

**36TH AVENUE WEST
IMPROVEMENT PROJECT
LYNNWOOD, WASHINGTON**

TRAFFIC REPORT

- FINAL -

Prepared for:
CITY OF LYNNWOOD, WASHINGTON

Prepared by:
DAVID EVANS AND ASSOCIATES, INC.
415 - 118th Avenue SE
Bellevue, WA 98005-3518

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Appendix A – Overview of Traffic Findings (PowerPoint Presentation Summary)

1. Introduction

This report summarizes the land use assumptions and roadway improvement assumptions used in the City of Lynnwood (City) traffic forecasting model for the PM peak hour in the forecast year 2025. The City's traffic forecasting model is used to forecast 2025 PM peak hour traffic volumes for the 36th Avenue West Improvement Project, between Maple Road / 179th Street SW and 165th Place SW. The traffic operational analysis at major intersections within the study corridor was performed, and improvement recommendations are proposed based upon that analysis.

2. Traffic Modeling

2.1 Land Use Assumptions

The land use for the City 2025 traffic forecasting model using VISUM traffic modeling software was built upon the assumptions described in the City's current Comprehensive Plan and the City Center Sub-Area Plan which includes 9.1 million square feet of total mixed-use development by the year 2020. In addition, 250 hotel rooms have been added to an anticipated new facility located north of 182nd Street SW and east of Alderwood Mall Parkway. Furthermore, the forecast model includes 500 additional parking spaces added to the existing park-and-ride lot, south of 200th Street SW between 46th Avenue W and 48th Avenue W.

2.2 Roadway Improvement Assumptions

2.2.1 Initial Roadway Network Improvement Assumptions

Substantial transportation improvements within the City will be required by 2025 to meet the land-use growth and traffic demand in the City. For purposes of travel demand forecasting, certain assumptions were made and included in the traffic forecasting model. Most of the improvement projects initially assumed were also described in the *Lynnwood City Center Access Study* (Perteet, Inc., September 2007). Projects included in the initial assumptions are not necessarily committed, funded, or even adopted, but rather have a high possibility for inclusion in future plans based on several meetings and discussions with the City. **Table 1** lists the roadway improvements initially added to the base 2005 road network. Seven new roadway segments are added to provide additional capacity and better travel patterns. Four other arterial corridors are likely to be widened to provide additional capacity with through travel lanes: 196th Street SW and 200th Street SW for east-west travel, and 36th Avenue W and 44th Avenue W serving north-south travel. The costs of roadway improvements provided by the City total approximately \$200.5 million. The costs of the roadway improvements were obtained from the City and are shown in **Table 1**.

Table 1. Assumed Roadway Improvements Completed by 2025

No.	Description	Cost in 2009 Dollars
1	Build a new 5-lane roadway (33rd Avenue W Bypass) between Alderwood Mall Parkway and 184th Street SW, passing through or around the existing Lynnwood High School site.	\$9,257,000
2	Build a 5-lane roadway for the 33rd Avenue W extension to Poplar Way.	\$38,408,000
3	Build a new 2-lane roadway for 179th Street SW (Maple Road) between 36th Avenue W and Alderwood Mall Parkway.	\$1,662,000
4	Extend Ash Way farther south to Beech Road which goes behind Target and Kohl's and eventually connects to Alderwood Mall Parkway, at approximately 188th Street SW.	\$3,158,000

No.	Description	Cost in 2009 Dollars
5	Widen 196th Street SW to a 7-lane roadway from 48th Avenue W to 37th Avenue W.	\$15,911,815
6	Widen 44th Avenue W to a 7-lane roadway from I-5 to 194th Street SW (completed by 2010).	\$13,281,000
7	Include 194th Street SW extended 40th Avenue W to 33rd Avenue W.	\$26,936,805
8	Build the 204th Street SW connection between 68th Avenue W and SR 99.	\$2,031,000
9	Build a braided ramp southbound I-5 / 196th Street SW / SR 525.	\$47,250,000
10	Scenario 1: Widen 200th Street SW to a 5-lane roadway from 48th Avenue W to SR 99. Scenario 2: Keep the existing a 3-lane roadway on 200th Street SW from 48th Avenue W to SR 99.	\$30,032,072 (if widening)
11	Scenario 1: Widen 36th Avenue W to a 5-lane roadway from 179th Street SW to 164th Street SW. Scenario 2: Keep the existing a 3-lane roadway on 36th Avenue W from 179th Street SW to 164th Street SW.	\$12,596,000 (if widening)
Total Estimated Cost		\$200,523,692

2.2.2 City Center Street Grid Street System Improvement Assumptions

The 2025 VISUM traffic forecasting model includes the proposed City Center Street Grid System in the road network as a background assumption, with the exception of the 198th extension west to 45th Avenue W. This grid system includes all new streets within the City Center area bounded by I-5, 194th Street SW, and 48th Avenue W, and includes those boundary streets.

2.3 Intersection Improvement Assumptions

Table 2 lists the intersection improvements initially added to the base 2005 road network. Additional left-turn lanes are added to two intersections on 44th Avenue W, at 196th Street SW and at 200th Street SW, along with signal phasing optimizations. At other intersections, a traffic signal is installed or a right-in / right-out only configuration is placed, along with other related channelization and signal timing adjustments. **Table 2** describes the details of the assumed intersection improvements.

Table 2. Assumed Intersection Improvements Completed by 2025

No.	Description
1	Install a new traffic signal at the following intersections: <ul style="list-style-type: none"> • 28th Avenue W and Alderwood Mall Parkway (completed before 2010) • 30th Place and 33rd Avenue W Bypass • B Street and 33rd Avenue W Bypass • Creekside and 33rd Avenue W Bypass • 198th Street SW and 40th Avenue W • 40th Avenue W and 200th Street SW (completed before 2010) • 48th Avenue W and 188th Street SW • 48th Avenue W and 194th Street SW • 66th Avenue W and 212th Street SW • SR 99 and 204th Street SW

No.	Description
2	Install a traffic signal or a roundabout at the following intersections: <ul style="list-style-type: none"> • 36 Avenue W and 172nd Street SW • 36th Avenue W and Maple Road / 179th Street SW • 52nd Avenue W and 176th Street SW • 68th Avenue W and 204th Street SW
3	Add an additional left-turn only lane to the westbound approach and optimize the signal phasing at the intersection of 200th Street SW and 44th Avenue W
4	Add a second left-turn only lane for the northbound approach at the intersection of 196th Street SW and 44th Avenue W
5	Channelize the intersection of 33rd Avenue W Bypass and 184th Street SW
6	Eliminate left-turn off 196th Street SW at the intersection of 33rd Poplar Extension and 196th Street SW
7	Place Right-In / Right-Out control at the following intersections: <ul style="list-style-type: none"> • Alderwood Mall Parkway and 182nd Street SW • D Street and 184th Street SW • Alderwood Mall Parkway and 182nd Street SW
8	Place Right-In / Right-Out control at these intersections in the City Grid Street System: <ul style="list-style-type: none"> • 44th Avenue W and 195th Street SW • 44th Avenue W and 197th Street SW • 44th Avenue W and 199th Street SW • 44th Avenue W and 200th Street SW Connector • 43rd Avenue W and 200th Street SW • 43rd Avenue W and 196th Street SW • 41st Avenue W and 200th Street SW • 41st Avenue W and 196th Street SW • 45th Avenue W and 196th Street SW • 45th Avenue W and 200th Street SW

2.4 Analysis Steps

The City VISUM traffic forecasting model for 2025 was built on the existing 2005 base year model, with the addition of 2025 land use and the assumed transportation improvements as described in Section 2.2 and 2.3, respectively. A SYNCHRO traffic operational model and a macro-driven Excel workbook were developed using inputs of traffic volumes from the VISUM traffic model to perform the traffic analysis. The following analysis steps were taken to identify the performance at the intersections:

- 2025 land use was added to the City's 2005 base land use inventory.
- The assumed improvements of the roadway segments and intersections were updated in the City's 2005 network.

- Trip generation was updated to include the new development(s).
- Total trip generation was balanced by adjustments at the VISUM zones representing the remote external areas, so that all trip generation calculations in the Lynnwood area were as originally calculated.
- Trips were assigned to the road network using the multi-equilibrium method in VISUM software for the afternoon peak hour.
- Traffic model output volumes were systematically adjusted in a standardized post-processing step in order to remove the known base year (2005) calibration differences from all forecast volumes.
- Final adjusted intersection turning volumes were exported from the VISUM traffic forecasting model to the macro-driven Excel workbook, which provided turning volume inputs for the SYNCHRO analysis. The signal timings and phases at the intersections were optimized for future scenarios by the SYNCHRO program. The SYNCHRO output of Level of Service (LOS), control delay, queue length, and volume to capacity (V / C) ratios were evaluated.

3. Model Volumes

3.1 Volume Sensitivity

The determination of whether 36th Avenue W and 200th Street SW will be widened to 5 lanes or kept to 3 lanes has not been determined. Therefore, a traffic volume sensitivity test was performed for the following four scenarios based on the number of lanes on 36th Avenue W and on 200th Street SW to determine if the volumes on one corridor had an effect on the other.

- **Scenario 1:** A 5-lane roadway on 36th Avenue W and a 5-lane roadway on 200th Street SW
- **Scenario 2:** A 5-lane roadway on 36th Avenue W and a 3-lane roadway on 200th Street SW
- **Scenario 3:** A 3-lane roadway on 36th Avenue W and a 5-lane roadway on 200th Street SW
- **Scenario 4:** A 3-lane roadway on 36th Avenue W and a 3-lane roadway on 200th Street SW

The 2025 PM peak hour volumes on the major corridors of 36th Avenue W, 200th Street SW, and 196th Street SW are shown in **Table 3**.

Table 3. 2025 PM Spot Volumes on 36th Avenue W and 200th Street SW

Spot	Scenario 1			Scenario 2			Scenario 3			Scenario 4		
	36th Avenue W (5-lane) and 200th Street SW (5-lane)			36th Avenue W (5-lane) and 200th Street SW (3-lane)			36th Avenue W (3-lane) and 200th Street SW (5-lane)			36th Avenue W (3-lane) and 200th Street SW (3-lane)		
36th Avenue W	SB	NB	Two-way Total									
n / o 196th Street SW	924	1,026	1,950	889	1,009	1,898	787	996	1,783	782	990	1,772
s / o 188th Street SW	1,287	1,588	2,875	1,296	1,565	2,861	1,109	1,474	2,583	1,095	1,471	2,566
s / o Maple	1,513	1,719	3,232	1,498	1,739	3,237	1,140	1,466	2,606	1,152	1,415	2,567
n / o Maple	1,538	1,920	3,458	1,520	1,925	3,445	887	1,203	2,090	899	1,226	2,125
n / o 172nd Street SW	1,333	1,518	2,851	1,319	1,526	2,845	617	849	1,466	628	855	1,483
n / o 164th Street SW	912	1,279	2,191	960	1,337	2,297	774	1,098	1,872	789	1,082	1,871

Spot	Scenario 1			Scenario 2			Scenario 3			Scenario 4		
	36th Avenue W (5-lane) and 200th Street SW (5-lane)			36th Avenue W (5-lane) and 200th Street SW (3-lane)			36th Avenue W (3-lane) and 200th Street SW (5-lane)			36th Avenue W (3-lane) and 200th Street SW (3-lane)		
200th Street SW	WB	EB	Two-way Total									
e / o SR 99	749	566	1,315	631	494	1,125	746	567	1,313	626	507	1,133
e / o 60th Avenue W	684	671	1,355	542	557	1,099	684	672	1,356	538	562	1,100
e / o 48th Avenue W	1,043	1,010	2,053	909	894	1,803	1,036	1,010	2,046	922	912	1,834
w / o 44th Avenue W	1,271	1,390	2,661	1,198	1,308	2,506	1,280	1,385	2,665	1,189	1,293	2,482
196th Street SW	WB	EB	Two-way Total									
e / o SR 99	1,545	1,487	3,032	1,605	1,535	3,140	1,553	1,489	3,042	1,623	1,527	3,150
e / o 58th Avenue W	1,690	1,695	3,385	1,746	1,767	3,513	1,673	1,663	3,336	1,767	1,718	3,485
w / o 52nd Avenue W	1,772	1,771	3,543	1,846	1,847	3,693	1,752	1,737	3,489	1,848	1,798	3,646
e / o 48th Avenue W	2,014	1,894	3,908	2,043	1,935	3,978	2,008	1,889	3,897	2,034	1,922	3,956
w / o 44th Avenue W	2,464	2,005	4,469	2,520	2,035	4,555	2,477	1,983	4,460	2,514	2,015	4,529

Figures 1, 2, and 3 graphically display the scenario volumes for the 36th Avenue W, 200th Street SW, and 196th Street SW corridors.

Figure 1 shows that the forecasted volumes on 36th Avenue W with a 5-lane roadway vary significantly from the volumes on 36th Avenue W with a 3-lane roadway. A maximum of 1,300 additional PM peak hour trips were attracted to 36th Avenue W with a 5-lane roadway between Maple Road / 179th Street SW and 164th Street SW compared to the same roadway segments with a 3-lane roadway. The figure also indicates that the number of lanes on 200th Street SW has a negligible effect on the PM peak hour volumes on 36th Avenue W.

Figure 1. Two-Way 2025 PM Peak Hour Volumes on 36th Avenue W

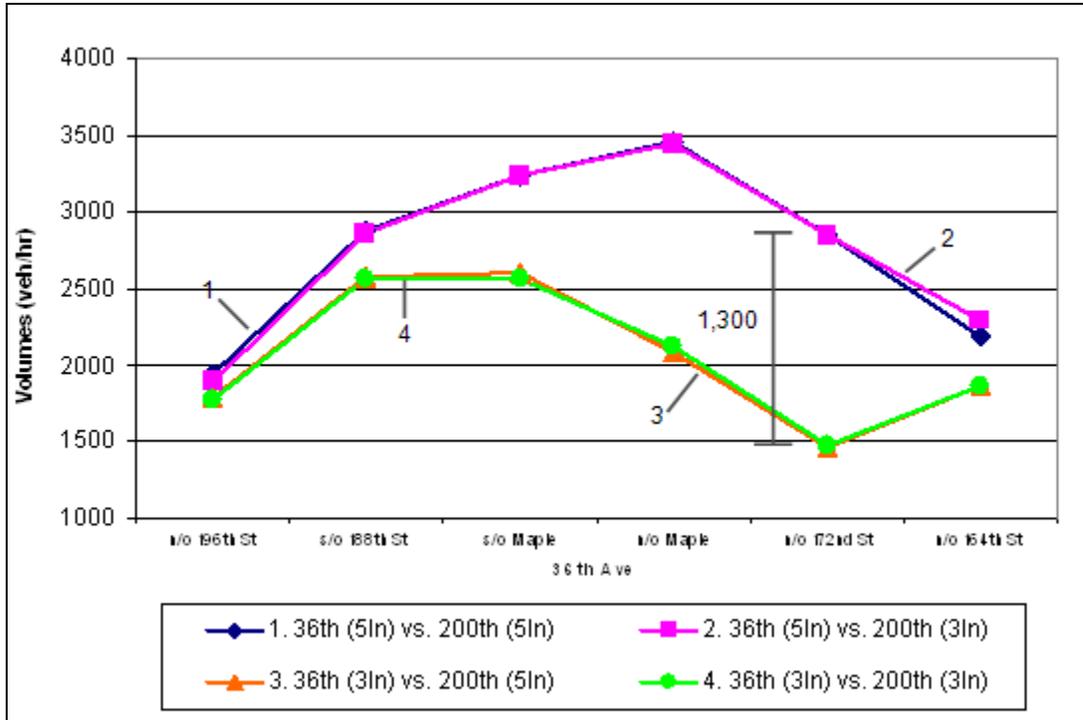


Figure 2 shows that the forecasted PM peak hour volumes on 200th Street SW with a 5-lane roadway increase approximately 250 trips as compared to 200th Street SW with a 3-lane roadway. The figure also indicates that the number of lanes on 36th Avenue W has a negligible effect on the PM peak hour volumes on 200th Street SW.

Figure 2. Two-Way 2025 PM Peak Hour Volumes on 200th Street SW

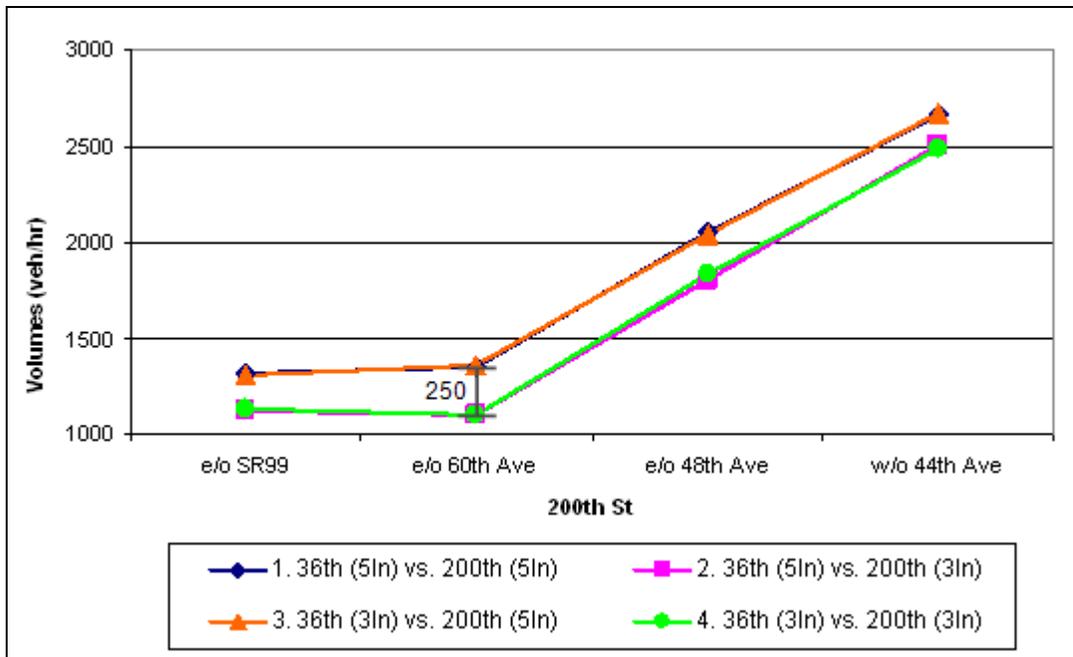
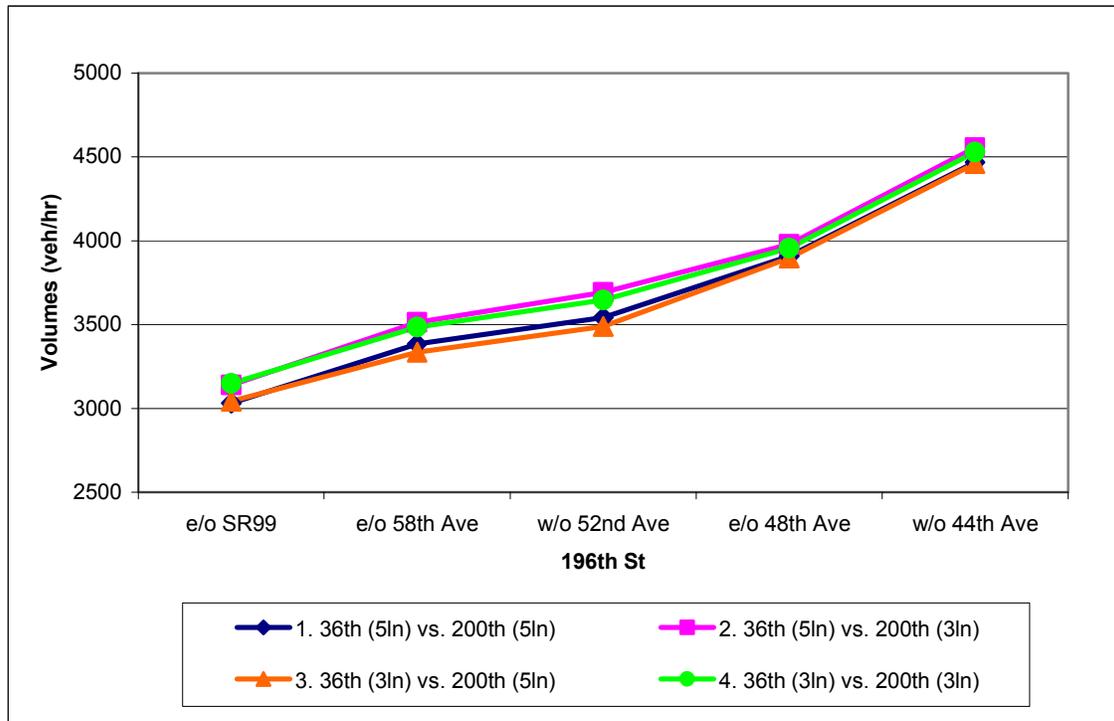


Figure 3 shows that the forecasted PM peak hour volumes on 196th Street SW are less sensitive to the configurations on 36th Avenue W and 200th Street SW. The number of lanes on both 36th Avenue W and 200th Street SW has minimal effect on the PM peak hour volumes on 196th Street SW.

Figure 3. Two-Way 2025 PM Peak Hour Volumes on 196th Street SW



3.2 City-wide Corridor and Intersection Delay Evaluation

City-wide total vehicle delay was measured by major corridors and by scenarios based on the total entering vehicle trips and the control delay at the signalized intersections. When a 5-lane roadway is assumed on 36th Avenue W, the demand on 36th Avenue W is forecasted to increase significantly due to greater capacity added; yet the delay is also forecasted to increase. Conversely, the forecasted volumes and delay on 44th Avenue W and Alderwood Mall Parkway are expected to decrease with the 5-lane scenario for 36th Avenue W.

The city-wide delay difference between Scenario 1 and Scenario 3 is approximately 89.4 vehicle-hours, or a 2 percent increase from a 3-lane option to a 5-lane option on 36th Avenue W and with a 5-lane option on 200th Street SW. The city-wide delay difference between Scenario 2 and Scenario 4 is approximately 114.6 vehicle-hours, which is also a 2 percent increase from a 3-lane option to a 5-lane option on 36th Avenue W but with a 3-lane option 200th Street SW. The vehicle delay by corridors and by scenarios is shown in **Table 4**.

Table 4. City-wide Major Corridor Delay Evaluation

Corridor	Scenario 1: 36th-5 lanes vs. 200th-5 lanes	Scenario 3: 36th-3 lanes vs. 200th-5 lanes	Difference between Scenario 1 and Scenario 3	Percent change over 3-lane option on 36th Avenue W
	Delay (Vehicle-Hour)	Delay (Vehicle-Hour)	Delay (Vehicle-Hour)	
SR 99	1421.2	1410.2	11.0	1%
44th Avenue W	1081.1	1130.4	-49.3	-4%
36th Avenue W n / o 180th Street SW	83.5	69.4	14.1	20%
36th Avenue W s / o 180th Street SW	350.2	217.0	133.2	61%
Alderwood Mall Parkway	611.5	641.7	-30.2	-5%
168th Street SW	66.0	77.8	-11.8	-15%
188th Street SW	64.2	57.1	7.0	12%
194th Street SW	51.9	62.6	-10.6	-17%
196th Street SW	1127.7	1084.5	43.2	4%
200th Street SW	97.8	100.2	-2.4	-2%
Others	401.7	416.4	-14.7	-4%
City-wide	5356.7	5267.2	89.4	2%
Corridor	Scenario 2: 36th-5 lanes vs. 200th-3 lanes	Scenario 4: 36th-3 lanes vs. 200th-3 lanes	Difference between Scenario 2 and Scenario 4	Percent change over 3-lane option on 36th Avenue W
	Delay (Vehicle-Hour)	Delay (Vehicle-Hour)	Delay (Vehicle-Hour)	
SR 99	1369.2	1376.8	-7.6	-1%
44th Avenue W	1060.7	1069.8	-9.1	-1%
36th Avenue W n / o 180th Street SW	78.3	68.9	9.4	14%
36th Avenue W s / o 180th Street SW	363.3	227.3	136.0	60%
Alderwood Mall Parkway	574.5	602.1	-27.6	-5%
168th Street SW	67.2	77.5	-10.4	-13%
188th Street SW	61.6	60.2	1.3	2%
194th Street SW	57.0	56.4	0.7	1%
196th Street SW	1219.6	1178.3	41.3	4%
200th Street SW	97.4	97.2	0.2	0%
Others	398.8	418.4	-19.6	-5%
City-wide	5347.5	5232.9	114.6	2%

The individual intersection delay difference between Scenario 1 and 3 is shown in **Figure 4**. The individual intersection delay difference between Scenario 2 and 4 is shown in **Figure 5**. **Figures 4 and 5** illustrate that a 5-lane roadway on 36th Avenue W would result in increased delay which would adversely affect the following intersections:

- 164th Street SW and SR 99
- 196th Street SW and SR 99
- 212th Street SW and SR 99

- 164th Street SW and 36th Avenue W
- 184th Street SW and 36th Avenue W
- 188th Street SW and 33rd Avenue W
- 188th Street SW and 33rd Avenue W
- 194th Street SW and 36th Avenue W
- 196th Street SW and 36th Avenue W
- 196th Street SW and 40th Avenue W

The following corridors would be primarily affected with increased delay:

- 36th Avenue W between 164th Street SW and 196th Street SW
- 196th Street SW between 44th Avenue W and 36th Avenue W
- 188th Street SW between 40th Avenue W and 33rd Avenue W

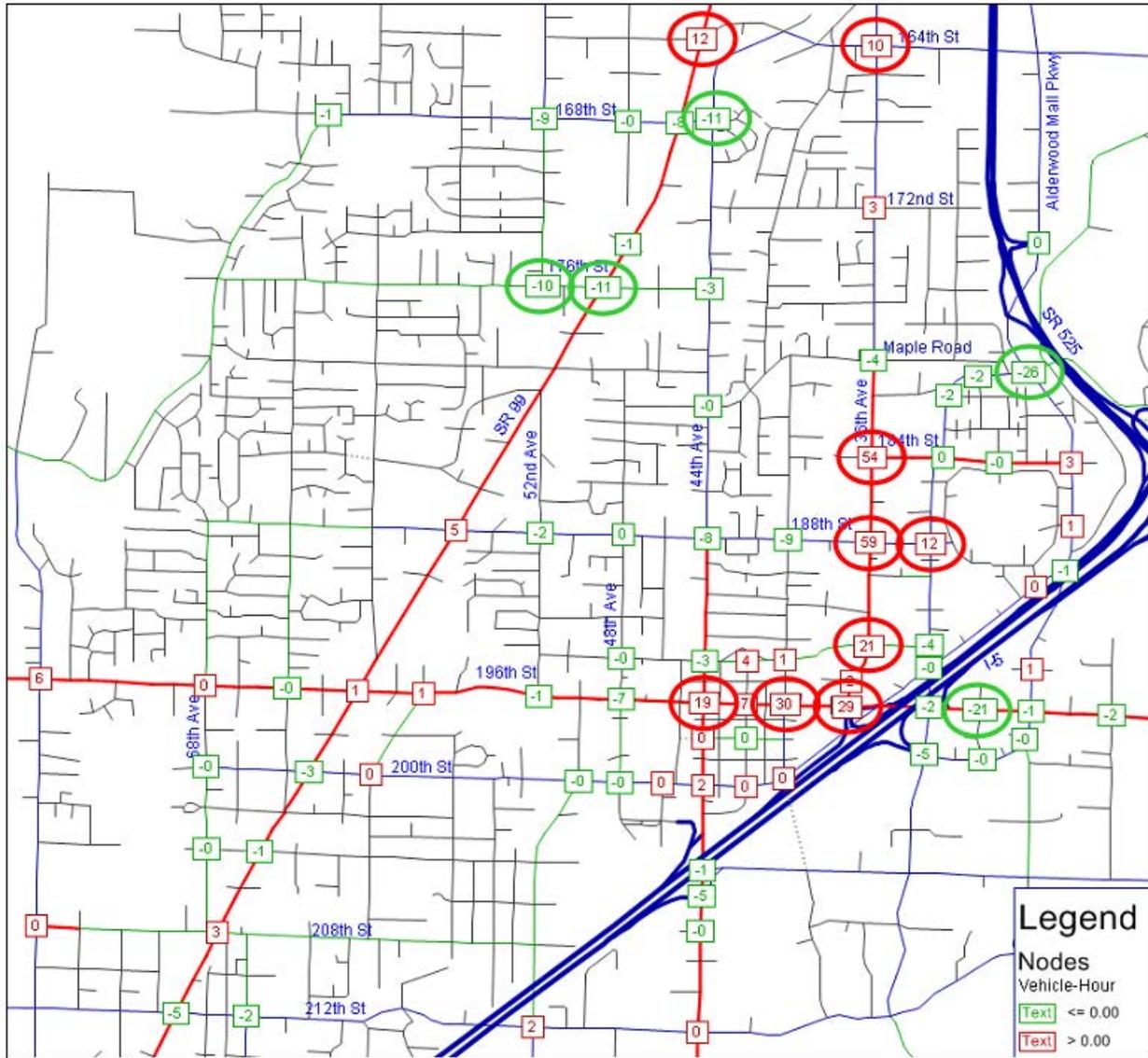
A 5-lane roadway on 36th Avenue W would result in major decreased delay, which would favorably affect the following intersections:

- Alderwood Mall Pkwy and 30th Place W
- 196th Street SW and 33rd Avenue W
- 168th Street SW and 44th Avenue W
- 176th Street SW and 44th Avenue W
- 188th Street SW and 44th Avenue W
- 204th Street SW and 44th Avenue W
- 176th Street SW and SR 99
- 200th Street SW and SR 99

The following corridors would receive reduced delay as a result of a 5-lane roadway on 36th Avenue W:

- 168th Street SW between Olympic View Drive and 44th Avenue W
- 44th Avenue W between 168th Street SW and 212th Street SW
- Alderwood Mall Parkway between the SR 525 on-ramp / off-ramp and 30th Place W

Figure 5. Signalized Intersection Delay Difference (vehicle-hour) between Scenarios 2 and 4



3.3 Forecasted Traffic Volumes on 36th Avenue W

The volume sensitivity test of the four scenarios shows that the number of lanes on 200th Street SW has a negligible effect on the volumes on 36th Avenue W. Scenario 1 with a 5-lane roadway on both 36th Avenue W and 200th Street SW has been identified as having the maximum volumes on 36th Avenue W, while Scenario 4 with a 3-lane roadway on both 36th Avenue W and 200th Street SW has been identified as having the minimum volumes on 36th Avenue W.

The model volumes were simulated for the PM peak hour only in 2025. The 2025 PM peak hour volumes were rounded to the nearest 10 vehicles for the purpose of design volumes. The K-Factor, a ratio of PM peak hour volumes to Average Weekday Traffic, was assumed to be 0.09, which was estimated using 2004 tube counts on 44th Avenue W and Alderwood Mall Parkway. The 2025 Average Weekday Traffic was estimated and rounded to the nearest 100 vehicles for the purpose of design volumes based on the PM peak hour volumes and the assumed K-Factor.

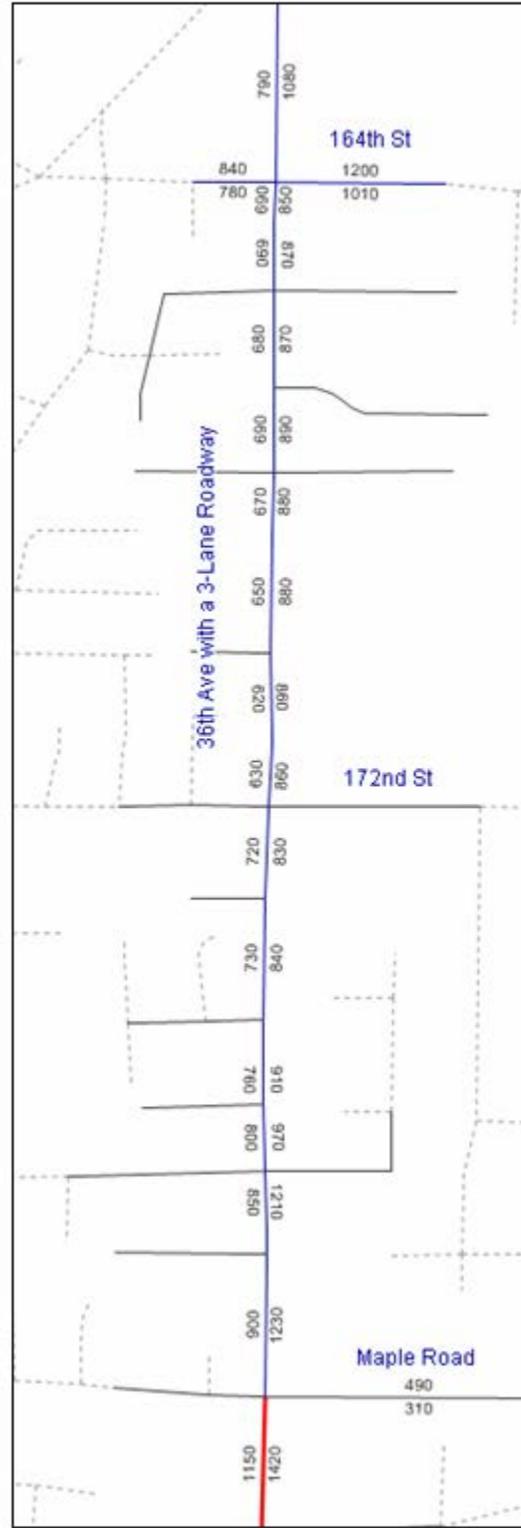
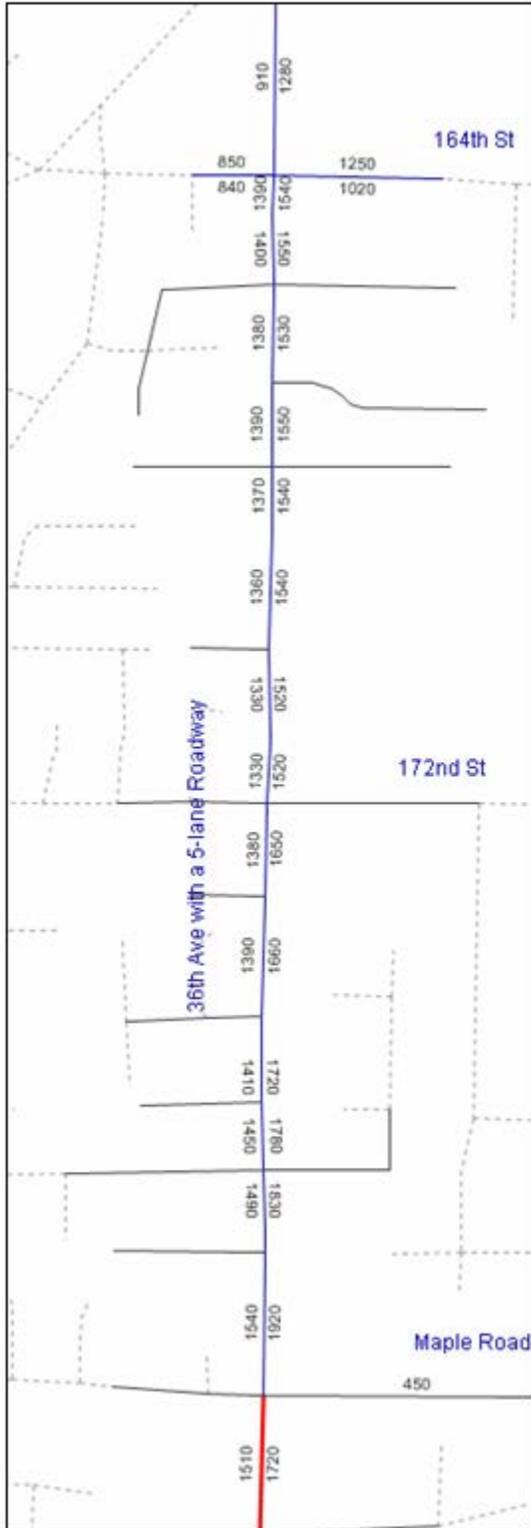
The 2025 spot PM peak hour volumes and Average Weekday Traffic on 36th Avenue W with a 5-lane roadway and a 3-lane roadway are shown in **Table 5**. The 2025 PM peak hour directional volumes on 36th Avenue W with a 5-lane roadway and a 3-lane roadway are shown in **Figure 6**.

Table 5. 2025 PM Peak Hour Volumes and Average Weekday Traffic on 36th Avenue W

Spot	5-lane Roadway on 36th Avenue W						3-lane Roadway on 36th Avenue W					
	PM Peak Hour Volumes			Average Weekday Traffic			PM Peak Hour Volumes			Average Weekday Traffic		
36th Avenue W	SB	NB	Two-way Total	SB	NB	Two-way Total	SB	NB	Two-way Total	SB	NB	Two-way Total
s / o Maple Road	1,510	1,720	3,230	15,900	18,100	34,000	1,140	1,470	2,610	12,000	15,500	27,500
N / o Maple Road	1,540	1,920	3,460	16,200	20,200	36,400	890	1,200	2,090	9,400	12,600	22,000
n / o 172nd Street SW	1,330	1,520	2,850	14,000	16,000	30,000	620	850	1,470	6,500	8,900	15,400
n / o 164th Street SW	910	1,280	2,190	9,600	13,500	23,100	780	1,100	1,880	8,200	11,600	19,800

In general, the 5-lane roadway on 36th Avenue W within the project limits has a northbound PM peak hour volume of 1,500-1,900 vehicles and a southbound PM peak hour volume of 1,400-1,500 vehicles. The 3-lane roadway on 36th Avenue W within the project limits has a northbound PM peak hour volume of 800-1,200 vehicles and a southbound PM peak hour volume of 600-900 vehicles.

Figure 6. 2025 PM Peak Hour Volumes on 36th Avenue W
 (5-lane Roadway) (3-lane Roadway)

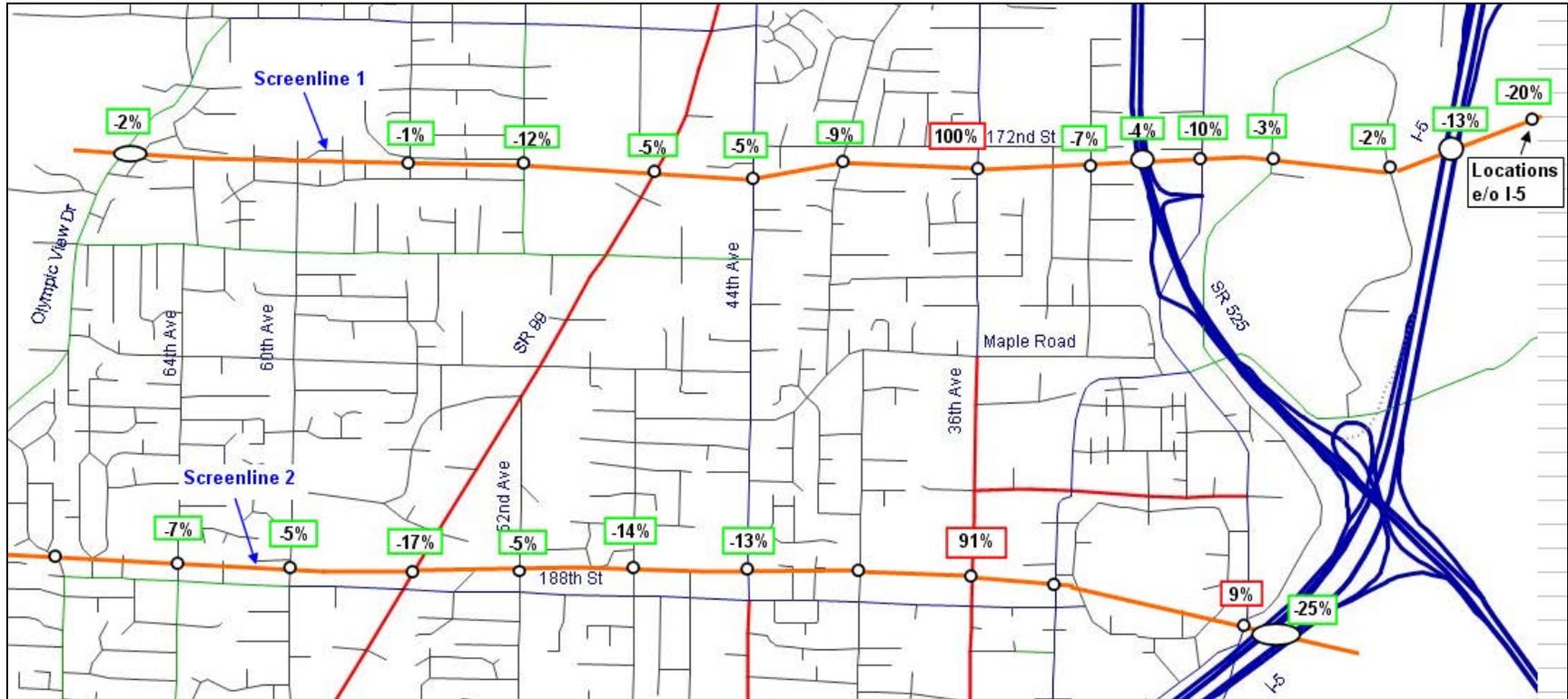


3.4 Screenline Volume Difference

Screenline 1 immediately south of 172nd Street SW was drawn horizontally across the major north-south arterials. Screenline 2 immediately north of 188th Street SW was also drawn horizontally across the major north-south arterials to capture most of the traffic entering and exiting Alderwood Mall. The 2025 PM peak hour volumes (two-way total) on those north-south arterials crossing with the screenlines were compared between Scenario 1 (with maximum volumes) that has a 5-lane roadway on 36th Avenue W and Scenario 4 (with minimum volumes) that has a 3-lane roadway on 36th Avenue W. The volume difference was converted into percentages, assuming a 100 percent increase on 36th Avenue W with a 5-lane roadway from the 3-lane roadway.

Figure 7 illustrates that although the traffic volumes increase on 36th Avenue W with a 5-lane roadway, traffic volumes decrease on most of the other north-south arterials, particularly on SR 99, 48th Avenue W, 44th Avenue W, and Alderwood Mall Parkway. Screenline 1 indicates that the increased traffic on 36th Avenue W with a 5-lane roadway is equivalent to 100 percent, and the total decreased traffic on major north-south arterials adds up to 93 percent, with the remaining 7 percent of the decreased traffic spreading to other roadways city-wide. Screenline 2 shows that there is a 91 percent traffic increase on 36th Avenue W after diverting 9 percent of the traffic to and from the Alderwood Mall. The total decreased traffic on the major north-south arterials adds up to 86 percent, indicating that the remaining 5 percent of the decreased traffic spreads to other roadways city-wide.

Figure 7. Volume Difference between a 5-Lane and a 3-Lane Roadway on 36th Avenue W



4. Intersection Level of Service Standards

The 2000 Highway Capacity Manual (HCM 2000) methodology prepared by the Transportation Research Board (TRB) was used to calculate the level of service (LOS) at the intersections within the project limits. LOS is a qualitative measure describing operational conditions within a traffic stream and the perception thereof by road users. For un-signalized intersections, signalized intersections, and roundabouts, LOS is defined in terms of delay, which is a measure of driver discomfort and frustration, fuel consumption, and lost travel time. There are six LOS levels ranging from LOS A to LOS F, with LOS A representing the best operating conditions and LOS F the worst. Specifically, LOS criteria are stated in terms of the average vehicle control delay for a peak 15-minute analysis period, factored to a full hour, for the intersection or roundabout as a whole. **Table 6** provides LOS definitions for roundabouts, signalized intersections, and un-signalized intersections.

Table 6. Level of Service Definitions

LOS	Signalized Intersection and Roundabout Control Delay (Second / Vehicle)	Un-signalized Intersection Control Delay (Second / Vehicle)	Expected Delays
A	Less than 10	Less than 10	Little or no delay
B	Between 10 and 20	Between 10 and 15	Short traffic delays
C	Between 20 and 35	Between 15 and 25	Average traffic delays
D	Between 35 and 55	Between 25 and 35	Long traffic delays
E	Between 55 and 80	Between 35 and 50	Very long traffic delays
F	Greater than 80	Greater than 50	(1)

(1) When demand volume exceeds the capacity of the movement, extreme delays will be encountered with queuing, which may cause severe congestion affecting other traffic movements in the intersection.

SOURCE: 2000 Highway Capacity Manual (TRB SR 209, 2000) (TRB 2000)

In the City's transportation comprehensive plan, the City has developed a level of service standard to measure the overall transportation system's ability to move people and goods. The level of service standard is established differently for City Center arterials, state facilities, and the rest of the City.

The City's LOS standards are as follows:

- LOS C for local streets at all times.
- LOS D for State Highways during the PM peak hour based on WSDOT's LOS standard for urban arterials.
- LOS D for non-City Center arterials and non-State Highways during the PM peak hour.
- LOS E for City Center arterials during the PM peak hour.

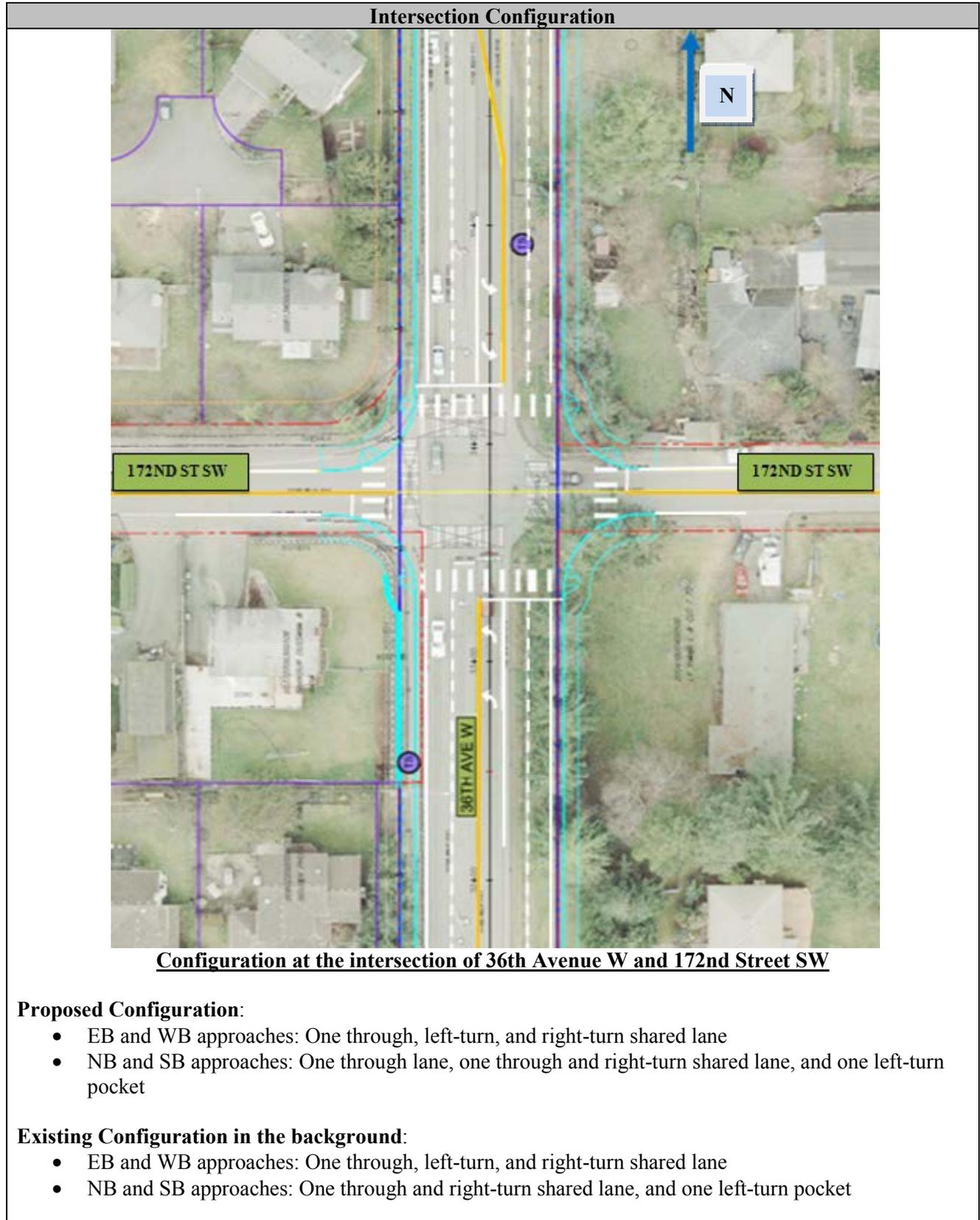
36th Avenue W is classified as a minor arterial, therefore LOS D is the level of service standard for this corridor.

5. Intersection Performance with a 5-Lane Roadway on 36th Avenue W

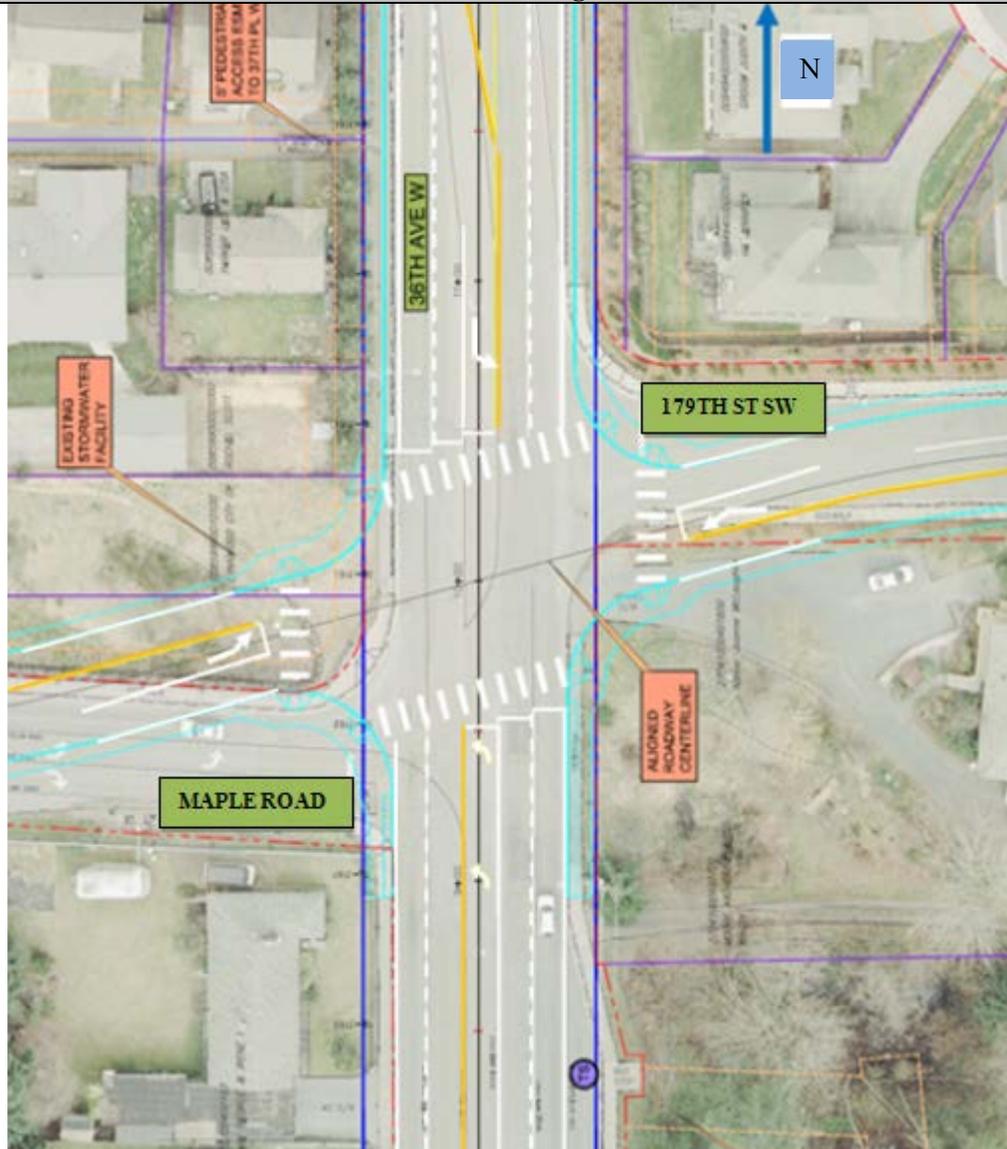
5.1 Intersection Configuration

The intersection configuration with a 5-lane roadway on 36th Avenue W is proposed for the intersection performance evaluation in 2025. The lengths of the turn-pockets have been determined by the queue lengths. The lane configuration for each significant intersection within the project limits was optimized using SYNCHRO Traffic Operations program, and is shown in **Figure 8**.

Figure 8. Optimized Intersection Configurations for 5-lane Scenario



Intersection Configuration



Configuration at the intersection of 36th Avenue W and 179th Street SW

Proposed Configuration:

- EB and WB approaches: Realign the east leg and west leg, one through and right-turn shared lane and one left-turn pocket
- NB and SB approaches: One through lane, one through and right-turn shared lane, and one left-turn pocket

Existing Configuration in the background:

- EB approach: No through lane, one left-turn lane and one right-turn lane
- WB approach: No through lane, one right-turn and left-turn shared lane
- NB and SB approaches: One through lane, one through and right-turn shared lane, and one left-turn pocket

5.2 Intersection Level of Service

The intersection volumes with a 5-lane roadway on 36th Avenue W were extracted from the 2025 City VISUM traffic forecasting model. The traffic operations of major intersections along 36th Avenue W between 179th Street SW and 165th Place SW were performed using the City's SYNCHRO network model. The phasing and signal timings at the signalized intersections were optimized using SYNCHRO. The level of service, lane configuration, control method, and storage length requirements were evaluated.

Table 7 shows that the LOS of the major intersections within the study corridor of 36th Avenue W with a 5-lane roadway between 179th Street SW and 164th Street SW meets the City's LOS standard of LOS D or better.

**Table 7. Intersection LOS in 2025 PM Peak Hour
(a 5-lane roadway on 36th Avenue W)**

Intersection	Type	LOS ¹	Delay ²	V / C ³
172nd Street SW and 36th Avenue W	Signal	B	16.4	0.72
179th Street SW and 36th Avenue W	Signal	C	28.6	0.91

¹LOS – Level of Service

²Delay – Control Delay, seconds / vehicle

³V / C – Volume to Capacity Ratio

5.3 Intersection Queue Length and Proposed Storage

Table 8 shows the 95th percentile queues on each movement at the major intersections within the study corridor of 36th Avenue W with a 5-lane roadway between 179th Street SW and 165th Place SW. The proposed storage lengths are determined based on the left-turn queue lengths and the right-turn queue lengths.

**Table 8. 95th Percentile Queue in 2025 PM Peak Hour
(a 5-lane roadway on 36th Avenue W)**

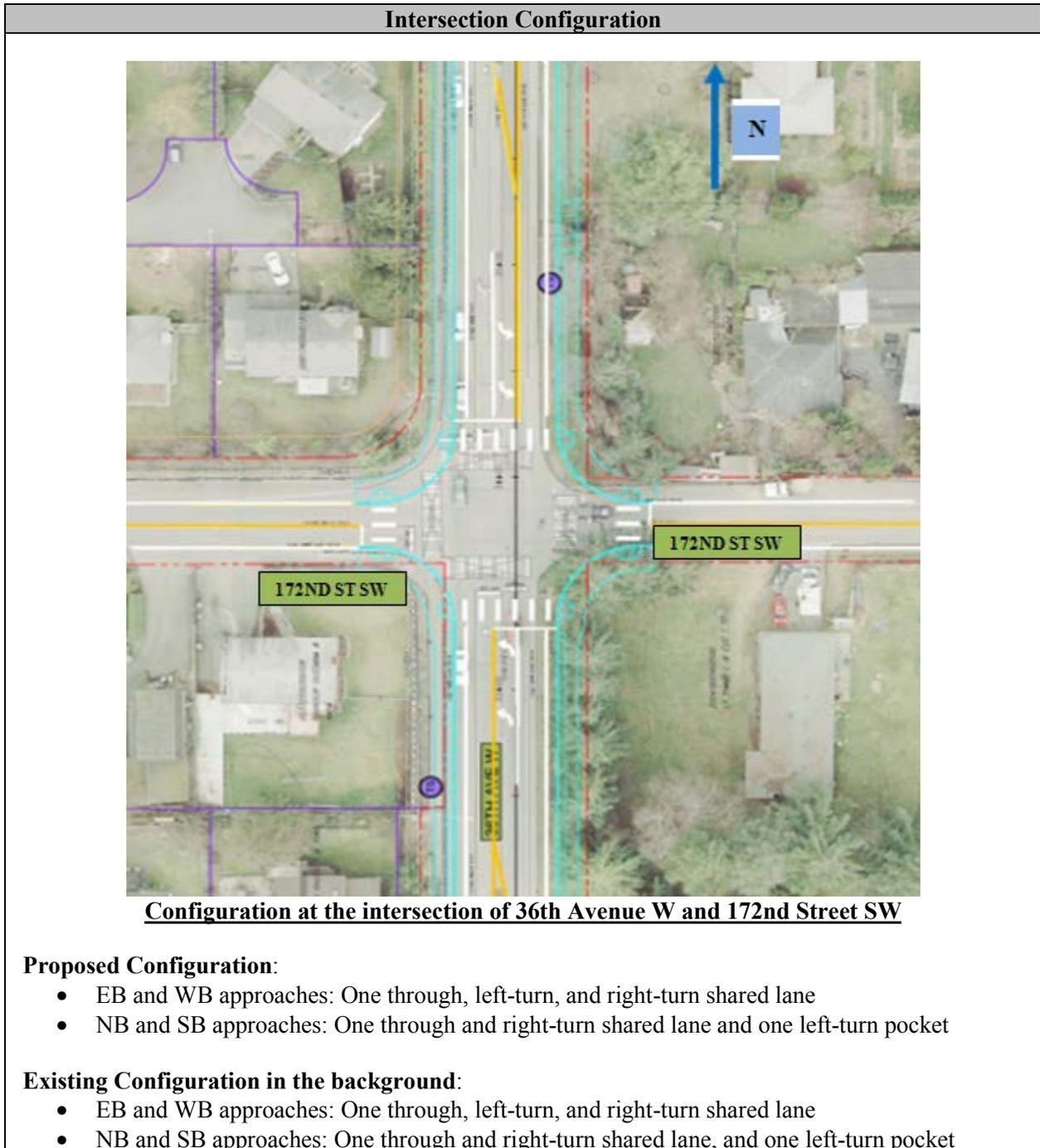
Intersection Movement	Control Type	95th Percentile Queue (ft)	Proposed Storage (ft)
172nd Street SW and 36th Avenue W	Signal		
EB Left-turn + Through + Right-turn Shared		89	NA
WB Left-turn + Through + Right-turn Shared		22	NA
NB Left-turn		177	200
NB Through + Right-turn Shared		480	NA
SB Left-turn		29	50
SB Through + Right-turn Shared		413	NA
179th Street SW and 36th Avenue W	Signal		
EB Left-turn		27	50
EB Through + Right-turn Shared		142	NA
WB Left-turn		20	50
WB Through + Right-turn Shared		436	NA
NB Left-turn		23	50
NB Through + Right-turn Shared		700	NA
SB Left-turn		21	50
SB Through + Right-turn Shared		527	NA

6. Intersection Performance with a 3-Lane Roadway on 36th Avenue W

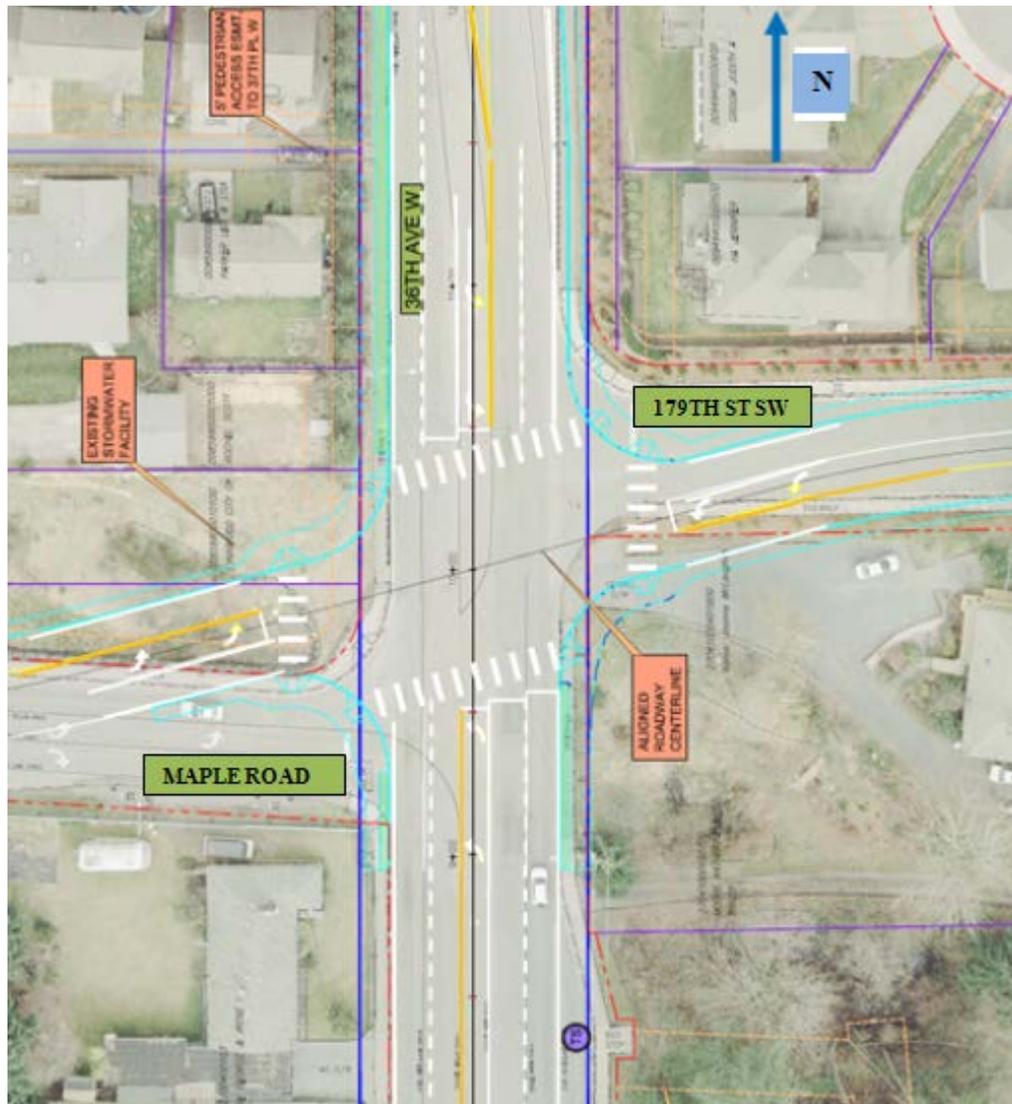
6.1 Intersection Configuration

The intersection configuration with a 3-lane roadway on 36th Avenue W is proposed for the intersection performance evaluation. The lengths of the turn pockets will be determined later by the queue lengths. The intersection configuration is described as follows in **Figure 9**.

Figure 9. Optimized Intersection Configurations for 3-lane Scenario



Intersection Configuration



Configuration at the intersection of 36th Avenue W and 179th Street SW

Proposed Configuration:

- EB and approaches: one through and right-turn shared lane and one left-turn pocket
- NB and SB approach: one through lane, one through and right-turn shared lane and one left-turn pocket

Existing Configuration in the background:

- EB approach: No through lane, one left-turn lane and one right-turn lane
- WB approach: No through lane, one right-turn and left-turn shared lane
- NB and SB approaches: One through lane, one through and right-turn shared lane, and one left-turn pocket

6.2 Intersection Level of Service

The intersection volumes with a 3-lane roadway on 36th Avenue W were extracted from the City's VISUM traffic forecasting model. The traffic operations of major intersections along 36th Avenue W between 179th Street SW and 165th Place SW were performed using the City's SYNCHRO network model. The intersection of 172nd Street SW and 36th Avenue W was evaluated with four-way stop-control and signalized control. The phasing and signal timings at the signalized intersections were optimized using SYNCHRO. The level of service, lane configuration, control method, and storage length requirements were evaluated.

Table 9 shows that the LOS of the major intersections with a signal control within the study corridor of 36th Avenue W with a 3-lane roadway between 179th Street SW and 164th Street SW meets the City's LOS standard of LOS D or better. The intersection of 172nd Street SW and 36th Avenue W with a four-way stop-control has LOS F, which does not meet the City's LOS standard of LOS D.

**Table 9. Intersection LOS in 2025 PM Peak Hour
(a 3-lane roadway on 36th Avenue W)**

Intersection	Control Type	LOS ¹	Delay ²	V / C ³
172nd Street SW and 36th Avenue W	Signal	B	14.1	0.68
172nd Street SW and 36th Avenue W	Four-Way Stop-Control	F	193.0	NA
179th Street SW and 36th Avenue W	Signal	C	26.2	0.79

¹LOS – Level of Service

²Delay – Control Delay, seconds / vehicle

³V / C – Volume to Capacity Ratio

6.3 Intersection Queue Length and Proposed Storage

Table 10 shows the 95th percentile queues on each movement at the major intersections within the study corridor of 36th Avenue W with a 3-lane roadway between 179th Street SW and 165th Place SW. The proposed storage lengths are determined based on the left-turn queue lengths and the right-turn queue lengths.

**Table 10. Intersection Approach Queue in 2025 PM Peak Hour
(a 3-lane roadway on 36th Avenue W)**

Intersection Movement	Control Type	95th Percentile Queue (ft)	Proposed Storage (ft)
172nd Street SW and 36th Avenue W	Signal		
EB Left-turn + Through + Right-turn Shared		104	NA
WB Left-turn + Through + Right-turn Shared		49	NA
NB Left-turn		24	50
NB Through + Right-turn Shared		540	NA
SB Left-turn		11	50
SB Through + Right-turn Shared		331	NA
179th Street SW and 36th Avenue W	Signal		
EB Left-turn		7	50
EB Through + Right-turn Shared		170	NA
WB Left-turn		221	250
WB Through + Right-turn Shared		196	NA
NB Left-turn		32	50
NB Through + Right-turn Shared		567	NA
SB Left-turn		17	50
SB Through + Right-turn Shared		274	NA

7. Queue Length Comparison

Figure 10 shows the maximum queue length on each approach at major intersections within the study corridor of 36th Avenue W with a 5-lane roadway and a 3-lane roadway. **Figure 10** indicates that east-west approach queue lengths and northbound approach queue lengths are generally shorter at the major intersections on 36th Avenue W with a 5-lane roadway compared to a 3-lane roadway on 36th Avenue W.

Figure 10. Maximum Approach Queues



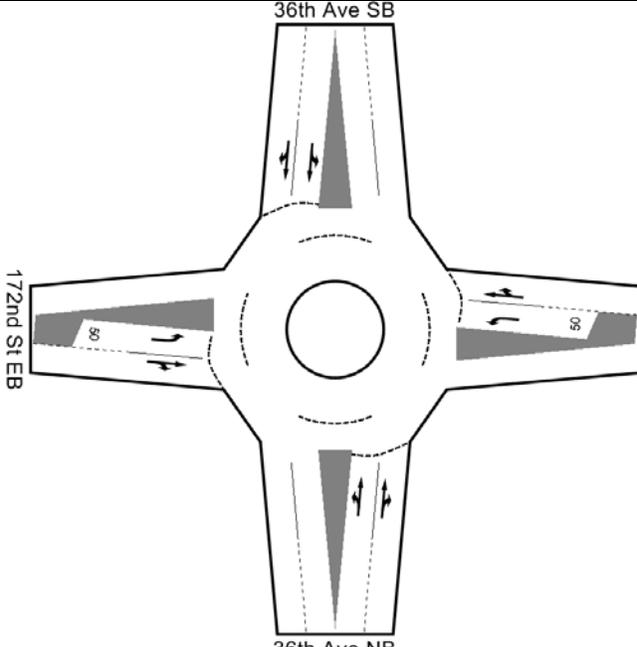
8. Roundabout Performance with a 5-Lane Roadway on 36th Avenue W

8.1 Roundabout Configuration

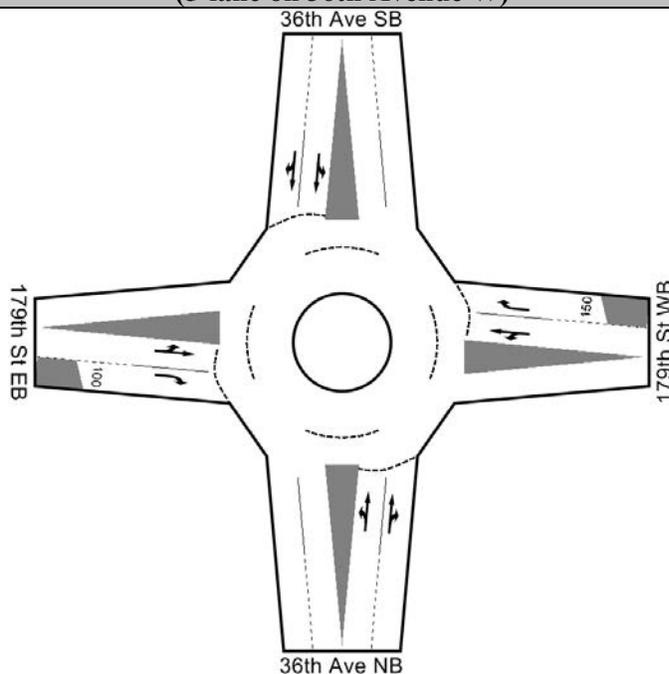
Roundabout alternatives were evaluated at the intersections of 172nd Street SW and 36th Avenue W and 179th Street SW and 36th Avenue W. Two-lane roundabouts were proposed at the intersections of 172nd Street SW and 36th Avenue W and 179th Street SW and 36th Avenue W when a 5-lane roadway is assumed on 36th Avenue W.

The roundabout configuration for the 5-lane scenario is described in **Figure 11**.

Figure 11. Roundabout Configurations for 5-lane Scenario

Roundabout Configuration (5-lane on 36th Avenue W)	Description
	<p>Roundabout:</p> <ul style="list-style-type: none"> Island Diameter: 90 feet Inscribed Circle Diameter: 150 feet Circulating lanes: 2 *Environment Factor: 1.0 <p>Approach:</p> <ul style="list-style-type: none"> EB and WB approaches: one through and right-turn shared lane and one left-turn pocket NB and SB approaches: two through and right-turn and left-turn shared lanes

Roundabout Configuration (5-lane on 36th Avenue W)	Description
---	-------------



Roundabout:

Island Diameter: 90 feet
 Inscribed Circle Diameter: 150 feet
 Circulating lanes: 2
 *Environment Factor: 1.0

Approach:

EB and WB approaches: one through and left-turn shared lane and one right-turn pocket

NB and SB approaches: two through and left-turn and right-turn shared lanes

*Environment Factor 1.0 represents the general roundabout environment in terms of design type, visibility, significant grades, operating speeds, lighting, heavy vehicles, driver aggressiveness, and driver perception and reaction times. Capacity increases with decreasing value of the environment factor (standard default =1.0, US HCM versions default = 1.2). Good visibility, more aggressive drivers, smaller response times, negligible pedestrian volumes, and insignificant parking and heavy vehicles activity could be justified for a smaller factor resulting in higher capacity conditions.

8.2 Roundabout Level of Service and Approach Queue Length

The level of service and approach queues at the intersections of 172nd Street SW and 36th Avenue W and 179th Street SW and 36th Avenue W were evaluated using the SIDRA program.

Table 11 shows that the LOS of the roundabouts meets the City’s LOS standard or better. The 95th percentile queues, which are the values below which 95 percent of all observed queue lengths fail, or 5 percent of all observed queue lengths exceed, are shown in **Table 11**. The approach queues on the EB and WB approaches do not block the left-turning or right-turning traffic. The queue lengths on the NB and SB approaches do not spill back to the upstream intersections and most likely dissipate in a short time due to a yield control in place on every approach of the roundabout.

**Table 11. Roundabout LOS and Queue Length 2025 PM
(a 5-lane roadway on 36th Avenue W)**

Intersection / Approach	Control Type	LOS¹	Delay²	V / C³	95th Percentile Queue (ft)	Storage Space (ft)
172nd Street SW and 36th Avenue W	Two-lane Roundabout	A	5.3	0.65		
Eastbound		A	8.2	0.19	30	50 (Left-turn Pocket)
Westbound		B	10.6	0.04	6	50 (Left-turn Pocket)
Northbound		A	5.2	0.65	185	NA
Southbound		A	5.1	0.56	132	NA
179th Street SW and 36th Avenue W	Two-lane Roundabout	A	6.9	0.75		
Eastbound		A	7.5	0.28	49	100 (Right-turn Pocket)
Westbound		B	12.9	0.58	110	150 (Right-turn Pocket)
Northbound		A	5.4	0.73	248	NA
Southbound		A	6.8	0.70	227	NA

¹LOS – Level of Service

²Delay – Control Delay, seconds / vehicle

³V / C – Volume to Capacity Ratio

9. Roundabout Performance with a 3-Lane Roadway on 36th Avenue W

9.1 Roundabout Configuration

A single-lane roundabout at the intersection of 172nd Street SW and a two-lane roundabout at the intersection of 36th Avenue W and 179th Street SW were proposed when a 3-lane roadway is assumed on 36th Avenue W. An analysis of a single-lane roundabout at the intersection of 36th Avenue W and 179th Street SW is also shown for comparison purposes.

The roundabout configurations for the 3-lane scenario are described in **Figure 12**.

Figure 12. Roundabout Configurations for 3-lane Scenario

Roundabout Configuration (3-lane on 36th Avenue W)	Description
	<p>Roundabout:</p> <ul style="list-style-type: none"> Island Diameter: 70 feet Inscribed Circle Diameter: 100 feet Circulating lane: 1 Environment Factor: 1.0 <p>Approach:</p> <p>All four approaches: one lane shared with left-turn, through, and right-turn movements</p>
	<p>Roundabout (Two-Lane):</p> <ul style="list-style-type: none"> Island Diameter: 90 feet Inscribed Circle Diameter: 150 feet Circulating lanes: 2 Environment Factor: 1.0 <p>Approach:</p> <p>EB and WB approaches: one through and right-turn shared lane and one left-turn pocket</p> <p>NB and SB approaches: two through and left-turn and right-turn shared lanes</p>

Figure 12. Roundabout Configurations for 3-lane Scenario (continued)

Roundabout Configuration (3-lane on 36th Avenue W)	Description
	<p>Roundabout (Partial One-Lane):</p> <p>Island Diameter: 70 feet Inscribed Circle Diameter: 100 feet except 115 feet for NB Circulating lanes: 1 except 2 for NB Environment Factor: 1.0</p> <p>Approach:</p> <p>EB: 1 lane WB: 1 lane NB: 2 lanes SB: 1 lane</p>
	<p>Roundabout (Half Two-Lane):</p> <p>Island Diameter: 70 feet Inscribed Circle Diameter: 100 feet except 115 feet for NB and WB approaches Circulating lanes: 1 except 2 for NB and WB approaches Environment Factor: 1.0</p> <p>Approach:</p> <p>EB: 1 lane WB: 2 lanes NB: 2 lanes SB: 1 lane</p>

9.2 Roundabout Level of Service and Approach Queue Length

The level of service and approach queues at the intersections of 172nd Street SW and 36th Avenue W and 179th Street SW and 36th Avenue W were evaluated using SIDRA.

Table 12 shows that the LOS of the roundabouts meets the City’s LOS standard or better for the single-lane roundabout at 172nd Street SW and for the two-lane roundabout at 179th Street SW. The partial one-lane roundabout and half two-lane roundabout alternatives for the intersection with 179th Street SW are calculated to be LOS F and do not meet the City’s LOS standard. The 95th percentile queues, which are the values below which 95 percent of all observed queue lengths fail, or 5 percent of all observed queue lengths exceed, are shown in **Table 12**. The approach queues do not spill back to the upstream intersections and most likely dissipate in a short time due to a yield control in place on every approach of the roundabout.

**Table 12. Roundabout LOS and Queue Length 2025 PM
(a 3-lane roadway on 36th Avenue W)**

Intersection Approach	Type	LOS¹	Delay²	V / C³	95th Percentile Queue (ft)	Storage Space (ft)
172nd Street SW and 36th Avenue W	Single-Lane Roundabout	A	9.0	0.73		
Eastbound		A	10.0	0.39	88	NA
Westbound		B	15.9	0.57	168	NA
Northbound		A	8.0	0.73	268	NA
Southbound		A	6.8	0.61	173	NA
179th Street SW and 36th Avenue W	Two-Lane Roundabout	A	6.8	0.60		
Eastbound		A	6.5	0.26	46	50 (Left-turn Pocket)
Westbound		B	11.3	0.50	73	50 (Left-turn Pocket)
Northbound		A	5.2	0.6	158	NA
Southbound		A	6.7	0.51	105	NA
179th Street SW and 36th Avenue W	Partial One-Lane Roundabout	F	170.2	3.01		
Eastbound		B	18.7	0.53	150	NA
Westbound		F	967.1	3.02	3527	NA
Northbound		B	17.5	1.0	1104	NA
Southbound		B	10.9	0.85	454	NA
179th Street SW and 36th Avenue W	Half Two-Lane Roundabout	F	84.7	1.84		
Eastbound		B	16.2	0.47	126	NA
Westbound		F	313.5	1.83	2066	50 (Left-turn Pocket)
Northbound		B	16.1	0.99	1073	NA
Southbound		F	139.5	1.27	2199	NA

¹LOS – Level of Service

²Delay – Control Delay, seconds / vehicle

³V / C – Volume to Capacity Ratio

10. Preferred Option

Although 36th Avenue W widened from a 3-lane to a 5-lane roadway would beneficially reduce some delays on roadways that are not heavily congested, the project would result in significant traffic increasing on 36th Avenue W and adverse delay impacts on the two heavily-congested segments: 36th Avenue between 184th Street SW and 196th Street SW, and 196th Street between 44th Avenue W and 36th Avenue W. In addition, the cost of the widening the corridor to a 5-lane roadway is approximately \$12.5 million, which does not include the cost to mitigate the added congestion on the above two roadway segments. Therefore, it is preferred to keep the existing 3-lane roadway on 36th Avenue W.

Both the signal and roundabout options are feasible at 172nd Street SW and at 179th Street SW / Maple Road on 36th Avenue W in terms of traffic operational performance. A roundabout would reduce future maintenance costs and reduce the high collision rates occurring at the intersection because the traffic with yield control would circulate throughout the roundabout at a lower speed. It is preferred to construct a single-lane roundabout at 172nd Street SW and 36th Avenue W. A signal is preferred to be installed at the intersection of 36th Avenue W and 179th Street SW / Maple Road to fully utilize the existing two-lane configuration on 36th Avenue W and minimize the right-of-way and other environmental impacts that would result if a roundabout is constructed at this intersection.

The preferred option includes a 3-lane roadway on 36th Avenue W, a roundabout at the intersection of 36th Avenue W and 172nd Street, and a signal at 36th Avenue W and 179th Street SW / Maple Road.

11. Intersection Performance in 2005, 2015, 2025, and 2040

For air quality purposes, it is preferred to evaluate the intersection LOS for the project existing year, project opening year, project build-out year, and regional transportation long-term forecast year 2040. The project existing year was defined as 2005 and was consistent with the year of the city-wide 2005 traffic forecasting model. The project opening year of 2015 was defined by the City, and the project build-out year was 2025.

The 2005 intersection turning movement volumes were obtained from the 2005 traffic counts or were estimated from 2004 counts by assuming 2 percent straight-line growth from 2004.

The 2015 intersection turning movement volumes were extracted from the city-wide 2015 traffic forecasting model. The 2015 traffic forecasting model was built upon the city-wide 2005 travel demand model by adding the City's current 2006-2015 Transportation Improvement Program (TIP) and the 2015 land use growth. The 2015 land use growth was interpolated between the 2005 land use and the 2025 land use for all areas except the City Center area, where 20 percent growth from 2005 was assumed.

The 2025 intersection turning movement volumes were extracted from the city-wide 2025 traffic forecasting model for the preferred option.

The 2040 intersection turning movement volumes were obtained from the 2025 intersection turning movement volumes by applying 1.5 percent per year straight-line growth for 15 years. According to Puget Sound Regional Council (PSRC) household and employment forecast data for the City between 2020 and 2040, the employment and the household units will grow by 1.7 percent and 1.2 percent per year, respectively, between 2020 and 2040. The average 1.5 percent per year straight-line growth for all land use categories was estimated for the City between 2025 and 2040.

The SYNCHRO network for the preferred option including a 3-lane roadway on 36th Avenue W, a roundabout at the intersection of 36th Avenue W and 172nd Street SW, and a signal at the intersection of 36th Avenue W and 179th Street SW / Maple was used to evaluate the intersection LOS for the project opening year 2015, the project build-out year 2025, and the regional transportation long-term forecast year 2040. The existing intersection configuration was used to evaluate intersection LOS for the project existing year 2005. The timing and phasing at the signalized intersection in the future years 2015, 2025, and 2040 was optimized using SYNCHRO. SIDRA was used to evaluate roundabout LOS at the intersection of 36th Avenue W and 172nd Street.

Table 13 shows that there is only one intersection LOS deficiency present at the two-way stop intersection of 179th Street SW and 36th Avenue under the 2005 existing condition.

Table 13. Intersection LOS in PM Peak Hour

Intersection	Control Type		Existing 2005	Opening Year 2015	Build-Out Year 2025	Long-Term Forecast Year 2040
	Existing Condition	Preferred Option				
			LOS (Delay ¹)	LOS (Delay ¹)	LOS (Delay ¹)	LOS (Delay ¹)
172nd Street SW and 36th Avenue W	Four-Way Stop	Single-Lane Roundabout	D (30.6)	A (6.2)	A (9.0)	A(9.3)
179th Street SW and 36th Avenue W	Two-Way Stop	Signal	E (40.3)	B (15.8)	C (26.2)	D (46.4)

¹Delay-Control delay, vehicle / seconds

12. Collision Analysis

The City provided collision data on 36th Avenue W between 196th Street SW and 165th Place SW for a three-year period, from February 2006 to December 2008. The 36th Avenue West Improvement Project study area is on 36th Avenue W between 179th Street SW and 164th Street SW.

Over the three-year period from 2006 to 2008, 141 collisions were recorded on 36th Avenue W between 196th Street SW and 166th Street SW, of which 20 collisions were recorded in the study area. The collisions were analyzed by year, type, and severity.

Table 14 indicates that approximately 14 percent of the collisions occurred in the study area and 86 percent occurred outside of the study area. Within the study area, approximately 9 percent of the collisions occurred at the intersection of 36th Avenue W and 172nd Street SW, and 1 percent occurred at the intersection of 36th Avenue W and 179th Street SW. Outside of the study area, the highest collision percentage (48 percent) occurred at the intersection of 36th Avenue W and 196th Street SW (SR 524), followed by the intersection of 188th Street SW and 36th Avenue W (21 percent) and the intersection of 184th Street SW and 36th Avenue W (12 percent). Approximately 32 percent of the collisions occurred in 2008, 38 percent occurred in 2007, and 30 percent occurred in 2006.

Table 14. Collisions by Year

Location	2006	2007	2008	Total	Total Percent
Within the Study Area					
36th Avenue W, 55 ft s / o of 165th Place (6,017 ft. n / o 184th Street SW)			1	1	0.7%
166th Place at 36th Avenue W			1	1	0.7%
170th Street SW at 36th Avenue W			1	1	0.7%
172nd Street SW at 36th Avenue W	3	3	6	12	8.5%
175th Street SW at 36th Avenue W	1			1	0.7%
177th Place at 36th Avenue W	1	1		2	1.4%
179th Street SW at 36th Avenue W	1		1	2	1.4%
Subtotal	6	4	10	20	14.1%
Outside of the Study Area					
180th Place at 36th Avenue W	1			1	0.7%
36th Avenue W, 180 ft s / o 180th Place (990 ft. n / o 184th Street SW)			1	1	0.7%
36th Avenue W, 370 ft s / o 180th Place (800 ft. n / o 184th Street SW)			1	1	0.7%
184th Street SW at 36th Avenue W	3	7	7	17	12.1%
188th Street SW at 36th Avenue W	10	10	10	30	21.3%
36th Avenue W, 600 ft. s / o 188th Street SW	1			1	0.7%
191st Place at 36th Avenue W			1	1	0.7%
36th Avenue W, 200 ft s / o 191st Place (1,300 ft. s / o 188th Street SW)			1	1	0.7%
192nd Place at 36th Avenue W			1	1	0.7%
36th Avenue W at 196th Street SW (SR 524)	22	32	13	67	47.5%
Subtotal	37	49	35	121	85.8%
Total on Entire 36th Avenue W	43	53	45	141	
Total Percent on Entire 36th Avenue W	30%	38%	32%		100%

Table 15 indicates that approximately 30 percent or 43 collisions involved sideswipe collisions, 17 percent or 24 collisions involved right-angle collisions, 12 percent or 17 collisions involved approach turn collisions, 12 percent or 17 collisions involved rear-end collisions, 9 percent or 13 collisions involved fixed-object or parked vehicle collisions, and 19 percent or 27 collisions involved other collisions. Right-angle collisions are the dominant collisions in the study area, and side-swipe collisions are the predominant type within the entire 36th Avenue W corridor.

Table 15. Collisions by Type

Location	Sideswipe	Right-Angle	Approach Turn	Rear-End	Fixed-Object / Parked Vehicle	Other	Total
Within the Study Area							
36th Avenue W, 55 ft s / o of 165th Place (6,017 ft. n / o 184th Street SW)			1				1
166th Place at 36th Avenue W						1	1
170th Street SW at 36th Avenue W		1					1
172nd Street SW at 36th Avenue W	2	4	1	2	1	2	12
175th Street SW at 36th Avenue W					1		1
177th Place at 36th Avenue W						2	2
179th Street SW at 36th Avenue W		1			1		2
Subtotal	2	6	2	2	3	5	20
Outside of the Study Area							
180th Place at 36th Avenue W					1		1
36th Avenue W, 180 ft s / o 180th Place (990 ft. n / o 184th Street SW)						1	1
36th Avenue W, 370 ft s / o 180th Place (800 ft. n / o 184th Street SW)		1					1
184th Street SW at 36th Avenue W	5	4	4		1	3	17
188th Street SW at 36th Avenue W	6	5	6	3	4	6	30
36th Avenue W, 600 ft. s / o 188th Street SW						1	1
191st Place at 36th Avenue W	1						1
36th Avenue W, 200 ft s / o 191st Place (1,300 ft. s / o 188th Street SW)	1						1
192nd Place at 36th Avenue W		1					1
36th Avenue W at 196th Street SW (SR 524)	28	7	5	12	4	11	67
Subtotal	41	18	15	15	10	22	121
Total on Entire 36th Avenue W	43	24	17	17	13	27	141
Total Percent on Entire 36th Avenue W	30%	17%	12%	12%	9%	19%	100%

Table 16 indicates that approximately 74 percent of all collisions involved property damage only (PDO), while 26 percent involved injury. There were no fatal collision on the entire 36th Avenue W within the 3-year period evaluated.

Table 16. Collisions by Severity

Location	Fatal	Injury	PDO
Within the Study Area			
36th Avenue W, 55 ft s / o of 165th Place (6,017 ft. n / o 184th Street SW)			1
166th Place at 36th Avenue W			1
170th Street SW at 36th Avenue W			1
172nd Street SW at 36th Avenue W		3	7
175th Street SW at 36th Avenue W			1
177th Place at 36th Avenue W			2
179th Street SW at 36th Avenue W		1	1
Subtotal		4	14
Outside of the Study Area			
180th Place at 36th Avenue W			1
36th Avenue W, 180 ft s / o 180th Place (990 ft. n / o 184th Street SW)		1	
36th Avenue W, 370 ft s / o 180th Place (800 ft. n / o 184th Street SW)		2	
184th Street SW at 36th Avenue W		4	13
188th Street SW at 36th Avenue W		7	23
36th Avenue W, 600 ft. s / o 188th Street SW			1
191st Place at 36th Avenue W			1
36th Avenue W, 200 ft s / o 191st Place (1,300 ft. s / o 188th Street SW)		1	
192nd Place at 36th Avenue W			1
36th Avenue W at 196th Street SW (SR 524)		18	49
Subtotal		33	89
Total on Entire 36th Avenue W		37	103
Total Percent on Entire 36th Avenue W		26%	74%

Further analysis of intersection collisions was conducted by converting the collision data to a collision rate so that high and low traffic volume locations can be compared on an equivalent basis. Intersection collision rates are expressed as collisions per million entering vehicles (MEV). The following equation was used to determine the intersection collision rate:

$$R_{\text{intersection}} = A \times 1,000,000 / (365 \times T \times \text{AADT})$$

Where $R_{\text{intersection}}$ = Intersection collision rate, in collisions per million entering vehicles (MEV)

A = Number of reported collisions

T = Time period of the analysis (year)

AADT = Annual Average Daily Traffic entering the intersection (vehicle / day)

A collision rate of 1.0 collision per MEV is typically considered as a threshold of concern. **Table 17** shows the existing accident rates for the major intersections on 36th Avenue W.

Within the study area, **Table 17** shows that the intersection of 172nd Street SW and 36th Avenue W has a collision rate of 0.98 collisions per MEV, which is slightly below the threshold of concern. It is notable that during the three-year period, approximately 33 percent of the collisions occurring at the intersection of 172nd Street SW and 36th Avenue W were right-angle collisions, and 17 percent were sideswipe collisions, and 17 percent were rear-end collisions. The right-angle collisions may be a result of anxious or frustrated drivers on the stop-controlled minor approaches taking more risks while attempting to make turns onto or across the major corridor without adequate gaps in the through traffic. This type of accident hazard can be remedied with a traffic signal or roundabout to give traffic from the minor approaches more predictable access to or across 36th Avenue W.

Outside of the study area, two intersections of 196th Street SW (SR 524) and 36th Avenue W and 188th Street SW and 36th Avenue W have collision rates higher than the threshold of concern; therefore, safety issues likely exist. The intersection of 184th Street SW and 36th Avenue W has a collision rate of 0.92 collision per MEV, which is slightly below the threshold of concern and a potential safety issues may exist. Both of these intersections are beyond the limits of improvement for this project.

Table 17. Intersection Collision Rate

Location	2006	2007	2008	Total	AADT ¹	Collisions per MEV
Within the Study Area						
166th Place and 36th Avenue W			1	1		NC ²
170th Street SW and 36th Avenue W			1	1		NC ²
172nd Street SW and 36th Avenue W	3	3	6	12	11,180	0.98
175th Street SW and 36th Avenue W	1			1		NC ²
177th Place and 36th Avenue W	1	1		2		NC ²
179th Street SW and 36th Avenue W	1		1	2	14,340	0.13
Outside of the Study Area						
180th Place and 36th Avenue W	1			1		NC ²
184th Street SW and 36th Avenue W	3	7	7	17	16,840	0.92
188th Street SW and 36th Avenue W	10	10	10	30	26,720	1.03
191st Place and 36th Avenue W			1	1		NC ²
192nd Place and 36th Avenue W			1	1		NC ²
196th Street SW (SR 524) and 36th Avenue W	22	32	13	67	46,100	1.33

¹ AADT - Estimated Annual Average Daily Traffic, rounded to the nearest 10.

² NC - Not calculated due to fewer collisions.

13. Conclusions

The following summary of conclusions was drawn based on the City's future traffic modeling and the traffic operations analysis for the major intersections within the study corridor and the city-wide intersection delay evaluation.

- Lane choice (5 lanes or 3 lanes) on 200th Street SW has a negligible effect on traffic volumes on 36th Avenue W:
 - With a 5-lane option on 36th Avenue W:
 - 36th Avenue W Corridor volumes increase significantly
 - Queue lengths are slightly shorter on most eastbound, westbound, and northbound intersection approaches
 - Queue lengths are slightly longer on the southbound intersection approaches
 - Beneficial reductions in delay are widely dispersed elsewhere
 - 36th Avenue W between Maple Road and 196th Street SW is adversely impacted
 - 196th Street SW (SR 524) between 44th Avenue W and 36th Avenue W is adversely impacted
 - Some intersections on SR 99 are adversely impacted
 - With a 3-lane option on 36th Avenue W:
 - The north-south legs would be widened with two through lanes each way at the intersections of 164th Street SW and 36th Avenue W and 179th Street SW and 36th Avenue W
 - A single-lane roundabout is functional at the intersection of 172nd Street SW and 36th Avenue W
- Signal vs. roundabout options at the intersections of 172nd Street SW and 36th Avenue W and 179th Street SW and 36th Avenue W:
 - Both are feasible from traffic operations perspective
 - Roundabout options appear to have shorter queues and better LOS for both the 3- and 5-lane alternatives
 - Limiting eastbound and westbound to right-turn-only at 172nd Street SW can be an option to be considered
- 5-lane vs. 3-lane options:
 - LOS and queues at the major intersections can be managed with proposed optimized configurations
 - If the 3-lane option is selected, use larger intersection configurations of the 5-lane option in case higher volumes occur
 - Modifications of the existing configuration on 164th Street SW warrant further discussion with Snohomish County
 - Decision to select either option can be based on considerations other than traffic findings
- Collision Analysis:
 - Collision rate at the intersection of 172nd Street SW and 36th Avenue W is at the threshold of concern
 - A traffic signal or roundabout should reduce the collisions at this intersection

14. Recommendations

The traffic analysis shows that widening 36th Avenue W to a 5-lane roadway would: 1) attract significant traffic traveling on 36th Avenue W, 2) decrease some delays on the other north-south corridors that are not heavily congested, and 3) result in adverse delay impacts on two heavily-congested segments: 36th Avenue W between 184th Street SW and 196th Street SW, and 196th Street SW between 44th Avenue W and 36th Avenue W. In addition, the cost of the 5-lane widening project is approximately \$12.5 million, which does not include the cost to mitigate the added congestion on the above two segments (36th and 196th). Therefore, it is not recommended to widen 36th Avenue W to a 5-lane roadway.

Both signal and roundabout options are feasible at 172nd Street SW and at 179th Street SW / Maple Road on 36th Avenue W. A roundabout would reduce future maintenance costs and reduce the collision rates occurring at the intersection because the traffic would circulate throughout the roundabout at a lower speed than what it typically traveled through a signalized intersection. It is recommended to construct a single-lane roundabout at 172nd Street SW and 36th Avenue W. A signal is recommended to be installed at the intersection of 36th Avenue W and 179th Street SW / Maple Road to fully utilize the existing two-lane configuration on 36th Avenue W and to minimize the level of right-of-way and other environmental impacts over what would be realized should a roundabout be constructed at this location.

In summary, based upon the findings included within this traffic report, it is recommended to build a 3-lane roadway on 36th Avenue W, a single-lane roundabout at the intersection of 36th Avenue W and 172nd Street, and a signal at 36th Avenue W and 179th Street SW / Maple Road.

Appendix A – Overview of Traffic Findings (PowerPoint Presentation Summary)