduction (vph)	80	0	0	0	0	17
Lane Group Flow (vph)	1253	0	25	803	269	11
Confl. Peds. (#/hr)		1	1		2	
Heavy Vehicles (%)	2%	2%	2%	2%	2%	4%
Turn Type	NA		Prot	NA	Prot	Perm
Protected Phases	4		3	8	2	
Permitted Phases						2
Actuated Green, G (s)	24.0		0.6	28.6	12.5	12.5
Effective Green, g (s)	24.0		0.6	28.6	12.5	12.5
Actuated g/C Ratio	0.49		0.01	0.58	0.25	0.25
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1637		21	2061	450	395
v/s Ratio Prot	c0.37		0.01	c0.23	c0.15	
v/s Ratio Perm						0.01
v/c Ratio	0.77		1.19	0.39	0.60	0.03
Uniform Delay, d1	10.2		24.2	5.5	16.1	13.7
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	2.2		261.4	0.1	2.1	0.0
Delay (s)	12.4		285.6	5.7	18.2	13.8
Level of Service	B		F	A	B	B
Approach Delay (s)	12.4			14.1	17.8	
Approach LOS	B			B	B	

Intersection Summary			
HCM 2000 Control Delay	13.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	49.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	58.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

DELAY (CONTROL)

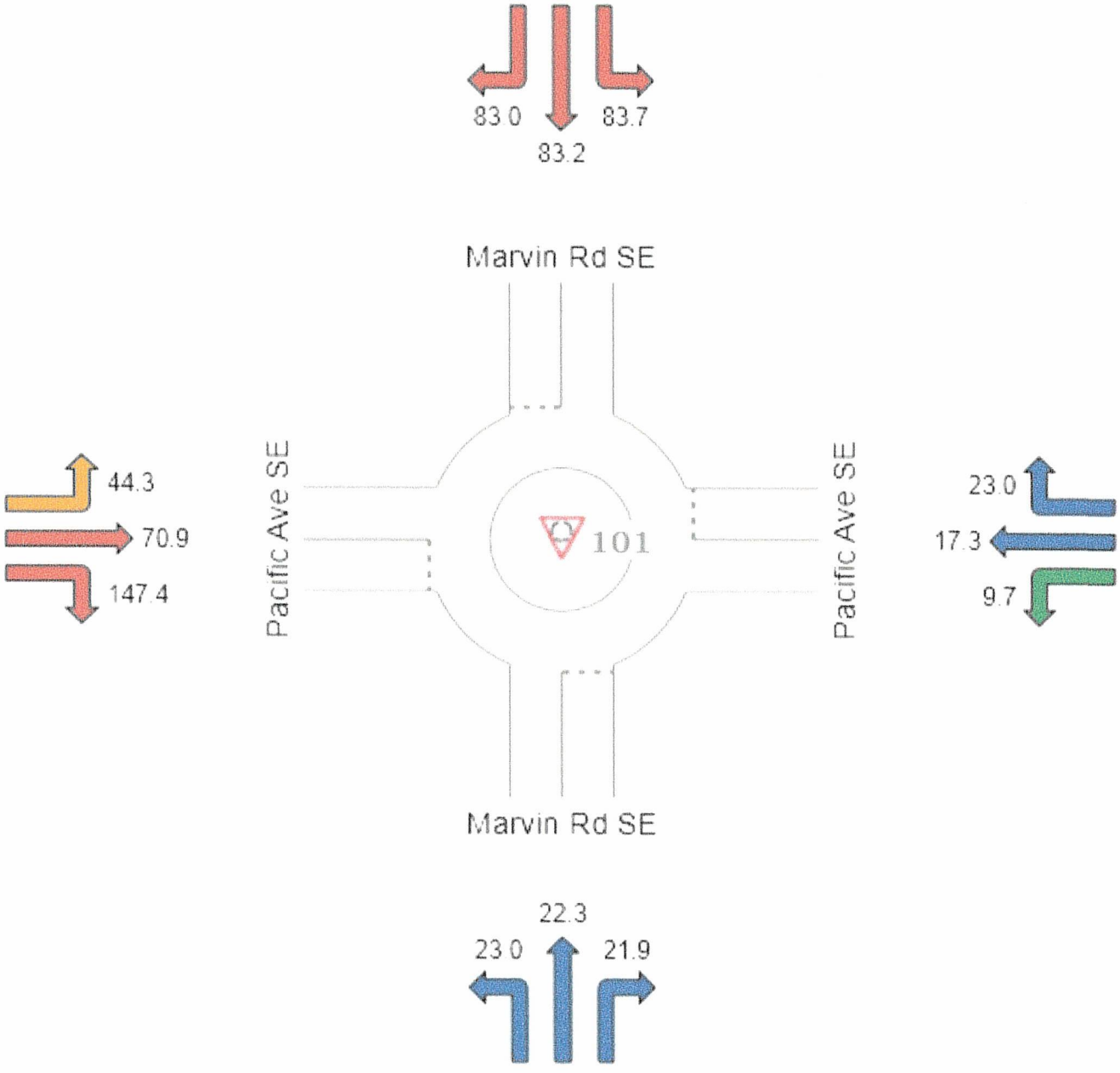
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 2020 Baseline

Pacific avenue/Marvin Rd
Roundabout

All Movement Classes

	South	East	North	West	Intersection
	22.5	19.5	83.3	108.3	65.1
LOS	C	C	F	F	F



Colour code based on Level of Service

Level of Service Method: Delay & v/c (HCM 2010)
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Roundabout Level of Service Method: Same as Sign Control
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.

Intersection	
Int Delay, s/veh	73

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	53	168	85	655	1186	39
Conflicting Peds, #/hr	0	1	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	180	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	6
Mvmt Flow	58	183	92	712	1289	42

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2208	1311	1333	0	-	0
Stage 1	1311	-	-	-	-	-
Stage 2	897	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 49	194	518	-	-	-
Stage 1	252	-	-	-	-	-
Stage 2	398	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 40	194	518	-	-	-
Mov Cap-2 Maneuver	~ 40	-	-	-	-	-
Stage 1	252	-	-	-	-	-
Stage 2	327	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	$ 717.3	1.5	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	518	-	101	-	-
HCM Lane V/C Ratio	0.178	-	2.378	-	-
HCM Control Delay (s)	13.5	-	$ 717.3	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0.6	-	21.6	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	23.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	16	0	4	10	0	193	4	442	9	342	981	23
Conflicting Peds, #/hr	1	0	3	3	0	1	0	0	4	4	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	105	-	-	100	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	91	91	91	91	91	91	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	2	4	2	2	2	2	2	2
Mvmt Flow	18	0	4	11	0	212	4	486	10	376	1078	25

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2453	2352	1098	2350	2360	498	1106	0	0	499	0	0
Stage 1	1845	1845	-	502	502	-	-	-	-	-	-	-
Stage 2	608	507	-	1848	1858	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.24	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.336	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	21	36	259	25	35	568	631	-	-	1065	-	-
Stage 1	96	125	-	552	542	-	-	-	-	-	-	-
Stage 2	483	539	-	96	123	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 9	23	257	18	22	565	629	-	-	1061	-	-
Mov Cap-2 Maneuver	~ 9	23	-	18	22	-	-	-	-	-	-	-
Stage 1	95	81	-	547	537	-	-	-	-	-	-	-
Stage 2	299	534	-	61	79	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	$ 1143.9	102.2	0.1	2.6
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	629	-	-	11	226	1061	-	-
HCM Lane V/C Ratio	0.007	-	-	1.998	0.987	0.354	-	-
HCM Control Delay (s)	10.8	-	-	$ 1143.9	102.2	10.2	-	-
HCM Lane LOS	B	-	-	F	F	B	-	-
HCM 95th %tile Q(veh)	0	-	-	3.6	9	1.6	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	1.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	91	531	319	20	23	29
Conflicting Peds, #/hr	0	0	0	0	4	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	105	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	4	2
Mvmt Flow	100	584	351	22	25	32

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	377	0	-	0	1150	366
Stage 1	-	-	-	-	366	-
Stage 2	-	-	-	-	784	-
Critical Hdwy	4.12	-	-	-	6.44	6.22
Critical Hdwy Stg 1	-	-	-	-	5.44	-
Critical Hdwy Stg 2	-	-	-	-	5.44	-
Follow-up Hdwy	2.218	-	-	-	3.536	3.318
Pot Cap-1 Maneuver	1181	-	-	-	217	679
Stage 1	-	-	-	-	697	-
Stage 2	-	-	-	-	446	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1181	-	-	-	197	677
Mov Cap-2 Maneuver	-	-	-	-	197	-
Stage 1	-	-	-	-	695	-
Stage 2	-	-	-	-	407	-

Approach	EB	WB	SB
HCM Control Delay, s	1.2	0	18.4
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1181	-	-	-	326
HCM Lane V/C Ratio	0.085	-	-	-	0.175
HCM Control Delay (s)	8.3	-	-	-	18.4
HCM Lane LOS	A	-	-	-	C
HCM 95th %tile Q(veh)	0.3	-	-	-	0.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	878	417	24	772	267	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	0.95		1.00	0.95	1.00	1.00
Frpb, ped/bikes	0.99		1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.95		1.00	1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	3345		1769	3539	1770	1553
Flt Permitted	1.00		0.95	1.00	0.95	1.00
Satd. Flow (perm)	3345		1769	3539	1770	1553
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	915	434	25	804	278	28
RTOR Reduction (vph)	85	0	0	0	0	16
Lane Group Flow (vph)	1264	0	25	804	278	12
Confl. Peds. (#/hr)		1	1		2	
Heavy Vehicles (%)	2%	2%	2%	2%	2%	4%
Turn Type	NA		Prot	NA	Prot	Perm
Protected Phases	4		3	8	2	
Permitted Phases						2
Actuated Green, G (s)	24.1		0.6	28.7	12.7	12.7
Effective Green, g (s)	24.1		0.6	28.7	12.7	12.7
Actuated g/C Ratio	0.49		0.01	0.58	0.26	0.26
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1631		21	2056	455	399
v/s Ratio Prot	c0.38		0.01	c0.23	c0.16	
v/s Ratio Perm						0.01
v/c Ratio	0.77		1.19	0.39	0.61	0.03
Uniform Delay, d1	10.4		24.4	5.6	16.2	13.7
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	2.4		261.4	0.1	2.4	0.0
Delay (s)	12.8		285.8	5.7	18.6	13.8
Level of Service	B		F	A	B	B
Approach Delay (s)	12.8			14.2	18.2	
Approach LOS	B			B	B	

Intersection Summary			
HCM 2000 Control Delay	13.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	49.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	59.1%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

DELAY (CONTROL)

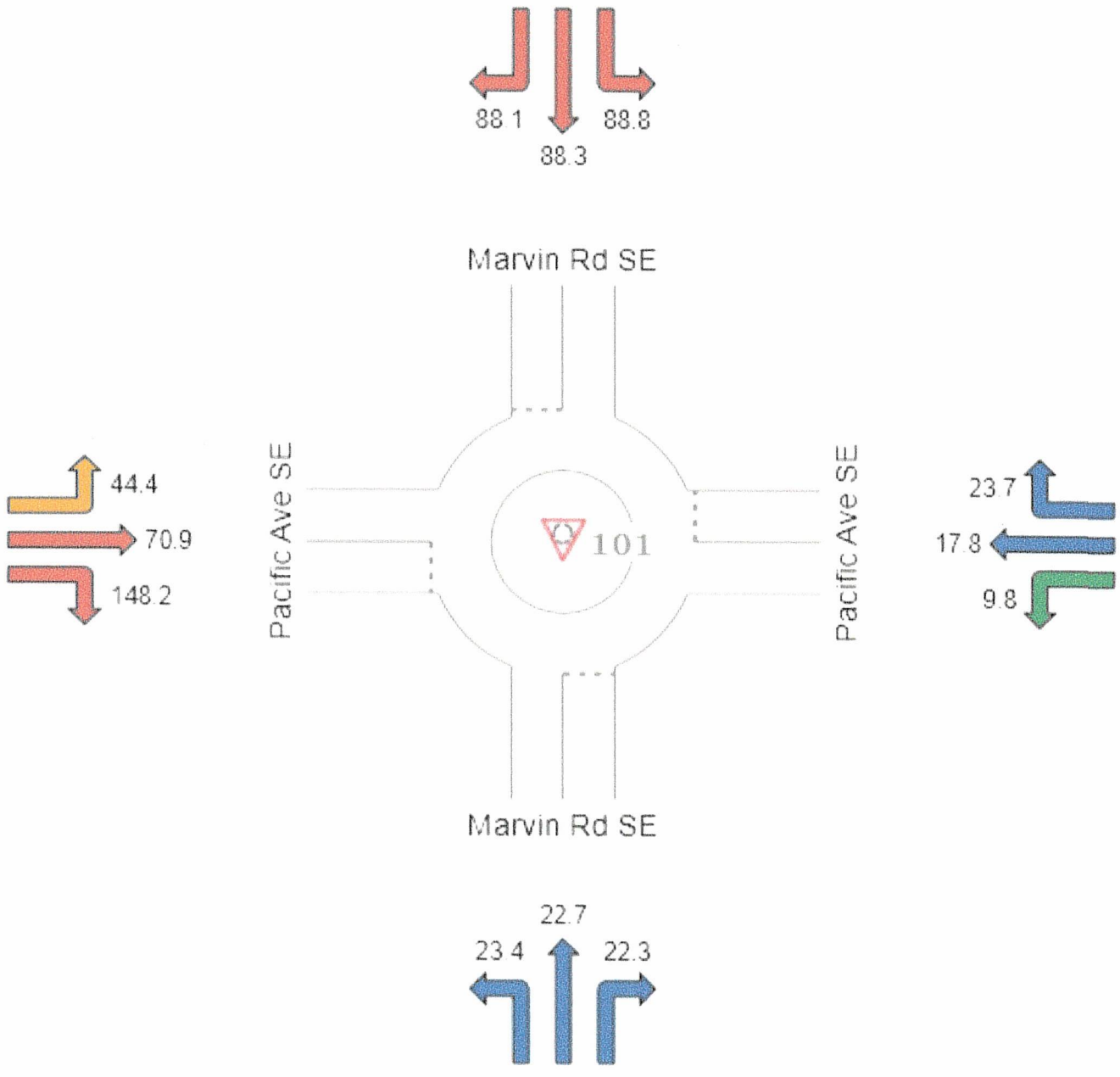
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: 2020 with Oak Springs

Pacific avenue/Marvin Rd
Roundabout

All Movement Classes

	South	East	North	West	Intersection
	22.9	20.0	88.4	108.9	67.6
LOS	C	C	F	F	F



Colour code based on Level of Service

Level of Service Method: Delay & v/c (HCM 2010)
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Roundabout Level of Service Method: Same as Sign Control
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.

Intersection	
Int Delay, s/veh	89.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	53	184	94	668	1208	39
Conflicting Peds, #/hr	0	1	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	180	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	6
Mvmt Flow	58	200	102	726	1313	42

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2265	1335	1356	0	-	0
Stage 1	1335	-	-	-	-	-
Stage 2	930	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 45	~ 188	507	-	-	-
Stage 1	245	-	-	-	-	-
Stage 2	384	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 36	~ 188	507	-	-	-
Mov Cap-2 Maneuver	~ 36	-	-	-	-	-
Stage 1	245	-	-	-	-	-
Stage 2	306	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	$ 842.6	1.7	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	507	-	97	-	-
HCM Lane V/C Ratio	0.202	-	2.656	-	-
HCM Control Delay (s)	13.9	-	$ 842.6	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0.7	-	24.1	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	28.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	16	0	4	10	0	193	4	464	9	342	1019	23
Conflicting Peds, #/hr	1	0	3	3	0	1	0	0	4	4	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	105	-	-	100	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	91	91	91	91	91	91	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	2	4	2	2	2	2	2	2
Mvmt Flow	18	0	4	11	0	212	4	510	10	376	1120	25

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2520	2419	1139	2416	2427	522	1148	0	0	523	0	0
Stage 1	1887	1887	-	527	527	-	-	-	-	-	-	-
Stage 2	633	532	-	1889	1900	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.24	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.336	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	19	32	245	22	32	551	609	-	-	1043	-	-
Stage 1	91	119	-	535	528	-	-	-	-	-	-	-
Stage 2	468	526	-	90	117	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 8	20	244	15	20	548	607	-	-	1040	-	-
Mov Cap-2 Maneuver	~ 8	20	-	15	20	-	-	-	-	-	-	-
Stage 1	90	76	-	530	523	-	-	-	-	-	-	-
Stage 2	284	521	-	56	75	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	$ 1289.2	149.6	0.1	2.6
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	607	-	-	10	199	1040	-	-
HCM Lane V/C Ratio	0.007	-	-	2.198	1.121	0.361	-	-
HCM Control Delay (s)	11	-	-	$ 1289.2	149.6	10.4	-	-
HCM Lane LOS	B	-	-	F	F	B	-	-
HCM 95th %tile Q(veh)	0	-	-	3.7	10.8	1.7	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	2.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	130	531	319	34	31	52
Conflicting Peds, #/hr	0	0	0	0	4	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	105	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	4	2
Mvmt Flow	143	584	351	37	34	57

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	392	0	-	0	1242	373
Stage 1	-	-	-	-	373	-
Stage 2	-	-	-	-	869	-
Critical Hdwy	4.12	-	-	-	6.44	6.22
Critical Hdwy Stg 1	-	-	-	-	5.44	-
Critical Hdwy Stg 2	-	-	-	-	5.44	-
Follow-up Hdwy	2.218	-	-	-	3.536	3.318
Pot Cap-1 Maneuver	1167	-	-	-	191	673
Stage 1	-	-	-	-	692	-
Stage 2	-	-	-	-	407	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1167	-	-	-	166	671
Mov Cap-2 Maneuver	-	-	-	-	166	-
Stage 1	-	-	-	-	690	-
Stage 2	-	-	-	-	356	-

Approach	EB	WB	SB
HCM Control Delay, s	1.7	0	21.1
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1167	-	-	-	314
HCM Lane V/C Ratio	0.122	-	-	-	0.29
HCM Control Delay (s)	8.5	-	-	-	21.1
HCM Lane LOS	A	-	-	-	C
HCM 95th %tile Q(veh)	0.4	-	-	-	1.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	922	427	24	788	279	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	0.95		1.00	0.95	1.00	1.00
Frpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.95		1.00	1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	3357		1770	3539	1770	1553
Flt Permitted	1.00		0.95	1.00	0.95	1.00
Satd. Flow (perm)	3357		1770	3539	1770	1553
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	960	445	25	821	291	31
RTOR Reduction (vph)	82	0	0	0	0	18
Lane Group Flow (vph)	1323	0	25	821	291	13
Confl. Peds. (#/hr)		1	1		2	
Heavy Vehicles (%)	2%	2%	2%	2%	2%	4%
Turn Type	NA		Prot	NA	Prot	Perm
Protected Phases	4		3	8	2	
Permitted Phases						2
Actuated Green, G (s)	25.3		1.3	30.6	13.0	13.0
Effective Green, g (s)	25.3		1.3	30.6	13.0	13.0
Actuated g/C Ratio	0.49		0.03	0.59	0.25	0.25
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1645		44	2098	445	391
v/s Ratio Prot	c0.39		0.01	c0.23	c0.16	
v/s Ratio Perm						0.01
v/c Ratio	0.80		0.57	0.39	0.65	0.03
Uniform Delay, d1	11.1		24.9	5.6	17.3	14.6
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	3.0		15.7	0.1	3.4	0.0
Delay (s)	14.0		40.6	5.7	20.7	14.6
Level of Service	B		D	A	C	B
Approach Delay (s)	14.0			6.7	20.1	
Approach LOS	B			A	C	

Intersection Summary			
HCM 2000 Control Delay	12.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	51.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	61.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

DELAY (CONTROL)

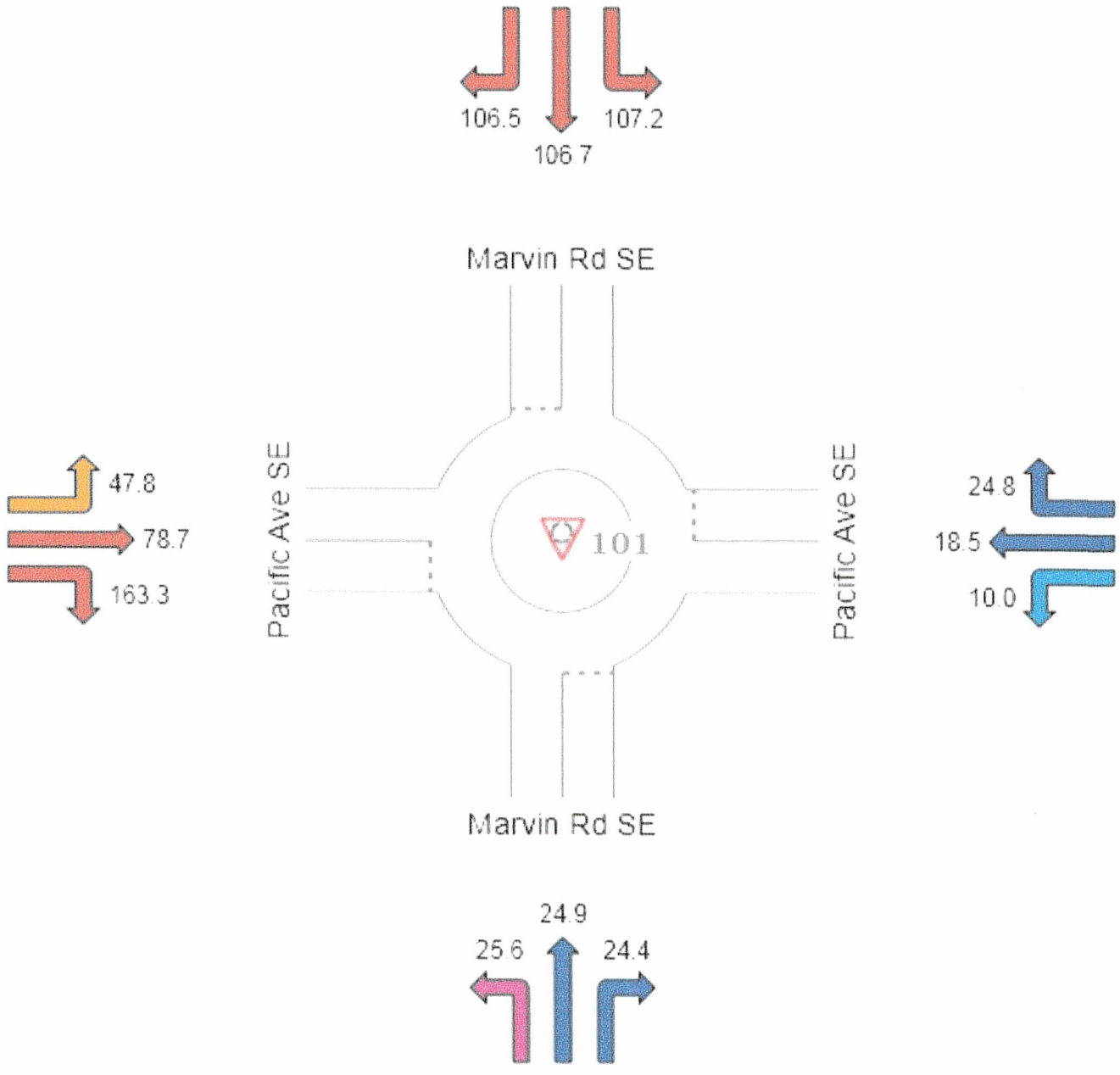
Average control delay per vehicle, or average pedestrian delay (seconds)

Site: Pacific avenue/Marvin Rd

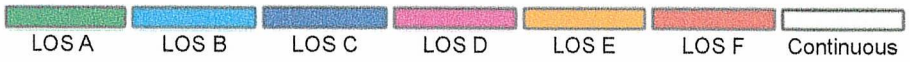
New Site
Roundabout

All Movement Classes

	South	East	North	West	Intersection
	25.0	20.9	106.9	119.6	78.8
LOS	D	C	F	F	F



Colour code based on Level of Service



Level of Service Method: Delay & v/c (HCM 2010)
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Roundabout Level of Service Method: Same as Sign Control
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.

Intersection	
Int Delay, s/veh	120.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	55	198	98	692	1264	41
Conflicting Peds, #/hr	0	1	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	180	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	6
Mvmt Flow	60	215	107	752	1374	45

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2362	1397	1419	0	-	0
Stage 1	1397	-	-	-	-	-
Stage 2	965	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 39	~ 173	480	-	-	-
Stage 1	229	-	-	-	-	-
Stage 2	370	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 30	~ 173	480	-	-	-
Mov Cap-2 Maneuver	~ 30	-	-	-	-	-
Stage 1	229	-	-	-	-	-
Stage 2	287	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	$ 1111.2	1.8	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	480	-	85	-	-
HCM Lane V/C Ratio	0.222	-	3.235	-	-
HCM Control Delay (s)	14.6	-	$ 1111.2	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0.8	-	27.5	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	33.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	16	0	4	10	0	190	4	474	10	353	1076	24
Conflicting Peds, #/hr	1	0	3	3	0	1	0	0	4	4	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	105	-	-	100	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	91	91	91	91	91	91	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	2	4	2	2	2	2	2	2
Mvmt Flow	18	0	4	11	0	209	4	521	11	388	1182	26

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2617	2518	1203	2515	2526	533	1212	0	0	535	0	0
Stage 1	1974	1974	-	538	538	-	-	-	-	-	-	-
Stage 2	643	544	-	1977	1988	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.24	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.336	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	~ 16	28	225	19	28	543	576	-	-	1033	-	-
Stage 1	81	108	-	527	522	-	-	-	-	-	-	-
Stage 2	462	519	-	80	106	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 7	17	224	13	17	540	574	-	-	1030	-	-
Mov Cap-2 Maneuver	~ 7	17	-	13	17	-	-	-	-	-	-	-
Stage 1	80	67	-	522	517	-	-	-	-	-	-	-
Stage 2	280	514	-	49	66	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	$ 1467.6	196.5	0.1	2.6
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	574	-	-	9	178	1030	-	-
HCM Lane V/C Ratio	0.008	-	-	2.442	1.235	0.377	-	-
HCM Control Delay (s)	11.3	-	-	$ 1467.6	196.5	10.6	-	-
HCM Lane LOS	B	-	-	F	F	B	-	-
HCM 95th %tile Q(veh)	0	-	-	3.8	12.1	1.8	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	2.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	134	544	330	35	31	52
Conflicting Peds, #/hr	0	0	0	0	4	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	105	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	4	2
Mvmt Flow	147	598	363	38	34	57

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	405	0	-	0	1278	386
Stage 1	-	-	-	-	386	-
Stage 2	-	-	-	-	892	-
Critical Hdwy	4.12	-	-	-	6.44	6.22
Critical Hdwy Stg 1	-	-	-	-	5.44	-
Critical Hdwy Stg 2	-	-	-	-	5.44	-
Follow-up Hdwy	2.218	-	-	-	3.536	3.318
Pot Cap-1 Maneuver	1154	-	-	-	182	662
Stage 1	-	-	-	-	683	-
Stage 2	-	-	-	-	397	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1154	-	-	-	158	660
Mov Cap-2 Maneuver	-	-	-	-	158	-
Stage 1	-	-	-	-	681	-
Stage 2	-	-	-	-	345	-

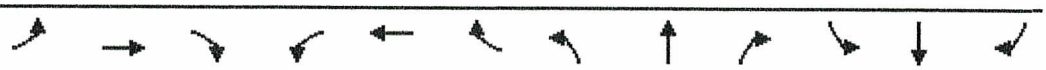
Approach	EB	WB	SB
HCM Control Delay, s	1.7	0	22
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1154	-	-	-	302
HCM Lane V/C Ratio	0.128	-	-	-	0.302
HCM Control Delay (s)	8.6	-	-	-	22
HCM Lane LOS	A	-	-	-	C
HCM 95th %tile Q(veh)	0.4	-	-	-	1.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	16	0	4	10	0	193	4	464	9	342	1019	23
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		0.97	1.00		0.97	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1829	1900	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	18	0	4	11	0	212	4	510	10	376	1120	25
Adj No. of Lanes	0	1	0	0	1	0	1	1	0	1	1	0
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	35	0	8	12	0	241	154	722	14	416	1226	27
Arrive On Green	0.02	0.00	0.02	0.17	0.00	0.17	0.40	0.40	0.40	0.23	0.68	0.68
Sat Flow, veh/h	1411	0	313	75	0	1441	489	1820	36	1774	1814	40
Grp Volume(v), veh/h	22	0	0	223	0	0	4	0	520	376	0	1145
Grp Sat Flow(s),veh/h/ln	1724	0	0	1516	0	0	489	0	1855	1774	0	1854
Q Serve(g_s), s	1.1	0.0	0.0	13.0	0.0	0.0	0.6	0.0	21.3	18.6	0.0	47.4
Cycle Q Clear(g_c), s	1.1	0.0	0.0	13.0	0.0	0.0	22.8	0.0	21.3	18.6	0.0	47.4
Prop In Lane	0.82		0.18	0.05		0.95	1.00		0.02	1.00		0.02
Lane Grp Cap(c), veh/h	43	0	0	253	0	0	154	0	736	416	0	1253
V/C Ratio(X)	0.52	0.00	0.00	0.88	0.00	0.00	0.03	0.00	0.71	0.90	0.00	0.91
Avail Cap(c_a), veh/h	305	0	0	268	0	0	155	0	738	510	0	1353
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	43.6	0.0	0.0	36.8	0.0	0.0	32.8	0.0	22.9	33.6	0.0	12.4
Incr Delay (d2), s/veh	9.3	0.0	0.0	26.1	0.0	0.0	0.1	0.0	3.1	17.1	0.0	9.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	0.0	0.0	7.3	0.0	0.0	0.1	0.0	11.5	11.1	0.0	27.1
LnGrp Delay(d),s/veh	52.9	0.0	0.0	62.9	0.0	0.0	32.8	0.0	25.9	50.8	0.0	21.8
LnGrp LOS	D			E			C		C	D		C
Approach Vol, veh/h		22			223			524			1521	
Approach Delay, s/veh		52.9			62.9			26.0			28.9	
Approach LOS		D			E			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6		8
Phs Duration (G+Y+Rc), s	25.2	39.9		6.2		65.1		19.1
Change Period (Y+Rc), s	4.0	4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s	26.0	36.0		16.0		66.0		16.0
Max Q Clear Time (g_c+I1), s	20.6	24.8		3.1		49.4		15.0
Green Ext Time (p_c), s	0.6	8.6		0.0		11.8		0.1

Intersection Summary	
HCM 2010 Ctrl Delay	31.8
HCM 2010 LOS	C



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	16	0	4	10	0	190	4	474	10	353	1076	24
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.96	1.00		0.97	1.00		0.97	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1829	1900	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	18	0	4	11	0	209	4	521	11	388	1182	26
Adj No. of Lanes	0	1	0	0	1	0	1	1	0	1	1	0
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	34	0	8	12	0	227	135	764	16	426	1270	28
Arrive On Green	0.02	0.00	0.02	0.16	0.00	0.16	0.42	0.42	0.42	0.24	0.70	0.70
Sat Flow, veh/h	1409	0	313	76	0	1440	461	1816	38	1774	1815	40
Grp Volume(v), veh/h	22	0	0	220	0	0	4	0	532	388	0	1208
Grp Sat Flow(s),veh/h/ln	1722	0	0	1515	0	0	461	0	1855	1774	0	1855
Q Serve(g_s), s	1.3	0.0	0.0	14.5	0.0	0.0	0.8	0.0	23.6	21.6	0.0	56.9
Cycle Q Clear(g_c), s	1.3	0.0	0.0	14.5	0.0	0.0	29.3	0.0	23.6	21.6	0.0	56.9
Prop In Lane	0.82		0.18	0.05		0.95	1.00		0.02	1.00		0.02
Lane Grp Cap(c), veh/h	42	0	0	239	0	0	135	0	780	426	0	1298
V/C Ratio(X)	0.53	0.00	0.00	0.92	0.00	0.00	0.03	0.00	0.68	0.91	0.00	0.93
Avail Cap(c_a), veh/h	272	0	0	239	0	0	135	0	780	542	0	1389
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	48.9	0.0	0.0	42.1	0.0	0.0	37.9	0.0	23.9	37.5	0.0	13.1
Incr Delay (d2), s/veh	10.1	0.0	0.0	37.4	0.0	0.0	0.1	0.0	2.4	16.9	0.0	11.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	0.0	0.0	8.5	0.0	0.0	0.1	0.0	12.6	12.6	0.0	32.5
LnGrp Delay(d),s/veh	59.0	0.0	0.0	79.5	0.0	0.0	38.0	0.0	26.3	54.4	0.0	24.1
LnGrp LOS	E			E			D		C	D		C
Approach Vol, veh/h		22			220			536			1596	
Approach Delay, s/veh		59.0			79.5			26.4			31.4	
Approach LOS		E			E			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6		8
Phs Duration (G+Y+Rc), s	28.4	46.7		6.4		75.0		20.0
Change Period (Y+Rc), s	4.0	4.0		4.0		4.0		4.0
Max Green Setting (Gmax), s	31.0	41.0		16.0		76.0		16.0
Max Q Clear Time (g_c+I1), s	23.6	31.3		3.3		58.9		16.5
Green Ext Time (p_c), s	0.8	7.9		0.0		12.1		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	35.0
HCM 2010 LOS	D