



TECHNICAL MEMORANDUM

DATE: October 22, 2021

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SUBJECT: Stafford Road/65th Avenue/Elligsen Road
Temporary Traffic Signal Analysis

P18197-013

PROJECT BACKGROUND

A temporary traffic signal at Stafford Road/65th Avenue/Elligsen Road is proposed as part of the Boeckman Road Dip Improvement project to mitigate vehicle delays related to detoured traffic from the Boeckman Road closure during construction (see figure to right). Coordination on the temporary traffic signal layout and phasing has been initiated with Clackamas County and Washington County so that the City of Wilsonville can receive approval from both agencies to design and install the temporary traffic signal.



Based on feedback from Clackamas County and Washington County, below are the recommendations for the temporary traffic signal:

1. Contractor constructs signal to Clackamas County/Washington County standards.
2. Clackamas County operates traffic signal with feedback from Washington County.
3. Contractor is responsible to maintain signal during Boeckman Dip project with direction from Clackamas County.

The study roadways (65th Avenue, Elligsen Road and Safford Road) are all under county jurisdiction. This memorandum contains a signal warrant analysis, operations analysis with the temporary traffic signal, and the proposed phasing and timing.

SIGNAL WARRANT ANALYSIS

The Stafford Road/65th Avenue/Elligsen Road geometric configuration is two closely spaced “T-intersections”, which are currently unsignalized with stop signs on the minor street approaches. See the figure below:



The intersections were evaluated to determine if the existing volumes (under normal conditions, no detour traffic) meet the signal warrants identified in the Manual on Uniform Traffic Control Devices

(MUTCD)¹. The MUTCD traffic signal warrants that were evaluated in this analysis are listed below. If any of the warrants are met, then a traffic signal is justified.

- Warrant #1: Eight-Hour Vehicular Volume
- Warrant #2: Four-Hour Vehicular Volume
- Warrant #3: Peak Hour

The warrant analysis was conducted using 24-hour tube count data from 2016 provided by Clackamas County. No detour traffic volumes were added to these traffic counts used for the signal warrant analysis. A reduction of minor street right turn volumes was calculated using HCM 2000 methodology for right-turn-on-red (RTOR) reductions. This was done in accordance with MUTCD guidance for signal warrant analysis.² The RTOR reduction for the 65th Avenue approach to Stafford Road was calculated to be small (7.5%) and the reduction for the Elligsen Road approach to 65th Avenue was calculated to be higher (55%). The Stafford Road/65th Avenue/Elligsen Road intersections met the three evaluated signal warrants, justifying the installation of a traffic signal under typical 2016 conditions. Because the detour traffic will increase vehicle volumes at the intersection, a traffic signal is also warranted under detour conditions.

TABLE 1: TRAFFIC SIGNAL WARRANT ANALYSIS RESULTS (2016, TYPICAL CONDITIONS)

STUDY INTERSECTION	WARRANT #1 EIGHT-HOUR VEHICULAR VOLUME	WARRANT #2 FOUR-HOUR VEHICULAR VOLUME	WARRANT #3 PEAK HOUR
STAFFORD RD/65TH AVE/ELIGSEN RD	YES	YES	YES

For the Eight-Hour Vehicular Volume warrant to be met, eight hours of volume data at the study intersections must meet the criteria of Condition A, Condition B, or a combination of Condition A and Condition B. For the Four-Hour Vehicular Volume warrant to be met, four hours of volume data must sit above the curve presented in Figure 4C-1 of the MUTCD. For the Peak Hour warrant to be met, at least one of the hours of vehicle volume must sit above the curve presented in Figure 4C-3 of the MUTCD. See the appendix for the full traffic signal warrant analysis data.

¹ Chapter 4C, Manual on Uniform Traffic Control Devices, FHWA, 2009.

² Section 4C.01,08, Manual on Uniform Traffic Control Devices, FHWA, 2009.

TRAFFIC ANALYSIS

This section presents the findings of the traffic analysis of the Stafford Road/65th Avenue/Elligsen Road intersections. The intersection operations were conducted for the PM peak hour for four different scenarios:

- 2021 Existing Conditions
- 2023 Future Conditions with Detour (Two-way Stop Controlled)
- 2023 Future Conditions with Detour (Temporary Traffic Signal)
- 2023 Future Conditions No Detour (Temporary Traffic Signal)

TRAFFIC VOLUMES

Traffic volumes from a previous traffic analysis³ for the Boeckman Road Dip detour were utilized for the intersection operations analysis in this report for the Stafford Road/65th Avenue intersection. For the Elligsen Road/65th Avenue intersection, historic 2019 traffic counts were utilized. The 2019 volumes were grown to 2021 conditions using average growth rates calculated from the Wilsonville Travel Demand Model. The raw traffic count data for the two “T-intersections” are provided in the Appendix.

REQUIRED OPERATING STANDARDS

The Stafford Road/65th Avenue study intersection is owned and maintained by Clackamas County, and therefore must meet the County’s operating standards. Clackamas County requires unsignalized intersections to function at LOS E or better during the AM and PM peak hours. For signalized and roundabout intersections, the volume-to-capacity (v/c) ratio must be 0.90 or less during the AM and PM peak hours.⁴

The 65th Avenue/Elligsen Road study intersection is owned and maintained by Washington County, and therefore must meet the County’s operating standards. The target standard and acceptable standard for rural areas is 0.90 v/c and LOS D in Washington County.⁵

OPERATING CONDITIONS

Existing (2021) and future (2023) traffic operations at the Stafford Road/65th Avenue/Elligsen Road intersections were determined for the PM peak hours based on the Highway Capacity Manual (HCM) 6th Edition methodology for signalized and unsignalized intersections.⁶

³ Wilsonville Boeckman Road Dip Detour - Traffic Study, DKS Associates, June 17, 2019.

⁴ Table 5-2b, Clackamas County Comprehensive Plan, Amended January 18, 2017.

⁵ Table 4, Washington County Transportation System Plan, Effective September 26, 2019.

⁶ Highway Capacity Manual, 6th Edition, Transportation Research Board, 2016.

Table 2 below lists the estimated v/c ratio, delay, and LOS for the Stafford Road/65th Avenue/Elligsen Road intersections under the four analysis scenarios.

TABLE 2: STAFFORD RD/65TH AVENUE INTERSECTION OPERATIONS

ALTERNATIVE	TRAFFIC CONTROL	INTERSECTION	OPERATING STANDARD	PM PEAK HOUR		
				V/C RATIO	DELAY (SECS)	LOS
2021 EXISTING	TWSC	Stafford Rd/65th Ave	LOS D	4.23	>300	B/F
		65th Ave/Elligsen Rd	LOS D	0.83	51.4	B/F
2023 DETOUR	TWSC	Stafford Rd/65th Ave	LOS D	17.2	>300	C/F
		65th Ave/Elligsen Rd	LOS D	2.66	>300	C/F
2023 DETOUR	TRAFFIC SIGNAL	Stafford Rd/65th Ave	v/c ≤ 0.90	1.39	168.4	F
		65th Ave/Elligsen Rd	v/c ≤ 0.90	1.54	241.3	F
2023 NO DETOUR	TRAFFIC SIGNAL	Stafford Rd/65th Ave	v/c ≤ 0.90	1.05	122.6	F
		65th Ave/Elligsen Rd	v/c ≤ 0.90	1.13	87.7	F

TWO-WAY STOP CONTROLLED (TWSC) INTERSECTION:

Delay = Worst Movement Delay (secs)
v/c = Associated Movement Volume-to-Capacity Ratio
LOS = Level of Service (Major/Minor Road)

SIGNALIZED INTERSECTION:

Delay = Average Delay (secs) of Intersection
v/c = Average Volume-to-Capacity Ratio of Intersection
LOS = Level of Service of Intersection

Bold/Highlighted = Does not meet the County’s operating standard

As shown, the intersections still fail to meet the County’s operating standards even with the temporary traffic signal during the 2023 Detour scenario. However, the average delay and v/c ratio are significantly improved from the scenarios with the two-way stop control. Also, the operations are shown to improve even further after the detour traffic is removed but the traffic signal remains in 2023.

QUEUING

As shown in Table 2, the two intersections are estimated to be 39% - 54% over capacity in 2023 during the traffic detour with the signal in place. Under these constrained conditions, SimTraffic does not provide an accurate estimate of vehicle queuing. However, based on the vehicle volumes and the introduction of signal controlled approaches, there will be the potential for end of queue exposure on the Stafford Road approaches.



The figure to the right shows the existing southbound vehicle queue on 65th Avenue during the PM peak hour. With the introduction of the signals at the two intersections, the southbound queues and average vehicle delay on 65th Avenue as it approaches Stafford Road should be reduced.

SAFETY BENEFITS

The conversion of a stop-controlled intersection into a signalized intersection in an urban area can reduce angle crashes by up to 67% but will typically increase rear-end crashes by up to 143%.⁷ This increase in rear-ends is caused by the introduction of the red light to the major street approaches where there had previously been no traffic control. However, the signal provides vehicles on the minor streets dedicated green time to advance through the intersection without taking risky gaps in major street traffic that would be expected with the long stop-controlled delays, reducing the number of angle collisions. Additionally, warning signage, careful signal head placement, and a queue warning system should all be considered for installation on the major road approaches in advance of the traffic signal to notify drivers of the new traffic control. Both Counties and the City will have opportunities to review these suggested safety enhancements during the design process.

Based on the most recent 5 years of available crash data (2015 – 2019), there has been a total of 31 crashes in the vicinity of the study intersections. Of the 31 total crashes, one serious injury crash and 5 minor injury crashes occurred. The serious injury, turning/angle crash occurred in 2017 and involved a vehicle that failed to yield to major street traffic as it was turning left from 65th Avenue onto Stafford Road.

Approximately 40% (13) of the crashes were turning/angle related and 30% (10) were fixed object crashes. Only 15% (5) crashes were rear-end collisions. The fixed objects that were hit were most often the guardrail or ditch along 65th Avenue between Stafford Road and Elligsen Road.

⁷ CMF ID: 323 and CMF ID: 324, Federal Highway Administration, CMFClearinghouse.org.

TRAFFIC SIGNAL PHASING AND TIMING

Due to the expected high volume of detoured vehicles, the close proximity of the two intersections (160 feet), and the proposed change in traffic control, it will be crucial to move vehicles efficiently through the short segment of SW 65th Avenue between SW Stafford Road and SW Elligsen Road. As a result, some unique signal phasing is proposed. The two intersections Elligsen Road/65th Avenue and Stafford Road/65th Avenue will use standard signal phasing assignments while the northbound left/thru maneuver on SW 65th at SW Elligsen will require the use of an overlap phase that coincides with the ingress and egress of traffic to/from the Stafford Road/65th Avenue intersection. A 150 second cycle length is anticipated to be needed to utilize all of the signal phasing assignments to operate the closely spaced intersections.

The temporary traffic signals include pedestrian phasing. Although there is no existing pedestrian infrastructure in the area, a design exception would be required if full ADA pedestrian accommodations were not included with the temporary traffic signals. Further discussion between Clackamas County, Washington County, and City of Wilsonville staff for pedestrian accommodations is needed.

The proposed signal phasing and timing has been coordinated with Washington County staff and Clackamas County staff. Refer to the appendix for the traffic signal phasing diagram.

SUMMARY

A summary of findings from the temporary traffic signal analysis is provided below for the Stafford Road/65th Avenue/Elligsen Road intersections.

- A traffic signal warrant analysis for the Stafford Road/65th Avenue/Elligsen Road intersections showed that the installation of a traffic signal is justified based on 2019 vehicle volumes under typical conditions (no detour). With the Boeckman Road detour, traffic volumes would be higher and continue to justify a traffic signal.
- Under 2023 detour conditions with the existing stop-controlled approaches, the intersections fail to meet the Counties' operating standards.
- Under 2023 detour conditions with the temporary traffic signals, the intersections still fail to meet the Counties' operating standards. However, the operations are significantly improved from the scenarios with the two-way stop control.
- The temporary traffic signal provides safer, dedicated turning opportunities for vehicles on the side streets, reducing the number of angle collisions (up to 67%). Although, rear-end collisions may increase with the introduction of a traffic signal on the major street, warning signage can be installed on the major road approaches in advance of the traffic signal to notify drivers of the new traffic control to mitigate this safety issue.
- The temporary traffic signal phasing and timing were designed to maximize operations by the use of overlap phasing. The phasing and timing was coordinated with Washington County and Clackamas County staff.

Attachments:

- A. Traffic Signal Warrant Data
- B. 2019 Traffic Count Data
- C. HCM Reports – 2021 Existing Conditions
- D. HCM Reports – 2023 Detour Conditions (TWSC)
- E. HCM Reports – 2023 Detour Conditions (Temporary Traffic Signal)
- F. HCM Reports – 2023 No Detour Conditions (Temporary Traffic Signal)
- G. Temporary Traffic Signal Phasing Diagram
- H. Email Correspondence with Washington County and Clackamas County

Study Name Stafford & 65th
Start Date Wednesday, August 31, 2016 12:00 AM
End Date Thursday, September 01, 2016 12:00 AM
Site Code

Road Volumes

TMV Interval	Movement Southbound	Northbound	Southeastbound	Grand Total
8/31/2016	5	6	2	13
Motorcycles	0	0	0	0
Cars	5	6	2	13
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 0:15	5	5	4	14
Motorcycles	0	0	0	0
Cars	5	5	4	14
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 0:30	2	3	3	8
Motorcycles	0	0	0	0
Cars	2	3	3	8
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 0:45	1	0	2	3
Motorcycles	0	0	0	0
Cars	1	0	2	3
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 1:00	2	0	1	3
Motorcycles	0	0	0	0
Cars	2	0	1	3
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0

2016 ADT_Stafford Rd/65th Ave

Bicycles on Road	0	0	0	0
8/31/2016 1:15	3	0	0	3
Motorcycles	0	0	0	0
Cars	3	0	0	3
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 1:30	3	4	4	11
Motorcycles	0	0	0	0
Cars	3	4	4	11
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 1:45	4	0	2	6
Motorcycles	0	0	0	0
Cars	4	0	2	6
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 2:00	0	0	3	3
Motorcycles	0	0	0	0
Cars	0	0	3	3
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 2:15	0	0	1	1
Motorcycles	0	0	0	0
Cars	0	0	1	1
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 2:30	1	3	2	6
Motorcycles	0	0	0	0
Cars	1	3	2	6
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0

2016 ADT_Stafford Rd/65th Ave

8/31/2016 2:45	1	0	3	4
Motorcycles	0	0	0	0
Cars	0	0	3	3
Light Goods Vehicles	1	0	0	1
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 3:00	1	2	2	5
Motorcycles	0	0	0	0
Cars	1	2	2	5
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 3:15	1	3	3	7
Motorcycles	0	0	0	0
Cars	1	3	3	7
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 3:30	2	4	2	8
Motorcycles	0	0	0	0
Cars	2	4	2	8
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 3:45	1	2	2	5
Motorcycles	0	0	0	0
Cars	1	2	2	5
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 4:00	4	5	0	9
Motorcycles	0	0	0	0
Cars	4	5	0	9
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 4:15	0	6	3	9

2016 ADT_Stafford Rd/65th Ave

Motorcycles	0	0	0	0
Cars	0	6	3	9
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 4:30	4	12	1	17
Motorcycles	0	0	0	0
Cars	4	12	1	17
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 4:45	6	9	2	17
Motorcycles	0	0	0	0
Cars	4	9	2	15
Light Goods Vehicles	2	0	0	2
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 5:00	6	13	1	20
Motorcycles	0	0	0	0
Cars	6	11	1	18
Light Goods Vehicles	0	1	0	1
Buses	0	0	0	0
Single-Unit Trucks	0	1	0	1
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 5:15	8	20	3	31
Motorcycles	0	0	0	0
Cars	8	19	3	30
Light Goods Vehicles	0	1	0	1
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 5:30	17	37	2	56
Motorcycles	0	0	0	0
Cars	17	32	2	51
Light Goods Vehicles	0	5	0	5
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 5:45	16	30	9	55
Motorcycles	0	0	0	0

2016 ADT_Stafford Rd/65th Ave

Cars	16	28	8	52
Light Goods Vehicles	0	2	1	3
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 6:00	26	37	13	76
Motorcycles	0	0	0	0
Cars	17	33	11	61
Light Goods Vehicles	7	4	1	12
Buses	0	0	0	0
Single-Unit Trucks	2	0	1	3
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 6:15	25	47	4	76
Motorcycles	0	0	0	0
Cars	20	39	4	63
Light Goods Vehicles	5	7	0	12
Buses	0	0	0	0
Single-Unit Trucks	0	1	0	1
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 6:30	48	93	23	164
Motorcycles	0	1	0	1
Cars	40	82	14	136
Light Goods Vehicles	7	10	8	25
Buses	0	0	0	0
Single-Unit Trucks	1	0	0	1
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	1	1
8/31/2016 6:45	58	92	30	180
Motorcycles	1	0	0	1
Cars	46	80	24	150
Light Goods Vehicles	10	11	6	27
Buses	0	0	0	0
Single-Unit Trucks	1	0	0	1
Articulated Trucks	0	1	0	1
Bicycles on Road	0	0	0	0
8/31/2016 7:00	58	142	31	231
Motorcycles	0	0	0	0
Cars	47	114	19	180
Light Goods Vehicles	9	26	9	44
Buses	0	0	1	1
Single-Unit Trucks	2	1	2	5
Articulated Trucks	0	1	0	1
Bicycles on Road	0	0	0	0
8/31/2016 7:15	74	136	36	246
Motorcycles	0	1	1	2
Cars	56	117	25	198

2016 ADT_Stafford Rd/65th Ave

Light Goods Vehicles	17	18	7	42
Buses	0	0	3	3
Single-Unit Trucks	0	0	0	0
Articulated Trucks	1	0	0	1
Bicycles on Road	0	0	0	0
8/31/2016 7:30	72	148	46	266
Motorcycles	0	0	0	0
Cars	62	134	28	224
Light Goods Vehicles	9	13	11	33
Buses	0	0	3	3
Single-Unit Trucks	0	1	3	4
Articulated Trucks	1	0	1	2
Bicycles on Road	0	0	0	0
8/31/2016 7:45	73	141	43	257
Motorcycles	0	0	0	0
Cars	60	125	31	216
Light Goods Vehicles	11	14	11	36
Buses	0	1	1	2
Single-Unit Trucks	2	1	0	3
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 8:00	84	112	35	231
Motorcycles	1	0	0	1
Cars	68	91	24	183
Light Goods Vehicles	14	16	8	38
Buses	0	1	0	1
Single-Unit Trucks	1	3	2	6
Articulated Trucks	0	1	1	2
Bicycles on Road	0	0	0	0
8/31/2016 8:15	65	87	45	197
Motorcycles	0	0	0	0
Cars	55	72	24	151
Light Goods Vehicles	9	14	19	42
Buses	0	0	0	0
Single-Unit Trucks	0	1	2	3
Articulated Trucks	1	0	0	1
Bicycles on Road	0	0	0	0
8/31/2016 8:30	59	80	77	216
Motorcycles	0	0	1	1
Cars	49	64	57	170
Light Goods Vehicles	8	11	19	38
Buses	0	0	0	0
Single-Unit Trucks	2	3	0	5
Articulated Trucks	0	2	0	2
Bicycles on Road	0	0	0	0
8/31/2016 8:45	87	119	79	285
Motorcycles	0	0	0	0
Cars	68	103	53	224
Light Goods Vehicles	18	13	20	51

2016 ADT_Stafford Rd/65th Ave

Buses	0	0	0	0
Single-Unit Trucks	0	2	5	7
Articulated Trucks	1	1	1	3
Bicycles on Road	0	0	0	0
8/31/2016 9:00	73	153	77	303
Motorcycles	1	2	0	3
Cars	57	113	58	228
Light Goods Vehicles	12	32	14	58
Buses	1	0	0	1
Single-Unit Trucks	1	5	5	11
Articulated Trucks	1	1	0	2
Bicycles on Road	0	0	0	0
8/31/2016 9:15	82	159	69	310
Motorcycles	0	0	0	0
Cars	65	119	49	233
Light Goods Vehicles	14	32	16	62
Buses	1	0	0	1
Single-Unit Trucks	2	6	4	12
Articulated Trucks	0	2	0	2
Bicycles on Road	0	0	0	0
8/31/2016 9:30	98	176	65	339
Motorcycles	1	2	0	3
Cars	70	149	42	261
Light Goods Vehicles	22	23	18	63
Buses	0	0	0	0
Single-Unit Trucks	4	2	5	11
Articulated Trucks	1	0	0	1
Bicycles on Road	0	0	0	0
8/31/2016 9:45	108	168	47	323
Motorcycles	0	0	0	0
Cars	81	130	34	245
Light Goods Vehicles	23	29	11	63
Buses	1	0	1	2
Single-Unit Trucks	2	5	1	8
Articulated Trucks	1	4	0	5
Bicycles on Road	0	0	0	0
8/31/2016 10:00	110	175	61	346
Motorcycles	0	0	0	0
Cars	82	143	36	261
Light Goods Vehicles	22	22	20	64
Buses	0	0	0	0
Single-Unit Trucks	5	5	5	15
Articulated Trucks	1	5	0	6
Bicycles on Road	0	0	0	0
8/31/2016 10:15	74	142	64	280
Motorcycles	0	7	0	7
Cars	66	110	46	222
Light Goods Vehicles	6	20	14	40
Buses	1	2	0	3

2016 ADT_Stafford Rd/65th Ave

Single-Unit Trucks	1	3	3	7
Articulated Trucks	0	0	1	1
Bicycles on Road	0	0	0	0
8/31/2016 10:30	58	112	63	233
Motorcycles	1	0	0	1
Cars	45	85	41	171
Light Goods Vehicles	8	21	19	48
Buses	1	1	1	3
Single-Unit Trucks	2	5	2	9
Articulated Trucks	1	0	0	1
Bicycles on Road	0	0	0	0
8/31/2016 10:45	60	104	73	237
Motorcycles	0	0	0	0
Cars	48	81	47	176
Light Goods Vehicles	12	20	21	53
Buses	0	0	0	0
Single-Unit Trucks	0	3	5	8
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 11:00	53	88	41	182
Motorcycles	0	0	0	0
Cars	41	73	33	147
Light Goods Vehicles	9	12	7	28
Buses	0	0	0	0
Single-Unit Trucks	2	2	1	5
Articulated Trucks	1	1	0	2
Bicycles on Road	0	0	0	0
8/31/2016 11:15	72	60	71	203
Motorcycles	0	0	0	0
Cars	59	50	56	165
Light Goods Vehicles	9	9	14	32
Buses	0	0	0	0
Single-Unit Trucks	4	1	1	6
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 11:30	91	62	74	227
Motorcycles	0	0	0	0
Cars	74	51	59	184
Light Goods Vehicles	16	9	14	39
Buses	0	0	0	0
Single-Unit Trucks	1	1	1	3
Articulated Trucks	0	1	0	1
Bicycles on Road	0	0	0	0
8/31/2016 11:45	65	51	52	168
Motorcycles	0	0	0	0
Cars	55	42	38	135
Light Goods Vehicles	8	9	13	30
Buses	1	0	0	1
Single-Unit Trucks	1	0	1	2

2016 ADT_Stafford Rd/65th Ave

Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 12:00	50	57	39	146
Motorcycles	0	0	0	0
Cars	43	53	36	132
Light Goods Vehicles	5	4	3	12
Buses	1	0	0	1
Single-Unit Trucks	1	0	0	1
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 12:15	44	65	69	178
Motorcycles	0	0	0	0
Cars	37	51	55	143
Light Goods Vehicles	6	13	14	33
Buses	0	0	0	0
Single-Unit Trucks	1	1	0	2
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 12:30	55	58	69	182
Motorcycles	0	0	0	0
Cars	45	40	55	140
Light Goods Vehicles	9	16	12	37
Buses	0	0	0	0
Single-Unit Trucks	1	2	2	5
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 12:45	72	66	60	198
Motorcycles	0	1	0	1
Cars	61	54	50	165
Light Goods Vehicles	9	11	9	29
Buses	0	0	0	0
Single-Unit Trucks	2	0	1	3
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 13:00	60	58	59	177
Motorcycles	0	0	0	0
Cars	49	45	49	143
Light Goods Vehicles	11	11	8	30
Buses	0	0	0	0
Single-Unit Trucks	0	2	2	4
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 13:15	55	59	68	182
Motorcycles	0	0	1	1
Cars	45	46	56	147
Light Goods Vehicles	8	11	10	29
Buses	0	0	1	1
Single-Unit Trucks	2	2	0	4
Articulated Trucks	0	0	0	0

2016 ADT_Stafford Rd/65th Ave

Bicycles on Road	0	0	0	0
8/31/2016 13:30	79	57	51	187
Motorcycles	0	0	0	0
Cars	64	40	45	149
Light Goods Vehicles	15	15	2	32
Buses	0	0	3	3
Single-Unit Trucks	0	2	1	3
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 13:45	50	52	57	159
Motorcycles	1	0	0	1
Cars	42	47	47	136
Light Goods Vehicles	6	5	9	20
Buses	0	0	0	0
Single-Unit Trucks	1	0	1	2
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 14:00	51	68	57	176
Motorcycles	0	0	0	0
Cars	43	55	48	146
Light Goods Vehicles	7	13	9	29
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	1	0	0	1
Bicycles on Road	0	0	0	0
8/31/2016 14:15	73	56	66	195
Motorcycles	0	0	0	0
Cars	62	49	51	162
Light Goods Vehicles	10	7	13	30
Buses	0	0	0	0
Single-Unit Trucks	0	0	1	1
Articulated Trucks	1	0	1	2
Bicycles on Road	0	0	0	0
8/31/2016 14:30	67	79	88	234
Motorcycles	0	0	0	0
Cars	61	54	66	181
Light Goods Vehicles	5	22	21	48
Buses	0	0	0	0
Single-Unit Trucks	1	3	1	5
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 14:45	56	71	102	229
Motorcycles	0	0	0	0
Cars	44	59	87	190
Light Goods Vehicles	11	10	15	36
Buses	0	0	0	0
Single-Unit Trucks	1	2	0	3
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0

2016 ADT_Stafford Rd/65th Ave

8/31/2016 15:00	75	94	118	287
Motorcycles	0	0	0	0
Cars	61	73	103	237
Light Goods Vehicles	10	19	15	44
Buses	0	0	0	0
Single-Unit Trucks	2	2	0	4
Articulated Trucks	2	0	0	2
Bicycles on Road	0	0	0	0
8/31/2016 15:15	87	108	91	286
Motorcycles	0	0	2	2
Cars	71	91	76	238
Light Goods Vehicles	10	15	13	38
Buses	1	0	0	1
Single-Unit Trucks	3	1	0	4
Articulated Trucks	1	1	0	2
Bicycles on Road	1	0	0	1
8/31/2016 15:30	75	111	100	286
Motorcycles	1	1	0	2
Cars	63	94	82	239
Light Goods Vehicles	10	15	14	39
Buses	0	0	0	0
Single-Unit Trucks	1	1	2	4
Articulated Trucks	0	0	2	2
Bicycles on Road	0	0	0	0
8/31/2016 15:45	97	112	92	301
Motorcycles	0	0	0	0
Cars	71	100	73	244
Light Goods Vehicles	22	11	19	52
Buses	0	0	0	0
Single-Unit Trucks	4	0	0	4
Articulated Trucks	0	1	0	1
Bicycles on Road	0	0	0	0
8/31/2016 16:00	127	130	104	361
Motorcycles	0	0	1	1
Cars	107	114	90	311
Light Goods Vehicles	20	16	13	49
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 16:15	113	114	104	331
Motorcycles	1	1	0	2
Cars	92	93	90	275
Light Goods Vehicles	15	18	13	46
Buses	0	0	1	1
Single-Unit Trucks	4	2	0	6
Articulated Trucks	1	0	0	1
Bicycles on Road	0	0	0	0
8/31/2016 16:30	142	134	87	363

2016 ADT_Stafford Rd/65th Ave

Motorcycles	0	0	0	0
Cars	117	112	80	309
Light Goods Vehicles	22	21	5	48
Buses	0	0	0	0
Single-Unit Trucks	3	0	1	4
Articulated Trucks	0	1	1	2
Bicycles on Road	0	0	0	0
8/31/2016 16:45	135	138	106	379
Motorcycles	2	1	1	4
Cars	118	117	90	325
Light Goods Vehicles	12	19	14	45
Buses	0	0	0	0
Single-Unit Trucks	3	1	1	5
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 17:00	162	143	95	400
Motorcycles	0	0	0	0
Cars	146	121	82	349
Light Goods Vehicles	15	18	13	46
Buses	0	1	0	1
Single-Unit Trucks	0	3	0	3
Articulated Trucks	1	0	0	1
Bicycles on Road	0	0	0	0
8/31/2016 17:15	176	145	99	420
Motorcycles	0	0	0	0
Cars	154	122	79	355
Light Goods Vehicles	21	22	19	62
Buses	0	0	0	0
Single-Unit Trucks	1	1	0	2
Articulated Trucks	0	0	1	1
Bicycles on Road	0	0	0	0
8/31/2016 17:30	142	116	117	375
Motorcycles	0	0	0	0
Cars	128	95	107	330
Light Goods Vehicles	14	21	9	44
Buses	0	0	0	0
Single-Unit Trucks	0	0	1	1
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 17:45	137	111	116	364
Motorcycles	0	0	0	0
Cars	119	92	104	315
Light Goods Vehicles	16	18	10	44
Buses	0	0	0	0
Single-Unit Trucks	2	0	2	4
Articulated Trucks	0	1	0	1
Bicycles on Road	0	0	0	0
8/31/2016 18:00	98	88	77	263
Motorcycles	1	0	0	1

2016 ADT_Stafford Rd/65th Ave

Cars	84	76	74	234
Light Goods Vehicles	12	12	2	26
Buses	0	0	0	0
Single-Unit Trucks	1	0	0	1
Articulated Trucks	0	0	1	1
Bicycles on Road	0	0	0	0
8/31/2016 18:15	93	96	57	246
Motorcycles	0	0	0	0
Cars	80	83	54	217
Light Goods Vehicles	13	13	2	28
Buses	0	0	0	0
Single-Unit Trucks	0	0	1	1
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 18:30	77	76	54	207
Motorcycles	0	0	0	0
Cars	65	65	52	182
Light Goods Vehicles	10	11	2	23
Buses	0	0	0	0
Single-Unit Trucks	2	0	0	2
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 18:45	58	72	55	185
Motorcycles	0	0	0	0
Cars	53	61	45	159
Light Goods Vehicles	5	11	10	26
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 19:00	42	49	54	145
Motorcycles	0	0	3	3
Cars	37	45	46	128
Light Goods Vehicles	5	4	5	14
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 19:15	35	42	41	118
Motorcycles	0	0	0	0
Cars	30	34	36	100
Light Goods Vehicles	4	7	5	16
Buses	0	0	0	0
Single-Unit Trucks	1	1	0	2
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 19:30	41	38	36	115
Motorcycles	0	0	0	0
Cars	36	30	30	96

2016 ADT_Stafford Rd/65th Ave

Light Goods Vehicles	5	8	6	19
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 19:45	26	35	36	97
Motorcycles	0	0	0	0
Cars	25	32	31	88
Light Goods Vehicles	1	3	4	8
Buses	0	0	0	0
Single-Unit Trucks	0	0	1	1
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 20:00	21	39	39	99
Motorcycles	0	0	0	0
Cars	20	37	37	94
Light Goods Vehicles	1	2	2	5
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 20:15	36	30	33	99
Motorcycles	0	0	0	0
Cars	33	28	31	92
Light Goods Vehicles	3	2	1	6
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	1	1
Bicycles on Road	0	0	0	0
8/31/2016 20:30	37	39	31	107
Motorcycles	0	0	0	0
Cars	36	38	31	105
Light Goods Vehicles	1	1	0	2
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 20:45	46	30	19	95
Motorcycles	0	0	0	0
Cars	46	30	19	95
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 21:00	35	18	12	65
Motorcycles	0	0	0	0
Cars	31	17	12	60
Light Goods Vehicles	4	1	0	5

2016 ADT_Stafford Rd/65th Ave

Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 21:15	26	23	25	74
Motorcycles	0	0	0	0
Cars	25	22	25	72
Light Goods Vehicles	1	0	0	1
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	1	0	1
Bicycles on Road	0	0	0	0
8/31/2016 21:30	16	21	11	48
Motorcycles	0	0	0	0
Cars	16	20	11	47
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	1	0	1
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 21:45	10	10	11	31
Motorcycles	0	0	0	0
Cars	10	10	11	31
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 22:00	16	12	15	43
Motorcycles	0	0	0	0
Cars	15	12	15	42
Light Goods Vehicles	1	0	0	1
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 22:15	22	10	12	44
Motorcycles	0	0	0	0
Cars	22	10	12	44
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 22:30	12	10	9	31
Motorcycles	0	0	0	0
Cars	12	10	9	31
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0

2016 ADT_Stafford Rd/65th Ave

Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 22:45	9	13	6	28
Motorcycles	0	0	0	0
Cars	9	13	6	28
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 23:00	6	10	13	29
Motorcycles	0	0	0	0
Cars	6	10	13	29
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 23:15	4	4	5	13
Motorcycles	0	0	0	0
Cars	4	4	5	13
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 23:30	5	9	5	19
Motorcycles	0	0	0	0
Cars	5	9	5	19
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
8/31/2016 23:45	4	2	1	7
Motorcycles	0	0	0	0
Cars	4	2	1	7
Light Goods Vehicles	0	0	0	0
Buses	0	0	0	0
Single-Unit Trucks	0	0	0	0
Articulated Trucks	0	0	0	0
Bicycles on Road	0	0	0	0
Grand Total	4721	5826	3947	14494

Hour	Major St (Stafford)	Minor St (65th)
12:00 AM	27	11
1:00 AM	16	7
2:00 AM	5	9
3:00 AM	16	9
4:00 AM	46	6
5:00 AM	147	15
6:00 AM	426	70
7:00 AM	844	156
8:00 AM	693	236
9:00 AM	1017	258
10:00 AM	835	261
11:00 AM	542	238
12:00 PM	467	237
1:00 PM	470	235
2:00 PM	521	313
3:00 PM	759	401
4:00 PM	1033	401
5:00 PM	1132	427
6:00 PM	658	243
7:00 PM	308	167
8:00 PM	278	122
9:00 PM	159	59
10:00 PM	104	42
11:00 PM	44	24
	10547	3947

Posted Speed is 45 mph on Stafford Rd

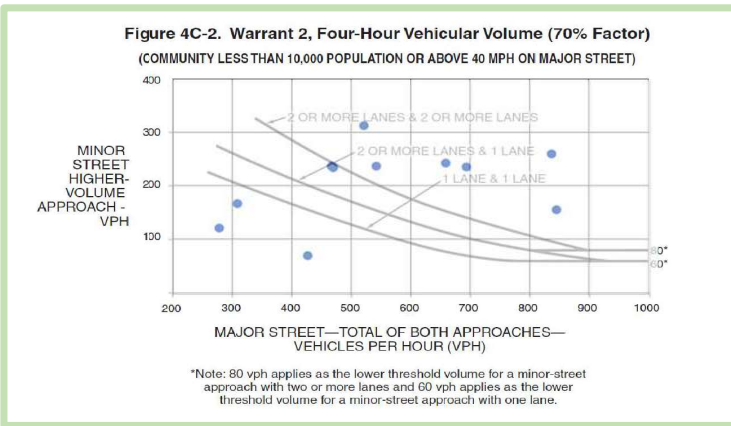
Posted Speed is 45 mph on 65th Avenue

WARRANT #1 YES

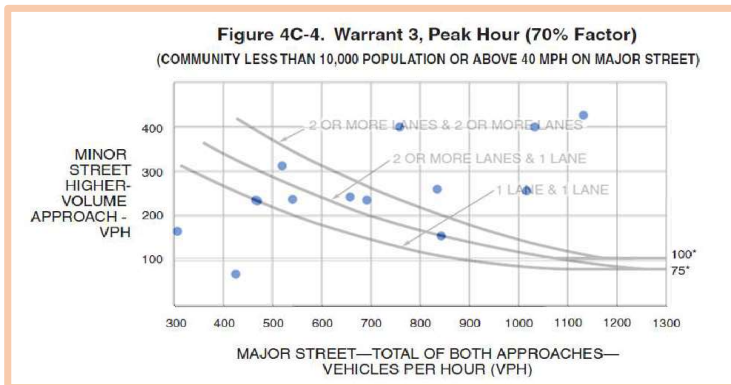
Any of the three conditions below may be met to satisfy Eight-Hour Signal Warrant

	Major (1 lane)	Minor (1 lane)	Condition	Condition Met?
Condition A (70%)	350	105	Need 8 hours of condition A	Yes
Condition B (70%)	525	53	Need 8 hours of condition B	Yes
Condition A (56%)	280	84	8 hours each condition for both conditions	Yes
Condition B (56%)	420	42		Yes

WARRANT #2 YES



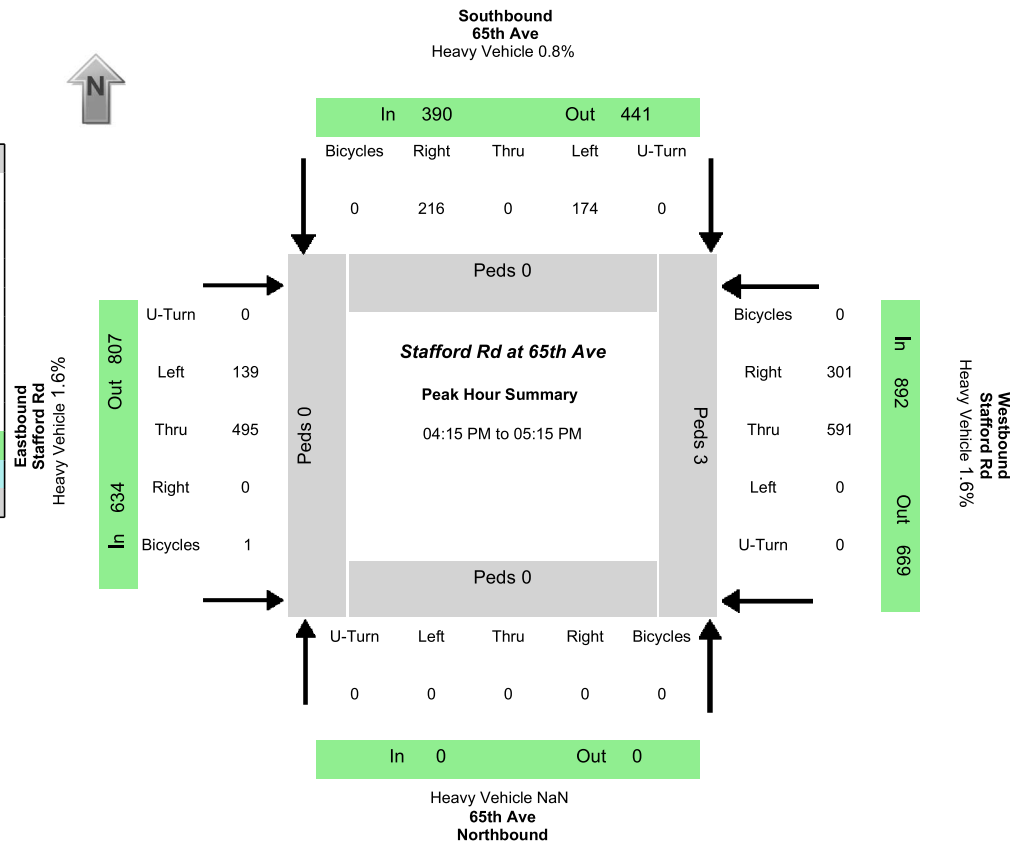
WARRANT #3 YES





KEY DATA NETWORK

Data Provided by K-D-N.com 503-594-4224	
N/S street	65th Ave
E/W street	Stafford Rd
City, State	Wilsonville OR
Site Notes	
Location	45.335919 - -122.74347
Start Date	Thursday, May 09, 2019
Start Time	04:00:00 PM
Weather	
Study ID #	
Peak Hour Start	04:15:00 PM
Peak 15 Min Start	05:00:00 PM
PHF (15-Min Int)	0.84



Peak-Hour Volumes (PHV)																							
Northbound				Southbound				Eastbound				Westbound				Entering				Leaving			
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	NB	SB	EB	WB	NB	SB	EB	WB
0	0	0	0	174	0	216	0	139	495	0	0	0	591	301	0	0	390	634	892	0	440	807	669
Percent Heavy Vehicles																							
0.0%	0.0%	0.0%	0.0%	1.1%	0.0%	0.5%	0.0%	4.3%	0.8%	0.0%	0.0%	0.0%	1.0%	2.7%	0.0%	NaN	0.8%	1.6%	1.6%	NaN	3.2%	0.9%	0.9%

PHV - Bicycles														PHV - Pedestrians							
Northbound				Southbound				Eastbound				Westbound				Sum	in Crosswalk				Sum
Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn		NB	SB	EB	WB	
0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	3	3

Time	Northbound 65th Ave				Southbound 65th Ave				Eastbound Stafford Rd				Westbound Stafford Rd				15 Min Sum	1 HR Sum
	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn	Left	Thru	Right	Uturn		
04:00:00 PM	0	0	0	0	24	0	23	0	5	29	0	0	0	25	20	0		
04:05:00 PM	0	0	0	0	12	0	16	0	10	33	0	0	0	49	19	0		
04:10:00 PM	0	0	0	0	14	0	15	0	11	28	0	0	0	34	21	0	388	
04:15:00 PM	0	0	0	0	19	0	23	0	8	40	0	0	0	35	20	0	407	
04:20:00 PM	0	0	0	0	8	0	10	0	14	32	0	0	0	43	14	0	389	
04:25:00 PM	0	0	0	0	15	0	19	0	12	41	0	0	0	49	22	0	424	
04:30:00 PM	0	0	0	0	19	0	19	0	6	46	0	0	0	50	24	0	443	
04:35:00 PM	0	0	0	0	9	0	12	0	9	36	0	0	0	39	27	0	454	
04:40:00 PM	0	0	0	0	14	0	19	0	10	31	0	0	0	35	27	0	432	
04:45:00 PM	0	0	0	0	10	0	15	0	11	33	0	0	0	54	25	0	416	
04:50:00 PM	0	0	0	0	13	0	19	0	10	33	0	0	0	50	31	0	440	
04:55:00 PM	0	0	0	0	9	0	14	0	16	53	0	0	0	63	31	0	490	1734
05:00:00 PM	0	0	0	0	14	0	20	0	12	32	0	0	0	34	23	0	477	1743
05:05:00 PM	0	0	0	0	15	0	15	0	10	37	0	0	0	42	20	0	460	1743
05:10:00 PM	0	0	0	0	29	0	31	0	21	81	0	0	0	97	37	0	570	1916
05:15:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	435	1771
05:20:00 PM	0	0	0	0	9	0	11	0	12	38	0	0	0	60	20	0	446	1800
05:25:00 PM	0	0	0	0	11	0	21	0	8	35	0	0	0	56	21	0	302	1794
05:30:00 PM	0	0	0	0	14	0	23	0	11	30	0	0	0	32	20	0	432	1760
05:35:00 PM	0	0	0	0	17	0	17	0	6	37	0	0	0	46	15	0	420	1766
05:40:00 PM	0	0	0	0	11	0	29	0	17	34	0	0	0	38	24	0	421	1783
05:45:00 PM	0	0	0	0	16	0	10	0	11	33	0	0	0	36	19	0	416	1760
05:50:00 PM	0	0	0	0	11	0	21	0	8	28	0	0	0	29	12	0	387	1713
05:55:00 PM	0	0	0	0	14	0	25	0	9	27	0	0	0	21	18	0	348	1641



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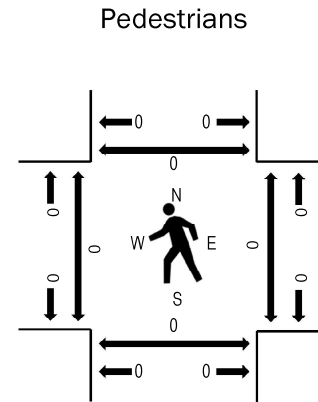
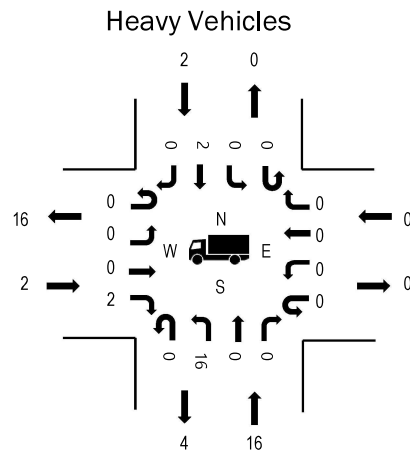
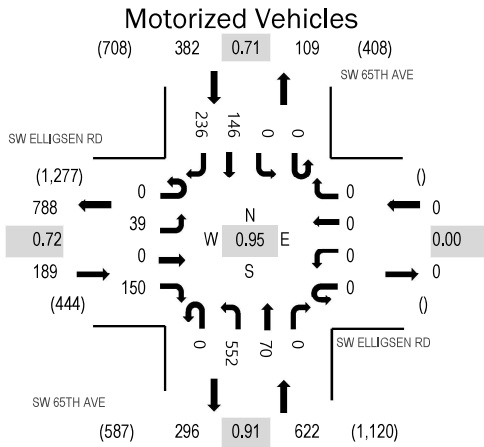
Location: 1 SW 65TH AVE & SW ELLIGSEN RD PM

Date: Wednesday, June 12, 2019

Peak Hour: 04:00 PM - 05:00 PM

Peak 15-Minutes: 04:00 PM - 04:15 PM

Peak Hour



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	1.1%	0.72
WB	0.0%	0.00
NB	2.6%	0.91
SB	0.5%	0.71
All	1.7%	0.95

Traffic Counts - Motorized Vehicles

Interval Start Time	SW ELLIGSEN RD Eastbound				SW ELLIGSEN RD Westbound				SW 65TH AVE Northbound				SW 65TH AVE Southbound				Total	Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right		
4:00 PM	0	3	0	13	0	0	0	0	0	31	2	0	0	0	29	29	107	1,193
4:05 PM	0	2	0	13	0	0	0	0	0	60	4	0	0	0	7	16	102	1,174
4:10 PM	0	3	0	16	0	0	0	0	0	50	5	0	0	0	9	22	105	1,167
4:15 PM	0	6	0	14	0	0	0	0	0	54	2	0	0	0	9	17	102	1,152
4:20 PM	0	2	0	11	0	0	0	0	0	33	11	0	0	0	14	22	93	1,163
4:25 PM	0	3	0	12	0	0	0	0	0	57	3	0	0	0	13	16	104	1,170
4:30 PM	0	3	0	11	0	0	0	0	0	41	6	0	0	0	11	12	84	1,163
4:35 PM	0	3	0	15	0	0	0	0	0	43	10	0	0	0	9	22	102	1,164
4:40 PM	0	1	0	16	0	0	0	0	0	34	10	0	0	0	13	30	104	1,153
4:45 PM	0	4	0	12	0	0	0	0	0	39	5	0	0	0	11	25	96	1,127
4:50 PM	0	4	0	12	0	0	0	0	0	49	9	0	0	0	16	20	110	1,117
4:55 PM	0	5	0	5	0	0	0	0	0	61	3	0	0	0	5	5	84	1,094
5:00 PM	0	3	0	6	0	0	0	0	0	47	8	0	0	0	6	18	88	1,079
5:05 PM	0	9	0	7	0	0	0	0	0	46	11	0	0	0	5	17	95	
5:10 PM	0	3	0	7	0	0	0	0	0	42	18	0	0	0	6	14	90	
5:15 PM	0	7	0	20	0	0	0	0	0	27	10	0	0	0	19	30	113	
5:20 PM	0	5	0	6	0	0	0	0	0	32	18	0	0	0	16	23	100	
5:25 PM	0	6	0	17	0	0	0	0	0	12	13	0	0	0	20	29	97	
5:30 PM	0	7	0	12	0	0	0	0	0	24	14	0	0	0	14	14	85	
5:35 PM	0	13	0	19	0	0	0	0	0	14	23	0	0	0	13	9	91	
5:40 PM	0	11	0	17	0	0	0	0	0	10	20	0	0	0	12	8	78	
5:45 PM	0	9	0	18	0	0	0	0	0	15	22	0	0	0	8	14	86	
5:50 PM	0	16	0	17	0	0	0	0	0	9	22	0	0	0	6	17	87	
5:55 PM	0	6	0	14	0	0	0	0	0	16	25	0	0	0	6	2	69	
Count Total	0	134	0	310	0	0	0	0	0	846	274	0	0	0	277	431	2,272	
Peak Hour	0	39	0	150	0	0	0	0	0	552	70	0	0	0	146	236	1,193	

Location: 1 SW 65TH AVE & SW ELLIGSEN RD PM

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
4:00 PM	0	3	0	0	3	4:00 PM	0	0	0	0	0	4:00 PM	0	0	0	0	0
4:05 PM	0	1	0	1	2	4:05 PM	0	0	0	0	0	4:05 PM	0	0	0	0	0
4:10 PM	0	3	0	0	3	4:10 PM	0	0	0	0	0	4:10 PM	0	0	0	0	0
4:15 PM	0	1	0	0	1	4:15 PM	0	0	0	0	0	4:15 PM	0	0	0	0	0
4:20 PM	0	1	0	0	1	4:20 PM	0	0	0	0	0	4:20 PM	0	0	0	0	0
4:25 PM	1	0	0	0	1	4:25 PM	0	0	0	0	0	4:25 PM	0	0	0	0	0
4:30 PM	0	0	0	0	0	4:30 PM	0	0	0	0	0	4:30 PM	0	0	0	0	0
4:35 PM	0	0	0	1	1	4:35 PM	0	0	0	0	0	4:35 PM	0	0	0	0	0
4:40 PM	0	0	0	0	0	4:40 PM	0	0	0	0	0	4:40 PM	0	0	0	0	0
4:45 PM	1	4	0	0	5	4:45 PM	0	0	0	0	0	4:45 PM	0	0	0	0	0
4:50 PM	0	2	0	0	2	4:50 PM	0	0	0	0	0	4:50 PM	0	0	0	0	0
4:55 PM	0	1	0	0	1	4:55 PM	0	0	0	0	0	4:55 PM	0	0	0	0	0
5:00 PM	0	1	0	0	1	5:00 PM	0	0	0	0	0	5:00 PM	0	0	0	0	0
5:05 PM	0	2	0	0	2	5:05 PM	0	0	0	0	0	5:05 PM	0	0	0	0	0
5:10 PM	1	1	0	1	3	5:10 PM	0	0	0	0	0	5:10 PM	0	0	0	0	0
5:15 PM	0	0	0	1	1	5:15 PM	0	0	0	0	0	5:15 PM	0	0	0	0	0
5:20 PM	0	0	0	0	0	5:20 PM	0	0	0	0	0	5:20 PM	0	0	0	0	0
5:25 PM	0	0	0	0	0	5:25 PM	0	0	0	0	0	5:25 PM	0	0	0	0	0
5:30 PM	0	0	0	1	1	5:30 PM	0	0	0	0	0	5:30 PM	0	0	0	0	0
5:35 PM	0	1	0	1	2	5:35 PM	0	0	0	0	0	5:35 PM	0	0	0	0	0
5:40 PM	0	3	0	0	3	5:40 PM	0	0	0	0	0	5:40 PM	0	0	0	0	0
5:45 PM	1	0	0	0	1	5:45 PM	0	0	0	0	0	5:45 PM	0	0	0	0	0
5:50 PM	0	3	0	0	3	5:50 PM	0	0	0	0	0	5:50 PM	0	0	0	0	0
5:55 PM	0	1	0	0	1	5:55 PM	0	0	0	0	0	5:55 PM	0	0	0	0	0
Count Total	4	28	0	6	38	Count Total	0	0	0	0	0	Count Total	0	0	0	0	0
Peak Hour	2	16	0	2	20	Peak Hour	0	0	0	0	0	Peak Hour	0	0	0	0	0

HCM 6th TWSC
1: Stafford Rd & 65th Ave

10/19/2021

Intersection						
Int Delay, s/veh	313.6					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	180	270	185	560	675	335
Future Vol, veh/h	180	270	185	560	675	335
Conflicting Peds, #/hr	0	3	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	1	0	4	1	1	3
Mvmt Flow	189	284	195	589	711	353
Major/Minor	Minor2	Major1		Major2		
Conflicting Flow All	1867	891	1064	0	0	
Stage 1	888	-	-	-	-	
Stage 2	979	-	-	-	-	
Critical Hdwy	6.41	6.2	4.14	-	-	
Critical Hdwy Stg 1	5.41	-	-	-	-	
Critical Hdwy Stg 2	5.41	-	-	-	-	
Follow-up Hdwy	3.509	3.3	2.236	-	-	
Pot Cap-1 Maneuver	~ 80	344	647	-	-	
Stage 1	404	-	-	-	-	
Stage 2	366	-	-	-	-	
Platoon blocked, %				-	-	
Mov Cap-1 Maneuver	~ 56	343	647	-	-	
Mov Cap-2 Maneuver	~ 56	-	-	-	-	
Stage 1	282	-	-	-	-	
Stage 2	366	-	-	-	-	
Approach	EB	NB	SB			
HCM Control Delay, \$	1531.3	3.2	0			
HCM LOS	F					
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR	
Capacity (veh/h)	647	-	112	-	-	
HCM Lane V/C Ratio	0.301	-	4.229	-	-	
HCM Control Delay (s)	12.9	\$	1531.3	-	-	
HCM Lane LOS	B	-	F	-	-	
HCM 95th %tile Q(veh)	1.3	-	48.8	-	-	
Notes						
~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon						

HCM 6th TWSC
2: 65th Ave & Elligsen Rd

10/19/2021

Intersection						
Int Delay, s/veh	15					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	T		T		T	
Traffic Vol, veh/h	39	227	457	63	223	236
Future Vol, veh/h	39	227	457	63	223	236
Conflicting Peds, #/hr	0	0	0	0	0	0
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	95	95	95	95	95	95
Heavy Vehicles, %	0	1	3	0	1	0
Mvmt Flow	41	239	481	66	235	248

Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	1387	359	483	0	-	0
Stage 1	359	-	-	-	-	-
Stage 2	1028	-	-	-	-	-
Critical Hdwy	6.4	6.21	4.13	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.309	2.227	-	-	-
Pot Cap-1 Maneuver	159	688	1074	-	-	-
Stage 1	711	-	-	-	-	-
Stage 2	348	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	85	688	1074	-	-	-
Mov Cap-2 Maneuver	85	-	-	-	-	-
Stage 1	380	-	-	-	-	-
Stage 2	348	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	51.4	9.7	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1074	-	337	-	-
HCM Lane V/C Ratio	0.448	-	0.831	-	-
HCM Control Delay (s)	11	0	51.4	-	-
HCM Lane LOS	B	A	F	-	-
HCM 95th %tile Q(veh)	2.4	-	7.3	-	-

HCM 6th TWSC
1: Stafford Rd & 65th Ave

Future 2023 With Detour_TWSC
Stafford/65th/Elligsen Temporary Traffic Signal

Intersection						
Int Delay, s/veh	2108.9					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	224	545	399	531	674	352
Future Vol, veh/h	224	545	399	531	674	352
Conflicting Peds, #/hr	0	3	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	1	0	4	1	1	3
Mvmt Flow	236	574	420	559	709	371
Major/Minor	Minor2	Major1		Major2		
Conflicting Flow All	2294	898	1080	0	0	
Stage 1	895	-	-	-	-	
Stage 2	1399	-	-	-	-	
Critical Hdwy	6.41	6.2	4.14	-	-	
Critical Hdwy Stg 1	5.41	-	-	-	-	
Critical Hdwy Stg 2	5.41	-	-	-	-	
Follow-up Hdwy	3.509	3.3	2.236	-	-	
Pot Cap-1 Maneuver	~ 43	~ 341	638	-	-	
Stage 1	401	-	-	-	-	
Stage 2	~ 230	-	-	-	-	
Platoon blocked, %				-	-	
Mov Cap-1 Maneuver	~ 15	~ 340	638	-	-	
Mov Cap-2 Maneuver	~ 15	-	-	-	-	
Stage 1	~ 137	-	-	-	-	
Stage 2	~ 230	-	-	-	-	
Approach	EB	NB	SB			
HCM Control Delay, \$	7462.3	8.9	0			
HCM LOS	F					
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR	
Capacity (veh/h)	638	-	47	-	-	
HCM Lane V/C Ratio	0.658	-	17.223	-	-	
HCM Control Delay (s)	20.8	\$	7462.3	-	-	
HCM Lane LOS	C	-	F	-	-	
HCM 95th %tile Q(veh)	4.9	-	98.4	-	-	
Notes						
~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon						

Intersection

Int Delay, s/veh 262.3

Movement EBL EBR NBL NBT SBT SBR

Lane Configurations							
Traffic Vol, veh/h	40	542	686	65	227	241	
Future Vol, veh/h	40	542	686	65	227	241	
Conflicting Peds, #/hr	0	0	0	0	0	0	
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	95	95	95	95	95	95	
Heavy Vehicles, %	0	1	3	0	1	0	
Mvmt Flow	42	571	722	68	239	254	

Major/Minor Minor2 Major1 Major2

Conflicting Flow All	1878	366	493	0	-	0
Stage 1	366	-	-	-	-	-
Stage 2	1512	-	-	-	-	-
Critical Hdwy	6.4	6.21	4.13	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.309	2.227	-	-	-
Pot Cap-1 Maneuver	79	681	1065	-	-	-
Stage 1	706	-	-	-	-	-
Stage 2	203	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 23	681	1065	-	-	-
Mov Cap-2 Maneuver	~ 23	-	-	-	-	-
Stage 1	208	-	-	-	-	-
Stage 2	203	-	-	-	-	-

Approach EB NB SB

HCM Control Delay, s\$ 793.6 13.9 0
HCM LOS F

Minor Lane/Major Mvmt NBL NBT EBLn1 SBT SBR

Capacity (veh/h)	1065	-	230	-	-
HCM Lane V/C Ratio	0.678	-	2.664	-	-
HCM Control Delay (s)	15.2	0\$	793.6	-	-
HCM Lane LOS	C	A	F	-	-
HCM 95th %tile Q(veh)	5.6	-	52.2	-	-

Notes

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

HCM Signalized Intersection Capacity Analysis Stafford/65th/Elligsen Temporary Traffic Signal 1: Stafford Rd & 65th Ave

Future 2023 With Detour_Signal



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	224	545	399	531	674	352
Future Volume (vph)	224	545	399	531	674	352
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5	4.5	4.5	
Lane Util. Factor	1.00		1.00	1.00	1.00	
Frpb, ped/bikes	0.99		1.00	1.00	0.99	
Flpb, ped/bikes	1.00		1.00	1.00	1.00	
Frt	0.90		1.00	1.00	0.95	
Flt Protected	0.99		0.95	1.00	1.00	
Satd. Flow (prot)	1649		1805	1900	1797	
Flt Permitted	0.99		0.07	1.00	1.00	
Satd. Flow (perm)	1649		128	1900	1797	
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	226	551	403	536	681	356
RTOR Reduction (vph)	59	0	0	0	13	0
Lane Group Flow (vph)	718	0	403	536	1024	0
Confl. Peds. (#/hr)			3			3
Confl. Bikes (#/hr)		1				
Heavy Vehicles (%)	4%	0%	0%	0%	0%	0%
Turn Type	Prot		D.P+P	NA	NA	
Protected Phases	8		1	6	2	
Permitted Phases			2			
Actuated Green, G (s)	59.5		77.0	81.5	59.5	
Effective Green, g (s)	59.5		77.0	81.5	59.5	
Actuated g/C Ratio	0.40		0.51	0.54	0.40	
Clearance Time (s)	4.5		4.5	4.5	4.5	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	654		261	1032	712	
v/s Ratio Prot	c0.44		c0.18	0.28	0.57	
v/s Ratio Perm			c0.61			
v/c Ratio	1.10		1.54	0.52	1.44	
Uniform Delay, d1	45.2		50.0	21.8	45.2	
Progression Factor	0.55		1.00	1.00	1.00	
Incremental Delay, d2	47.0		263.0	0.4	205.4	
Delay (s)	71.7		313.0	22.2	250.6	
Level of Service	E		F	C	F	
Approach Delay (s)	71.7			147.0	250.6	
Approach LOS	E			F	F	
Intersection Summary						
HCM 2000 Control Delay			164.8		HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio			1.39			
Actuated Cycle Length (s)			150.0		Sum of lost time (s)	18.0
Intersection Capacity Utilization			136.4%		ICU Level of Service	H
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis Stafford/65th/Elligsen Temporary Traffic Signal 2: 65th Ave & Elligsen Rd

Future 2023 With Detour_Signal



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	40	542	686	65	227	241
Future Volume (vph)	40	542	686	65	227	241
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5			4.5	4.5	
Lane Util. Factor	1.00			1.00	1.00	
Frt	0.87			1.00	0.93	
Flt Protected	1.00			0.96	1.00	
Satd. Flow (prot)	1640			1769	1759	
Flt Permitted	1.00			0.34	1.00	
Satd. Flow (perm)	1640			632	1759	
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	40	547	693	66	229	243
RTOR Reduction (vph)	328	0	0	0	26	0
Lane Group Flow (vph)	259	0	0	759	446	0
Heavy Vehicles (%)	0%	1%	3%	0%	1%	0%
Turn Type	Prot		Perm	NA	NA	
Protected Phases	3			4 6	4	
Permitted Phases			4 6			
Actuated Green, G (s)	14.5			126.5	40.5	
Effective Green, g (s)	14.5			126.5	40.5	
Actuated g/C Ratio	0.10			0.84	0.27	
Clearance Time (s)	4.5				4.5	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	158			532	474	
v/s Ratio Prot	c0.16				0.25	
v/s Ratio Perm				c1.20		
v/c Ratio	1.64			1.43	0.94	
Uniform Delay, d1	67.8			11.8	53.6	
Progression Factor	1.00			3.32	1.00	
Incremental Delay, d2	314.6			193.0	27.2	
Delay (s)	382.4			232.1	80.8	
Level of Service	F			F	F	
Approach Delay (s)	382.4			232.1	80.8	
Approach LOS	F			F	F	

Intersection Summary

HCM 2000 Control Delay	241.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.54		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	115.1%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis Stafford/65th/Elligsen Temporary Traffic Signal 1: Stafford Rd & 65th Ave

Future 2023 No Detour_Signal



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	184	275	189	571	689	342
Future Volume (vph)	184	275	189	571	689	342
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5	4.5	4.5	
Lane Util. Factor	1.00		1.00	1.00	1.00	
Frpb, ped/bikes	0.99		1.00	1.00	0.99	
Flpb, ped/bikes	1.00		1.00	1.00	1.00	
Frt	0.92		1.00	1.00	0.96	
Flt Protected	0.98		0.95	1.00	1.00	
Satd. Flow (prot)	1684		1736	1881	1772	
Flt Permitted	0.98		0.07	1.00	1.00	
Satd. Flow (perm)	1684		119	1881	1772	
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	1.00
Adj. Flow (vph)	186	278	191	577	696	342
RTOR Reduction (vph)	36	0	0	0	12	0
Lane Group Flow (vph)	428	0	191	577	1026	0
Confl. Peds. (#/hr)			3			3
Confl. Bikes (#/hr)		1				
Heavy Vehicles (%)	1%	0%	4%	1%	1%	3%
Turn Type	Prot		D.P+P	NA	NA	
Protected Phases	8		1	6	2	
Permitted Phases			2			
Actuated Green, G (s)	59.3		77.0	81.5	61.5	
Effective Green, g (s)	59.3		77.0	81.5	61.5	
Actuated g/C Ratio	0.40		0.51	0.54	0.41	
Clearance Time (s)	4.5		4.5	4.5	4.5	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	666		228	1023	727	
v/s Ratio Prot	c0.25		c0.09	0.31	c0.58	
v/s Ratio Perm			0.34			
v/c Ratio	0.64		0.84	0.56	1.41	
Uniform Delay, d1	36.7		44.9	22.5	44.2	
Progression Factor	0.30		1.00	1.00	1.00	
Incremental Delay, d2	0.6		22.6	0.7	193.3	
Delay (s)	11.8		67.6	23.2	237.5	
Level of Service	B		E	C	F	
Approach Delay (s)	11.8			34.2	237.5	
Approach LOS	B			C	F	
Intersection Summary						
HCM 2000 Control Delay			122.6		HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio			1.05			
Actuated Cycle Length (s)			149.8		Sum of lost time (s)	18.0
Intersection Capacity Utilization			106.0%		ICU Level of Service	G
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis Stafford/65th/Elligsen Temporary Traffic Signal 2: 65th Ave & Elligsen Rd

Future 2023 No Detour_Signal



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	40	232	466	65	227	241
Future Volume (vph)	40	232	466	65	227	241
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5			4.5	4.5	
Lane Util. Factor	1.00			1.00	1.00	
Frt	0.88			1.00	0.93	
Flt Protected	0.99			0.96	1.00	
Satd. Flow (prot)	1655			1773	1759	
Flt Permitted	0.99			0.33	1.00	
Satd. Flow (perm)	1655			618	1759	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	42	244	491	68	239	254
RTOR Reduction (vph)	139	0	0	0	26	0
Lane Group Flow (vph)	147	0	0	559	467	0
Heavy Vehicles (%)	0%	1%	3%	0%	1%	0%
Turn Type	Prot		Perm	NA	NA	
Protected Phases	3			4 6	4	
Permitted Phases			4 6			
Actuated Green, G (s)	14.3			126.5	40.5	
Effective Green, g (s)	14.3			126.5	40.5	
Actuated g/C Ratio	0.10			0.84	0.27	
Clearance Time (s)	4.5				4.5	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	157			521	475	
v/s Ratio Prot	c0.09				0.27	
v/s Ratio Perm				c0.91		
v/c Ratio	0.93			1.07	0.98	
Uniform Delay, d1	67.3			11.7	54.3	
Progression Factor	1.00			2.70	1.00	
Incremental Delay, d2	52.3			36.9	36.9	
Delay (s)	119.6			68.3	91.2	
Level of Service	F			E	F	
Approach Delay (s)	119.6			68.3	91.2	
Approach LOS	F			E	F	

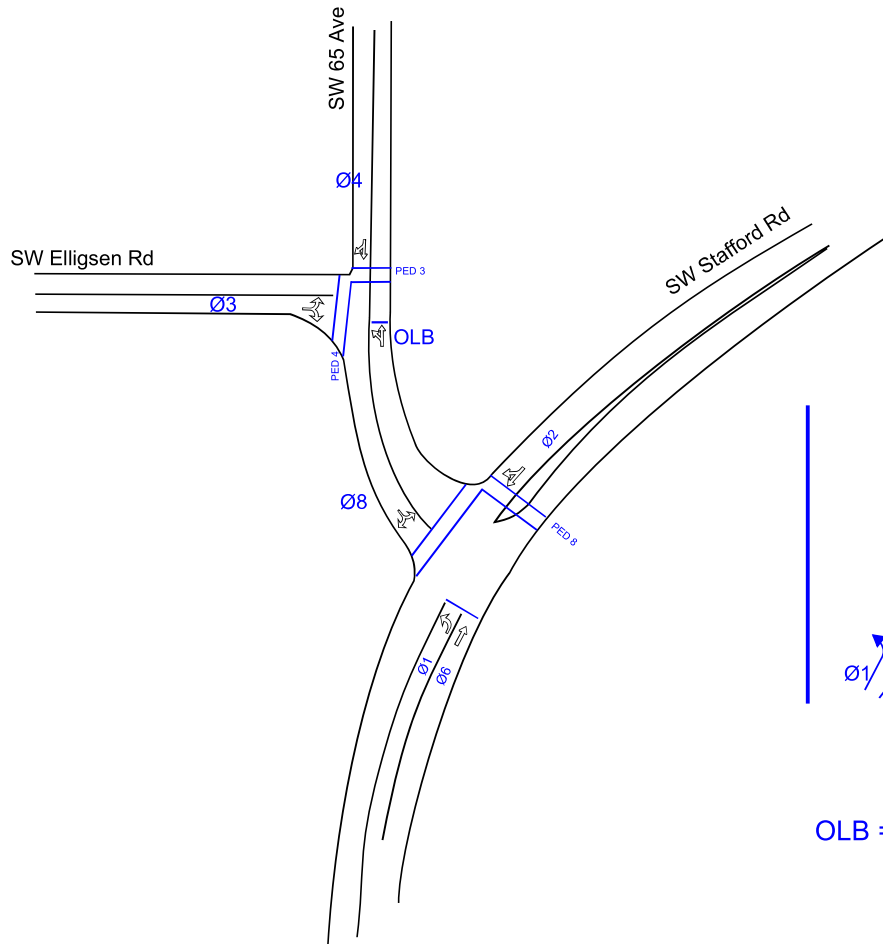
Intersection Summary

HCM 2000 Control Delay	87.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.13		
Actuated Cycle Length (s)	149.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	83.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

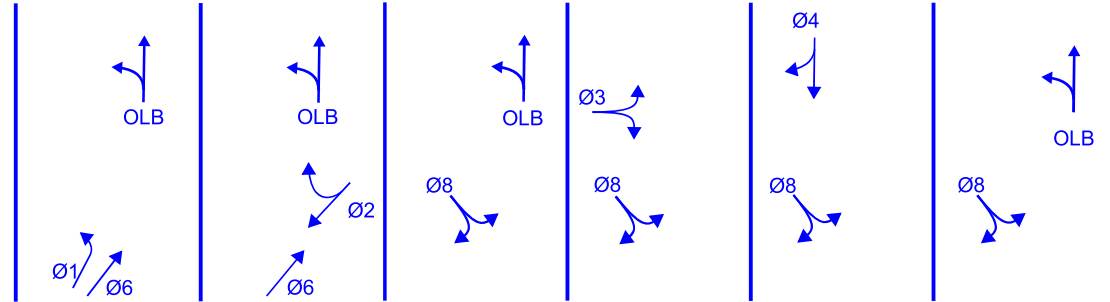


Attachment G

SW Stafford Rd / SW 65th Ave / SW Elligsen Temp Signal



1	2	9	3	4	10
6		8			



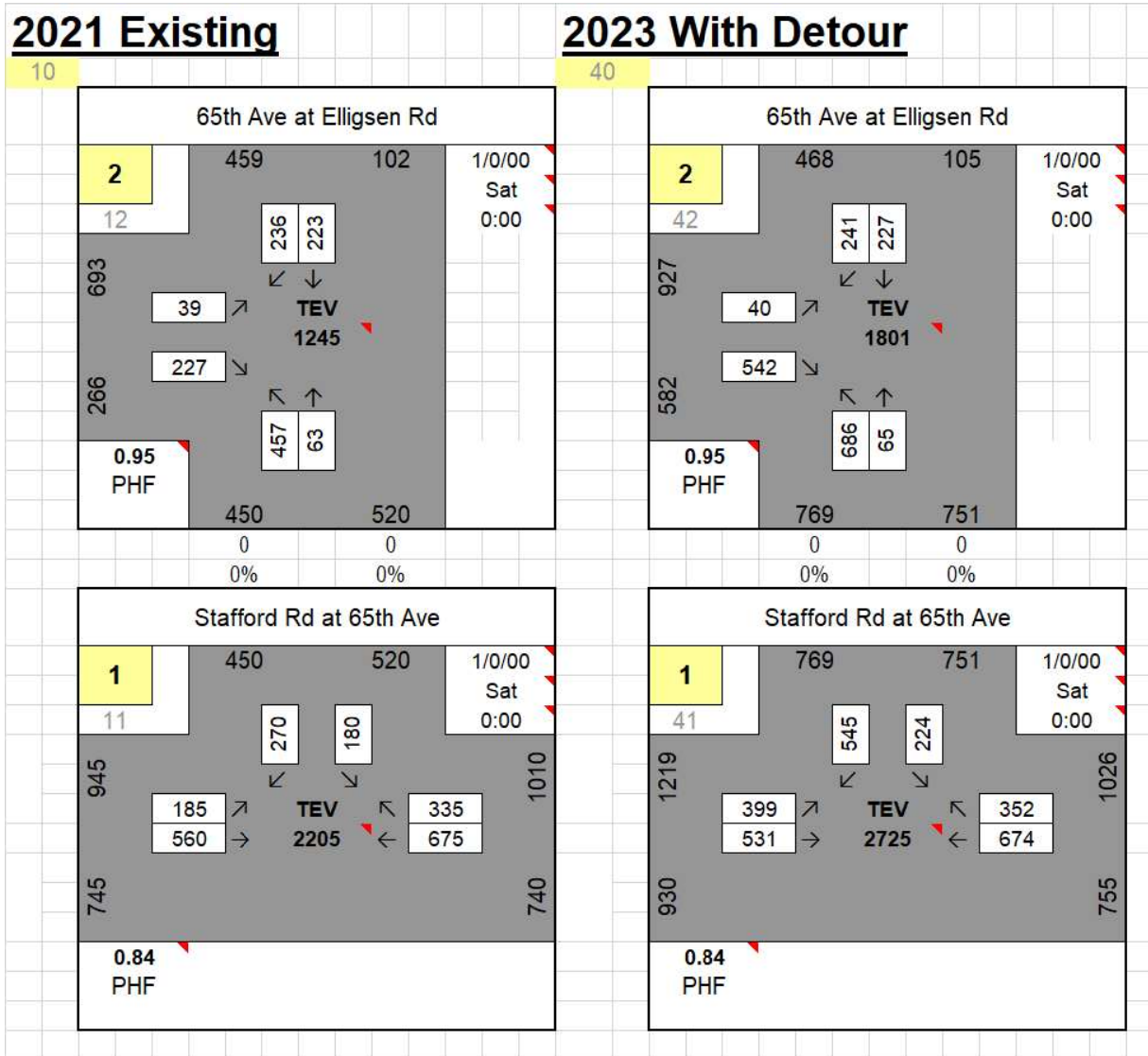
NORMAL PHASE ROTATION

OLB = Ø6, Ø9, Ø10

Assumptions:

- > Lane configuration remains the same
- > Northbound left (OLB) on 65th @ Elligsen is protected.
- > Phasing is setup to keep the portion of 65th between Elligsen and Stafford Road flowing as much as possible.
- > Ped phasing may be added as needed.
- > See volumes on page 2.

SW Stafford Rd / SW 65th Ave / SW Elligsen Temp Signal





Jenna Bogert <jenna.bogert@dksassociates.com>

Fwd: Stafford/65th/Elligsen Temp Signal Phasing

1 message

Craig Black <craig.black@dksassociates.com>
To: Jenna Bogert <jenna.bogert@dksassociates.com>

Mon, Aug 30, 2021 at 10:34 AM

Craig Black, P.E., Transportation Engineer
Desk: 971-332-5309 | Cell: 503-302-7873
craig.black@dksassociates.com



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From: **Craig Black** <craig.black@dksassociates.com>
Date: Mon, Jul 26, 2021 at 1:52 PM
Subject: Re: Stafford/65th/Elligsen Temp Signal Phasing
To: Olson, Carl <COlson@clackamas.us>
Cc: Maggie Lin <maggie.lin@dksassociates.com>, Scott Mansur <smm@dksassociates.com>

Hi Karl,

Thank you for the feedback. I appreciate your input and am glad you talked with Maggie. As per direction from Scott Mansur last week, we are assuming ped phasing will be installed. If this changes to no ped phases, I am happy to use the sequential phasing. For now though, assuming ped phasing is to be incorporated, we'll go with the phase sequence with southbound 65th @ Stafford as phase 8 with ped 8.

Thanks so much for your input.

Craig Black, P.E., Transportation Engineer
Desk: 971-332-5309 | Cell: 503-302-7873
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On Thu, Jul 22, 2021 at 7:27 AM Olson, Carl <COlson@clackamas.us> wrote:

Hello Craig,

I reviewed both of these and discussed them a bit with Maggie yesterday. Overall I'm happy with either approach. I think the key item to figure out will be if a ped phase is required or not. If ped phases are required, I want to use the phase configuration where phase 8 and ped 8 are for the southbound 65th movement. If no ped phases will be present, I prefer the sequential operation with two overlaps.

Thank you,

Carl

Carl Olson, P.E., ASEP

Senior Traffic Engineer

503-742-4684 (Office)

971-235-3260 (Cell)

From: Craig Black [mailto:craig.black@dksassociates.com]

Sent: Wednesday, July 21, 2021 2:39 PM

To: Olson, Carl <COlson@clackamas.us>

Cc: Maggie Lin <maggie.lin@dksassociates.com>; Scott Mansur <smm@dksassociates.com>

Subject: Stafford/65th/Elligsen Temp Signal Phasing

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Hi Carl,

Per our discussion, after the comments you and John made, I worked up another version of possible signal phasing and passed it by Maggie for her input. Maggie provided her input which I greatly appreciate. As we discussed, I found I was attempting to reduce the number of overlap phases while Maggie had another approach to use sequential phasing and using two overlaps. Both options are doable and I have no stake in how the phasing is laid

out. I just want to keep the 160 foot section between Elligsen and Stafford flowing as much as possible. I also removed the permissive left overlap per the comments last week.

Since Clackamas County might likely be the one timing and operating this signal, if you take a look at this in a manner as to how you would likely set up the phasing, I would appreciate it. Whatever you come up with I am happy to move forward so we can move on to the next phase of the design as soon as possible.

Thanks again for your input.

Craig Black, P.E., Transportation Engineer

Desk: 971-332-5309 | Cell: 503-302-7873

craig.black@dksassociates.com



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Jenna Bogert <jenna.bogert@dksassociates.com>

Wilsonville Boeckman Dip- Stafford Rd/65th/Elligsen Temp Signal Proposed Phasing and Operation

Craig Black <craig.black@dksassociates.com>

Mon, Jul 19, 2021 at 4:02 PM

To: "Olson, Carl" <COlson@clackamas.us>

Cc: "Kraushaar, Nancy" <kraushaar@ci.wilsonville.or.us>, Shaun Quayle <Shaun_Quayle@co.washington.or.us>, John Fasana <John_Fasana@co.washington.or.us>, Scott Mansur <smm@dksassociates.com>, "Huffman, Dominique" <huffman@ci.wilsonville.or.us>, Stacy Shetler <Stacy_Shetler@co.washington.or.us>, "Snuffin, Christian" <CSnuffin@clackamas.us>, "Marek, Joe" <JoeMar@clackamas.us>, Aaron Clodfelter <Aaron_Clodfelter@co.washington.or.us>, Jenna Bogert <jenna.bogert@dksassociates.com>

Greetings All,

Thank you all for your comments. They are appreciated. No problem removing the permissive left at 65th/Elligsen. The ped phasing will be easy to add timing wise but seeing the narrow shoulders on google, my thoughts were to add them in as needed after geometric design decisions were made on which ones to install. Good catch on the reverse order of phases 3 versus 4. We can correct that. Phase 8 is intended to be the parent phase for SW65th @ SW Stafford Road. Based on your input, allow us to rework the ring-barrier and normal phase rotation diagrams and resend that back out.

Thank you.

Craig Black, P.E., Transportation Engineer
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craig.black@dksassociates.com



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On Mon, Jul 19, 2021 at 9:55 AM Olson, Carl <COlson@clackamas.us> wrote:

Hello All,

I have the following to add:

- I concur with John's comment and would suggest removing the permissive portion of OLA/OLB. I would prefer simply gapping out phase 4 when appropriate.
- Regarding pedestrian requirements, even though there is zero pedestrian infrastructure in the area, I think a design exception is still required for anything outside of a full ADA pedestrian build-out.
- Minor phase rotation comments:
 - Diagram shows 3 before 4, but below its reversed

- Wasn't clear to me what phases 9 and 10 are for initially. Assumption that these are the clear-out between Stafford and Elligsen
- Phase 8 – dummy phase?

Thank you,

Carl

Carl Olson, P.E., ASEP

Senior Traffic Engineer

503-742-4684 (Office)

971-235-3260 (Cell)

From: Kraushaar, Nancy [mailto:kraushaar@ci.wilsonville.or.us]

Sent: Thursday, July 15, 2021 12:10 PM

To: Shaun Quayle <Shaun_Quayle@co.washington.or.us>; John Fasana <John_Fasana@co.washington.or.us>; Scott Mansur <smm@dksassociates.com>; Huffman, Dominique <huffman@ci.wilsonville.or.us>; Stacy Shetler <Stacy_Shetler@co.washington.or.us>; Olson, Carl <COlson@clackamas.us>; Snuffin, Christian <CSnuffin@clackamas.us>; Marek, Joe <JoeMar@clackamas.us>; Aaron Clodfelter <Aaron_Clodfelter@co.washington.or.us>; Craig Black <craig.black@dksassociates.com>; Jenna Bogert <jenna.bogert@dksassociates.com>

Subject: RE: [EXTERNAL] Wilsonville Boeckman Dip- Stafford Rd/65th/Elligsen Temp Signal Proposed Phasing and Operation

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All: What I do know is that many cyclists use this intersection. Please keep that in mind as we signal and sign and stripe it. I don't think there are many pedestrians, but is there any statutorial requirement that we accommodate peds and ADA? -Nancy

From: Shaun Quayle <Shaun_Quayle@co.washington.or.us>

Sent: Thursday, July 15, 2021 11:24 AM

To: John Fasana <John_Fasana@co.washington.or.us>; Scott Mansur <smm@dksassociates.com>; Huffman, Dominique <huffman@ci.wilsonville.or.us>; Kraushaar, Nancy <kraushaar@ci.wilsonville.or.us>; Stacy Shetler <Stacy_Shetler@co.washington.or.us>; Olson, Carl <COlson@clackamas.us>; Snuffin, Christian <CSnuffin@clackamas.us>; Marek, Joe <JoeMar@clackamas.us>; Aaron Clodfelter <Aaron_Clodfelter@co.washington.or.us>; Craig Black <craig.black@dksassociates.com>; Jenna Bogert <jenna.bogert@dksassociates.com>

Subject: RE: [EXTERNAL] Wilsonville Boeckman Dip- Stafford Rd/65th/Elligsen Temp Signal Proposed Phasing and Operation

[This email originated outside of the City of Wilsonville]

Thanks for looping me in on this John. I generally concur with your comments and clarification.

This will be a challenging implementation. If a NB permissive left is allowed up at Ellingsen, then double check sight distance and use gap-dependent FYA so that it only turns on if there is a detected gap in traffic. Also use not-ped FYA assuming pedestrian movements will be accommodated at these signals.

From: John Fasana <John_Fasana@co.washington.or.us>

Sent: Wednesday, July 14, 2021 2:56 PM

To: Scott Mansur <smm@dksassociates.com>; Huffman, Dominique <huffman@ci.wilsonville.or.us>; Nancy Kraushaar <kraushaar@ci.wilsonville.or.us>; Stacy Shetler <Stacy_Shetler@co.washington.or.us>; Olson, Carl <COlson@clackamas.us>; Snuffin, Christian <CSnuffin@clackamas.us>; Marek, Joe <JoeMar@clackamas.us>; Aaron Clodfelter <Aaron_Clodfelter@co.washington.or.us>; Craig Black <craig.black@dksassociates.com>; Jenna Bogert <jenna.bogert@dksassociates.com>

Cc: Shaun Quayle <Shaun_Quayle@co.washington.or.us>

Subject: RE: [EXTERNAL] Wilsonville Boeckman Dip- Stafford Rd/65th/Ellingsen Temp Signal Proposed Phasing and Operation

Hi Scott,

Thanks for passing this along. I did a very quick, high level review of the phasing diagram and like what you came up with. These are my only comments/questions:

- The protected/permissive OLB and OLA from a single lane is a bit odd. With 85-90% of the NB traffic making the left for this movement, my personal preference would be to eliminate the permissive and just run this with one overlap. This would slightly simplify operations and if there ends up being a large enough gap in Phase 4 traffic for permissive lefts, I'd rather just have the movement gap out and keep signal operations snappy.
- Are we planning on accommodating pedestrian movements?

I'm also reattaching the diagram and including Shaun Quayle on the e-mail to give him a chance to review/comment.

Thanks,

John Fasana | Principal Engineer

503-846-7948

From: Scott Mansur <smm@dksassociates.com>

Sent: Wednesday, July 14, 2021 11:06 AM

To: Huffman, Dominique <huffman@ci.wilsonville.or.us>; Nancy Kraushaar <kraushaar@ci.wilsonville.or.us>; Stacy Shetler <Stacy_Shetler@co.washington.or.us>; John Fasana <John_Fasana@co.washington.or.us>; Olson, Carl <COlson@clackamas.us>; Snuffin, Christian <CSnuffin@clackamas.us>; Marek, Joe <JoeMar@clackamas.us>; Aaron Clodfelter <Aaron_Clodfelter@co.washington.or.us>; Craig Black <craig.black@dksassociates.com>; Jenna Bogert <jenna.bogert@dksassociates.com>

Subject: [EXTERNAL] Wilsonville Boeckman Dip- Stafford Rd/65th/Elligsen Temp Signal Proposed Phasing and Operation

Carl and John-

As a follow up to our May meeting where we discussed the City of Wilsonville's planned Boeckman Road Dip project, DKS has been evaluating the potential phasing for the temporary traffic signal at the SW Stafford Road/ SW 65th Ave/SW Elligsen Road intersections. The purpose of the temporary traffic signal is to facilitate detouring motorists around the project. The Stafford/65th/Elligsen intersections are separated by approximately 160 feet.

The attached proposed signal operations outlines the draft Normal Phase Rotation along with the Ring Barrier diagram that DKS is initially proposing for signal phasing (see page 1 of the attachment). Page 2 includes existing traffic volumes (that were collected pre-pandemic) plus 2023 volumes estimated with the Boeckman Dip detour.

The temporary traffic signal phasing was set up with basic signal phasing in mind with SW Stafford Road @ SW 65th Ave having phases 1, 2, 6 and 8 while Elligsen and SW 65th operate with phases 3 and 4. Under low volume conditions, the basic signal phasing would likely operate well. However, with the two intersections only 160 feet apart and with moderate to high volumes already occurring during the peak periods and to likely increase as a result of the detoured traffic, it seemed crucial to keep the portion of SW 65th Ave between Stafford Rd and Elligsen Rd flowing as much as possible by adding overlaps and/or special timing features allowed by the ATC software. As a result, we are proposing some more unique signal phasing to accomplish this.

Assumptions for the signal phasing and operations include the following:

- Lane configuration remains the same.
- Phasing is set up to keep the portion between SW Elligsen Rd and SW Stafford Rd flowing as much as possible thus incorporating overlaps.
- A key aspect to the phase rotation is the transition between the Stafford Road phasing and the 65th/Elligsen intersection phasing and back again.
- The northbound left from 65th onto westbound Elligsen is currently shown as protected/permissive from the single lane. The idea being when SB 65th is green, the NB left can still show a permissive left as well as have a NB thru movement. To not allow a NB permissive left, can remove OLA. When Elligsen Rd or 65th has a green, Stafford Road will be stopped.

Please take a look at the draft phasing and traffic volumes and let us know your thoughts? Any ideas or creative thoughts would be appreciated. Once we get your feedback, we will do some additional analysis and simulation to evaluate the intersection operations.

Thank you!

Scott

Scott Mansur, P.E. (OR, WA, ID), PTOE

Principal/Office Manager, Salem Office

Ph: [503.391.8773](tel:503.391.8773) | Cell: [503.602.9575](tel:503.602.9575) | Email: smm@dksassociates.com



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Jenna Bogert <jenna.bogert@dksassociates.com>

Fwd: Stafford/65th/Elligsen Temp Signal Phasing

1 message

Craig Black <craig.black@dksassociates.com>
To: Jenna Bogert <jenna.bogert@dksassociates.com>

Mon, Aug 30, 2021 at 10:34 AM

Craig Black, P.E., Transportation Engineer
Desk: 971-332-5309 | Cell: 503-302-7873
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From: **Craig Black** <craig.black@dksassociates.com>
Date: Mon, Jul 26, 2021 at 1:52 PM
Subject: Re: Stafford/65th/Elligsen Temp Signal Phasing
To: Olson, Carl <COlson@clackamas.us>
Cc: Maggie Lin <maggie.lin@dksassociates.com>, Scott Mansur <smm@dksassociates.com>

Hi Karl,

Thank you for the feedback. I appreciate your input and am glad you talked with Maggie. As per direction from Scott Mansur last week, we are assuming ped phasing will be installed. If this changes to no ped phases, I am happy to use the sequential phasing. For now though, assuming ped phasing is to be incorporated, we'll go with the phase sequence with southbound 65th @ Stafford as phase 8 with ped 8.

Thanks so much for your input.

Craig Black, P.E., Transportation Engineer
Desk: 971-332-5309 | Cell: 503-302-7873
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On Thu, Jul 22, 2021 at 7:27 AM Olson, Carl <COlson@clackamas.us> wrote:

Hello Craig,

I reviewed both of these and discussed them a bit with Maggie yesterday. Overall I'm happy with either approach. I think the key item to figure out will be if a ped phase is required or not. If ped phases are required, I want to use the phase configuration where phase 8 and ped 8 are for the southbound 65th movement. If no ped phases will be present, I prefer the sequential operation with two overlaps.

Thank you,

Carl

Carl Olson, P.E., ASEP

Senior Traffic Engineer

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From: Craig Black [mailto:craig.black@dksassociates.com]

Sent: Wednesday, July 21, 2021 2:39 PM

To: Olson, Carl <COlson@clackamas.us>

Cc: Maggie Lin <maggie.lin@dksassociates.com>; Scott Mansur <smm@dksassociates.com>

Subject: Stafford/65th/Elligsen Temp Signal Phasing

Warning: External email. Be cautious opening attachments and links.

Hi Carl,

Per our discussion, after the comments you and John made, I worked up another version of possible signal phasing and passed it by Maggie for her input. Maggie provided her input which I greatly appreciate. As we discussed, I found I was attempting to reduce the number of overlap phases while Maggie had another approach to use sequential phasing and using two overlaps. Both options are doable and I have no stake in how the phasing is laid

out. I just want to keep the 160 foot section between Elligsen and Stafford flowing as much as possible. I also removed the permissive left overlap per the comments last week.

Since Clackamas County might likely be the one timing and operating this signal, if you take a look at this in a manner as to how you would likely set up the phasing, I would appreciate it. Whatever you come up with I am happy to move forward so we can move on to the next phase of the design as soon as possible.

Thanks again for your input.

Craig Black, P.E., Transportation Engineer

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