Appendix 1 Traffic Operations Analysis



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# MEMORANDUM

Date:	August 2, 2019	Project #: 23910.0
To:	Lance Calvert and Erich Lais City of West Linn 22500 Salamo Road West Linn, OR 97068	
From:	Matt Bell, Bryan Graveline, Marc Butorac, PE, PTOE	
CC:	Gabe Crop, PE, Murraysmith	
Project:	West Linn Arterial Roadways	
Subject:	Intersection Control Evaluation	

## INTRODUCTION

The City of West Linn (City) is planning to reconfigure the segment of Willamette Falls Drive (WFD) from Chestnut Street to the Lake Oswego Highway (OR 43) to improve traffic operations and safety performance along the corridor as well as facilitate future development of the waterfront area. A conceptual layout of the study area was developed by the City that includes removal of the segment of WFD from Chestnut Street to OR 43 and construction of new street connections from WFD to Sunset Drive, Sunset Drive to West A Street, and Sunset Drive to OR 43. The conceptual layout also includes the reconfiguration of several intersections, including the WFD/Sunset Avenue, Sunset Avenue/West A Street, and Sunset Avenue/OR 43 intersections. Appendix "A" contains the conceptual layout of the roadway.

This memorandum summarizes the results of an intersection control evaluation (ICE) at the study intersections. The purpose of an intersection control evaluation is to consistently consider multiple context-sensitive control strategies when planning a new or modified intersection. This evaluation consists of the following elements at several study intersections:

- An analysis of right-of-way and topographical constraints;
- Operational analysis under weekday existing and year 2040 traffic conditions; and
- An analysis of safety performance.

- eastbound approach, and separate left-turn lane and through lane at the westbound approach.
- approach, and a shared left/through lane at the westbound approach.
- approach, and separate left and through lanes at the westbound approach.
  - intersection until the I-205/OR 43 intersection is developed into a roundabout.

# **RIGHT-OF-WAY AND TOPOGRAPHICAL CONSTRAINTS**

The following section describes constraints stemming from existing rights-of-way and topography at the study intersections that may limit the possible intersection control options at the study intersections.

## WFD/Sunset Drive

The northbound approach of this intersection has a steep uphill grade and the eastbound approach of this intersection is a bridge structure that spans I-205. While there is sufficient right-of-way to explore a roundabout solution here, topographical constraints preclude this configuration. As such, a roundabout configuration was not analyzed at this intersection.

## West A Street/WFD

Sufficient right-of-way exists to explore a roundabout alternative at this location and no topographical constraints preclude this possibility. As such, a roundabout configuration was analyzed at this intersection.

## OR 43/WFD

Sufficient right-of-way exists to explore a roundabout alternative at this location and no topographical constraints preclude this possibility. As such, a roundabout configuration was analyzed at this intersection.

 Configure the WFD/Sunset Drive intersection as a two-way stop-controlled intersection with separate left- and right-turn lanes at the northbound approach, a shared through/right-turn lane at the

Configure the Sunset Avenue/West A Street intersection as a single lane roundabout with a shared left/right-turn lane at the southbound approach, a shared through/right-turn lane at the eastbound

Configure the Sunset Avenue/OR 43 intersection as a two-lane roundabout with separate left- and rightturn lanes at the northbound approach, separate through and right-turn lanes at the eastbound

 Note that this intersection should not be developed into a roundabout until the intersection of I-205/OR 43 is developed into a roundabout, as the current signalized configuration of I-205/OR 43 could result in queueing that adversely impacts the Sunset Avenue/OR 43 roundabout. As such, the Sunset Avenue/OR 43 intersection should be developed as an interim signalized

## **OPERATIONAL ANALYSIS**

Additional information on the study methodology and findings of the operational analysis is provided herein.

## Analysis Tools and Methodology

All analyses described in this memorandum were performed in accordance with the procedures stated in the *Highway Capacity Manual, 6<sup>th</sup> Edition* (HCM, Reference 1). Synchro 10 was used to analyze traffic operations at the study intersections as signalized and unsignalized intersections. SIDRA was used to analyze traffic operations at the study intersection as roundabouts. Synchro and SIDRA are software tools designed to assist with implementation of HCM methodologies.

## Intersection Performance Measures

The following performance measures were used to evaluate traffic operations at the study intersections under existing and future year 2040 traffic conditions.

Level-of-service (LOS) is the most commonly used performance measure. LOS uses an "A" to "F" ranking system based on the average control delay experienced by motorists. LOS "A" reflects relatively low vehicle delay times (10 seconds or less), while LOS "F" reflects relatively high vehicle delay times (over 80 seconds per vehicle at a signalized intersection and over 50 seconds per vehicle at an unsignalized intersection or roundabout). The LOS for signalized intersections and roundabouts is based on a weighted average of control delay for the overall intersection while the LOS for unsignalized intersections is based on the average control delay of the critical movement. According to the *City of West Linn Transportation System Plan* (TSP, Reference 2), both signalized and unsignalized intersections are expected to operate at LOS D or better, except at major arterials where the minimum is LOS E (OR 43 is a major arterial).

Volume-to-capacity (V/C) compares the volume of traffic to the theoretical capacity of the facility to accommodate traffic. A V/C ratio of 1.0 indicates an intersection is operating at capacity. A V/C ratio over 1.0 indicates the intersection's capacity is exceeded, meaning that the vehicle may have to wait more than one signal cycle length at a signalized intersection before moving through the intersection. Per the Oregon Highway Plan (OHP – Reference 3), the V/C ratio target for the OR 43/WFD and the OR 43/Mill Street intersections is 1.1 in the 1<sup>st</sup> Hour and 0.99 in the 2<sup>nd</sup> hour.

## **Existing Traffic Conditions**

The existing traffic conditions analysis identifies the current physical and operational characteristics of the study intersections. These conditions will be compared with future conditions later in this report. Figure 1 illustrates the existing lane configurations and traffic control devices at the study intersections.



## **Traffic Volumes**

Manual turning movement counts were conducted at the study intersections in June 2019 when school was insession and no inclement weather was present that affected typical traffic patterns. The counts were conducted on a typical mid-week day during the morning (7:00 to 9:00 AM) and evening (4:00 to 6:00 PM) peak time periods. The system-wide morning and evening peak hours were found to occur from 7:30 to 8:30 AM and 4:00 to 5:00 PM, respectively. Figures 2 and 3 summarize the turning movement counts for the weekday morning and evening peak hours. *Appendix "B" contains the traffic count worksheets used in this study.* 

## **Existing Intersection Operations**

Table 1 and Figures 2 and 3 summarize the results of the existing traffic conditions analysis. As shown, all the study intersections currently operate acceptably during the weekday AM and PM peak hours per their respective mobility standards and targets except the West A Street/WFD (#4) and OR 43/WFD (#6) intersections. *Appendix "C" includes the existing traffic conditions worksheets*.

## **Table 1: Existing Traffic Conditions**

		А	M Peak I	Hour		Р	M Peak I	Hour			
Map ID	Delay	LOS	v/c	95% Queues Exceed Storage?	Delay	LOS	v/c	95% Queues Exceed Storage?	Agency	Standard/ Target	Met?
1	10.9	В	0.09	No	9.7	A	0.04	No	West Linn	LOS D	Yes
2	14.6	В	0.05	No	12.7	В	0.11	No	West Linn	LOS D	Yes
3	20.8	С	0.62	No	15.6	С	0.37	No	West Linn	LOS D	Yes
4	51.2	F	0.32	No	34.0	D	0.47	No	West Linn	LOS D	No
5	13.0	В	0.06	No	18.7	С	0.27	No	West Linn	LOS D	Yes
6	104.7	F	0.98	Yes	107.6	F	1.06	Yes	ODOT	LOS E/1.1	No
7	36.1	E	0.10	No	39.0	E	0.08	No	ODOT	LOS E/1.1	Yes

## West A Street/WFD

The southbound approach to the West A Street/WFD intersection currently operates at LOS F during the weekday AM peak hour due to delay; however, it operates below capacity and the intersection does not meet signal warrants.

## OR 43/WFD

The eastbound approach to the OR 43/WFD intersection currently operates at LOS F during the weekday AM and PM peak hours due to delay and above capacity during the weekday PM peak hour. The intersection does not meet signal warrants.

## Year 2040 No-Build Traffic Conditions

The year 2040 no-build traffic conditions analysis identifies how the study intersections will operate without the conceptual layout. This analysis includes traffic attributed to general growth in the region but does not include any changes in traffic patterns related to the conceptual layout.





#### Forecast Traffic Volumes

Forecast traffic volumes were developed for the study intersections based on the existing traffic counts and information provided in Metro's regional travel demand model. The travel demand model provides base year 2015 and forecast year 2040 traffic volume projections that reflect anticipated land use changes and planned transportation improvements within the study area. The forecast traffic volumes were developed by applying the post-processing methodology presented in the National Cooperative Highway Research Program (NCHRP) Report 255 *Highway Traffic Data for Urbanized Area Project Planning and Design*, in conjunction with engineering judgment and knowledge of the study area. Figures 4 and 5 summarize the traffic volumes developed at the study intersections for the year 2040 no-build traffic conditions analysis.

Note that a peak hour trip generation estimate for the Waterfront development project was not available at the time of this study. As such, this needs to be required as part of an update TIA when the development proposal is submitted.

#### Year 2040 No-Build Intersection Operations

Table 2 and Figures 4 and 5 summarize the results of the year 2040 no-build traffic conditions analysis. As shown, all the study intersections are expected to operate acceptably during the weekday AM and PM peak hours per their respective mobility standards and targets except the West A Street/WFD (#4) and OR 43/WFD (#6) intersections. *Appendix "D" includes the year 2040 no-build traffic conditions worksheets*.

#### Table 2: Year 2040 No-Build Traffic Conditions

		А	M Peak I	Hour		F	PM Peak I	Hour			
Map ID	Delay	LOS	v/c	95% Queues Exceed Storage?	Delay	LOS	v/c	95% Queues Exceed Storage?	Agency	Standard /Target	Met?
1	10.6	В	0.07	No	9.6	А	0.05	No	West Linn	LOS D	Yes
2	16.8	С	0.07         No           0.11         No		15.2	С	0.09	No	West Linn	LOS D	Yes
3	25.4	D	0.71	No	14.6	В	0.33	No	West Linn	LOS D	Yes
4	88.1	F	0.54	No	68.9	F	0.76	No	West Linn	LOS D	No
5	13.0	В	0.06	No	20.1	С	0.29	No	West Linn	LOS D	Yes
6	170.1	F	1.14	Yes	248.2	F	1.38	Yes	ODOT	LOS E/1.1	No
7	73.0	F	0.19	No	64.0	F	0.13	No	ODOT	LOS E/1.1	Yes

## West A Street/WFD

The southbound approach to the West A Street/WFD intersection is expected to operate at LOS F during the weekday AM and PM peak hours due to delay; however, the intersection is expected to operate below capacity and it is not expected to meet signal warrants under year 2040 no build traffic conditions.

## OR 43/WFD

The eastbound approach to the OR 43/WFD intersection is expected to operate at LOS F and above capacity during the weekday AM and PM peak hours. The intersection is expected to meet signal warrants under year 2040 no build traffic conditions. *Appendix "E" contains the signal warrant analysis worksheets*.





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160 CM=EB LOS=B Del=14.6 V/C=0.33

West Linn Arterial Roadways August 2, 2019

### Year 2040 Build Traffic Conditions

The year 2040 build traffic conditions analysis identifies how the study intersections will operate with the proposed conceptual layout as well as with signalized and unsignalized intersections and roundabouts. Figure 6 illustrates the year 2040 build lane configurations and traffic control devices at the study intersections with the conceptual layout.

### Forecast Traffic Volumes

Forecast traffic volumes were developed at the study intersection by re-routing the background traffic volumes shown in Figures 4 and 5 to reflect the conceptual layout. Figures 7 and 8 summarize the traffic volumes developed at the study intersections for the year 2040 build traffic conditions analysis.

#### Year 2040 Build Intersection Operations

Table 3 and Figures 7 and 8 summarize the results of the year 2040 build traffic conditions analysis. As shown, the WFD/Sunset Avenue intersection operates acceptably under two-way stop-control. Because it does not meet signal warrants, this location was not evaluated as a traffic signal, and because of topographical constraints, this intersection was not evaluated as a roundabout. While the Sunset Avenue/West A Street and Sunset Avenue/OR 43 intersections do not operate acceptably under two-way stop-control, both intersections operate acceptably as traffic signals and roundabouts. *Appendix "F" includes the year 2040 build traffic conditions worksheets.* 

#### Table 3: Year 2040 Build Traffic Conditions

		A	M Peak H	our		F	PM Peak H	lour			
ID	Delay	LOS	v/c	95% Queues Exceed Storage?	Delay	LOS	v/c	95% Queues Exceed Storage?	Agency	Standard/ Target	Met?
					Two-v	vay Stop	-Control				
2	43.1	E	0.28	No	23.1	С	0.13	No	West Linn	LOS D	Yes
3	70.8	F	0.47	No	>80	F	0.84	No	West Linn	LOS D	No
6	>80	F	>1.1	Yes	>80	F	>1.1	Yes	ODOT	LOS E/1.1	No
					Tr	affic Sig	nals				
2				No	t Analyzed	– Does N	lot Meet S	Signal Warrants			
3	8.2	А	0.50	No	7.3	Α	0.54	No	West Linn	LOS D	Yes
6	7.8	Α	0.44	Yes <sup>1</sup>	10.9	В	0.42	Yes <sup>1</sup>	OODT	LOS E/1.1	Yes
					R	oundabo	outs	•	,	,	
2					Not Analyz	ed – Top	ographica	l Constraints			
3	17.4	В	0.80	No	14.8	В	0.76	No	West Linn	LOS D	Yes
6	9.7	Α	0.75	No	17.4	В	0.85	Yes <sup>2</sup>	ODOT	LOS E/1.1	Yes

<sup>1</sup> 95<sup>th</sup> percentile queue lengths from the Sunset Avenue/OR 43 signalized intersection concept northbound left turn movement have the potential to extend past the existing northbound left turn storage length.

<sup>2</sup> 95<sup>th</sup> percentile queue lengths from the Sunset Avenue/OR 43 roundabout concept eastbound approach have the potential to extend to the Terminal Drive access.





**Operational Analysis Findings** 

Based on the results of this operational analysis, the City should consider installation of a single lane roundabout or traffic signal at the Sunset Avenue/West A Street intersection and a two-lane roundabout or traffic signal at the Sunset Avenue/OR 43 intersections in conjunction with the overall conceptual layout. The following summarizes findings from the analysis:

- All the study intersections currently operate acceptably during the weekday AM and PM peak hours except the West A Street/WFD and OR 43/WFD intersections.
  - The West A Street/WFD intersection operates at LOS F during the weekday AM peak hour due to delay; however, the intersection operates below capacity and does not meet signal warrants.
  - The OR 43/WFD intersection operates at LOS F during the weekday AM and PM peak hours due to delay and above capacity during the weekday PM peak hour. The intersection does not meet signal warrants.
- All the study intersections are expected to operate acceptably under year 2040 no-build traffic conditions during the weekday AM and PM peak hours except the West A Street/WFD and OR 43/WFD intersections.
  - The West A Street/WFD intersection operates at LOS F during the weekday AM and PM peak hours due to delay; however, the intersection is expected to operate below capacity and does not meet signal warrants.
  - The OR 43/WFD intersection operates at LOS F and above capacity during the weekday AM and PM peak hours. The intersection is expected to meet signal warrants.
- All the study intersections are expected to operate acceptably under year 2040 build traffic conditions during the weekday AM and PM peak hours assuming buildout of the proposed conceptual layout and the installation of traffic signals or roundabouts as described at the intersections of West A Street/WFD and OR 43/WFD.
  - Analysis conducted for the I-205 traffic study was reviewed to determine potential impacts on the study intersections described in this report. However, the I-205 traffic study was placed on hold at the time of this study. Per the I-205 traffic study, a roundabout should not be developed at the intersection of OR 43/WFD until the intersection of I-205/OR 43 is developed into a roundabout, as the current signalized configuration of I-205/OR 43 could result in queueing that adversely impacts a Sunset Avenue/OR 43 roundabout. As such, if a roundabout concept is selected at the Sunset Avenue/OR 43 intersection, it should be developed as an interim signalized intersection until the I-205/OR 43 intersection is developed into a roundabout.

# SAFETY PERFORMANCE

The Highway Safety Manual (HSM, Reference 4) contains data on the potential crash effects of converting a minorroad stop-controlled intersection into a signal or a roundabout. Per the HSM, converting an intersection with minorroad stop control in an urban environment to a modern roundabout with one or two lanes has the potential to reduce all crashes by between 29% and 39%. Converting an intersection with minor-road stop control in an urban environment to a signalized intersection has the potential to reduce all crashes by 5%.

Additionally, crashes occurring at roundabouts tend to occur at lesser severities than at signalized intersections, given the lower likelihood of angle and head-on crashes and the higher likelihood of sideswipe crashes. Sideswipe crashes tend to have lesser severities than angle or head-on crashes because with both vehicles travelling the same direction, less kinetic energy is transferred upon impact.

Given the greater capacity of roundabouts to reduce crashes compared to signalized intersections and the lesser expected severities of crashes occurring at roundabouts compared to signalized intersections, roundabouts were selected over signalized intersections where possible to account for their expected improved safety performance.

# RECOMMENDATIONS

The following summarizes the recommended lane configurations and traffic control devices at the study intersections to be installed in conjunction with the proposed conceptual layout to ensure feasible construction, acceptable operations, and desirable safety performance under year 2040 traffic conditions. Table 4 summarizes the intersection control evaluation for each intersection.

- eastbound approach, and separate left-turn lane and through lane at the westbound approach.
- approach, and a shared left/through lane at the westbound approach.
- eastbound approach, and separate left and through lanes at the westbound approach.
  - intersection until the I-205/OR 43 intersection is developed into a roundabout.

 Configure the WFD/Sunset Avenue intersection as a two-way stop-controlled intersection with separate left- and right-turn lanes at the northbound approach, a shared through/right-turn lane at the

Configure the Sunset Avenue/West A Street intersection as a single lane roundabout with a shared left/right-turn lanes at the southbound approach, a shared through/right-turn lanes at the eastbound

 Configure the future Sunset Avenue/OR 43 intersection as a two-lane roundabout with separate leftand right-turn lanes at the northbound approach, separate through and right-turn lanes at the

 Note that this intersection should not be developed into a roundabout until the intersection of I-205/OR 43 is developed into a roundabout, as the current signalized configuration of I-205/OR 43 could result in queueing that adversely impacts the Sunset Avenue/OR 43 roundabout. As such, the Sunset Avenue/OR 43 intersection should be developed as an interim signalized

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#### **Table 4. Intersection Control Evaluation Summary**

	Keep as Minor-Approach Stop-Control	Install Traffic Signal	Install Roundabout
WFD/Sunset Drive	Acceptable operations	Does not meeting signal warrants	Topographical constraints preclude roundabout
West A Street/WFD	Unacceptable operations	Acceptable operations but less desirable safety performance	Acceptable operations and desirable safety performance
OR 43/WFD	Unacceptable operations	Acceptable operations but less desirable safety performance	Acceptable operations and desirable safety performance

Given the potential for development within the waterfront area, the City should continue to monitor traffic conditions at the study intersections and confirm the recommendations included in this memorandum prior to construction.

## REFERENCES

- 1. Transportation Research Board. *Highway Capacity Manual, 6<sup>th</sup> Edition*. 2018.
- 2. City of West Linn. City of West Linn Transportation System Plan. 2016.
- 3. Oregon Department of Transportation. *Oregon Highway Plan*. 2015.
- 2010.

## APPENDIX

- A. Conceptual Layout
- B. Traffic Counts
- C. Existing Traffic Conditions Worksheets
- D. Year 2040 No-build Traffic Conditions Worksheets
- E. Signal Warrant Analysis Worksheets
- F. Year 2040 Build Traffic Conditions Worksheets

4. American Association of State Highway and Transportation Officials. *Highway Safety Manual, 1st Edition.* 

Appendix A Conceptual Layout





Appendix B Traffic Counts

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#### LOCATION: Chestnut St -- Sunset Ave QC JOB #: 14992604 CITY/STATE: West Linn, OR DATE: Thu, May 30 2019 Peak-Hour: 4:35 PM -- 5:35 PM Peak 15-Min: 5:20 PM -- 5:35 PM ŧ ŧ **↑** 0 . . 19 🛥 0 🛊 316 🛥 0 ٤ 0 **t** 0 **a** 23 141 🔺 0.84 **+** 251 3.5 👄 ÷ 3.4 🔶 2.9 🥆 176 🔿 35 🥆 ŧ ŧ c 1.5 ŧ ŧ + ↑ 1.3 Quality Counts 4.8 DATA THAT DRIVES COMMUNITIES . 0 🖌 **t** 0 AD 2 ╘┰ 0 7 **r** 0 ŧ NA . t t و 🔶 NA NA NA NA .... c ŧ ŧ NA NA Chestnut St Chestnut St Sunset Ave Sunset Ave 5-Min Count Period Hourly Totals (Northbound) (Southbound) (Eastbound) (Westbound) Total Beginning At Left Thru Right υ Left Right υ Left Thru Right υ Left Thru Right υ Thru 4:00 PM 7 4:05 PM 4:10 PM 5 5 4:15 PM 4:20 PM 4:25 PM 4:30 PM

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Comments: This is signed as Sunset Ave/Chestnut St

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#### Comments:

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#### Comments:

Report generated on 6/5/2019 5:41 PM

QC JOB #: 14992609 DATE: Thu, May 30 2019

LOCATION: Broadway St/Pickins St -- Willamette Falls Dr CITY/STATE: West Linn, OR

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Comments:

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QC JOB #: 14992610

LOCATION: Broadway St/Pickins St -- Willamette Falls Dr CITY/STATE: West Linn, OR

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Period Beginning At	Left	<u>(North</u> Thru	<u>ibound)</u> Right	U	Left	<u>(South</u> Thru	ibound) Right	U	Left	<u>(Eastt</u> Thru	ound) Right	U	Left	<u>(West</u> Thru	bound) Right	U	Total	Totals
4:00 PM	0	0	0	0	8	0	3	0	1	57	0	0	0	36	0	0	105	
4:10 PM 4:15 PM 4:20 PM 4:25 PM 4:30 PM 4:35 PM 4:40 PM 4:45 PM 4:50 PM 4:55 PM	0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	7 9 2 7 8 6 9 4 6 12	0 0 0 0 0 0 0 0 0 0	2 0 0 1 0 1 0 2 1	0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1 0 0	51 76 47 52 62 41 62 49 62 49 62 45	0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	27 35 29 33 24 38 24 38 24 33 42 27	0 0 0 5 0 2 1 1 2	000000000000000000000000000000000000000	87 120 78 92 100 85 98 88 113 87	1149
5:00 PM 5:05 PM 5:10 PM 5:15 PM 5:20 PM 5:25 PM 5:30 PM 5:35 PM 5:40 PM 5:45 PM 5:50 PM 5:55 PM	0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0		0 0 0 0 0 0 0 0 0 0 0 0 0	12 7 6 10 6 12 6 6 13 11 13 14	0 0 0 0 0 0 0 0 0 0 0 0	2 2 0 0 0 0 0 0 0 0 2 0 0		0 0 0 0 0 0 1 0 0 0 0	51 40 50 46 45 57 40 38 53 49 50 59	0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0		26 31 33 34 37 46 32 29 19 34 38 25	1 1 0 1 3 1 2 2 1 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0	92 81 89 91 116 80 76 86 96 101 98	1136 1121 1123 1094 1107 1131 1111 1102 1090 1098 1086 1097
Peak 15-Min Flowrates	Left	North	bound Bight		loft	South	bound Bight	11	left	Eastb	ound Bight		left	West	bound Bight	11	To	tal
All Vehicles Heavy Trucks Pedestrians Bicycles	0 0 0	0 0 0 0	0 0 0	0	80 8 0	0 0 0 0	8 0 0	0	0000	740 12 0 0	0 0 0	0	0 0 0	384 8 0 0	0 0 0	0	12 2 (	12 8 )

Railroad Stopped Buses Comments:

Report generated on 6/5/2019 5:41 PM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

LOCATION: OR-43 -- Willamette Falls Dr OC JOB #: 14992611 CITY/STATE: West Linn, OR DATE: Thu, May 30 2019 Peak-Hour: 7:20 AM -- 8:20 AM 1.7 Peak 15-Min: 7:45 AM -- 8:00 AM ŧ ŧ **↑** 0 278 313 5.8 1.3 . . 618 🛥 188 🛊 44 - 53 + • 0 0 £ 0.93 + • 3.3 + 1.2 **€** 0 → 0 360 🔸 172 🍾 0 🔸 c ŧ 3.2 0.6 ÷ ŧ + ŧ Quality Counts 1.2 DATA THAT DRIVES COMMUNITIES . 0 1 ٤ 0 A **f** 0 ŧ NA . t و t NA NA NA NA T ] ... c ъ £ ŧ C NA NA ŧ OR-43 OR-43 Willamette Falls Dr Willamette Falls Dr 5-Min Count Period Hourly Totals (Northbound) (Southbound) (Eastbound) (Westbound) Total Beginning At Left Thru Right υ Left Right υ Left Right υ Left Right υ Thru Thru Thru 7:00 AM 7:05 AM 7:10 AM 7:15 AM 7:20 AM 29 67 0 0 7:25 AM 7:30 AM 7:35 AM 7:40 AM 55 34 7:45 AM 7:50 AM 7:55 AN 

8:30 AM 8:35 AM 8:40 AM 8:45 AM 8:50 AM 8:55 AM Northbound Southbound Eastbound Westbound Peak 15-Min Flowrates Total Left U Left υ Left υ Left υ Thru Right Thru Right Thru Right Thru Right All Vehicles Heavy Trucks 0 0 0 Pedestrians Bicycles Railroad Stopped Buses Comments:

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#### Comments:

8:00 AM

8:05 AM

8:10 AM

8:15 AM

8:20 AM

8:25 AM

Report generated on 6/5/2019 5:41 PM

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SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

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LOCATION: OR-43 -- Willamette Falls Dr QC JOB #: 14992612 CITY/STATE: West Linn, OR DATE: Thu, May 30 2019 Peak-Hour: 4:00 PM -- 5:00 PM 686 708 1.7 2.1 ŧ Peak 15-Min: 4:05 PM -- 4:20 PM ŧ **↑** 0 4 195 491 2.6 1.4 0 . 391 🗢 287 🌶 2 🗲 4.2 🗲 0 **+** 0 **a** 0 0 4 0 🌩 0 0.96 0 0 ٠ 3.2 🔶 2.5 🥆 758 🔶 471 🥆 ↑ ↑ ↑ 196 421 0 ŧ 15 ♦ 2 0.7 0 **♦** 962 ŧ ŧ Quality Counts 617 DATA THAT DRIVES COMMUNITIES 4 0 2 ↓ 1 🖌 **t** 0 AD 0 3 0 🌩 **+** 0 1 7 **f** 0 **ה** 2 C **↑** 0 0 NΔ t 🕈 NA NA NA NA ŧ NA NΔ Willamette Falls Dr OR-43 OR-43 Willamette Falls Dr 5-Min Count *.*.. Hourby 10 ... ...

Period		(North	bound)			(South	bound)			(Eastb	ound)			(Westl	bound)		Total	Totals
Beginning At	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		TOtals
4:00 PM	19	41	0	0	0	32	17	0	26	0	39	0	0	0	0	0	174	
4:05 PM	14	42	0	0	0	41	18	0	23	0	39	0	0	0	0	0	177	
4:10 PM	14	39	0	0	0	44	13	0	19	0	41	0	0	0	0	0	170	
4:15 PM	16	33	0	0	0	31	20	0	35	0	52	0	0	0	0	0	187	
4:20 PM	21	35	0	0	0	49	11	0	17	0	32	0	0	0	0	0	165	
4:25 PM	18	44	0	0	0	40	13	0	22	0	38	0	0	0	0	0	175	
4:30 PM	10	29	0	0	0	44	19	0	33	0	43	0	0	0	0	0	178	
4:35 PM	19	33	0	0	0	46	18	0	18	0	29	0	0	0	0	0	163	
4:40 PM	13	30	0	0	0	50	12	0	26	0	46	0	0	0	0	0	177	
4:45 PM	14	32	0	0	0	41	20	0	25	0	36	0	0	0	0	0	168	
4:50 PM	23	28	0	0	0	33	21	0	21	0	45	0	0	0	0	0	171	
4:55 PM	15	35	0	0	0	40	13	0	22	0	31	0	0	0	0	0	156	2061
5:00 PM	12	26	0	0	0	39	15	0	28	0	30	0	0	0	0	0	150	2037
5:05 PM	17	36	0	0	0	39	17	0	18	0	31	0	0	0	0	0	158	2018
5:10 PM	17	61	0	0	0	35	15	0	20	0	32	0	0	0	0	0	180	2028
5:15 PM	19	49	0	0	0	32	17	0	19	0	36	0	0	0	0	0	172	2013
5:20 PM	26	38	0	0	0	31	15	0	17	0	36	0	0	0	0	0	163	2011
5:25 PM	18	35	0	0	0	36	31	0	31	0	39	0	0	0	0	0	190	2026
5:30 PM	19	50	0	0	0	35	15	0	16	0	28	0	0	0	0	0	163	2011
5:35 PM	17	41	0	0	0	35	14	0	18	0	32	0	0	0	0	0	157	2005
5:40 PM	11	33	0	0	0	45	13	0	27	0	32	0	0	0	0	0	161	1989
5:45 PM	11	29	0	0	0	41	21	0	32	0	30	0	0	0	0	0	164	1985
5:50 PM	12	47	0	0	0	27	26	0	27	0	40	0	0	0	0	0	179	1993
5:55 PM	10	28	0	0	0	29	17	0	39	0	40	0	0	0	0	0	163	2000
Peak 15-Min		North	bound			South	bound			Eastb	ound			West	oound		Та	tal
Flowrates	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	10	Lai
All Vehicles	176	456	0	0	0	464	204	0	308	0	528	0	0	0	0	0	21	36
Heavy Trucks	4	4	0		0	12	8		12	0	12		0	0	0		5	2
Pedestrians		0				0				0				0			(	)
Bicycles	0	0	0		0	0	0		0	0	1		0	0	0		1	
Railroad																		
Stopped Buses																		
Comments:																		

#### comments:

Report generated on 6/5/2019 5:41 PM

#### LOCATION: OR-43 -- Mill St QC JOB #: 14992613 CITY/STATE: West Linn, OR DATE: Thu, May 30 2019 Peak-Hour: 7:10 AM -- 8:10 AM 1.8 Peak 15-Min: 7:45 AM -- 8:00 AM ÷ ŧ ŧ ŧ 5.3 1.3 . . 23 🛥 10 🛊 • 0 **+** 0 43 + 10 1 t 0 0 0 🌩 0.91 + + + 7.1 🔹 0 🥆 4 7 **€** 0 **→** 0 14 🔺 ŧ ŧ 1.7 ŧ ŧ ŧ ŧ Quality Counts 1.3 1.7 DATA THAT DRIVES COMMUNITIES ┥ • • **t** 0 A **+** 0 1 7 **f** 0 • C ŧ NA . L, -t t و t 🗲 NA NA NA NA ... c ŧ r NA NA ŧ OR-43 OR-43 Mill St Mill St 5-Min Count Period Hourly Totals (Northbound) (Southbound) (Eastbound) (Westbound) Total Beginning At Left Thru Right υ Left Thru Right υ Left Thru Right υ Left Thru Right υ 7:00 AM 7:05 AM 7:10 AM 0 0 24 2 2 0 0 0 7:15 AM 0 0 0 2 0 0 0 0 7:20 AM 93 0 0 31 0 0 0 0 0 0 7:25 AM 1 2 7:30 AM 7:35 AM 7:40 AM 90 7:45 AM 0 7:50 AM 7:55 AM 68 1477 8:00 AM 0 0 0 0 0 0 0 8:05 AM ō õ õ

8:10 AM	0	80	0	0	0	24	0	0	0	0	0	0	0	0	0	0	104	1468
8:15 AM	0	68	0	0	0	49	1	0	1	0	0	0	0	0	0	0	119	1472
8:20 AM	0	76	0	0	0	41	1	0	0	0	0	0	0	0	0	0	118	1462
8:25 AM	0	66	0	0	0	39	0	0	0	0	0	0	0	0	0	0	105	1458
8:30 AM	0	68	0	0	0	33	0	0	1	0	0	0	0	0	0	0	102	1434
8:35 AM	0	61	0	0	0	39	2	0	1	0	0	0	0	0	0	0	103	1400
8:40 AM	0	52	0	0	0	31	0	0	1	0	0	0	0	0	0	0	84	1361
8:45 AM	0	51	0	0	0	43	0	0	0	0	0	0	0	0	0	0	94	1314
8:50 AM	0	76	0	0	0	33	1	0	0	0	0	0	0	0	0	0	110	1293
8:55 AM	0	52	0	0	0	32	0	0	1	0	0	0	0	0	0	0	85	1242
Peak 15-Min		North	bound			South	bound			Eastb	ound			West	bound		То	tal
Peak 15-Min Flowrates	Left	North Thru	bound Right	U	Left	South Thru	bound Right	U	Left	Eastb Thru	ound Right	U	Left	Westl Thru	bound Right	U	То	tal
Peak 15-Min Flowrates	Left	North Thru 984	bound Right 0	U	Left 0	South Thru 604	bound Right 28	U	Left 8	Eastb Thru 0	oound Right 4	U	Left 0	Westl Thru 0	bound Right 0	U 0	To	tal 32
Peak 15-Min Flowrates All Vehicles Heavy Trucks	Left 4 0	North Thru 984 24	bound Right 0 0	U	Left 0 0	South Thru 604 0	bound Right 28 4	U 0	Left 8 4	Eastb Thru 0 0	Right	<b>U</b> 0	Left 0 0	Westl Thru 0 0	bound Right 0 0	U 0	To 16 3	tal 32 2
Peak 15-Min Flowrates All Vehicles Heavy Trucks Pedestrians	Left 4 0	North Thru 984 24 0	bound Right 0 0	<b>U</b>	Left 0 0	South Thru 604 0 0	bound Right 28 4	U 0	Left 8 4	Eastb Thru 0 16	Right 4 0	<b>U</b>	Left 0 0	Westl Thru 0 0 0	bound Right 0 0	U 0	To	tal 32 2 6
Peak 15-Min Flowrates All Vehicles Heavy Trucks Pedestrians Bicycles	Left 4 0	North Thru 984 24 0 0	bound Right 0 0	<b>U</b>	Left 0 0	South Thru 604 0 0 1	bound Right 28 4 0	U 0	Left 8 4 0	Eastb Thru 0 16 0	Right 4 0 0	<b>U</b> 0	Left 0 0	Westl Thru 0 0 0 0	bound Right 0 0	U 0	To 16 3 1	tal 32 2 6
Peak 15-Min Flowrates All Vehicles Heavy Trucks Pedestrians Bicycles Railroad	Left 4 0 0	North Thru 984 24 0 0	bound Right 0 0 0	U 0	Left 0 0	South Thru 604 0 1	bound Right 28 4 0	U 0	Left 8 4 0	Eastb Thru 0 0 16 0	A cound cound cound cound cound cound cound cound cound count count count count count cound coun	U 0	Left 0 0 0 0	Westl Thru 0 0 0 0 0 0 0	bound Right 0 0 0	U 0	To 16 3 1	tal 32 2 6
Peak 15-Min Flowrates All Vehicles Heavy Trucks Pedestrians Bicycles Railroad Stopped Buses	Left 4 0	North Thru 984 24 0 0	bound Right 0 0 0	0	Left 0 0	South Thru 604 0 0 1	bound Right 28 4 0	U 0	Left 8 4 0	Eastb Thru 0 16 0	Arright 0 0 0	U 0	Left 0 0	Westl Thru 0 0 0 0 0 0 0	bound Right 0 0 0	U 0	- To 16 3 1	tal 32 2 6 L

#### Comments:

Report generated on 6/5/2019 5:41 PM

Location: ( City/state:	OR-43 - West L	- Mill S _inn, O	St R												QC DATE:	C <b>JOB</b> i Thu, I	#: 1499 May 30	92614 ) 2019
13 ← 8 . 0 • 9 → 1	944 11 933 934 934	599 3 0 ↓ 3 • ↓ 3 • ↓ 4 • ↓ 593	0 ← 0 0 0 ← 0			Pe Pea	eak-Hou ak 15-M Qua DATA TH	ur: 4:00 lin: 4:0 Lity		- 5:00 4:15 unts	PM PM			7.7 <b>•</b> 0 0 0 <b>•</b> 0	18 9.1 1 9.2 1 9.4 0 9.1 1 9.1 1 1 9.1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0.8 .7 0 	€ 0 ↔ ◆ 0 € 0 →	0 0
14		• [ • [	2		-		↓				<b>an</b>	_		0 0 0			€ 0 ← 0 € 0	
€ + NA + F +			NA		-	510	ŝ			4		_		NA	۲ ۲ ۲ ۲ ۲ ۲		€ ◆ NA F	
5-Min Count Period Beginning At	Left	OR (North) Thru	-43 bound) Right	U	Left	OR (South Thru	-43 bound) Right	U	Left	Mil (Eastb Thru	l St ound) Right	U	Left	Mil (Westb Thru	ll St bound) Right	U	Total	Hourly Totals
4:00 PM	1	56	0	0	0	73	1	0	1	0	0	0	0	0	0	0	132	

Period		(North	bouna)		(Southbound)					(Eastr	ouna)			(west	oouna)		Total	Totals
Beginning At	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		TOtals
4:00 PM	1	56	0	0	0	73	1	0	1	0	0	0	0	0	0	0	132	
4:05 PM	0	55	0	0	0	71	1	0	0	0	0	0	0	0	0	0	127	
4:10 PM	0	49	0	0	0	84	1	0	2	0	0	0	0	0	0	0	136	
4:15 PM	0	47	0	0	0	79	0	0	1	0	0	0	0	0	0	0	127	
4:20 PM	0	51	0	0	0	78	1	0	1	0	0	0	0	0	0	0	131	
4:25 PM	0	57	0	0	0	74	0	0	1	0	0	0	0	0	0	0	132	
4:30 PM	1	39	0	0	0	84	2	0	0	0	0	0	0	0	0	0	126	
4:35 PM	0	49	0	0	0	77	0	0	1	0	0	0	0	0	0	0	127	
4:40 PM	0	45	0	0	0	91	3	0	0	0	0	0	0	0	0	0	139	
4:45 PM	0	45	0	0	0	68	1	0	0	0	1	0	0	0	0	0	115	
4:50 PM	0	49	0	0	0	78	1	0	1	0	0	0	0	0	0	0	129	
4:55 PM	0	49	0	0	0	76	0	0	0	0	0	0	0	0	0	0	125	1546
5:00 PM	0	34	0	0	0	66	1	0	4	0	1	0	0	0	0	0	106	1520
5:05 PM	0	53	0	0	0	70	2	0	2	0	0	0	0	0	0	0	127	1520
5:10 PM	0	71	0	0	0	67	0	0	4	0	0	0	0	0	0	0	142	1526
5:15 PM	0	64	0	0	0	64	1	0	1	0	0	0	0	0	0	0	130	1529
5:20 PM	0	62	0	0	0	69	1	0	1	0	0	0	0	0	0	0	133	1531
5:25 PM	0	51	0	0	0	71	2	0	0	0	0	0	0	0	0	0	124	1523
5:30 PM	2	67	0	0	0	63	1	0	1	0	0	0	0	0	0	0	134	1531
5:35 PM	2	56	0	0	0	65	0	0	0	0	0	0	0	0	0	0	123	1527
5:40 PM	0	43	0	0	0	76	0	0	0	0	0	0	0	0	0	0	119	1507
5:45 PM	0	36	0	0	0	71	2	0	1	0	0	0	0	0	0	0	110	1502
5:50 PM	0	60	0	0	0	65	0	0	1	0	0	0	0	0	0	0	126	1499
5:55 PM	0	37	0	0	0	72	0	0	1	0	0	0	0	0	0	0	110	1484
Peak 15-Min		North	bound			South	bound			Eastb	ound			Westk	oound		То	tal
Flowrates	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	10	ai
All Vehicles	4	640	0	0	0	912	12	0	12	0	0	0	0	0	0	0	15	80
Heavy Trucks	0	12	0		0	16	0		0	0	0		0	0	0		2	8
Pedestrians		0				0				12				0			1	2
Bicycles	0	0	0		0	1	0		0	0	0		0	0	0		1	L
Railroad																		
Stopped Buses																		
Comments:																		

Report generated on 6/5/2019 5:41 PM

Appendix C Existing Traffic Conditions Worksheets 1.1

## Intersection

Int Delay, s/veh

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4			4			4			4	
Traffic Vol, veh/h	18	230	0	0	387	0	0	0	0	0	0	53
Future Vol, veh/h	18	230	0	0	387	0	0	0	0	0	0	53
Conflicting Peds, #/hr	0	0	1	1	0	0	0	0	0	0	0	0
Sign Control I	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	ŧ _	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	5	-	-	-5	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	11	3	0	0	4	0	0	0	0	0	0	4
Mvmt Flow	20	250	0	0	421	0	0	0	0	0	0	58

Major/Minor	Major1		Ν	/lajor2		Ν	linor1		Ν	1inor2			
Conflicting Flow All	421	0	0	251	0	0	741	712	251	711	712	421	
Stage 1	-	-	-	-	-	-	291	291	-	421	421	-	
Stage 2	-	-	-	-	-	-	450	421	-	290	291	-	
Critical Hdwy	4.21	-	-	4.1	-	-	8.1	7.5	6.7	6.1	5.5	5.74	
Critical Hdwy Stg 1	-	-	-	-	-	-	7.1	6.5	-	5.1	4.5	-	
Critical Hdwy Stg 2	-	-	-	-	-	-	7.1	6.5	-	5.1	4.5	-	
Follow-up Hdwy	2.299	-	-	2.2	-	-	3.5	4	3.3	3.5	4	3.336	
Pot Cap-1 Maneuver	1091	-	-	1326	-	-	272	296	765	427	439	666	
Stage 1	-	-	-	-	-	-	665	623	-	690	666	-	
Stage 2	-	-	-	-	-	-	523	527	-	783	732	-	
Platoon blocked, %		-	-		-	-							
Mov Cap-1 Maneuver	1091	-	-	1325	-	-	244	289	764	420	429	666	
Mov Cap-2 Maneuver	-	-	-	-	-	-	244	289	-	420	429	-	
Stage 1	-	-	-	-	-	-	650	609	-	676	666	-	
Stage 2	-	-	-	-	-	-	478	527	-	767	716	-	
-													

Approach	EB	WB	NB	SB	
HCM Control Delay, s	0.6	0	0	10.9	
HCM LOS			А	В	

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR S	SBLn1
Capacity (veh/h)	-	1091	-	-	1325	-	-	666
HCM Lane V/C Ratio	-	0.018	-	-	-	-	-	0.086
HCM Control Delay (s)	0	8.4	0	-	0	-	-	10.9
HCM Lane LOS	A	Α	А	-	А	-	-	В
HCM 95th %tile Q(veh)	-	0.1	-	-	0	-	-	0.3

06/24/20 <sup>-</sup>	19
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Intersection						
Int Delay, s/veh	0.4					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	4			ų	۲	
Traffic Vol, veh/h	316	53	0	200	18	0
Future Vol, veh/h	316	53	0	200	18	0
Conflicting Peds, #/hr	0	3	3	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage	e, #0	-	-	0	0	-
Grade, %	-3	-	-	3	3	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	4	4	0	5	11	0
Mvmt Flow	359	60	0	227	20	0

Major/Minor	Major1	Ν	/lajor2		Minor1		
Conflicting Flow All	0	0	422	0	619	392	
Stage 1	-	-	-	-	392	-	
Stage 2	-	-	-	-	227	-	
Critical Hdwy	-	-	4.1	-	7.11	6.5	
Critical Hdwy Stg 1	-	-	-	-	6.11	-	
Critical Hdwy Stg 2	-	-	-	-	6.11	-	
Follow-up Hdwy	-	-	2.2	-	3.599	3.3	
Pot Cap-1 Maneuver	-	-	1148	-	395	640	
Stage 1	-	-	-	-	622	-	
Stage 2	-	-	-	-	761	-	
Platoon blocked, %	-	-		-			
Mov Cap-1 Maneuver	r -	-	1145	-	394	638	
Mov Cap-2 Maneuver	r -	-	-	-	394	-	
Stage 1	-	-	-	-	620	-	
Stage 2	-	-	-	-	761	-	

Approach	EB	WB	NB
HCM Control Delay, s	0	0	14.6
HCM LOS			В

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT		
Capacity (veh/h)	394	-	-	1145	-		
HCM Lane V/C Ratio	0.052	-	-	-	-		
HCM Control Delay (s)	14.6	-	-	0	-		
HCM Lane LOS	В	-	-	А	-		
HCM 95th %tile Q(veh)	0.2	-	-	0	-		

#### Intersection

Int Delay, s/veh 5.8 EBL Movement EBR NBL NBT SBT SBR Y ŧ 1 Lane Configurations Æ Traffic Vol, veh/h 316 0 0 230 387 200 Future Vol, veh/h 316 0 0 230 387 200 0 Conflicting Peds, #/hr 3 0 0 0 3 Sign Control Stop Stop Free Free Free Free RT Channelized None None -None --Storage Length 0 0 -\_ --Veh in Median Storage, # 0 -0 0 --Grade, % 0 0 -5 ---Peak Hour Factor 89 89 89 89 89 89 Heavy Vehicles, % 4 0 0 3 5 6 Mvmt Flow 355 0 0 258 435 225

Major/Minor	Minor2	Ν	/lajor1	Majo	or2		
Conflicting Flow All	696	438	663	0	-	0	
Stage 1	438	-	-	-	-	-	
Stage 2	258	-	-	-	-	-	
Critical Hdwy	5.44	5.7	4.1	-	-	-	
Critical Hdwy Stg 1	4.44	-	-	-	-	-	
Critical Hdwy Stg 2	4.44	-	-	-	-	-	
Follow-up Hdwy	3.536	3.3	2.2	-	-	-	
Pot Cap-1 Maneuver	491	662	935	-	-	-	
Stage 1	730	-	-	-	-	-	
Stage 2	838	-	-	-	-	-	
Platoon blocked, %				-	-	-	
Mov Cap-1 Maneuver	488	660	932	-	-	-	
Mov Cap-2 Maneuver	575	-	-	-	-	-	
Stage 1	728	-	-	-	-	-	
Stage 2	835	-	-	-	-	-	

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

Minor Lane/Major Mvmt	NBL	NBT EBLn1	SBT	SBR	
Capacity (veh/h)	932	- 575	-	-	
HCM Lane V/C Ratio	-	- 0.617	-	-	
HCM Control Delay (s)	0	- 20.8	-	-	
HCM Lane LOS	А	- C	-	-	
HCM 95th %tile Q(veh)	0	- 4.2	-	-	

4.1

### Intersection

Int Delay, s/veh

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4î»			4 î <del>)</del>			4			<del>स</del> ्	1
Traffic Vol, veh/h	203	343	0	0	477	133	0	0	0	31	0	110
Future Vol, veh/h	203	343	0	0	477	133	0	0	0	31	0	110
Conflicting Peds, #/hr	2	0	0	0	0	2	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	Stop
Storage Length	-	-	-	-	-	-	-	-	-	-	-	75
Veh in Median Storage,	# -	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	3	-	-	3	-	-	-3	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	4	3	0	100	4	3	0	0	0	3	0	5
Mvmt Flow	231	390	0	0	542	151	0	0	0	35	0	125

Major/Minor	Major1		Μ	lajor2		N	Minor1		ľ	Minor2			
Conflicting Flow All	695	0	0	390	0	0	1123	1547	195	1277	1472	349	
Stage 1	-	-	-	-	-	-	852	852	-	620	620	-	
Stage 2	-	-	-	-	-	-	271	695	-	657	852	-	
Critical Hdwy	4.18	-	-	6.1	-	-	8.1	7.1	7.2	6.96	5.9	6.7	
Critical Hdwy Stg 1	-	-	-	-	-	-	7.1	6.1	-	5.96	4.9	-	
Critical Hdwy Stg 2	-	-	-	-	-	-	7.1	6.1	-	5.96	4.9	-	
Follow-up Hdwy	2.24	-	-	3.2	-	-	3.5	4	3.3	3.53	4	3.35	
Pot Cap-1 Maneuver	883	-	-	687	-	-	135	89	807	151	164	657	
Stage 1	-	-	-	-	-	-	282	329	-	488	536	-	
Stage 2	-	-	-	-	-	-	686	398	-	466	437	-	
Platoon blocked, %		-	-		-	-							
Mov Cap-1 Maneuver	881	-	-	687	-	-	81	59	807	112	109	656	
Mov Cap-2 Maneuver	• -	-	-	-	-	-	81	59	-	112	109	-	
Stage 1	-	-	-	-	-	-	188	219	-	324	535	-	
Stage 2	-	-	-	-	-	-	555	397	-	310	291	-	

Approach	EB	WB	NB	SB	
HCM Control Delay, s	4.4	0	0	20.5	
HCM LOS			А	С	

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2	
Capacity (veh/h)	-	881	-	-	687	-	-	112	656	
HCM Lane V/C Ratio	-	0.262	-	-	-	-	-	0.315	0.191	
HCM Control Delay (s)	0	10.5	0.8	-	0	-	-	51.2	11.8	
HCM Lane LOS	А	В	А	-	А	-	-	F	В	
HCM 95th %tile Q(veh)	-	1.1	-	-	0	-	-	1.2	0.7	

0.6

#### Intersection

Int Delay, s/veh

				14/51				NDT		0.51	<b>0DT</b>	000
Movement	FRF	EBT	EBR	WBL	WBI	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4î b			ፋጉ			4			4	
Traffic Vol, veh/h	23	351	0	0	592	30	0	0	0	9	0	18
Future Vol, veh/h	23	351	0	0	592	30	0	0	0	9	0	18
Conflicting Peds, #/hr	1	0	1	1	0	1	12	0	0	0	0	12
Sign Control F	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	ŧ -	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	-3	-	-	3	-	-	0	-	-	-5	-
Peak Hour Factor	93	93	93	93	93	93	93	93	93	93	93	93
Heavy Vehicles, %	0	3	0	0	5	3	0	0	0	0	0	0
Mvmt Flow	25	377	0	0	637	32	0	0	0	10	0	19

Major/Minor	Major1		N	lajor2		N	linor1		Ν	linor2			
Conflicting Flow All	670	0	0	378	0	0	759	1098	190	893	1082	348	
Stage 1	-	-	-	-	-	-	428	428	-	654	654	-	
Stage 2	-	-	-	-	-	-	331	670	-	239	428	-	
Critical Hdwy	4.1	-	-	4.1	-	-	7.5	6.5	6.9	6.5	5.5	6.4	
Critical Hdwy Stg 1	-	-	-	-	-	-	6.5	5.5	-	5.5	4.5	-	
Critical Hdwy Stg 2	-	-	-	-	-	-	6.5	5.5	-	5.5	4.5	-	
Follow-up Hdwy	2.2	-	-	2.2	-	-	3.5	4	3.3	3.5	4	3.3	
Pot Cap-1 Maneuver	930	-	-	1192	-	-	299	215	826	307	296	686	
Stage 1	-	-	-	-	-	-	581	588	-	512	559	-	
Stage 2	-	-	-	-	-	-	662	459	-	800	662	-	
Platoon blocked, %		-	-		-	-							
Mov Cap-1 Maneuver	r 929	-	-	1191	-	-	280	207	825	299	285	678	
Mov Cap-2 Maneuver	r -	-	-	-	-	-	280	207	-	299	285	-	
Stage 1	-	-	-	-	-	-	561	567	-	494	558	-	
Stage 2	-	-	-	-	-	-	636	459	-	773	639	-	

Approach	EB	WB	NB	SB	
HCM Control Delay, s	0.6	0	0	13	
HCM LOS			А	В	

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR \$	SBLn1
Capacity (veh/h)	-	929	-	-	1191	-	-	477
HCM Lane V/C Ratio	-	0.027	-	-	-	-	-	0.061
HCM Control Delay (s)	0	9	0.1	-	0	-	-	13
HCM Lane LOS	A	А	А	-	А	-	-	В
HCM 95th %tile Q(veh)	-	0.1	-	-	0	-	-	0.2

#### Intersection

15						
EBL	EBR	NBL	NBT	SBT	SBR	
٦	1	٦	1	1	1	
188	172	328	618	342	294	
188	172	328	618	342	294	
0	0	0	0	0	0	
Stop	Stop	Free	Free	Free	Free	
-	Stop	-	None	-	Free	
0	0	115	-	-	0	
,# 0	-	-	0	0	-	
-3	-	-	0	0	-	
93	93	93	93	93	93	
5	1	3	1	1	6	
202	185	353	665	368	316	
	15 EBL 188 188 0 Stop - 0 ,# 0 -3 93 5 202	15 EBL EBR 188 172 188 172 188 172 0 0 Stop Stop - Stop 0 0 ,# 0 - -3 - 93 93 5 1 202 185	15           EBL         EBR         NBL           1         1         1         1           188         172         328           188         172         328           0         0         0           Stop         Stop         Free           Stop         O         115           #         0         -         -           93         93         93         93           5         1         3         202         185         353	15         EBL         EBR         NBL         NBT           ↑         ↑         ↑         ↑           188         172         328         618           188         172         328         618           188         172         328         618           0         0         0         0           Stop         Stop         Free         Free           -         Stop         -         None           0         0         115         -           ,# 0         -         -         0           ,3         -         -         0           93         93         93         93           5         1         3         1           202         185         353         665	15         NBL         NBT         SBT           EBL         EBR         NBL         NBT         SBT           Image: Image	15           EBL         EBR         NBL         NBT         SBT         SBR           Image: Image of the system           188         172         328         618         342         294           188         172         328         618         342         294           0         0         0         0         0         0           Stop         Stop         Free         Free         Free         Free           Stop         Stop         Free         Free         Free         Free           0         0         115         -         -         0           stop         -         -         0         0         -           stop         -         -         0         0

Major/Minor	Minor2		Major1	Majo	or2		
Conflicting Flow All	1739	368	368	0	-	0	
Stage 1	368	-	-	-	-	-	
Stage 2	1371	-	-	-	-	-	
Critical Hdwy	5.85	5.91	4.13	-	-	-	
Critical Hdwy Stg 1	4.85	-	-	-	-	-	
Critical Hdwy Stg 2	4.85	-	-	-	-	-	
Follow-up Hdwy	3.545	3.309	2.227	-	-	-	
Pot Cap-1 Maneuver	~ 126	701	1185	-	-	0	
Stage 1	737	-	-	-	-	0	
Stage 2	292	-	-	-	-	0	
Platoon blocked, %				-	-		
Mov Cap-1 Maneuver	~ 88	701	1185	-	-	-	
Mov Cap-2 Maneuver	207	-	-	-	-	-	
Stage 1	517	-	-	-	-	-	
Stage 2	292	-	-	-	-	-	

Approach	EB	NB	SB	
HCM Control Delay, s	60.4	3.2	0	
HCM LOS	F			

Minor Lane/Major Mvmt	NBL	NBT EBLn1	EBLn2	SBT
Capacity (veh/h)	1185	- 207	701	-
HCM Lane V/C Ratio	0.298	- 0.977	0.264	-
HCM Control Delay (s)	9.3	- 104.7	12	-
HCM Lane LOS	А	- F	В	-
HCM 95th %tile Q(veh)	1.3	- 8.4	1.1	-
Notes				

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

Intersection						
Int Delay, s/veh	0.3					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			<del>स</del> ्	4	
Traffic Vol, veh/h	8	3	4	938	498	16
Future Vol, veh/h	8	3	4	938	498	16
Conflicting Peds, #/hr	0	0	13	0	0	13
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage,	# 0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	89	89	89	89	89	89
Heavy Vehicles, %	12	0	0	2	1	6
Mvmt Flow	9	3	4	1054	560	18

Major/Minor	Minor2	Ν	lajor1	Maj	or2		
Conflicting Flow All	1644	582	591	0	-	0	
Stage 1	582	-	-	-	-	-	
Stage 2	1062	-	-	-	-	-	
Critical Hdwy	6.52	6.2	4.1	-	-	-	
Critical Hdwy Stg 1	5.52	-	-	-	-	-	
Critical Hdwy Stg 2	5.52	-	-	-	-	-	
Follow-up Hdwy	3.608	3.3	2.2	-	-	-	
Pot Cap-1 Maneuver	104	517	995	-	-	-	
Stage 1	540	-	-	-	-	-	
Stage 2	318	-	-	-	-	-	
Platoon blocked, %				-	-	-	
Mov Cap-1 Maneuver	100	511	983	-	-	-	
Mov Cap-2 Maneuver	100	-	-	-	-	-	
Stage 1	528	-	-	-	-	-	
Stage 2	314	-	-	-	-	-	

Approach	EB	NB	SB
HCM Control Delay, s	36.1	0	0
HCM LOS	Е		

Minor Lane/Major Mvmt	NBL	NBT EBLn1	SBT	SBR
Capacity (veh/h)	983	- 128	-	-
HCM Lane V/C Ratio	0.005	- 0.097	-	-
HCM Control Delay (s)	8.7	0 36.1	-	-
HCM Lane LOS	А	A E	-	-
HCM 95th %tile Q(veh)	0	- 0.3	-	-

0.7

### Intersection

Int Delay, s/veh

Movement         EBL         EBT         EBR         WBL         WBT         WBR         NBL         NBT         NBR         SBL         SBT         SBR           Lane Configurations
Lane Configurations         Image: Configuration of the state of
Traffic Vol, veh/h         46         552         0         0         231         7         0         0         0         0         29           Future Vol, veh/h         46         552         0         0         231         7         0         0         0         0         29           Conflicting Peds, #/hr         1         0         0         0         1         0
Future Vol, veh/h         46         552         0         0         231         7         0         0         0         0         29           Conflicting Peds, #/hr         1         0         0         0         1         0
Conflicting Peds, #/hr100010000Sign ControlFreeFreeFreeFreeFreeStopStopStopStop
Sign Control Free Free Free Free Free Free Stop Stop Stop Stop Stop
RT Channelized None None None
Storage Length
Veh in Median Storage, # - 0 0 0 0 -
Grade, % - 0 0 55 -
Peak Hour Factor 94 94 94 94 94 94 94 94 94 94 94 94 94
Heavy Vehicles, % 9 3 0 0 2 0 0 0 0 0 7
Mvmt Flow 49 587 0 0 246 7 0 0 0 0 31

Major/Minor	Major1		Μ	lajor2		N	linor1		Ν	linor2			
Conflicting Flow All	254	0	0	587	0	0	950	939	587	936	936	251	
Stage 1	-	-	-	-	-	-	685	685	-	251	251	-	
Stage 2	-	-	-	-	-	-	265	254	-	685	685	-	
Critical Hdwy	4.19	-	-	4.1	-	-	8.1	7.5	6.7	6.1	5.5	5.77	
Critical Hdwy Stg 1	-	-	-	-	-	-	7.1	6.5	-	5.1	4.5	-	
Critical Hdwy Stg 2	-	-	-	-	-	-	7.1	6.5	-	5.1	4.5	-	
Follow-up Hdwy	2.281	-	-	2.2	-	-	3.5	4	3.3	3.5	4	3.363	
Pot Cap-1 Maneuver	1271	-	-	998	-	-	186	205	473	321	346	803	
Stage 1	-	-	-	-	-	-	365	373	-	812	754	-	
Stage 2	-	-	-	-	-	-	692	653	-	534	546	-	
Platoon blocked, %		-	-		-	-							
Mov Cap-1 Maneuver	1270	-	-	998	-	-	171	193	473	307	326	802	
Mov Cap-2 Maneuver	-	-	-	-	-	-	171	193	-	307	326	-	
Stage 1	-	-	-	-	-	-	344	352	-	765	753	-	
Stage 2	-	-	-	-	-	-	665	652	-	504	515	-	

Approach	EB	WB	NB	SB	
HCM Control Delay, s	0.6	0	0	9.7	
HCM LOS			А	А	

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	
Capacity (veh/h)	-	1270	-	-	998	-	-	802	
HCM Lane V/C Ratio	-	0.039	-	-	-	-	-	0.038	
HCM Control Delay (s)	0	7.9	0	-	0	-	-	9.7	
HCM Lane LOS	A	А	А	-	А	-	-	А	
HCM 95th %tile Q(veh)	-	0.1	-	-	0	-	-	0.1	

06/24/20 <sup>-</sup>	19
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1.4					
EBT	EBR	WBL	WBT	NBL	NBR
ef 👘			<del>با</del>	۰Y	
174	26	3	240	46	7
174	26	3	240	46	7
0	1	1	0	0	0
Free	Free	Free	Free	Stop	Stop
-	None	-	None	-	None
-	-	-	-	0	-
# 0	-	-	0	0	-
-3	-	-	3	3	-
92	92	92	92	92	92
4	8	0	3	9	0
189	28	3	261	50	8
	1.4 EBT 174 174 0 Free - - - - - - - - - - - - - - - - - -	I.4         EBT       EBR         I74       26         174       26         174       26         174       26         I74       26         I75       27         I75       28         I75       28         I75       28         I75       28         I75       <	I.4       EBR       WBL         EBT       EBR       WBL         174       26       3         174       26       3         174       26       3         174       26       3         0       1       1         Free       Free       Free         -       None       -         -       -       -         4       0       -         92       92       92         4       8       0         189       28       3	I.4       WBL       WBT         EBT       EBR       WBL       WBT         174       26       3       240         174       26       3       240         174       26       3       240         174       26       3       240         174       26       3       240         0       1       1       0         Free       Free       Free       Free         None       -       None       -         -       -       -       -         #0       -       0       -         -3       -       -       3         92       92       92       92         4       8       0       3         189       28       3       261	I.4         WBL         WBT         NBL           EBT         EBR         WBL         WBT         NBL           I         I         I         I         IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0 218	0 471	204	
Stage 1	-		- 204	-	
Stage 2	-		- 267	-	
Critical Hdwy	-	- 4.1	- 7.09	6.5	
Critical Hdwy Stg 1	-		- 6.09	-	
Critical Hdwy Stg 2	-		- 6.09	-	
Follow-up Hdwy	-	- 2.2	- 3.581	3.3	
Pot Cap-1 Maneuver	-	- 1364	- 498	828	
Stage 1	-		- 787	-	
Stage 2	-		- 729	-	
Platoon blocked, %	-	-	-		
Mov Cap-1 Maneuver	r -	- 1363	- 496	827	
Mov Cap-2 Maneuver	r -		- 496	-	
Stage 1	-		- 786	-	
Stage 2	-		- 727	-	

Approach	EB	WB	NB
HCM Control Delay, s	0	0.1	12.7
HCM LOS			В

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	524	-	-	1363	-
HCM Lane V/C Ratio	0.11	-	-	0.002	-
HCM Control Delay (s)	12.7	-	-	7.6	0
HCM Lane LOS	В	-	-	А	Α
HCM 95th %tile Q(veh)	0.4	-	-	0	-

#### Intersection

Int Delay, s/veh	2.4						
Movement	EBL	EBR	NBL	NBT	SBT	SBR	
Lane Configurations	۰Y			<del>ب</del> ا	1	1	
Traffic Vol, veh/h	164	17	4	548	221	239	
Future Vol, veh/h	164	17	4	548	221	239	
Conflicting Peds, #/hr	0	0	1	0	0	1	
Sign Control	Stop	Stop	Free	Free	Free	Free	
RT Channelized	-	None	-	None	-	None	
Storage Length	0	-	-	-	-	0	
Veh in Median Storage	,# 0	-	-	0	0	-	
Grade, %	-5	-	-	0	0	-	
Peak Hour Factor	92	92	92	92	92	92	
Heavy Vehicles, %	3	0	0	3	2	2	
Mvmt Flow	178	18	4	596	240	260	

Major/Minor	Minor2	ľ	Major1	Majo	or2				
Conflicting Flow All	845	241	501	0	-	0			
Stage 1	241	-	-	-	-	-			
Stage 2	604	-	-	-	-	-			
Critical Hdwy	5.43	5.7	4.1	-	-	-			
Critical Hdwy Stg 1	4.43	-	-	-	-	-			
Critical Hdwy Stg 2	4.43	-	-	-	-	-			
Follow-up Hdwy	3.527	3.3	2.2	-	-	-			
Pot Cap-1 Maneuver	420	830	1074	-	-	-			
Stage 1	852	-	-	-	-	-			
Stage 2	643	-	-	-	-	-			
Platoon blocked, %				-	-	-			
Mov Cap-1 Maneuver	417	829	1073	-	-	-			
Mov Cap-2 Maneuver	515	-	-	-	-	-			
Stage 1	846	-	-	-	-	-			
Stage 2	642	-	-	-	-	-			

Approach	EB	NB	SB
HCM Control Delay, s	15.6	0.1	0
HCM LOS	С		

Minor Lane/Major Mvmt	NBL	NBT EBLn1	SBT	SBR
Capacity (veh/h)	1073	- 534	-	-
HCM Lane V/C Ratio	0.004	- 0.368	-	-
HCM Control Delay (s)	8.4	0 15.6	-	-
HCM Lane LOS	А	A C	-	-
HCM 95th %tile Q(veh)	0	- 1.7	-	-
3.9

## Intersection

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		ፋጉ			ፋጉ			<b>.</b>			<del>स</del> ी	1
Traffic Vol, veh/h	68	644	0	0	359	33	0	0	0	92	0	101
Future Vol, veh/h	68	644	0	0	359	33	0	0	0	92	0	101
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	Stop
Storage Length	-	-	-	-	-	-	-	-	-	-	-	75
Veh in Median Storage,	# -	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	3	-	-	3	-	-	-3	-
Peak Hour Factor	87	87	87	87	87	87	87	87	87	87	87	87
Heavy Vehicles, %	0	3	2	0	3	0	0	0	0	2	0	6
M∨mt Flow	78	740	0	0	413	38	0	0	0	106	0	116

Major/Minor	Major1		Μ	ajor2		N	/linor1		Ν	/linor2			
Conflicting Flow All	451	0	0	740	0	0	1103	1347	370	958	1328	226	
Stage 1	-	-	-	-	-	-	896	896	-	432	432	-	
Stage 2	-	-	-	-	-	-	207	451	-	526	896	-	
Critical Hdwy	4.1	-	-	4.1	-	-	8.1	7.1	7.2	6.94	5.9	6.72	
Critical Hdwy Stg 1	-	-	-	-	-	-	7.1	6.1	-	5.94	4.9	-	
Critical Hdwy Stg 2	-	-	-	-	-	-	7.1	6.1	-	5.94	4.9	-	
Follow-up Hdwy	2.2	-	-	2.2	-	-	3.5	4	3.3	3.52	4	3.36	
Pot Cap-1 Maneuver	1120	-	-	876	-	-	140	122	614	249	195	779	
Stage 1	-	-	-	-	-	-	263	311	-	615	629	-	
Stage 2	-	-	-	-	-	-	755	533	-	549	420	-	
Platoon blocked, %		-	-		-	-							
Mov Cap-1 Maneuver	1120	-	-	876	-	-	108	108	614	227	172	779	
Mov Cap-2 Maneuver	-	-	-	-	-	-	108	108	-	227	172	-	
Stage 1	-	-	-	-	-	-	232	274	-	542	629	-	
Stage 2	-	-	-	-	-	-	642	533	-	484	370	-	

Approach	EB	WB	NB	SB	
HCM Control Delay, s	1.2	0	0	21.6	
HCM LOS			А	С	

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2	
Capacity (veh/h)	-	1120	-	-	876	-	-	227	779	
HCM Lane V/C Ratio	-	0.07	-	-	-	-	-	0.466	0.149	
HCM Control Delay (s)	0	8.5	0.4	-	0	-	-	34	10.4	
HCM Lane LOS	А	А	А	-	А	-	-	D	В	
HCM 95th %tile Q(veh)	-	0.2	-	-	0	-	-	2.3	0.5	

1.4

## Intersection

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4 î þ			ፋት			4			4	
Traffic Vol, veh/h	2	734	0	0	382	11	0	0	0	82	0	10
Future Vol, veh/h	2	734	0	0	382	11	0	0	0	82	0	10
Conflicting Peds, #/hr	0	0	0	0	0	0	16	0	0	0	0	16
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	<b>4</b> -	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	-3	-	-	3	-	-	0	-	-	-5	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	0	3	0	0	1	0	0	0	0	6	0	0
Mvmt Flow	2	773	0	0	402	12	0	0	0	86	0	11

Major/Minor	Major1		N	lajor2		Ν	1inor1		Ν	/linor2			
Conflicting Flow All	414	0	0	773	0	0	994	1191	387	799	1185	223	
Stage 1	-	-	-	-	-	-	777	777	-	408	408	-	
Stage 2	-	-	-	-	-	-	217	414	-	391	777	-	
Critical Hdwy	4.1	-	-	4.1	-	-	7.5	6.5	6.9	6.62	5.5	6.4	
Critical Hdwy Stg 1	-	-	-	-	-	-	6.5	5.5	-	5.62	4.5	-	
Critical Hdwy Stg 2	-	-	-	-	-	-	6.5	5.5	-	5.62	4.5	-	
Follow-up Hdwy	2.2	-	-	2.2	-	-	3.5	4	3.3	3.56	4	3.3	
Pot Cap-1 Maneuver	1156	-	-	851	-	-	202	189	617	337	265	811	
Stage 1	-	-	-	-	-	-	360	410	-	650	672	-	
Stage 2	-	-	-	-	-	-	771	597	-	662	509	-	
Platoon blocked, %		-	-		-	-							
Mov Cap-1 Maneuver	1156	-	-	851	-	-	196	188	617	336	264	799	
Mov Cap-2 Maneuver	-	-	-	-	-	-	196	188	-	336	264	-	
Stage 1	-	-	-	-	-	-	359	409	-	648	672	-	
Stage 2	-	-	-	-	-	-	749	597	-	660	507	-	

Approach	EB	WB	NB	SB	
HCM Control Delay, s	0	0	0	18.7	
HCM LOS			А	С	

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR S	SBLn1
Capacity (veh/h)	-	1156	-	-	851	-	-	359
HCM Lane V/C Ratio	-	0.002	-	-	-	-	-	0.27
HCM Control Delay (s)	0	8.1	0	-	0	-	-	18.7
HCM Lane LOS	А	Α	А	-	А	-	-	С
HCM 95th %tile Q(veh)	-	0	-	-	0	-	-	1.1

Int Delay, s/veh	29.8						
Movement	EBL	EBR	NBL	NBT	SBT	SBR	
Lane Configurations	۲.	1	۳	1	•	1	
Traffic Vol, veh/h	309	507	197	421	491	196	
Future Vol, veh/h	309	507	197	421	491	196	
Conflicting Peds, #/hr	0	0	0	0	0	0	
Sign Control	Stop	Stop	Free	Free	Free	Free	
RT Channelized	-	Stop	-	None	-	Free	
Storage Length	0	0	115	-	-	0	
Veh in Median Storage,	# 0	-	-	0	0	-	
Grade, %	-3	-	-	0	0	-	
Peak Hour Factor	96	96	96	96	96	96	
Heavy Vehicles, %	4	3	2	1	1	3	
Mvmt Flow	322	528	205	439	511	204	

Major/Minor	Minor2		Major1	Maj	or2		
Conflicting Flow All	1360	511	511	0	-	0	
Stage 1	511	-	-	-	-	-	
Stage 2	849	-	-	-	-	-	
Critical Hdwy	5.84	5.93	4.12	-	-	-	
Critical Hdwy Stg 1	4.84	-	-	-	-	-	
Critical Hdwy Stg 2	4.84	-	-	-	-	-	
Follow-up Hdwy	3.536	3.327	2.218	-	-	-	
Pot Cap-1 Maneuver	~ 203	585	1054	-	-	0	
Stage 1	651	-	-	-	-	0	
Stage 2	479	-	-	-	-	0	
Platoon blocked, %				-	-		
Mov Cap-1 Maneuver	~ 164	585	1054	-	-	-	
Mov Cap-2 Maneuver	~ 303	-	-	-	-	-	
Stage 1	525	-	-	-	-	-	
Stage 2	479	-	-	-	-	-	

Approach	EB	NB	SB	
HCM Control Delay, s	68	2.9	0	
HCM LOS	F			

Minor Lane/Major Mvmt	NBL	NBT EBLn1	EBLn2	SBT	
Capacity (veh/h)	1054	- 303	585	-	
HCM Lane V/C Ratio	0.195	- 1.062	0.903	-	
HCM Control Delay (s)	9.2	- 107.6	43.9	-	
HCM Lane LOS	А	- F	E	-	
HCM 95th %tile Q(veh)	0.7	- 12.2	11	-	
N					
Notes					

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

06/24/2019

Intersection						
Int Delay, s/veh	0.2					
-						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	۰Y			- <del>4</del>	ef 👘	
Traffic Vol, veh/h	8	1	2	610	986	12
Future Vol, veh/h	8	1	2	610	986	12
Conflicting Peds, #/hr	0	0	14	0	0	14
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage	,# 0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles. %	0	0	0	1	2	9
Mymt Flow	8	1	2	622	1006	12

Major/Minor	Minor2	1	Major1	Majo	or2			
Conflicting Flow All	1652	1026	1032	0	-	0		
Stage 1	1026	-	-	-	-	-		
Stage 2	626	-	-	-	-	-		
Critical Hdwy	6.4	6.2	4.1	-	-	-		
Critical Hdwy Stg 1	5.4	-	-	-	-	-		
Critical Hdwy Stg 2	5.4	-	-	-	-	-		
Follow-up Hdwy	3.5	3.3	2.2	-	-	-		
Pot Cap-1 Maneuver	110	288	681	-	-	-		
Stage 1	349	-	-	-	-	-		
Stage 2	537	-	-	-	-	-		
Platoon blocked, %				-	-	-		
Mov Cap-1 Maneuver	r 107	284	672	-	-	-		
Mov Cap-2 Maneuver	r 107	-	-	-	-	-		
Stage 1	343	-	-	-	-	-		
Stage 2	530	-	-	-	-	-		

Approach	EB	NB	SB
HCM Control Delay, s	39	0	0
HCMLOS	F		

Minor Lane/Major Mvmt	NBL	NBT E	BLn1	SBT	SBR
Capacity (veh/h)	672	-	115	-	-
HCM Lane V/C Ratio	0.003	-	0.08	-	-
HCM Control Delay (s)	10.4	0	39	-	-
HCM Lane LOS	В	Α	Е	-	-
HCM 95th %tile Q(veh)	0	-	0.3	-	-

Appendix D Year 2040 No-build Traffic Conditions Worksheets 1

## Intersection

n í	EDI	EDT			MOT		NIDI	NDT	NDD	0.01	ODT	000
Movement	EBL	EBT	EBK	WBL	WBI	WBR	NBL	NBT	NBK	SBL	SBT	SBR
Lane Configurations		4			4			4			4	
Traffic Vol, veh/h	32	285	0	0	364	0	0	0	0	0	0	41
Future Vol, veh/h	32	285	0	0	364	0	0	0	0	0	0	41
Conflicting Peds, #/hr	0	0	1	1	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage,	# -	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	5	-	-	-5	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	11	3	0	0	4	0	0	0	0	0	0	4
Mvmt Flow	35	310	0	0	396	0	0	0	0	0	0	45

Major/Minor	Major1		Ν	/lajor2		N	linor1		Ν	/linor2			
Conflicting Flow All	396	0	0	311	0	0	800	777	311	776	777	396	
Stage 1	-	-	-	-	-	-	381	381	-	396	396	-	
Stage 2	-	-	-	-	-	-	419	396	-	380	381	-	
Critical Hdwy	4.21	-	-	4.1	-	-	8.1	7.5	6.7	6.1	5.5	5.74	
Critical Hdwy Stg 1	-	-	-	-	-	-	7.1	6.5	-	5.1	4.5	-	
Critical Hdwy Stg 2	-	-	-	-	-	-	7.1	6.5	-	5.1	4.5	-	
Follow-up Hdwy	2.299	-	-	2.2	-	-	3.5	4	3.3	3.5	4	3.336	
Pot Cap-1 Maneuver	1115	-	-	1261	-	-	245	266	703	393	410	686	
Stage 1	-	-	-	-	-	-	581	555	-	707	678	-	
Stage 2	-	-	-	-	-	-	548	544	-	718	686	-	
Platoon blocked, %		-	-		-	-							
Mov Cap-1 Maneuver	1115	-	-	1260	-	-	222	256	702	382	394	686	
Mov Cap-2 Maneuver	-	-	-	-	-	-	222	256	-	382	394	-	
Stage 1	-	-	-	-	-	-	558	533	-	680	678	-	
Stage 2	-	-	-	-	-	-	512	544	-	691	659	-	
-													

Approach	EB	WB	NB	SB	
HCM Control Delay, s	0.8	0	0	10.6	
HCM LOS			А	В	

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	
Capacity (veh/h)	-	1115	-	-	1260	-	-	686	
HCM Lane V/C Ratio	-	0.031	-	-	-	-	-	0.065	
HCM Control Delay (s)	0	8.3	0	-	0	-	-	10.6	
HCM Lane LOS	A	А	А	-	А	-	-	В	
HCM 95th %tile Q(veh)	-	0.1	-	-	0	-	-	0.2	

06/27/2	2019
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Intersection						
Int Delay, s/veh	0.8					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	4Î			<del>ب</del> ا ا	۰Y	
Traffic Vol, veh/h	357	41	0	247	32	0
Future Vol, veh/h	357	41	0	247	32	0
Conflicting Peds, #/hr	0	3	3	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage,	# 0	-	-	0	0	-
Grade, %	-3	-	-	3	3	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	4	4	0	5	11	0
Mvmt Flow	406	47	0	281	36	0

Major/Minor	Major1	Ν	lajor2		Minor1		
Conflicting Flow All	0	0	456	0	714	433	
Stage 1	-	-	-	-	433	-	
Stage 2	-	-	-	-	281	-	
Critical Hdwy	-	-	4.1	-	7.11	6.5	
Critical Hdwy Stg 1	-	-	-	-	6.11	-	
Critical Hdwy Stg 2	-	-	-	-	6.11	-	
Follow-up Hdwy	-	-	2.2	-	3.599	3.3	
Pot Cap-1 Maneuver	-	-	1115	-	342	605	
Stage 1	-	-	-	-	591	-	
Stage 2	-	-	-	-	712	-	
Platoon blocked, %	-	-		-			
Mov Cap-1 Maneuve	r -	-	1112	-	341	603	
Mov Cap-2 Maneuve	r -	-	-	-	341	-	
Stage 1	-	-	-	-	589	-	
Stage 2	-	-	-	-	712	-	

Approach	EB	WB	NB
HCM Control Delay, s	0	0	16.8
HCM LOS			С

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	341	-	-	1112	-
HCM Lane V/C Ratio	0.107	-	-	-	-
HCM Control Delay (s)	16.8	-	-	0	-
HCM Lane LOS	С	-	-	А	-
HCM 95th %tile Q(veh)	0.4	-	-	0	-

Movement	EBL	EBR	NBL	NBT	SBT	SBR	
Lane Configurations	Y			<del>ب</del> ا	1	1	
Traffic Vol, veh/h	357	0	0	285	364	247	
Future Vol, veh/h	357	0	0	285	364	247	
Conflicting Peds, #/hr	0	0	3	0	0	3	
Sign Control	Stop	Stop	Free	Free	Free	Free	
RT Channelized	-	None	-	None	-	None	
Storage Length	0	-	-	-	-	0	
Veh in Median Storage,	# 0	-	-	0	0	-	
Grade, %	-5	-	-	0	0	-	
Peak Hour Factor	89	89	89	89	89	89	
Heavy Vehicles, %	4	0	0	3	5	6	
Mvmt Flow	401	0	0	320	409	278	

Major/Minor	Minor2	Ν	1ajor1	Majo	or2		
Conflicting Flow All	732	412	690	0	-	0	
Stage 1	412	-	-	-	-	-	
Stage 2	320	-	-	-	-	-	
Critical Hdwy	5.44	5.7	4.1	-	-	-	
Critical Hdwy Stg 1	4.44	-	-	-	-	-	
Critical Hdwy Stg 2	4.44	-	-	-	-	-	
Follow-up Hdwy	3.536	3.3	2.2	-	-	-	
Pot Cap-1 Maneuver	472	682	914	-	-	-	
Stage 1	745	-	-	-	-	-	
Stage 2	800	-	-	-	-	-	
Platoon blocked, %				-	-	-	
Mov Cap-1 Maneuver	469	680	911	-	-	-	
Mov Cap-2 Maneuver	565	-	-	-	-	-	
Stage 1	743	-	-	-	-	-	
Stage 2	798	-	-	-	-	-	

Approach	EB	NB	SB
HCM Control Delay, s	25.4	0	0
HCMLOS	D		

Minor Lane/Major Mvmt	NBL	NBT E	BLn1	SBT	SBR	
Capacity (veh/h)	911	-	565	-	-	
HCM Lane V/C Ratio	-	-	0.71	-	-	
HCM Control Delay (s)	0	-	25.4	-	-	
HCM Lane LOS	А	-	D	-	-	
HCM 95th %tile Q(veh)	0	-	5.7	-	-	

6

## Intersection

Movement     EBL     EBT     EBR     WBL     WBT     WBR     NBL     NBT     NBR     SBL     SBT     SBR       Lane Configurations     III     III     IIII     IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
Lane Configurations   Image: configuration in the image: configuration
Traffic Vol, veh/h   246   396   0   0   461   134   0   0   0   41   0   150     Future Vol, veh/h   246   396   0   0   461   134   0   0   0   41   0   150     Conflicting Peds, #/hr   2   0   0   0   2   0   <
Future Vol, veh/h   246   396   0   0   461   134   0   0   0   41   0   150     Conflicting Peds, #/hr   2   0   0   0   0   2   0
Conflicting Peds, #/hr     2     0     0     0     2     0
Sign ControlFreeFreeFreeFreeFreeStopStopStopStopStopStopRT ChannelizedNoneNoneStopStorage LengthStopVeh in Median Storage, #0000Crade %0000-
RT Channelized   -   -   None   -   -   None   -   -   Stop     Storage Length   -   -   -   -   -   -   -   75     Veh in Median Storage, #   0   -   0   -   0   -   0   -     Grade %   0   -   3   3   3   3   3
Storage Length     -     -     -     -     -     -     -     75       Veh in Median Storage, #     0     -
Veh in Median Storage, # - 0 -
Peak Hour Factor     88
Heavy Vehicles, % 4 3 0 100 4 3 0 0 0 3 0 5
Mvmt Flow 280 450 0 0 524 152 0 0 0 47 0 170

Major/Minor	Major1		Μ	lajor2		N	Minor1		ľ	/linor2			
Conflicting Flow All	678	0	0	450	0	0	1272	1688	225	1387	1612	340	
Stage 1	-	-	-	-	-	-	1010	1010	-	602	602	-	
Stage 2	-	-	-	-	-	-	262	678	-	785	1010	-	
Critical Hdwy	4.18	-	-	6.1	-	-	8.1	7.1	7.2	6.96	5.9	6.7	
Critical Hdwy Stg 1	-	-	-	-	-	-	7.1	6.1	-	5.96	4.9	-	
Critical Hdwy Stg 2	-	-	-	-	-	-	7.1	6.1	-	5.96	4.9	-	
Follow-up Hdwy	2.24	-	-	3.2	-	-	3.5	4	3.3	3.53	4	3.35	
Pot Cap-1 Maneuver	897	-	-	637	-	-	102	71	770	128	138	666	
Stage 1	-	-	-	-	-	-	220	270	-	498	544	-	
Stage 2	-	-	-	-	-	-	695	406	-	399	379	-	
Platoon blocked, %		-	-		-	-							
Mov Cap-1 Maneuver	r 895	-	-	637	-	-	51	41	770	86	80	665	
Mov Cap-2 Maneuver	r -	-	-	-	-	-	51	41	-	86	80	-	
Stage 1	-	-	-	-	-	-	128	157	-	290	543	-	
Stage 2	-	-	-	-	-	-	517	405	-	233	221	-	

Approach	EB	WB	NB	SB	
HCM Control Delay, s	4.8	0	0	28.6	
HCM LOS			А	D	

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2	
Capacity (veh/h)	-	895	-	-	637	-	-	86	665	
HCM Lane V/C Ratio	-	0.312	-	-	-	-	-	0.542	0.256	
HCM Control Delay (s)	0	10.8	1	-	0	-	-	88.1	12.3	
HCM Lane LOS	А	В	А	-	А	-	-	F	В	
HCM 95th %tile Q(veh)	-	1.3	-	-	0	-	-	2.4	1	

0.5

## Intersection

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4 î b			4 þ			4			\$	
Traffic Vol, veh/h	23	428	0	0	565	30	0	0	0	9	0	18
Future Vol, veh/h	23	428	0	0	565	30	0	0	0	9	0	18
Conflicting Peds, #/hr	1	0	1	1	0	1	12	0	0	0	0	12
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage,	# -	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	-3	-	-	3	-	-	0	-	-	-5	-
Peak Hour Factor	93	93	93	93	93	93	93	93	93	93	93	93
Heavy Vehicles, %	0	3	0	0	5	3	0	0	0	0	0	0
M∨mt Flow	25	460	0	0	608	32	0	0	0	10	0	19

Major/Minor	Major1		Ν	/lajor2		Ν	1inor1		Ν	/linor2			
Conflicting Flow All	641	0	0	461	0	0	827	1152	231	905	1136	333	
Stage 1	-	-	-	-	-	-	511	511	-	625	625	-	
Stage 2	-	-	-	-	-	-	316	641	-	280	511	-	
Critical Hdwy	4.1	-	-	4.1	-	-	7.5	6.5	6.9	6.5	5.5	6.4	
Critical Hdwy Stg 1	-	-	-	-	-	-	6.5	5.5	-	5.5	4.5	-	
Critical Hdwy Stg 2	-	-	-	-	-	-	6.5	5.5	-	5.5	4.5	-	
Follow-up Hdwy	2.2	-	-	2.2	-	-	3.5	4	3.3	3.5	4	3.3	
Pot Cap-1 Maneuver	953	-	-	1111	-	-	267	199	777	302	279	700	
Stage 1	-	-	-	-	-	-	519	540	-	528	572	-	
Stage 2	-	-	-	-	-	-	675	473	-	766	623	-	
Platoon blocked, %		-	-		-	-							
Mov Cap-1 Maneuver	952	-	-	1110	-	-	249	192	776	294	269	691	
Mov Cap-2 Maneuver	· _	-	-	-	-	-	249	192	-	294	269	-	
Stage 1	-	-	-	-	-	-	500	521	-	509	571	-	
Stage 2	-	-	-	-	-	-	649	473	-	739	601	-	

Approach	EB	WB	NB	SB	
HCM Control Delay, s	0.5	0	0	13	
HCM LOS			А	В	

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	-	952	-	-	1110	-	-	477
HCM Lane V/C Ratio	-	0.026	-	-	-	-	-	0.061
HCM Control Delay (s)	0	8.9	0.1	-	0	-	-	13
HCM Lane LOS	A	А	А	-	А	-	-	В
HCM 95th %tile Q(veh)	-	0.1	-	-	0	-	-	0.2

Int Delay, s/veh 18.2 EBL Movement EBR NBL NBT SBT SBR Lane Configurations ٦ 7 ٦ Ŧ ŧ 7 Traffic Vol, veh/h 168 269 351 736 523 244 Future Vol, veh/h 168 269 351 736 523 244 Conflicting Peds, #/hr 0 0 0 0 0 0 Sign Control Stop Stop Free Free Free Free RT Channelized Stop -None -Free -Storage Length 0 115 0 0 --Veh in Median Storage, # 0 0 0 ---Grade, % 0 0 -3 ---Peak Hour Factor 93 93 93 93 93 93 5 Heavy Vehicles, % 1 3 1 1 6 Mvmt Flow 181 289 377 791 562 262

Major/Minor	Minor2		Major1	Major2		
Conflicting Flow All	2107	562	562	0 -	0	
Stage 1	562	-	-		-	
Stage 2	1545	-	-		-	
Critical Hdwy	5.85	5.91	4.13		-	
Critical Hdwy Stg 1	4.85	-	-		-	
Critical Hdwy Stg 2	4.85	-	-		-	
Follow-up Hdwy	3.545	3.309	2.227		-	
Pot Cap-1 Maneuver	~ 79	554	1004		0	
Stage 1	620	-	-		0	
Stage 2	247	-	-		0	
Platoon blocked, %						
Mov Cap-1 Maneuver	~ 49	554	1004		-	
Mov Cap-2 Maneuver	~ 159	-	-		-	
Stage 1	388	-	-		-	
Stage 2	247	-	-		-	
Approach	FB		NB	SB		
HCM Control Delay	76.7		3.5	0		
HCM LOS	70.7 F		0.0	0		
	1					
Minor Lane/Major Mvr	nt	NBL	NBT	EBLn1 EBLn2	SBT	
Canacity (yeh/h)		1004	_	150 554	_	

Capacity (veh/h)	1004	-	159	554	-			
HCM Lane V/C Ratio	0.376	-	1.136	0.522	-			
HCM Control Delay (s)	10.7	-	170.1	18.4	-			
HCM Lane LOS	В	-	F	С	-			
HCM 95th %tile Q(veh)	1.8	-	9.7	3	-			
Notes								
~: Volumo oxoooda oonooity	¢. Dolo		ode 31	100 +	· Comput	ation Not Dofined	*: All major volumo in platoon	

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

Intersection						
Int Delay, s/veh	0.4					
-						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	۰Y			4	4	
Traffic Vol, veh/h	8	3	4	1079	776	16
Future Vol, veh/h	8	3	4	1079	776	16
Conflicting Peds, #/hr	0	0	13	0	0	13
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage,	# 0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	89	89	89	89	89	89
Heavy Vehicles, %	12	0	0	2	1	6
Mymt Flow	9	3	4	1212	872	18
						-

Major/Minor	Minor2	N	1ajor1	Majo	or2			
Conflicting Flow All	2114	894	903	0	-	0		
Stage 1	894	-	-	-	-	-		
Stage 2	1220	-	-	-	-	-		
Critical Hdwy	6.52	6.2	4.1	-	-	-		
Critical Hdwy Stg 1	5.52	-	-	-	-	-		
Critical Hdwy Stg 2	5.52	-	-	-	-	-		
Follow-up Hdwy	3.608	3.3	2.2	-	-	-		
Pot Cap-1 Maneuver	52	343	761	-	-	-		
Stage 1	384	-	-	-	-	-		
Stage 2	266	-	-	-	-	-		
Platoon blocked, %				-	-	-		
Mov Cap-1 Maneuver	50	339	752	-	-	-		
Mov Cap-2 Maneuver	50	-	-	-	-	-		
Stage 1	373	-	-	-	-	-		
Stage 2	263	-	-	-	-	-		

Approach	EB	NB	SB
HCM Control Delay, s	73	0	0
HCMLOS	F		

Minor Lane/Major Mvmt	NBL	NBT E	BLn1	SBT	SBR
Capacity (veh/h)	752	-	65	-	-
HCM Lane V/C Ratio	0.006	-	0.19	-	-
HCM Control Delay (s)	9.8	0	73	-	-
HCM Lane LOS	А	А	F	-	-
HCM 95th %tile Q(veh)	0	-	0.6	-	-

0.7

## Intersection

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		<b>.</b>			<b>.</b>			4			4	
Traffic Vol, veh/h	23	491	0	0	210	8	0	0	0	0	0	35
Future Vol, veh/h	23	491	0	0	210	8	0	0	0	0	0	35
Conflicting Peds, #/hr	1	0	0	0	0	1	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage	, # -	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	5	-	-	-5	-
Peak Hour Factor	94	94	94	94	94	94	94	94	94	94	94	94
Heavy Vehicles, %	9	3	0	0	2	0	0	0	0	0	0	7
Mvmt Flow	24	522	0	0	223	9	0	0	0	0	0	37

Major/Minor	Major1		Ν	lajor2		N	linor1		Ν	1inor2			
Conflicting Flow All	233	0	0	522	0	0	816	803	522	799	799	229	
Stage 1	-	-	-	-	-	-	570	570	-	229	229	-	
Stage 2	-	-	-	-	-	-	246	233	-	570	570	-	
Critical Hdwy	4.19	-	-	4.1	-	-	8.1	7.5	6.7	6.1	5.5	5.77	
Critical Hdwy Stg 1	-	-	-	-	-	-	7.1	6.5	-	5.1	4.5	-	
Critical Hdwy Stg 2	-	-	-	-	-	-	7.1	6.5	-	5.1	4.5	-	
Follow-up Hdwy	2.281	-	-	2.2	-	-	3.5	4	3.3	3.5	4	3.363	
Pot Cap-1 Maneuver	1294	-	-	1055	-	-	238	255	520	382	401	824	
Stage 1	-	-	-	-	-	-	435	434	-	829	766	-	
Stage 2	-	-	-	-	-	-	712	671	-	597	596	-	
Platoon blocked, %		-	-		-	-							
Mov Cap-1 Maneuver	1293	-	-	1055	-	-	223	248	520	374	390	823	
Mov Cap-2 Maneuver	-	-	-	-	-	-	223	248	-	374	390	-	
Stage 1	-	-	-	-	-	-	424	423	-	807	765	-	
Stage 2	-	-	-	-	-	-	680	670	-	581	581	-	

Approach	EB	WB	NB	SB	
HCM Control Delay, s	0.4	0	0	9.6	
HCM LOS			А	А	

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR S	SBLn1
Capacity (veh/h)	-	1293	-	-	1055	-	-	823
HCM Lane V/C Ratio	-	0.019	-	-	-	-	-	0.045
HCM Control Delay (s)	0	7.8	0	-	0	-	-	9.6
HCM Lane LOS	A	А	А	-	А	-	-	Α
HCM 95th %tile Q(veh)	-	0.1	-	-	0	-	-	0.1

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0.7					
EBT	EBR	WBL	WBT	NBL	NBR
ef 👘			4	Y	
172	35	0	399	31	0
172	35	0	399	31	0
0	1	1	0	0	0
Free	Free	Free	Free	Stop	Stop
-	None	-	None	-	None
-	-	-	-	0	-
# 0	-	-	0	0	-
-3	-	-	3	3	-
92	92	92	92	92	92
4	8	0	3	9	0
187	38	0	434	34	0
	0.7 EBT 172 172 0 Free - - 4 0 -3 92 4 187	0.7 EBT EBR 172 355 172 355 172 355 0 1 Free Free - None  # 0 - -3 - 92 92 4 8 187 38	0.7 EBT EBR WBL 172 35 0 172 35 0	0.7     EBR     WBL     WBT       ▶      4       172     35     0     399       172     35     0     399       172     35     0     399       172     35     0     399       0     1     1     0       Free     Free     Free     Free       None     -     None       -     -     -     -       # 0     -     -     3       92     92     92     92       4     8     0     3       187     38     0     434	0.7     EBT     EBR     WBL     WBT     NBL       172     35     0     399     31       172     35     0     399     31       172     35     0     399     31       172     35     0     399     31       172     35     0     399     31       0     1     1     0     0       Free     Free     Free     Free     Stop       -     None     -     None     -       -     -     0     0     -       4     0     -     3     3       92     92     92     92     92     92       4     8     0     3     9       187     38     0     434     34

Major/Minor	Major1	Ν	lajor2		Minor1		
Conflicting Flow All	0	0	226	0	641	207	
Stage 1	-	-	-	-	207	-	
Stage 2	-	-	-	-	434	-	
Critical Hdwy	-	-	4.1	-	7.09	6.5	
Critical Hdwy Stg 1	-	-	-	-	6.09	-	
Critical Hdwy Stg 2	-	-	-	-	6.09	-	
Follow-up Hdwy	-	-	2.2	-	3.581	3.3	
Pot Cap-1 Maneuver	-	-	1354	-	385	824	
Stage 1	-	-	-	-	784	-	
Stage 2	-	-	-	-	594	-	
Platoon blocked, %	-	-		-			
Mov Cap-1 Maneuve	r -	-	1353	-	385	823	
Mov Cap-2 Maneuve	r -	-	-	-	385	-	
Stage 1	-	-	-	-	783	-	
Stage 2	-	-	-	-	594	-	

Approach	EB	WB	NB
HCM Control Delay, s	0	0	15.2
HCM LOS			С

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	385	-	-	1353	-	
HCM Lane V/C Ratio	0.088	-	-	-	-	
HCM Control Delay (s)	15.2	-	-	0	-	
HCM Lane LOS	С	-	-	А	-	
HCM 95th %tile Q(veh)	0.3	-	-	0	-	

2						
EBL	EBR	NBL	NBT	SBT	SBR	
Υ.			<del>ب</del> ا	•	1	
161	11	4	487	207	395	
161	11	4	487	207	395	
0	0	1	0	0	1	
Stop	Stop	Free	Free	Free	Free	
-	None	-	None	-	None	
0	-	-	-	-	0	
e, # 0	-	-	0	0	-	
-5	-	-	0	0	-	
92	92	92	92	92	92	
3	0	0	3	2	2	
175	12	4	529	225	429	
	2 EBL 161 161 0 Stop - 0 2, # 0 -5 92 3 175	2 EBL EBR ✓ 161 11 161 11 161 11 0 0 Stop Stop - None 0 x, # 0 y, # 0 92 92 3 0 175 12	2 EBL EBR NBL 161 11 4 161 11 4 161 11 4 0 0 1 Stop Stop Free None - None - 0 - 5 - 92 92 92 3 0 0 175 12 4	EBL     EBR     NBL     NBT       M     161     11     4     487       161     11     4     487       161     11     4     487       0     0     1     0       Stop     Stop     Free     Free       None     -     None     -       0     -     -     0       0     -     -     0       0     -     -     0       0     -     -     0       0     -     -     0       0     -     -     0       -5     -     -     0       92     92     92     92       3     0     0     3       175     12     4     529	2   EBL EBR NBL NBT SBT   Y - - -   161 11 4 487 207   161 11 4 487 207   161 11 4 487 207   0 0 1 0 0   Stop Stop Free Free Free   - None - None -   0 - - 0 0   5 - - 0 0   92 92 92 92 92   3 0 0 3 2   175 12 4 529 225	2   EBL EBR NBL NBT SBT SBR   M - - - - -   161 11 4 487 207 395   161 11 4 487 207 395   0 0 1 0 0 1   Stop Stop Free Free Free Free   None - None - None   0 - - 0 0   x# 0 - - 0   92 92 92 92 92   3 0 0 3 2 2   175 12 4 529 225 429

Major/Minor	Minor2	N	/lajor1	Majo	or2				
Conflicting Flow All	763	226	655	0	-	0			
Stage 1	226	-	-	-	-	-			
Stage 2	537	-	-	-	-	-			
Critical Hdwy	5.43	5.7	4.1	-	-	-			
Critical Hdwy Stg 1	4.43	-	-	-	-	-			
Critical Hdwy Stg 2	4.43	-	-	-	-	-			
Follow-up Hdwy	3.527	3.3	2.2	-	-	-			
Pot Cap-1 Maneuver	459	844	942	-	-	-			
Stage 1	862	-	-	-	-	-			
Stage 2	678	-	-	-	-	-			
Platoon blocked, %				-	-	-			
Mov Cap-1 Maneuver	455	843	941	-	-	-			
Mov Cap-2 Maneuver	546	-	-	-	-	-			
Stage 1	856	-	-	-	-	-			
Stage 2	677	-	-	-	-	-			

Approach	EB	NB	SB
HCM Control Delay, s	14.6	0.1	0
HCMLOS	В		

Minor Lane/Major Mvmt	NBL	NBT EBLn1	SBT	SBR
Capacity (veh/h)	941	- 559	-	-
HCM Lane V/C Ratio	0.005	- 0.334	-	-
HCM Control Delay (s)	8.8	0 14.6	-	-
HCM Lane LOS	А	A B	-	-
HCM 95th %tile Q(veh)	0	- 1.5	-	-

7.7

## Intersection

Movement E	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4 î <del>)</del>			4 þ			4			4	1
Traffic Vol, veh/h	86	562	0	0	455	59	0	0	0	120	0	147
Future Vol, veh/h	86	562	0	0	455	59	0	0	0	120	0	147
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control F	ree	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	Stop
Storage Length	-	-	-	-	-	-	-	-	-	-	-	75
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	3	-	-	3	-	-	-3	-
Peak Hour Factor	87	87	87	87	87	87	87	87	87	87	87	87
Heavy Vehicles, %	0	3	2	0	3	0	0	0	0	2	0	6
Mvmt Flow	99	646	0	0	523	68	0	0	0	138	0	169

Major/Minor	Major1		Μ	lajor2		N	Minor1		ľ	Minor2			
Conflicting Flow All	591	0	0	646	0	0	1106	1435	323	1078	1401	296	
Stage 1	-	-	-	-	-	-	844	844	-	557	557	-	
Stage 2	-	-	-	-	-	-	262	591	-	521	844	-	
Critical Hdwy	4.1	-	-	4.1	-	-	8.1	7.1	7.2	6.94	5.9	6.72	
Critical Hdwy Stg 1	-	-	-	-	-	-	7.1	6.1	-	5.94	4.9	-	
Critical Hdwy Stg 2	-	-	-	-	-	-	7.1	6.1	-	5.94	4.9	-	
Follow-up Hdwy	2.2	-	-	2.2	-	-	3.5	4	3.3	3.52	4	3.36	
Pot Cap-1 Maneuver	995	-	-	949	-	-	139	106	661	207	179	706	
Stage 1	-	-	-	-	-	-	285	332	-	529	566	-	
Stage 2	-	-	-	-	-	-	695	451	-	553	440	-	
Platoon blocked, %		-	-		-	-							
Mov Cap-1 Maneuver	995	-	-	949	-	-	93	90	661	182	151	706	
Mov Cap-2 Maneuver	· _	-	-	-	-	-	93	90	-	182	151	-	
Stage 1	-	-	-	-	-	-	241	281	-	447	566	-	
Stage 2	-	-	-	-	-	-	529	451	-	467	372	-	

Approach	EB	WB	NB	SB	
HCM Control Delay, s	1.6	0	0	37.4	
HCM LOS			А	E	

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2	
Capacity (veh/h)	-	995	-	-	949	-	-	182	706	
HCM Lane V/C Ratio	-	0.099	-	-	-	-	-	0.758	0.239	
HCM Control Delay (s)	0	9	0.5	-	0	-	-	68.9	11.7	
HCM Lane LOS	А	А	А	-	А	-	-	F	В	
HCM 95th %tile Q(veh)	-	0.3	-	-	0	-	-	4.9	0.9	

1.5

## Intersection

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4 î þ			4 î <del>)</del>			4			4	
Traffic Vol, veh/h	2	607	0	0	491	11	0	0	0	82	0	10
Future Vol, veh/h	2	607	0	0	491	11	0	0	0	82	0	10
Conflicting Peds, #/hr	0	0	0	0	0	0	16	0	0	0	0	16
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	4 -	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	-3	-	-	3	-	-	0	-	-	-5	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	0	3	0	0	1	0	0	0	0	6	0	0
Mvmt Flow	2	639	0	0	517	12	0	0	0	86	0	11

Major/Minor	Major1		N	lajor2		N	1inor1		Ν	/linor2			
Conflicting Flow All	529	0	0	639	0	0	918	1172	320	847	1166	281	
Stage 1	-	-	-	-	-	-	643	643	-	523	523	-	
Stage 2	-	-	-	-	-	-	275	529	-	324	643	-	
Critical Hdwy	4.1	-	-	4.1	-	-	7.5	6.5	6.9	6.62	5.5	6.4	
Critical Hdwy Stg 1	-	-	-	-	-	-	6.5	5.5	-	5.62	4.5	-	
Critical Hdwy Stg 2	-	-	-	-	-	-	6.5	5.5	-	5.62	4.5	-	
Follow-up Hdwy	2.2	-	-	2.2	-	-	3.5	4	3.3	3.56	4	3.3	
Pot Cap-1 Maneuver	1048	-	-	955	-	-	230	194	682	315	270	751	
Stage 1	-	-	-	-	-	-	433	472	-	572	617	-	
Stage 2	-	-	-	-	-	-	713	530	-	713	564	-	
Platoon blocked, %		-	-		-	-							
Mov Cap-1 Maneuver	1048	-	-	955	-	-	223	193	682	314	269	740	
Mov Cap-2 Maneuver	-	-	-	-	-	-	223	193	-	314	269	-	
Stage 1	-	-	-	-	-	-	432	471	-	570	617	-	
Stage 2	-	-	-	-	-	-	692	530	-	711	562	-	

Approach	EB	WB	NB	SB	
HCM Control Delay, s	0	0	0	20.1	
HCM LOS			А	С	

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	
Capacity (veh/h)	-	1048	-	-	955	-	-	335	
HCM Lane V/C Ratio	-	0.002	-	-	-	-	-	0.289	
HCM Control Delay (s)	0	8.4	0	-	0	-	-	20.1	
HCM Lane LOS	А	А	А	-	А	-	-	С	
HCM 95th %tile Q(veh)	-	0	-	-	0	-	-	1.2	

Movement     EBL     EBR     NBL     NBT     SBT     SBR       Lane Configurations     T
Lane Configurations   1   1   1   1   1   1     Traffic Vol, veh/h   252   437   303   583   644   199     Future Vol, veh/h   252   437   303   583   644   199     Conflicting Peds, #/hr   0   0   0   0   0   0     Conflicting Peds, #/hr   0   0   0   0   0   0
Traffic Vol, veh/h     252     437     303     583     644     199       Future Vol, veh/h     252     437     303     583     644     199       Conflicting Peds, #/hr     0     0     0     0     0     0
Future Vol, veh/h     252     437     303     583     644     199       Conflicting Peds, #/hr     0 <t< td=""></t<>
Conflicting Peds, #/hr 0 0 0 0 0 0
Cine Operators I Otan Otan Free Free Free
Sign Control Stop Stop Free Free Free
RT Channelized - Stop - None - Free
Storage Length 0 0 115 0
Veh in Median Storage, # 0 0 0 -
Grade, % -3 0 0 -
Peak Hour Factor 96 96 96 96 96 96
Heavy Vehicles, % 4 3 2 1 1 3
Mvmt Flow 263 455 316 607 671 207

Major/Minor	Minor2		Major1	Majo	or2		
Conflicting Flow All	1910	671	671	0	-	0	
Stage 1	671	-	-	-	-	-	
Stage 2	1239	-	-	-	-	-	
Critical Hdwy	5.84	5.93	4.12	-	-	-	
Critical Hdwy Stg 1	4.84	-	-	-	-	-	
Critical Hdwy Stg 2	4.84	-	-	-	-	-	
Follow-up Hdwy	3.536	3.327	2.218	-	-	-	
Pot Cap-1 Maneuver	~ 102	481	919	-	-	0	
Stage 1	564	-	-	-	-	0	
Stage 2	333	-	-	-	-	0	
Platoon blocked, %				-	-		
Mov Cap-1 Maneuver	~ 67	481	919	-	-	-	
Mov Cap-2 Maneuver	~ 190	-	-	-	-	-	
Stage 1	370	-	-	-	-	-	
Stage 2	333	-	-	-	-	-	
-							

Approach	EB	NB	SB	
HCM Control Delay, s	127.7	3.7	0	
HCM LOS	F			

Minor Lane/Major Mvmt	NBL	NBT EBLn1	EBLn2	SBT
Capacity (veh/h)	919	- 190	481	-
HCM Lane V/C Ratio	0.343	- 1.382	0.946	-
HCM Control Delay (s)	11	- 248.2	58.2	-
HCM Lane LOS	В	- F	F	-
HCM 95th %tile Q(veh)	1.5	- 15.4	11.6	-
Notes				

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

Intersection						
Int Delay, s/veh	0.3					
				NDT	ODT	000
Movement	EBL	EBK	NBL	NRT	SBT	SBR
Lane Configurations	۰Y			୍ କ	<b>P</b>	
Traffic Vol, veh/h	8	1	2	878	1069	12
Future Vol, veh/h	8	1	2	878	1069	12
Conflicting Peds, #/hr	0	0	14	0	0	14
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage,	# 0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	0	0	0	1	2	9
Mvmt Flow	8	1	2	896	1091	12

Major/Minor	Minor2	I	Major1	Majo	or2				
Conflicting Flow All	2011	1111	1117	0	-	0			
Stage 1	1111	-	-	-	-	-			
Stage 2	900	-	-	-	-	-			
Critical Hdwy	6.4	6.2	4.1	-	-	-			
Critical Hdwy Stg 1	5.4	-	-	-	-	-			
Critical Hdwy Stg 2	5.4	-	-	-	-	-			
Follow-up Hdwy	3.5	3.3	2.2	-	-	-			
Pot Cap-1 Maneuver	66	257	633	-	-	-			
Stage 1	318	-	-	-	-	-			
Stage 2	400	-	-	-	-	-			
Platoon blocked, %				-	-	-			
Mov Cap-1 Maneuver	64	254	625	-	-	-			
Mov Cap-2 Maneuver	64	-	-	-	-	-			
Stage 1	312	-	-	-	-	-			
Stage 2	395	-	-	-	-	-			

Approach	EB	NB	SB
HCM Control Delay, s	64	0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT EE	3Ln1	SBT	SBR
Capacity (veh/h)	625	-	70	-	-
HCM Lane V/C Ratio	0.003	- 0	.131	-	-
HCM Control Delay (s)	10.8	0	64	-	-
HCM Lane LOS	В	А	F	-	-
HCM 95th %tile Q(veh)	0	-	0.4	-	-

Appendix E Signal Warrant Analysis Worksheets

Based on 2009 Edition of the MUTCD

Project #:	23910		
Project Name:	West Linn Ar	terial Roadwa	iys
Analyst:	RBG		
Date:	7/2/2019		
Intersection:	Sunset Ave /	Willamette Fa	alls Dr (102)
Scenario:	2040 Build A	М	
Volume Adjustment Facto	1.0		
North-South Approach =		Minor	
East-West Approach =		Major	
Major Street Thru Lanes =		1	
Minor Street Thru Lanes =		1	
Speed > 40 mph?		No	
Population < 10,000?	No		
Warrant Factor	100%		
Peak Hour or Daily Count?	•	Peak Hour	

Warrant Summary						
Warrant	Name	Analyzed?	Met?			
#1	Eight-Highest	Yes	No			
#2	Four-Hour	Yes	No			
#3	Peak Hour	Yes	No			

Select Type Of Major Street Approach From Dropdown Menu Select Type Of Minor Street Approach From Dropdown Menu Urban Minor Arterial Urban Minor Arterial

	Traffic Volumes						
1	Hour	Major S	Street	Minor	Minor Street		Minor St.
Begin	End	EB	WB	NB	SB	Adj. Factor	Adj. Factor
7:30 AM	8:30 AM	398	611	32	0	1.00	1.00
2nd Highest	Hour	377	578	30	0	0.95	0.95
3rd Highest	Hour	371	570	30	0	0.93	0.93
4th Highest	Hour	356	546	29	0	0.89	0.89
5th Highest	Hour	350	538	28	0	0.88	0.88
6th Highest	Hour	350	538	28	0	0.88	0.88
7th Highest	Hour	334	513	27	0	0.84	0.84
8th Highest	Hour	329	505	26	0	0.83	0.83
9th Highest	Hour	318	489	26	0	0.80	0.80
10th Highes	t Hour	297	456	24	0	0.75	0.75
11th Highes	t Hour	287	440	23	0	0.72	0.72
12th Highes	t Hour	281	432	23	0	0.71	0.71
13th Highes	t Hour	271	415	22	0	0.68	0.68
14th Highes	t Hour	233	358	19	0	0.59	0.59
15th Highes	t Hour	186	285	15	0	0.47	0.47
16th Highes	t Hour	175	269	14	0	0.44	0.44
17th Highes	t Hour	122	187	10	0	0.31	0.31
18th Highes	t Hour	101	155	8	0	0.25	0.25
19th Highes	t Hour	53	81	4	0	0.13	0.13
20th Highes	t Hour	37	57	3	0	0.09	0.09
21st Highes	t Hour	32	49	3	0	0.08	0.08
22nd Highes	st Hour	21	33	2	0	0.05	0.05
23rd Highes	t Hour	11	16	1	0	0.03	0.03
24th Highes	t Hour	11	16	1	0	0.03	0.03

Based on 2009 Edition of the MUTCD

Project #:	23910	
Project Name:	West Linn Ar	terial Roadwa
Analyst:	RBG	
Date:	7/2/2019	
Intersection:	Sunset Ave /	West A St (10
Scenario:	2040 Build Pl	М
Volume Adjustment Facto	r =	1.0
North-South Approach =		Minor
East-West Approach =		Major
Major Street Thru Lanes =		1
Minor Street Thru Lanes =		1
Speed > 40 mph?		No
Population < 10,000?	No	
Warrant Factor	100%	
Peak Hour or Daily Count?	Peak Hour	

Warrant Summary						
Warrant	Name	Analyzed?	Met?			
#1	Eight-Highest	Yes	Yes			
#2	Four-Hour	Yes	Yes			
#3	Peak Hour	Yes	No			

Select Type Of Major Street Approach From Dropdown Menu Select Type Of Minor Street Approach From Dropdown Menu



Traffic Volumes				Minor	Street		
Begin	End	EB	WB	NB	SB	Major St. Adj. Factor	Minor St. Adj. Factor
7:30 AM	8:30 AM	648	514	0	127	1.00	1.00
2nd Highest	Hour	613	487	0	120	0.95	0.95
3rd Highest	Hour	605	480	0	119	0.93	0.93
4th Highest	Hour	579	459	0	113	0.89	0.89
5th Highest	Hour	570	452	0	112	0.88	0.88
6th Highest	Hour	570	452	0	112	0.88	0.88
7th Highest	Hour	544	432	0	107	0.84	0.84
8th Highest	Hour	536	425	0	105	0.83	0.83
9th Highest	Hour	518	411	0	102	0.80	0.80
10th Highest	t Hour	484	384	0	95	0.75	0.75
11th Highest	t Hour	467	370	0	91	0.72	0.72
12th Highest	t Hour	458	363	0	90	0.71	0.71
13th Highest	t Hour	441	350	0	86	0.68	0.68
14th Highest	t Hour	380	302	0	75	0.59	0.59
15th Highest	t Hour	302	240	0	59	0.47	0.47
16th Highest	t Hour	285	226	0	56	0.44	0.44
17th Highest	t Hour	199	158	0	39	0.31	0.31
18th Highest	t Hour	164	130	0	32	0.25	0.25
19th Highest	t Hour	86	69	0	17	0.13	0.13
20th Highest	t Hour	60	48	0	12	0.09	0.09
21st Highest	Hour	52	41	0	10	0.08	0.08
22nd Highes	t Hour	35	27	0	7	0.05	0.05
23rd Highes	t Hour	17	14	0	3	0.03	0.03
24th Highes	t Hour	17	14	0	3	0.03	0.03

Based on 2009 Edition of the MUTCD

Project #:	23910			
Project Name:	West Linn Ar	terial Roadwa	iys	
Analyst:	RBG			
Date:	7/2/2019			
Intersection:	Willamette F	alls Dr / West	A St (104)	
Scenario:	2040 No-Buil	ld PM		
Volume Adjustment Facto	r =	1.0		
North-South Approach =		Minor		
East-West Approach =		Major		
Major Street Thru Lanes =		2		
Minor Street Thru Lanes =		1		
Speed > 40 mph?		No		
Population < 10,000?		No		
Warrant Factor	100%			
Peak Hour or Daily Count?	Peak Hour			

Warrant Summary						
Warrant	Name	Analyzed?	Met?			
#1	Eight-Highest	Yes	Yes			
#2	Four-Hour	Yes	No			
#3	Peak Hour	Yes	No			

Select Type Of Major Street Approach From Dropdown Menu Select Type Of Minor Street Approach From Dropdown Menu Urban Minor Arterial Urban Minor Arterial

		Traffic Vo	olumes				
ł	Hour	Major S	Street	Minor Street		Major St.	Minor St.
Begin	End	EB	WB	NB	SB	Adj. Factor	Adj. Factor
7:30 AM	8:30 AM	648	514	0	120	1.00	1.00
2nd Highest	Hour	613	487	0	114	0.95	0.95
3rd Highest	Hour	605	480	0	112	0.93	0.93
4th Highest	Hour	579	459	0	107	0.89	0.89
5th Highest	Hour	570	452	0	106	0.88	0.88
6th Highest	Hour	570	452	0	106	0.88	0.88
7th Highest	Hour	544	432	0	101	0.84	0.84
8th Highest	Hour	536	425	0	99	0.83	0.83
9th Highest	Hour	518	411	0	96	0.80	0.80
10th Highest	t Hour	484	384	0	90	0.75	0.75
11th Highest	t Hour	467	370	0	86	0.72	0.72
12th Highest	t Hour	458	363	0	85	0.71	0.71
13th Highest	t Hour	441	350	0	82	0.68	0.68
14th Highest	t Hour	380	302	0	70	0.59	0.59
15th Highest	t Hour	302	240	0	56	0.47	0.47
16th Highest	t Hour	285	226	0	53	0.44	0.44
17th Highest	t Hour	199	158	0	37	0.31	0.31
18th Highest	t Hour	164	130	0	30	0.25	0.25
19th Highest	t Hour	86	69	0	16	0.13	0.13
20th Highest	t Hour	60	48	0	11	0.09	0.09
21st Highest	Hour	52	41	0	10	0.08	0.08
22nd Highes	t Hour	35	27	0	6	0.05	0.05
23rd Highes	t Hour	17	14	0	3	0.03	0.03
24th Highest	t Hour	17	14	0	3	0.03	0.03

Based on 2009 Edition of the MUTCD

Project #:	23910	
Project Name:	West Linn Ar	terial Roadwa
Analyst:	RBG	
Date:	7/2/2019	
Intersection:	OR 43 / Willa	mette Falls D
Scenario:	2040 No-Buil	d PM
Volume Adjustment Facto	r =	1.0
North-South Approach =		Major
East-West Approach =		Minor
Major Street Thru Lanes =		1
Minor Street Thru Lanes =		1
Speed > 40 mph?		No
Population < 10,000?	No	
Warrant Factor	100%	
Peak Hour or Daily Count?	•	Peak Hour

Warrant Summary							
Warrant	Name	Analyzed?	Met?	_			
#1	Eight-Highest	Yes	Yes				
#2	Four-Hour	Yes	Yes				
#3	Peak Hour	Yes	Yes	*This			

\*This signal warrant shall be applied only in unusual cases, such as affice complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time.

Select Type Of Major Street Approach From Dropdown Menu Select Type Of Minor Street Approach From Dropdown Menu Urban Minor Arterial Urban Minor Arterial

		Traffic Ve	olumes				
Hour		Major	Street	Minor	Street	Maior St.	Minor St.
Begin	End	NB	SB	EB	WB	Adj. Factor	Adj. Factor
7:30 AM 8	3:30 AM	886	843	280	0	1.00	1.00
2nd Highest Hou	r	839	798	265	0	0.95	0.95
3rd Highest Hour		827	787	261	0	0.93	0.93
4th Highest Hour		791	753	250	0	0.89	0.89
5th Highest Hour		780	742	246	0	0.88	0.88
6th Highest Hour		780	742	246	0	0.88	0.88
7th Highest Hour		744	708	235	0	0.84	0.84
8th Highest Hour		732	697	231	0	0.83	0.83
9th Highest Hour		709	674	224	0	0.80	0.80
10th Highest Hou	ır	662	629	209	0	0.75	0.75
11th Highest Hou	ır	638	607	202	0	0.72	0.72
12th Highest Hou	ır	626	596	198	0	0.71	0.71
13th Highest Hou	ır	602	573	190	0	0.68	0.68
14th Highest Hou	ır	520	495	164	0	0.59	0.59
15th Highest Hou	ır	413	393	131	0	0.47	0.47
16th Highest Hou	ır	390	371	123	0	0.44	0.44
17th Highest Hou	ır	272	259	86	0	0.31	0.31
18th Highest Hou	ır	224	214	71	0	0.25	0.25
19th Highest Hou	ır	118	112	37	0	0.13	0.13
20th Highest Hou	ır	83	79	26	0	0.09	0.09
21st Highest Hou	ır	71	67	22	0	0.08	0.08
22nd Highest Ho	ur	47	45	15	0	0.05	0.05
23rd Highest Hou	ur	24	22	7	0	0.03	0.03
24th Highest Hou	ır	24	22	7	0	0.03	0.03

Based on 2009 Edition of the MUTCD

Broject #:	22010	
FIUJECL #.	23310	
Project Name:	West Linn Ar	terial Roadwa
Analyst:	RBG	
Date:	7/2/2019	
Intersection:	OR 43 / Mill 9	St (107)
Scenario:	2040 No-Buil	d PM
Volume Adjustment Facto	r =	1.0
North-South Approach =		Major
East-West Approach =		Minor
Major Street Thru Lanes =		1
Minor Street Thru Lanes =		1
Speed > 40 mph?		No
Population < 10,000?		No
Warrant Factor		100%
Peak Hour or Daily Count?	)	Peak Hour

	Warrant	Summary	
Warrant	Name	Analyzed?	Met?
#1	Eight-Highest	Yes	No
#2	Four-Hour	Yes	No
#3	Peak Hour	Yes	No

Select Type Of Major Street Approach From Dropdown Menu Select Type Of Minor Street Approach From Dropdown Menu Urban Principal Arterial Urban Minor Arterial

		Traffic Vo	olumes				
ŀ	lour	Major S	Street	Minor	Street	Maior St.	Minor St.
Begin	End	NB	SB	EB	WB	Adj. Factor	Adj. Factor
7:30 AM	8:30 AM	880	1081	8	0	1.00	1.00
2nd Highest	Hour	823	1011	8	0	0.94	0.95
3rd Highest	Hour	811	997	7	0	0.92	0.93
4th Highest	Hour	789	969	7	0	0.90	0.89
5th Highest	Hour	720	884	7	0	0.82	0.88
6th Highest	Hour	709	870	7	0	0.81	0.88
7th Highest	Hour	663	814	7	0	0.75	0.84
8th Highest	Hour	617	758	7	0	0.70	0.83
9th Highest	Hour	617	758	6	0	0.70	0.80
10th Highest	t Hour	606	744	6	0	0.69	0.75
11th Highest	t Hour	571	702	6	0	0.65	0.72
12th Highest	t Hour	537	660	6	0	0.61	0.71
13th Highest	t Hour	526	646	5	0	0.60	0.68
14th Highest	t Hour	503	618	5	0	0.57	0.59
15th Highest	t Hour	400	491	4	0	0.45	0.47
16th Highest	t Hour	377	463	4	0	0.43	0.44
17th Highest	t Hour	343	421	2	0	0.39	0.31
18th Highes	t Hour	297	365	2	0	0.34	0.25
19th Highest	t Hour	240	295	1	0	0.27	0.13
20th Highest	t Hour	114	140	1	0	0.13	0.09
21st Highest	Hour	103	126	1	0	0.12	0.08
22nd Highes	t Hour	69	84	0	0	0.08	0.05
23rd Highes	t Hour	57	70	0	0	0.06	0.03
24th Highest	t Hour	57	70	0	0	0.06	0.03

Appendix F Year 2040 Build Traffic Conditions Worksheets

Int Delay, s/veh	8.4							
Movement	EBT	EBR	WBL	WBT	NBL	NBR		
Lane Configurations	ef 👘		۳	1	٦	1		
Traffic Vol, veh/h	161	46	199	403	27	487		
Future Vol, veh/h	161	46	199	403	27	487		
Conflicting Peds, #/hr	0	3	3	0	0	0		
Sign Control	Free	Free	Free	Free	Stop	Stop		
RT Channelized	-	None	-	None	-	None		
Storage Length	-	-	100	-	125	0		
Veh in Median Storage	,# 0	-	-	0	0	-		
Grade, %	-3	-	-	3	3	-		
Peak Hour Factor	88	88	88	88	88	88		
Heavy Vehicles, %	4	4	0	5	11	0		
Mvmt Flow	183	52	226	458	31	553		

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0 238	0 1122	212	
Stage 1	-		- 212	-	
Stage 2	-		- 910	-	
Critical Hdwy	-	- 4.1	- 7.11	6.5	
Critical Hdwy Stg 1	-		- 6.11	-	
Critical Hdwy Stg 2	-		- 6.11	-	
Follow-up Hdwy	-	- 2.2	- 3.599	3.3	
Pot Cap-1 Maneuver	-	- 1341	- 181	819	
Stage 1	-		- 775	-	
Stage 2	-		- 325	-	
Platoon blocked, %	-	-	-		
Mov Cap-1 Maneuver	· -	- 1337	- 150	817	
Mov Cap-2 Maneuver	· -		- 229	-	
Stage 1	-		- 773	-	
Stage 2	-		- 270	-	

Approach	EB	WB	NB
HCM Control Delay, s	0	2.7	18.4
HCM LOS			С

Minor Lane/Major Mvmt	NBLn1 I	NBLn2	EBT	EBR	WBL	WBT	
Capacity (veh/h)	229	817	-	-	1337	-	
HCM Lane V/C Ratio	0.134	0.677	-	-	0.169	-	
HCM Control Delay (s)	23.1	18.1	-	-	8.2	-	
HCM Lane LOS	С	С	-	-	А	-	
HCM 95th %tile Q(veh)	0.5	5.4	-	-	0.6	-	

# **MOVEMENT SUMMARY**

# **V** Site: 103 [2040 Build PM]

Sunset Ave / Willamette Falls Dr Site Category: (None) Roundabout

Move	ment Per	formance	e - Vehi	cles								
Mov ID	Turn	Demand F Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
East: S	Sunset Ave	;										
6	T1	511	2.0	0.576	11.2	LOS B	3.9	98.2	0.41	0.25	0.41	32.1
16	R2	66	2.0	0.576	11.2	LOS B	3.9	98.2	0.41	0.25	0.41	31.3
Approa	ach	578	2.0	0.576	11.2	LOS B	3.9	98.2	0.41	0.25	0.41	32.0
North:	Willamette	e Falls Dr										
7	L2	143	2.0	0.486	13.0	LOS B	2.9	71.7	0.65	0.76	0.96	30.2
14	R2	177	2.0	0.486	13.0	LOS B	2.9	71.7	0.65	0.76	0.96	29.0
Approa	ach	320	2.0	0.486	13.0	LOS B	2.9	71.7	0.65	0.76	0.96	29.5
West:	Sunset Ave	е										
5	L2	97	3.0	0.761	18.5	LOS B	14.4	366.8	0.69	0.69	1.04	28.9
2	T1	631	2.0	0.761	18.5	LOS B	14.4	366.8	0.69	0.69	1.04	28.9
Approa	ach	728	2.1	0.761	18.5	LOS B	14.4	366.8	0.69	0.69	1.04	28.9
All Veh	icles	1625	2.1	0.761	14.8	LOS B	14.4	366.8	0.58	0.55	0.80	30.1

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.

LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).

Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6). Roundabout Capacity Model: US HCM 2010.

HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies. Gap-Acceptance Capacity: Traditional M1.

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# **MOVEMENT SUMMARY**

# **V** Site: 106 [2040 Build PM]

Willamette Dr/Sunset Ave Site Category: (None) Roundabout

Move	ment Pe	formance	e - Vehi	cles								
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
South:	Willamett	e Dr										
3u	U	1	3.0	0.431	10.4	LOS B	2.3	56.8	0.57	0.58	0.66	31.0
3	L2	328	2.0	0.431	10.4	LOS B	2.3	56.8	0.57	0.58	0.66	30.3
18	R2	627	1.0	0.378	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	36.8
Approa	ach	956	1.3	0.431	3.6	LOS A	2.3	56.8	0.20	0.20	0.23	34.2
East: \	Villamette	Dr										
1u	U	1	3.0	0.845	28.1	LOS C	18.6	465.1	0.95	1.46	2.26	25.1
1	L2	675	1.0	0.845	28.0	LOS C	18.6	465.1	0.95	1.46	2.26	24.7
6	T1	223	3.0	0.284	7.8	LOS A	1.1	28.7	0.48	0.42	0.48	33.7
Approa	ach	899	1.5	0.845	23.0	LOS C	18.6	465.1	0.83	1.20	1.82	26.4
West:	Sunset Av	е										
5u	U	1	3.0	0.651	21.1	LOS C	4.8	123.5	0.77	1.00	1.49	28.9
2	T1	357	4.0	0.651	21.2	LOS C	4.8	123.5	0.77	1.00	1.49	28.2
12	R2	470	3.0	0.846	36.6	LOS D	10.6	270.4	0.90	1.39	2.47	22.9
Approa	ach	828	3.4	0.846	29.9	LOS C	10.6	270.4	0.84	1.22	2.05	25.0
All Veh	nicles	2683	2.0	0.846	18.2	LOS B	18.6	465.1	0.61	0.85	1.32	28.2

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.

LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).

Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010). Roundabout Capacity Model: US HCM 2010.

HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies. Gap-Acceptance Capacity: Traditional M1.

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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7.6						
EBT	EBR	WBL	WBT	NBL	NBR	
4Î		٦	1	٦	1	
357	41	364	247	32	285	
357	41	364	247	32	285	
0	3	3	0	0	0	
Free	Free	Free	Free	Stop	Stop	
-	None	-	None	-	None	
-	-	100	-	125	0	
# 0	-	-	0	0	-	
-3	-	-	3	3	-	
88	88	88	88	88	88	
4	4	0	5	11	0	
406	47	414	281	36	324	
	7.6 EBT 357 357 0 Free - - ,# 0 -3 88 4 406	7.6 EBT EBR 357 41 357 41 357 41 0 3 Free Free - None  ,# 0 -3 88 88 4 4 406 47	7.6   EBT EBR WBL   1 364   357 41 364   357 41 364   357 41 364   357 41 364   357 41 364   357 41 364   357 41 364   0 3 3   Free Free Free   None -   - 100   # 0 -   -3 -   88 88   4 4   406 47	7.6   WBL   WBT     EBR   WBL   WBT     1   1   1     357   41   364   247     357   41   364   247     357   41   364   247     0   3   33   0     Free   Free   Free   Free     None   -   None     -   100   -     # 0   -   100      -   0      -   100      -   0      -   0      -   0      -   0      -   0      -   0      -   0      -   0      -   0      -   0      -   0   -      -   0   -      -   0   - <td>7.6     EBT   EBR   WBL   WBT   NBL     1   1   364   247   32     357   41   364   247   32     357   41   364   247   32     357   41   364   247   32     0   3   3   0   0     Free   Free   Free   Free   Stop     -   None   -   None   -     -   100   -   125   -     #   0   -   3   3     88   88   88   88   88     4   4   0   5   11     406   47   414   281   36</td> <td>7.6     EBT   EBR   WBL   WBT   NBL   NBR     1   1   1   1   1   1     357   41   364   247   32   285     357   41   364   247   32   285     0   3   364   247   32   285     0   3   364   247   32   285     0   3   3   0   0   0     Free   Free   Free   Stop   Stop     -   None   -   None   -   None     -   100   -   125   0     #   0   -   3   3   -     88   88   88   88   88   88     4   4   0   5   11   0     406   47   414   281   36   324</td>	7.6     EBT   EBR   WBL   WBT   NBL     1   1   364   247   32     357   41   364   247   32     357   41   364   247   32     357   41   364   247   32     0   3   3   0   0     Free   Free   Free   Free   Stop     -   None   -   None   -     -   100   -   125   -     #   0   -   3   3     88   88   88   88   88     4   4   0   5   11     406   47   414   281   36	7.6     EBT   EBR   WBL   WBT   NBL   NBR     1   1   1   1   1   1     357   41   364   247   32   285     357   41   364   247   32   285     0   3   364   247   32   285     0   3   364   247   32   285     0   3   3   0   0   0     Free   Free   Free   Stop   Stop     -   None   -   None   -   None     -   100   -   125   0     #   0   -   3   3   -     88   88   88   88   88   88     4   4   0   5   11   0     406   47   414   281   36   324

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0 456	0 1542	433	
Stage 1	-		- 433	-	
Stage 2	-		- 1109	-	
Critical Hdwy	-	- 4.1	- 7.11	6.5	
Critical Hdwy Stg 1	-		- 6.11	-	
Critical Hdwy Stg 2	-		- 6.11	-	
Follow-up Hdwy	-	- 2.2	- 3.599	3.3	
Pot Cap-1 Maneuver	-	- 1115	- 93	605	
Stage 1	-		- 591	-	
Stage 2	-		- 252	-	
Platoon blocked, %	-	-	-		
Mov Cap-1 Maneuver	r –	- 1112	- 58	603	
Mov Cap-2 Maneuver	r –		- 130	-	
Stage 1	-		- 589	-	
Stage 2	-		- 158	-	

Approach	EB	WB	NB
HCM Control Delay, s	0	6	20.3
HCM LOS			С

Minor Lane/Major Mvmt	NBLn11	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	130	603	-	-	1112	-
HCM Lane V/C Ratio	0.28	0.537	-	-	0.372	-
HCM Control Delay (s)	43.1	17.7	-	-	10.1	-
HCM Lane LOS	E	С	-	-	В	-
HCM 95th %tile Q(veh)	1.1	3.2	-	-	1.7	-

# **MOVEMENT SUMMARY**

# **V** Site: 103 [2040 Build AM]

Sunset Ave / Willamette Falls Dr Site Category: (None) Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand F Total veh/h	lows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
East: S	Sunset Ave											
6	T1	518	2.0	0.804	23.5	LOS C	16.4	417.7	0.87	1.23	1.87	27.3
16	R2	151	2.0	0.804	23.5	LOS C	16.4	417.7	0.87	1.23	1.87	26.7
Approa	ach	669	2.0	0.804	23.5	LOS C	16.4	417.7	0.87	1.23	1.87	27.2
North: Willamette Falls Dr												
7	L2	46	2.0	0.327	9.8	LOS A	1.3	32.6	0.58	0.59	0.59	32.2
14	R2	171	0.0	0.327	9.6	LOS A	1.3	32.6	0.58	0.59	0.59	31.2
Approa	ich	217	0.4	0.327	9.7	LOS A	1.3	32.6	0.58	0.59	0.59	31.4
West: \$	Sunset Ave	9										
5	L2	276	4.0	0.688	14.1	LOS B	6.2	158.9	0.36	0.16	0.36	30.1
2	T1	445	2.0	0.688	14.0	LOS B	6.2	158.9	0.36	0.16	0.36	30.1
Approa	ich	721	2.8	0.688	14.1	LOS B	6.2	158.9	0.36	0.16	0.36	30.1
All Veh	icles	1607	2.1	0.804	17.4	LOS B	16.4	417.7	0.60	0.67	1.02	29.0

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.

LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).

Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6). Roundabout Capacity Model: US HCM 2010.

HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies. Gap-Acceptance Capacity: Traditional M1.

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# **MOVEMENT SUMMARY**

# **V** Site: 106 [2040 Build AM]

Willamette Dr/Sunset Ave Site Category: (None) Roundabout

Move	Movement Performance - Vehicles											
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
South:	Willamet	e Dr										
3u	U	1	3.0	0.456	9.5	LOS A	2.3	59.7	0.45	0.34	0.45	31.6
3	L2	377	3.0	0.456	9.5	LOS A	2.3	59.7	0.45	0.34	0.45	30.9
18	R2	791	1.0	0.456	0.4	LOS A	2.3	59.7	0.02	0.02	0.02	36.4
Approa	ach	1170	1.6	0.456	3.4	LOS A	2.3	59.7	0.16	0.12	0.16	34.4
East: V	Villamette	Dr										
1u	U	1	3.0	0.745	21.1	LOS C	10.3	260.3	0.82	1.15	1.69	27.2
1	L2	562	1.0	0.745	21.0	LOS C	10.3	260.3	0.82	1.15	1.69	26.7
6	T1	275	6.0	0.382	10.0	LOS A	1.6	41.8	0.54	0.53	0.56	32.7
Approa	ach	839	2.6	0.745	17.4	LOS B	10.3	260.3	0.73	0.95	1.32	28.4
West:	Sunset Av	e										
5u	U	1	3.0	0.299	9.8	LOS A	1.1	28.3	0.58	0.58	0.58	33.7
2	T1	181	5.0	0.299	9.9	LOS A	1.1	28.3	0.58	0.58	0.58	32.7
12	R2	296	1.0	0.468	12.9	LOS B	2.6	65.3	0.66	0.76	0.95	30.2
Approa	ach	477	2.5	0.468	11.8	LOS B	2.6	65.3	0.63	0.69	0.81	31.1
All Veh	nicles	2486	2.2	0.745	9.7	LOS A	10.3	260.3	0.44	0.51	0.68	31.5

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.

LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).

Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010). Roundabout Capacity Model: US HCM 2010.

HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies. Gap-Acceptance Capacity: Traditional M1.

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Appendix 2 Segment Alternatives Memorandum



851 SW 6th AVENUE, SUITE 600 PORTLAND, OR 97204 P 503.228.5230 F 503.273.8169

# MEMORANDUM

Date:	March 2, 2020	Project #: 23910
To	Lance Calvert	
10.	City of West Linn	
	22500 Salamo Road	
	West Linn, OR 97068	
From:	Nick Gross, Nicholas Polenske, PE, Marc Butorac, PE, PTOE	
Project:	West Linn Arterial Roadways	
Subject:	Project Roll Map Narrative	

## INTRODUCTION

The City of West Linn (City) is planning to improve Willamette Falls Drive (WFD) from the Tualatin River to the Lake Oswego Highway (OR43) to improve traffic operations and provide multimodal connectivity along the corridor as well as facilitate future development of the waterfront area. As part of the roadway reconfiguration, separated multimodal facilities including the preferred sidewalk and "cycletrack" configurations as defined by the City's standard details are proposed. A conceptual project roll map of the study area was developed to illustrate the best fit centerline alignment based on existing Geographic Information System (GIS) data. *Appendix "A" contains the conceptual project roll map of the project study area*.

## TRAFFIC CONDITIONS

A traffic operations analysis was conducted at several study intersections along the corridor under existing and year 2040 traffic conditions. The purpose of the traffic operations analysis was to ensure adequate capacity and determine the appropriate traffic control devices and lane configurations at each study intersection. A conceptual layout of the study area was developed by the City that includes removal of the segment of WFD from Chestnut Street to OR43 and construction of new street connections from WFD to Sunset Drive, Sunset Drive to West A Street, and Sunset Drive to OR43. The results of the analysis indicate that the proposed conceptual layout will improve traffic operations, safety, and multimodal connectivity along the corridor under year 2040 traffic conditions assuming minor modifications to the traffic control and lane configurations. *Appendix "B" contains the draft Traffic Operations Analysis*.

# CONNECTIVITY

WFD is an east-west connection and identified as a Minor Arterial in the City of West Linn Transportation System Plan (TSP – Reference 1). As defined in the TSP, "Minor arterials serve to interconnect and support the major arterial system. These streets link major commercial, residential, industrial and institutional areas. Minor arterial streets are typically spaced about one mile apart to assure accessibility and reduce traffic using collectors or local streets in lieu of a well-placed minor arterial street. Many of these routes connect to cities surrounding West Linn. Access control is a key feature of an arterial route. Minor arterials are typically multiple miles in length. Neighborhood Traffic Management strategies are not appropriate on minor arterials."

The Bicycle Plan Improvements within the TSP identify the installation of cycle tracks along Willamette Falls Drive from Willamette Drive to Sunset Avenue (Map ID B12) and Sunset Avenue to 10<sup>th</sup> Street (Map ID B13). Both projects are identified as High Priority projects.

Exhibit 1 illustrates Strava Data (Reference 2) along WFD. Strava "Heat Maps" are generated by users raw input activity streams and used to illustrate locations of frequent use by showing heat opacity.

### Exhibit 1: Strava Heat Map



As shown in Exhibit 1, WFD is the most heavily utilized east-west corridor for people biking in West Linn; however, WFD is not suitable for the majority of users as illustrated in the Bicycle Level of Traffic Stress Analysis (Appendix C) conducted as part of the TSP. In order to achieve a comfortable environment for people biking along WFD, a separated bicycle facility or "cycle track" as identified as part of the TSP must be installed to provide adequate separation between the travel land and dedicated space for people biking.

## **DESCRIPTION OF 5 SEGMENTS**

As illustrated on the Project Roll Map, WFD was separated into five segments based on changes in right-of-way, topography constraints, and general changes to the corridor context. The following analysis provides a brief description of the proposed alternatives within each of the five segments and provides a qualitative evaluation of each alternative utilizing an evaluation matrix scoring metric. A legend of the evaluation matrix is provided below. *Appendix "C" contains the alternatives for each segment as prepared for the initial analysis.* 



**Segment A-A** runs along WFD from just east of the Tualatin River "WF" 16+00 to the western leg of the WFD and 16<sup>th</sup> Street intersection, approximately "WF" 67+00. Three cross-section alternatives were developed within this segment and have been analyzed based on the evaluation criteria presented in Table 1.

## Table 1: Segment A-A Evaluation Matrix

Segment	Connectivity	Right-of-Way	Cost	Safety & Security
A-A (1)		0	$\bigcirc$	
A-A (2)		$\bigcirc$		
A-A (3)	$\Theta$		$\bigcirc$	$\Theta$

As illustrated in Table 1, the preferred cross-section alternative was determined to be **Segment A-A (2).** This crosssection alternative provides two 12-foot travel lanes with a four and a half-foot landscape strip, six and a half-foot one-way cycle track, and six-foot sidewalk on both sides of the roadway. As compared to Segment A-A (1), the preferred cross-section requires less right-of-way and will cost less to construct. Right-of-way acquisition will be necessary for the preferred alternative as the existing right-of-way boundaries are in the proposed sidewalk.





The section of WFD between 16<sup>th</sup> Street and 10<sup>th</sup> Street is currently being designed as part of a separate project. Segment A-A will match in to these improvements at 16<sup>th</sup> Street and Segment B-B will match in to these improvements at 10<sup>th</sup> Street.

**Segment B-B** runs along WFD from 10<sup>th</sup> Street intersection, approximately "WF" 93+00 to the WFD and 6<sup>th</sup> Street intersection at approximately "WF" 109+00. Two cross-section alternatives were developed within this segment and have been analyzed based on the evaluation criteria presented in Table 2.

#### **Table 2: Segment B-B Evaluation Matrix**

Segment	Connectivity	Right-of-Way	Cost	Safety & Security
В-В (1)	$\bigcirc$	0	$\bigcirc$	$\bigcirc$
В-В (2)	$\bigcirc$	$\bigcirc$		$\bigcirc$

As illustrated in Table 2, the preferred cross-section alternative was determined to be **Segment B-B (2)**. This crosssection alternative includes two 13-foot travel lanes with an offset eight-foot multi-use trail. No sidewalk is being proposed along WFD through this segment. While both cross-section alternatives accommodate people biking on the parallel frontage road located immediately south of WDF, the preferred alternative can fit within a smaller right-of-way resulting in a significant smaller construction cost. This is primarily due to Segment B-B (1) providing a two-way, left-turn lane (TWLTL). People biking on the frontage road will be accommodated using shared lane pavement marking or "sharrows" striped along the full length of the roadway with appropriate signage directing cyclists to this parallel facility. The frontage road has a posted speed of 20 miles per hour (mph) and is a comfortable facility for the majority of people biking (LTS 1). Additional safety features that will be investigated through this segment include a possible additional stop sign at the WFD and 6<sup>th</sup> Street intersection as well as closing an existing frontage road entrance east of the 10<sup>th</sup> Street intersection due to the proximity of a new traffic signal at WFD and 10<sup>th</sup> Street.

## Section B-B (2) – $10^{th}$ Street to $6^{th}$ Street, Looking East





**Segment C-C** runs along WFD from 6<sup>th</sup> Street, "WF" 109+00, to "WF" 162+00. This segment of WFD is extremely constrained due to the topography on both sides of the roadway. Five cross-section alternatives were developed within this segment and have been analyzed based on the evaluation criteria presented in Table 3.

### Table 3: Segment C-C Evaluation Matrix

Segment	Connectivity	Right-of-Way	Cost	Safety & Security
C-C (1)	$\bigcirc$			
C-C (2)	$\bigcirc$			$\bigcirc$
C-C (3)		$\Theta$	0	
C-C (4)		$\bigcirc$	0	
C-C (5)		$\bigcirc$	$\bigcirc$	

As illustrated in Table 3, the preferred cross-section alternative was determined to be **Segment C-C (1)**. This cross-section alternative includes two 12-foot travel lanes with a five-foot planter and a 10-foot shared-use path on the

south side of the road. While Segment C-C (2), scores closely to the preferred cross-section, it was determined that

two retaining walls would be required based on the lower level shared-use path, resulting in an increase to construction cost. All cross-section alternatives require a significant "fill" retaining wall on the south side of WFD

to accommodate the proposed shared-use path. Both the preferred alternative, C-C (1), and C-C (2), would require right-of-way acquisition (approximately 1.5 feet) on the south side of WFD to accommodate the proposed retaining

**Segment D-D** runs along WFD from "WF" 162+00 to "WF" 186+00 at the intersection of Chestnut Street and Sunset Avenue. Similar to Segment C-C, this segment of WFD is extremely constrained to topography on both sides of the roadway. Five cross-section alternatives were developed within this segment and have been analyzed based on the evaluation criteria presented in Table 4.



As illustrated in Table 4, the preferred cross-section alternative was determined to be **Segment D-D (1)**. This crosssection alternative is identical to Segment C-C. Segment D-D (2) would require two retaining walls resulting in an increase cost of construction. Maintaining the shared-use path facility on the south side of the roadway is consistent with the preferred alternatives selected for the additional segments along WFD. With the preferred alternative, people walking and biking will be accommodated along a 10-foot separated shared-use path. In order to construct this facility, a significant "fill" wall on the south side of WFD is required. Similarly to Segment C-C, all preferred alternatives would require right-of-way acquisition on the south side of WFD.

## Segment D-D (1) – Dan Davis Recycling Center to Sunset Avenue, Looking East





## Table 4: Segment D-D Evaluation Matrix

wall.

ay	Cost	Safety & Security
		$\bigcirc$
**Segment E-E** runs along Sunset Avenue to the proposed Sunset Avenue/OR43/I-205 entrance ramp roundabout. Once on Sunset Avenue, the alignment turns to the east and follows Sunset Avenue back to WFD where it is proposed to cross WFD to link into the West Linn Mill Property Development. Four cross-section alternatives were developed for this segment and have been analyzed based on the evaluation criteria presented in Table 5.

## **Table 5: Segment E-E Evaluation Matrix**

Segment	Connectivity	Right-of-Way	Cost	Safety & Security
E-E (1)		$\bigcirc$		
E-E (2)	$\bigcirc$			$\Theta$
E-E (3)	$\Theta$	0		
E-E (4)	$\Theta$			

As illustrated in Table 5, Segment E-E (1), Segment E-E (2), and Segment E-E (4) resulted in similar scoring metrics based on the evaluation criteria. **Segment E-E (1)** was determined to be the preferred alternative due to the need to accommodate a TWLTL. The preferred cross-section provides two 12-foot travel lanes and a 12-foot TWLTL to facilitate left-turns at the Chestnut intersection. On the northside of the roadway, a six-foot sidewalk is provided. On the southside, a five-foot landscape strip, 10-foot two-way cycle track, and six-foot sidewalk are provided. The preferred segment does not require walls on either side of WFD, however, walls could be used to limit the overall footprint. Due to the new alignments of WFD, Chestnut Street, and Sunset Avenue in this segment of the proposed improvements, right-of-way acquisition is anticipated and the road footprint will be optimized to minimize these impacts.





Segment E-E (4)

The West Linn Mill Property Development is proposed on the south side of WFD east of Sunset Avenue to W A Street. Within this segment of WFD, a separate alternative would have people walking and biking to be accommodated by a separated shared-use path within the West Linn Mill Property Development. The shared-use path alignment is illustrated in the Project Roll Map and coordination will be required with the development team to refine the path alignment and feasibility.

This alternative is preferred through Segment E-E if the development layout permits this concept. Separating the cycle track from the main road would improve safety for users and would provide a leaner roadway section along WFD, Chestnut Street, and Sunset Avenue allowing the development to maximize the developable space. This alternative would also require less overall R/W acquisition for the City as the cycle track through the development would be a part of the West Linn Mill Property Development.

## CONSTRUCTION STAGING

There are three on-going design projects directly adjacent to the Willamette Falls Drive project described in this memorandum:

- I-205 Corridor Widening Project (Oregon Department of Transportation)
- Old Mill Site Development Project (Private Developer)
- Historic Willamette Falls Drive Project (City of West Linn)

Each project is responsible for key components of the overall WFD corridor connectivity, but this project can be staged to construct most of the improvements regardless of when each of the three projects listed above are constructed. The ultimate layout of Segment E-E is dependent on both the I-205 Corridor Widening Project and the Old Mill Site Development Project and depending on when either of these two projects are constructed, there will be necessary interim connections of both OR43 and Broadway Street to maintain connectivity throughout the corridor.

## REFERENCES

- 1. West Linn Transportation System Plan
- 2. Strava Heat Maps Data

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Appendix A Project Roll Map





West Linn Arterial Roadways City of West Linn

Appendix B Traffic Operations Analysis See Appendix 1, main appendices

Appendix C Segment Alternatives from Analysis











Minor Arterial without Median/Center Lane Separated Cycle Track through Development