Traffic Impact Analysis Report

First Avenue S Redevelopment Plan

City of Normandy Park

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Introduction

The purpose of this report is to present the transportation impact analysis for the proposed First Avenue S redevelopment plan within the City of Normandy Park. Two redevelopment sites are proposed, one just north of Normandy Road and the other at SW 200th Street. Two land use development alternatives are evaluated for each site. The anticipated year of development completion for both sites is 2009.

Description of Study Area

The City of Normandy Park has proposed redevelopment plans at two neighborhood centers on First Avenue S. As illustrated in Figure 1, the North Neighborhood Center is located north of SW Normandy Road bounded by First Avenue S, SW 178th Street, and 3rd Avenue SW. The South Neighborhood Center is located from 19801 First Avenue S on the north to SW 200th Street on the south bounded by First Avenue S on the east and 2nd Avenue SW on the west.

The land uses along First Avenue S consist primarily of commercial businesses and offices with some multi-family land use. The North Neighborhood Center currently includes a QFC, Manhattan Village, Diary Queen, restaurant, daycare center, multi-family residential complex, and several single-family units. The proposed redevelopment will convert the restaurant and Diary Queen with mixed retail; and the existing single-family residential with retail and/or townhouses. The South Neighborhood Center is currently consists of mix retail and a gas station (a grocery store was recently closed). With the proposed plans, the area will be redeveloped as a mixed-use neighborhood center made up of townhouses, apartments, retail, offices, and/or supermarket.

First Avenue S is a major roadway that runs north south serving the City. It operates as State Route 509 south of the S 174th Street intersection. Four signalized intersections are located on First Avenue S at 174th Street S, SW Normandy Road, S 199th Street, and SW 200th Street. The City has classified First Avenue S as a major arterial and SW Normandy Road, SW 200th Street, and SW 208th Street as secondary arterials.

Methodology

This section describes the methods used to evaluate intersection level of service and the intersection locations to be evaluated.

Level of Service Approach

The Highway Capacity Manual (HCM) is the recognized source for the level-of-service (LOS) techniques used to measure transportation facility performance (TRB 2000). Using the HCM procedures, the quality of traffic operation is graded into one of six LOS designations: A, B, C, D, E, or F. LOS A and B represent the best traffic operation, and LOS C and D represent intermediate operation. LOS E indicates that traffic conditions are at or approaching congested levels, and LOS F represents a high level of congestion and unstable traffic flow.

LOS for signalized intersections is determined by the average amount of delay experienced by vehicles at the intersection. Table 1 summarizes the LOS criteria for signalized intersections.

Table 1. Level-of-Service Criteria for Signalized Intersections

Level-of-Service	Average Delay per Vehicle (seconds/vehicle)
A	= 10
B	> 10 – 20
C	> 20 – 35
D	> 35 – 55
E	> 55 – 80
F	> 80

Source: TRB 2000

For two-way stop-controlled intersections, LOS depends on the amount of delay experienced by drivers on the minor (stop-controlled) approaches. All-way stop-controlled intersections require drivers on all approaches to stop before proceeding into the intersection, so LOS is determined by the average computed or measured delay for all movements. Table 2 summarizes the LOS thresholds for stop-controlled intersections.

Table 2. Level-of-Service Criteria for Stop-Controlled Intersections

Level-of-Service	Average Delay per Vehicle (seconds/vehicle)
A	= 10
B	> 10 – 15
C	> 15 – 25
D	> 25 – 35
E	> 35 – 50
F	> 50

Source: TRB 2000

The LOS criteria for stop-controlled intersections have different threshold values than those for signalized intersections, primarily because drivers expect different levels of performance from distinct types of transportation facilities. In general, stop-controlled intersections are expected to carry lower volumes of traffic than signalized intersections. Thus for the same LOS, a lower level of delay is acceptable at stop-controlled intersections than it is for signalized intersections.

Standards

The City of Normandy Park has adopted level of service “C” as their standard for secondary and major arterial intersections and local access street and major arterial intersections. (Normandy Park 1995)

Intersections

The intersections selected for evaluation were based on discussions with City staff and review of the Hamlin Technical Study (David I. Hamlin and Associates 1999). The intersections adjacent to the site were selected, as they would be most impacted by the Redevelopment Plan. Additional intersections were selected as they were of concern to the City and for consistency with the Hamlin Technical Study. The six analysis intersections are:

- First Avenue S and S 174th Street
- First Avenue S and SW 178th Street
- First Avenue S and SW Normandy Road
- First Avenue S and S 199th Street
- First Avenue S and SW 200th Street
- First Avenue S and SW 208th Street

LOS C is the level of standard for all analysis intersections.

Existing (2004) Conditions Analysis

Peak Hour Definition

Traffic analysis was performed for the hour with the worst overall traffic conditions during a typical week. The analysis peak hour was determined to be the weekday PM peak hour.

Existing Traffic Volumes

PM peak-hour intersection traffic volumes were collected at the intersections of First Avenue S and SW 178th Street and SW Normandy Road. The counts were collected for a 2-hour span (4 p.m. to 6 p.m.) in the afternoon during a typical weekday in June 2004. The traffic count summary sheets are included in Appendix A. Historical traffic volumes from the Washington State Department of Transportation (WSDOT 2002) were also obtained. Both sets of traffic volume data were compared with traffic volumes collected for the Hamlin Technical Study. The comparisons revealed there has been little change in traffic volumes during the past 6 years (see Appendix B). Therefore, the Hamlin Technical Study peak hour intersection traffic counts are used as existing traffic volumes except where current traffic data was collected. The traffic volumes for the analysis intersections are presented in Figure 2.

Existing LOS

Table 3 presents the results of the LOS analysis for the study intersections under existing conditions. The LOS summary reports are included in Appendix C. For signalized intersections the LOS analysis were based on the actual signal timing and phasing information provided by the WSDOT. The table shows that all signalized intersections meet LOS standards with LOS C or better. As described earlier in the Methodology Section, LOS for two-way stop controlled intersections is measured by the average delay experienced by traffic on the stop-controlled legs of the intersection. The table shows the LOS at minor approaches at stop-controlled legs are

below the acceptable LOS in 3 of 4 cases.

Table 3. Existing (2004) Intersection LOS

Intersection	Traffic Control[1]	Average Delays[2] (sec/veh)	LOS[3]
First Avenue S and S 174th Street	S	8	A
First Avenue S and SW 178th Street	TWSC	EB 36 WB 26	E D
First Avenue S and SW Normandy Road	S	24	C
First Avenue S and S 199th Street	S	12	B
First Avenue S and SW 200th Street	S	14	B
First Avenue S and SW 208th Street	TWSC	EB 33 WB 21	D C

1. S = Signalized; TWSC = Two-way Stop-controlled.
2. For TWSC intersections, LOS and Delay are shown for both minor movements, displayed as Eastbound and Westbound.
3. LOS is the Level of Service based on the methodology outlined in the 2000 Highway Capacity Manual.

Intersection Collision Analysis

Intersection collision analysis was performed, based upon seven years (1996 through 2002) of collision data collected and compiled by the WSDOT Transportation Data Office for the State Highway (SR) 509 within the City. (WSDOT 2004) The WSDOT database records accidents by location, type, and severity. SR 509 within the City is not identified as high accident locations (HAL), pedestrian accident locations (PAL), and high accident corridor (HAC) by WSDOT.

Table 4 summarizes the accident rates of the six analysis intersections. An intersection may experience a high number of accidents, but only because the entering volume of traffic is high. To normalize the accident data, the rate of accidents per million entering vehicles was calculated. As shown in the table, the intersections of First Avenue S with SW Normandy Road and SW 178th Street have the highest accident rates per million entering vehicles among the study intersections. These two intersections are in the busiest shopping area along First Avenue S. Typically, an accident rate at or greater than 1.0 accident per million entering vehicles raises some concern about safety issues.

Table 4. Intersection Accident Rate

Intersection	Total Accidents (1996-2002)	Average Accidents per Year	Intersection Entering ADT[1]	Accident Rate (per MEV)
First Avenue S and S 174th Street	12	1.7	19,880	0.2
First Avenue S and SW 178th Street	23	3.3	15,250	0.6
First Avenue S and SW Normandy Road	40	5.7	19,461	0.8
First Avenue S and S 199th Street	7	1.0	15,060	0.2
First Avenue S and SW 200th Street	9	1.3	14,160	0.2
First Avenue S and SW 208th Street	5	0.7	11,960	0.2

1. ADT = Annual Daily Traffic; based on the existing PM peak hour traffic volumes applied with factors to convert peak hour volumes to ADT.
2. MEV = Million Entering Vehicles.

Table 5 summarizes the accidents of the six analysis intersections by severity and types. The table shows that no fatal accidents occurred at any of the analysis intersection in the past seven years. The accident type with the largest number involved vehicles rear-ending and vehicles entering at angle. Two accidents involved pedestrians.

Table 5. Intersection Accident Severity and Type (1996-2002)

Intersection	PDO[1]	INJ[1]	At Angle	Side-swipe	Rear End	Left Turn	Pedestrian
First Avenue S and S 174th Street	6	6	2	0	9	0	1
First Avenue S and SW 178th Street	16	7	11	5	3	4	0
First Avenue S and SW Normandy Road	25	15	13	0	23	4	0
First Avenue S and S 199th Street	5	2	0	0	6	0	0
First Avenue S and SW 200th Street	5	4	1	0	4	4	0
First Avenue S and SW 208th Street	2	3	2	0	2	0	1

1. PDO = Property Damage Only; INJ = Injuries.

Traffic Forecasts

Traffic Growth Rate

Future conditions analysis was performed for the projected year of project completion, 2009. Future baseline traffic volumes were projected by the application of an average annual traffic growth rate to the existing volumes. As per the City's direction, an average annual growth rate of 0.6 percent was assumed based on the annual traffic growth rate projected in the 1995 City of Normandy Park Comprehensive Plan. The average growth rate of 0.6 percent was applied to the 2004 volumes to project the 2009 baseline volumes.

Trip Generation

The City of Normandy Park has proposed two land use development alternatives for each of the North and South Neighborhood Center. The proposed development for each center is shown in Table 6. Traffic volumes expected to be generated by the proposed development alternatives were estimated using standard average trip generation rates found in the Institute of Traffic Engineers Trip Generation Manual (ITE 1997). Table 6 summarizes the estimated total PM peak hour trips generated by the proposed developments.

In addition, the City of Burien has issued development permits for a piece of property located on First Avenue S south of S 177th Pl, across the street from the North Neighborhood Center. Table 7 summarizes the estimated total PM peak hour trips generated by the Manhattan development. The development will be completed in 2005, which is before the completion of the North Neighborhood Center. Therefore, traffic volumes for this development will be added to the 2009 baseline volumes.

Table 6. Estimated Trip Generation for Proposed Developments

ITE No.[1]	Land Use	No. of Units	Unit[2]	Trip Rate[1] (trips/unit)	PM Peak Hour Trips	% In[1]	% Out[1]	Trips In	Trips Out
North Neighborhood Center Development - Alternative 1									
814	Retail (Specialty Retail Center)	36	1k SF	2.59	93	43	57	40	53
				Total Trips	**93**			**40**	**53**
North Neighborhood Center Development - Alternative 2									
230	Townhouse	14	DU	0.32	4	66	34	3	1
814	Retail (Specialty Retail Center)	31	1k SF	2.59	80	43	57	34	46
				Total Trips	**84**			**37**	**47**
South Neighborhood Center Development - Alternative 1									
230	Townhouse	14	DU	0.32	4	0.66	0.34	3	1
220	Apartment	113	DU	0.62	70	0.67	0.33	47	23
710	Office (General Office Building)	15	1k SF	1.49	22	0.17	0.83	4	18
814	Retail (Specialty Retail Center)	36	1k SF	2.59	93	0.43	0.57	40	53
				Total Trips	**189**			**94**	**95**
South Neighborhood Center Development - Alternative 2									
220	Apartment	55	DU	0.62	34	0.67	0.33	23	11
850	Supermarket	50	1k SF	11.51	576	0.51	0.49	294	282
814	Retail (Specialty	25	1k SF	2.59	65	0.43	0.57	28	37

ITE No.[1]	Land Use	No. of Units	Unit[2]	Trip Rate[1] (trips/unit)	PM Peak Hour Trips	% In[1]	% Out[1]	Trips In	Trips Out
	Retail Center)								
				Total Trips	**675**			**345**	**330**

1. Source for total trip rate and in-out percentages: ITE 1997
2. DU = Dwelling Unit; 1k SF = 1000 Square Feet.

Table 7. Estimated Trip Generation for Proposed Developments in City of Burien[1]

ITE No.[1]	Land Use	No. of Units[2]	Unit[3]	Trip Rate[1] (trips/unit)	PM Peak Hour Trips	% In[1]	% Out[1]	Trips In	Trips Out
Manhattan Development – Southeast at Intersection of First Ave S and S 177th Pl									
720	Medical Office	4.6	1k SF	3.66	17	0.27	0.73	5	12
814	Retail (Specialty Retail Center)	4.4	1k SF	2.59	11	0.43	0.57	5	6
				Total Trips	**28**			**10**	**18**

1. Source for total trip rate and in-out percentages: ITE 1997
2. Source for total units of new developments: Burien 2004
3. 1k SF = 1000 Square Feet.

Trip Distribution

Trip distribution is performed to estimate the number of site-generated trips that would utilize the study intersections. Distribution of the projected generated trips onto the roadway network was performed using an analogy method. This method utilizes distribution of similar existing development in the area, overall distribution of vehicle trips in the area, and the geography of surrounding development. Since the proposed development is similar to the existing surrounding development, the distribution of the projected generated trips was assumed to be of similar proportion to existing traffic volumes. Figure 3 and 4 illustrate the projected trip distribution for north and south neighborhood centers, based on the existing traffic distribution.

Future (2009) Conditions Analysis

2009 Baseline Conditions

Baseline conditions are those that are projected to occur in the expected build-out year, without the proposed North and South Neighborhood Center redevelopments in place.

Projected Baseline Traffic Volumes

The average annual growth rate of 0.6 percent was applied to existing traffic volumes to estimate all 2009 volumes needed for LOS analysis. The projected baseline 2009 traffic volumes for the PM peak hour are presented in Figure 5. These traffic volumes also account for the trips generated from the Manhattan development in City of Burien.

Level of Service

Table 8 presents the results of the LOS analysis for the study intersections under projected 2009 baseline conditions (LOS summary reports are in Appendix C). The table shows that under projected baseline conditions, all signalized intersections meet LOS standards with LOS C or better. The left-turn movements on the major approaches of two-way stop controlled intersections both meet LOS standards with LOS B or better. However, the average delays for the minor street approaches will be higher then delays under existing conditions. The increase in delay would not be sufficient to degrade the LOS designation any further.

Table 8. Projected 2009 Baseline Intersection LOS

Intersection	Traffic Control[1]	Average Delays[2] (sec/veh)	LOS[3]
First Avenue S and S 174th Street	S	9	A
First Avenue S and SW 178th Street	TWSC	EB 40 WB 28	E D
First Avenue S and SW Normandy Road	S	26	C
First Avenue S and S 199th Street	S	12	B
First Avenue S and SW 200th Street	S	13	B
First Avenue S and SW 208th Street	TWSC	EB 34 WB 22	D C

1. S = Signalized; TWSC = Two-way Stop-controlled.
2. For TWSC intersections, LOS and Delay are shown for both minor movements, displayed as Eastbound and Westbound.
3. LOS is the Level of Service based on the methodology outlined in the 2000 Highway Capacity Manual.

2009 Traffic Volumes with Proposed Developments

LOS analyses were completed for build-out year, with the proposed North and South Neighborhood Center redevelopments in place.

Projected 2009 Traffic Volumes

Projected traffic volumes with the proposed developments were determined by adding the

projected 2009 baseline volumes to the estimated site-generated volumes. Two development alternatives are proposed to both North and South Neighborhood Centers. Figure 6 shows the site generation trips of each North Neighborhood Center alternative and Figure 7 illustrates the site generation trips of each South Neighborhood Center alternative. It is assumed that 70% generation trips passing through the First Avenue S at SW 200th Street would be at SW 208 Street as some trips will spread out and generate between these two intersections. The projected 2009 traffic volumes for the PM peak hour, with the proposed development in place, are presented in Figure 8 and 9.

Level of Service

Table 9 presents the results of the LOS analysis for the study intersections under projected 2009 baseline conditions with the proposed developments in place (LOS summary reports are in Appendix C). The table shows that under projected conditions, all signalized intersections meet LOS standards with LOS C or better. However, the average delays at the minor approaches at stop-controlled legs will be higher than delays under baseline conditions.

Under the North Neighborhood Center development Alternative 1, the LOS for the eastbound movements at SW 178th Street will degrade two levels to LOS F; and under Alternative 2, the LOS for the eastbound movement will degrade one level to LOS E. The westbound movement will experience some delay with both alternatives; however, the LOS remains "D".

Under both South Neighborhood Center alternatives, the LOS for the eastbound movement at SW 208th Street will degrade one level to LOS E. The westbound movement will experience some delay with Alternative 1; however, the LOS remains "D". While under Alternative 2 it degrades one level to LOS D.

Table 9. Projected 2009 Intersection LOS with Proposed Developments

Intersection	Traffic Control[1]	Average Delays[2] (sec/veh)	LOS[3]
North Neighborhood Center Development - Alternative 1			
First Avenue S and S 174th Street	S	8	A
First Avenue S and SW 178th Street	TWSC	EB 53 WB 34	F D
First Avenue S and SW Normandy Road	S	24	C
North Neighborhood Center Development - Alternative 2			
First Avenue S and S 174th Street	S	8	A
First Avenue S and SW 178th Street	TWSC	EB 49 WB 33	E D
First Avenue S and SW Normandy Road	S	24	C
South Neighborhood Center Development - Alternative 1			

Intersection	Traffic Control[1]	Average Delays[2] (sec/veh)	LOS[3]
First Avenue S and S 199th Street	S	14	B
First Avenue S and SW 200th Street	S	15	B
First Avenue S and SW 208th Street	TWSC	EB 38 WB 23	E C
South Neighborhood Center Development - Alternative 2			
First Avenue S and S 199th Street	S	24	B
First Avenue S and SW 200th Street	S	26	B
First Avenue S and SW 208th Street	TWSC	EB 47 WB 25	E D

1. S = Signalized; TWSC = Two-way Stop-controlled.
2. For TWSC intersections, LOS and Delay are shown for both minor movements, displayed as Eastbound and Westbound.
3. LOS is the Level of Service based on the methodology outlined in the 2000 Highway Capacity Manual.

Mitigation Measures

Potential Mitigation

As shown in Table 9, the minor approaches at stop-controlled legs will fall below the Comprehensive Plan threshold. The average delays for the minor movements at SW 178th Street and SW 208th Street will possibly reach 53 seconds and 47 seconds respectively during the PM peak hour, which is the hour with the worst overall traffic conditions during a typical day. Since the minor approaches of the two-way stop controlled intersections have only one lane, right turning vehicles will experience delay when they are waiting behind vehicles that are waiting to turn left or go through the intersection. However, the actual volumes are so low on these approaches, the issue is inconsequential. Traffic signals are not warranted at these intersections because of the low minor approach volumes.

To address this issue on the minor approaches, the addition of second eastbound and westbound approaching lane was examined at SW 178th Street. Analysis showed the optimal configuration to be a right-turn-only lane and a shared through-left lane. This would allow right-turning traffic to experience only the delay that results from waiting for gaps in the same direction of travel, rather than gaps in both directions when waiting behind another vehicle. At the intersection of First Avenue S and SW 208th Street, 2 eastbound approaching lanes and 1 westbound lane were added to the intersection. Therefore, there would be a left-turn lane, a through lane, and a right-turn lane for the eastbound approach and a shared through-left lane and a right-turn lane for westbound approach.

Table 10 summarizes the LOS projected to result with these improvements in place. The table shows that addition of a second approaching lane would bring the eastbound movement at SW

178th Street to LOS E with the same delay as baseline conditions. However, the LOS of westbound movement would remain LOS D with 1 second of delay reduction.

At SW 200th Street, addition of a second approaching lane would bring the westbound movement to LOS C under Alternative 2. Under Alternative 1, the addition of two approach lanes would bring the eastbound movement to LOS D with the same delay as baseline conditions. While under Alternative 2, the LOS of eastbound movement would remain LOS E with 6 seconds of delay reduction.

As a result, the potential mitigations at SW 178th Street would improve the LOS of the minor movements to the level of baseline conditions. The westbound mitigations at SW 200th Street would bring LOS of westbound movement under Comprehensive Plan threshold. The eastbound mitigations would improve the eastbound movement for Alternative 1 to the level of baseline conditions. However, under Alternative 2, the LOS would still degrade one level

Table 10. Projected 2009 Peak Hour Intersection LOS with Mitigations

Intersection	Traffic Control[1]	Average Delays[2] (sec/veh)	LOS[3]
North Neighborhood Center Development - Alternative 1			
First Avenue S and SW 178th Street	TWSC	EB 40 WB 33	E D
North Neighborhood Center Development - Alternative 2			
First Avenue S and SW 178th Street	TWSC	EB 38 WB 32	E D
South Neighborhood Center Development - Alternative 1			
First Avenue S and SW 208th Street	TWSC	EB 34 WB 21	D C
South Neighborhood Center Development - Alternative 2			
First Avenue S and SW 208th Street	TWSC	EB 41 WB 23	E C

1. S = Signalized; TWSC = Two-way Stop-controlled.
2. For TWSC intersections, LOS and Delay are shown for both minor movements, displayed as Eastbound and Westbound.
3. LOS is the Level of Service based on the methodology outlined in the 2000 Highway Capacity Manual.

Roundabout Analysis

At the intersection of First Avenue S and SW Normandy Road, the City would like to consider the installation of a roundabout to replace the existing traffic signal. Roundabouts when properly designed can:

- move traffic efficiently through an intersection without a traffic signal
- reduce accidents over other types of intersection controls, and
- provide opportunity for landscaping and a gateway

The following is a preliminary analysis of the roundabout selection criteria described in the Washington State Department of Transportation (WSDOT 2004) Design Manual Chapter 915. These criteria are similar to the ones outlined in the Federal Highway Administration, Publication No. FHWA-RD-00-067 (FHWA 2000). The WSDOT criteria will need to be more fully addressed as First Avenue South is a State route.

Step1: Consider the context.

The intersection is currently controlled by a traffic signal, which was installed many years ago and was recently upgraded along with frontage improvements to the shopping center on the northwest corner. The public has grown accustomed to the signal controlling traffic and pedestrian movements at the intersection. The signal also provides easy access to First Avenue South for vehicles leaving the shopping center and vehicles using S. Normandy Park Road as a direct route from SR 509 to the City of Normandy Park.

There are two other traffic signals within 2000 ft of this location one at the intersection of S Normandy Park Road and SR 509 and the other at First Avenue South and SR 509. The intersection under consideration is isolated from these signals thus a roundabout would not interfere with traffic progression.

Roundabouts have been placed throughout the northwest urban area and have received motorist approval. However this would be the first one in the immediate area and on a major roadway. This may require additional effort in reaching community agreement on this particular location and support.

Step 2: Determine a preliminary lane configuration and roundabout category based on capacity requirements.

The selection of a roundabout configuration is based on number of vehicles entering the intersection and the intended purpose. Since the intersection is at a key location for the North Neighborhood Center, the function of a roundabout would be community enhancement and safety. If sufficient right of way exists an urban single-lane roundabout would be appropriate. Figure 9, shows 23% of the total intersection entering volumes are left turn vehicles and 36% of entering volumes are from minor approaches on Normandy Road. The maximum AADT for a single-lane roundabout with 23% left-turn traffic and 36% minor traffic is about 22,000 vehicles per day (AADT). Under the Alternative conditions, the 2009 AADT at the intersection is 20,500 vehicles per day, which is sufficient for a single-lane roundabout but may be inadequate for future needs. A two-lane roundabout would provide more capacity however raises geometric comers discussed later.

Step 3: Identify the justification category.

The WSDOT guidelines identify 4 justification categories: safety, intersection capacity, queue reduction, and special conditions.

- Safety: A signalized intersection with 20,000 AADT and 30% minor street traffic could have 57% fewer injury accidents with the installation of a roundabout. As shown in Table 5, the accidents at this intersection average 2.5 accidents per year. The installation of a roundabout would reduce this value by 15 over a 20-year period.

- Capacity: The current signalized intersection operates at LOS C with an average vehicle delay of 21 seconds and with the proposed land use development in 2009 will operate with 21 seconds of delay. The roundabout will reduce the average delay to 14 seconds. This would result in an annual savings of 16,500 vehicles-hours per year.

- Queue: The longest queue lengths are in the southbound direction in the PM peak hour. Operation of a traffic signal at this location will result in an average queue length of 245 ft in the southbound direction and a 95th percentile queue length of 455 ft. A roundabout would result in an average queue length of 14 ft and a 95th percentile length of 163 ft.

- Special Conditions: The intersection is skewed which restricts sight distance and requires vehicles to enter the intersection at and angle.

Step 4: Performance analysis.

The previous discussion highlights a number of performance measures that would be improved with the installation of the roundabout. However these measures are minimal compared to most locations considered for roundabouts.

Step 5: Determine the right of way requirements.

An urban single-lane roundabout design has been prepared for this location and is shown in Figure 10. The roundabout design required several modifications to fit this location. The 8% grade on S Normandy Road east of First Avenue S required moving the center of the roundabout to the west to avoid a portion of the roundabout being on a grade. Though this resolves the design configuration for the roundabout it still requires the regarding of S Normandy Road to allow an adequate vertical curve at the approach to the intersection. The roadway will remain at 8%, which exceeds the desirable maximum of 4%. Offsetting the roundabout also avoids the need to remove the building on the southeast corner. The southbound approach to the roundabout is currently 2 lanes. The proposed design would reduce this to 1 lane by merging the left hand through lane into the curb lane. Because of the shift additional right of way would be required on the west side of the roadway.

Step 6: If additional space must be acquired or alternative intersection forms are viable, an economic evaluation may be useful.

An economic evaluation was not performed however given the traffic signal exists and would continue to satisfy the capacity needs of the proposed North Neighborhood Center the

roundabout would be significantly more expensive then retaining the signal.

Conclusions

The proposed redevelopment would have little affect on the major signalized intersections within the City of Normandy Park. The 2 intersections affected by the increased traffic volumes are S 178th Street and S 208th Street. At both locations under current conditions the LOS exceeds acceptable standards, LOS E and D at S 178th Street and D at S 208th Street. These conditions become worse with the addition of development traffic. However the provision measures, installation of additional approach lanes, improves the LOS to current conditions or better for both alternatives at S 178th Street. At S 208th Street the mitigation measures were successful in improving the LOS to current conditions for Alternative 1 however for alternative 2 the eastbound approach remains at LOS E as compared to the existing LOS D.

The average vehicle delay at this approach would be 41 seconds for 25 vehicles. Though the LOS exceeds current standards the amount of delay would not be considered significant. Vehicles approaching the intersection from this direction would either find the delay tolerable or use 2nd Avenue SW as access to the traffic signal at SE 200th Street.

The installation of a roundabout would provide a significant landmark or gateway at S Normandy Park Road. However a review of WSDOT criteria for placement does not provide a convincing argument for installation. Of particular note is the 8% grade approaching from the east and lack of necessity given the adequate LOS.

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Appendixes

Appendix A - Traffic Counts

Appendix B – First Avenue S Historical Traffic Volumes

Appendix C - Level of service analysis summary reports