Intersection Control Analysis

Log Yard Road
Mason Transit Authority

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Log Yard Road Intersection Control Analysis

Project Information

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1. INTRODUCTION

1.1 BACKGROUND

In 2016, Mason Transit Authority (MTA) received Regional Mobility and Multimodal grant funds to enhance their existing park-and-ride program. The Belfair/North Mason service area was a priority of this park-and-ride project. There is no official park-and-ride lot in this area. Safeway and QFC committed to towing MTA users who parked in their lots starting in Spring of 2016. Currently, MTA relies on leasing space from the Assembly of God church and a gravel lot off of Roy Boad Road behind Safeway. The usage of these lots has been steadily increasing.

In 2016 and 2017, MTA went through a park-and-ride site selection process with a group of stakeholders including: MTA staff, Mason County staff, a Mason County Transit Advisory Board member, an MTA Worker-Driver, North Mason School Board Member, and a County Commissioner. The site selected was an undeveloped parcel just east of the existing Log Yard Road/State Route (SR 3) intersection. MTA purchased this lot in July of 2017.

The intersection of SR 3 and Log Yard Road is a three-way intersection with stop control on Log Yard Road. A fourth leg of the intersection exists as a gravel road for logging and for access to Belfair Water District facilities and the Belfair Sewage Treatment plant. Development of the MTA Belfair park-and-ride will pave this fourth leg, making the intersection a four-way intersection.

1.2 PURPOSE OF THIS MEMORANDUM

The purpose of this technical memorandum is to present an Intersection Control Analysis (ICA) for proposed improvements on SR 3 at Log Yard Road in Belfair. The intent of the analysis is to recommend an alternative that provides the best intersection control at this modified intersection to serve the new MTA park-and-ride and anticipated community growth, while minimizing impacts to SR 3 and nearby intersections.

2. EXISTING CONDITIONS

2.1 STUDY ROADWAYS

For the purposes of this analysis, SR 3 is considered the north-south roadway and Log Yard Road is considered the east-west roadway.

SR 3 runs north-south between Shelton and Bremerton and is designated a “Rural Other Principal Arterial.” In the study area, SR 3 has a single lane in each direction, with left-turn lanes and right-turn lanes present at some intersections. A northbound hill-climbing lane ends approximately 1,500 feet south of Log Yard Road. The speed limit is 55 mph in the study area.

Log Yard Road is a two-lane road that provides access to industrial uses on the west side of SR 3. Log Yard Road is a private roadway not controlled or maintained by Mason County. Log Yard Road provides connection to other private industrial access roadways west of SR 3, but does not provide any other outlet besides the intersection with SR 3.

2.2 STUDY INTERSECTIONS

SR 3/Log Yard Road

The intersection of SR 3 and Log Yard Road is currently a three-leg intersection with stop control on the minor approach. The existing intersection configuration is one travel lane in each direction on SR 3 with a left-turn-only lane on the northbound approach, a northbound acceleration lane for vehicles turning left onto SR 3 from Log Yard Road, and a right-turn-only lane on the southbound approach. On the eastbound approach, Log Yard Road has one left-turn lane and one right-turn lane.

Existing Land Use and Zoning

The intersection of SR 3 and Log Yard Road is in unincorporated Mason County within the Belfair Urban Growth Area (UGA). The existing land use near the study intersection is a mix of heavy industrial uses located on the west side of SR 3. On the east side of SR 3, the land is mostly vacant and undeveloped with a few businesses and a church located north and south of Log Yard Road. The current zoning of the MTA project site is General Commercial, while west of SR 3 is zoned for General Commercial and Business Industrial uses. **Figure 1** shows the site area and existing intersection geometry.

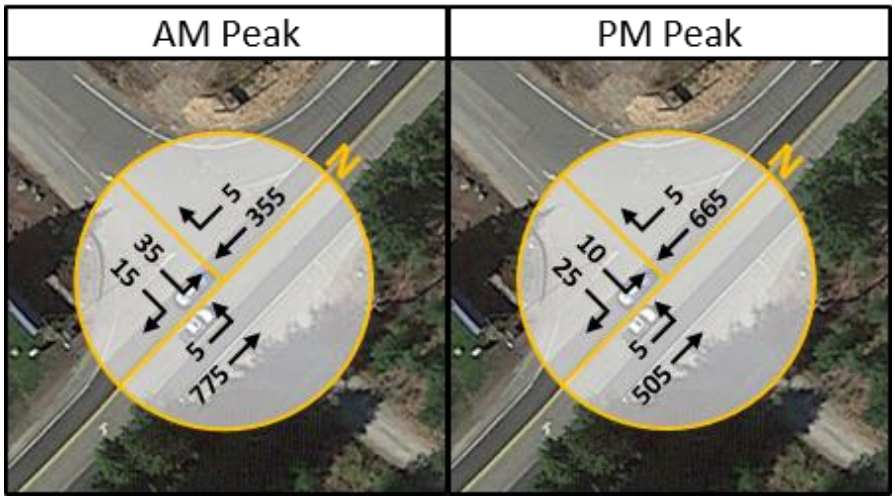
Figure 1. Intersection and Area Map

[1] Future Gas Station with Convenience Store
[2] Proposed MTA Park-and-Ride Lot

2.3 EXISTING TRAFFIC VOLUMES

A PM peak hour turning movement count was collected by Traffic Count Consultants, Inc. on March 8, 2017, between 4:00 pm and 6:00 pm. At the same time, a three-day tube count of each approach of the intersection was also collected. The PM peak hour was observed to occur between 4:00 pm and 5:00 pm. The AM peak hour was determined to occur between 7:00 am and 8:00 am. Turning movements on Log Yard Road were estimated for the AM peak hour based on the tube counts and PM peak hour turning movement counts. The existing peak hour volumes are summarized in **Figure 2**. The traffic count worksheets are included in **Appendix A**.

Figure 2. SR 3 and Log Yard Road – Existing 2017 Peak Hour Volumes



2.4 EXISTING CRASH HISTORY

This section includes a discussion of crash data resources, analysis methods, and crash history at the study intersection. A discussion of predictive crashes is included in Section 5 – Intersection Delay Analysis.

2.4.1 Crash Analysis Process

Crash data was obtained and compiled for a four-year period between January 1, 2013, and December 31, 2016. This information was obtained from the Washington State Department of Transportation's Crash Data and Reporting Branch.

A statistical analysis of the crash data in the study area was used to identify typical crash patterns and magnitude including identification of:

- Crash location and frequency
- Severity of crashes (i.e., fatal, serious injury, evident injury, possible injury, and non-injury or property damage only)
- Crash type (i.e., rear-end, sideswipe, turning, etc.)

In addition to the statistical assessment of crashes, crash rate calculations were developed and reviewed for the study intersection. Crash data worksheets are included in **Appendix B**.

"Under Section 409 of Title 23 of the United States Code, any collision data furnished is prohibited from use in any litigation against state, tribe or local government that involves the location(s) mentioned in the collision data."

2.4.2 Four-Year Crash Summary

The crashes reported for the four-year period between January 1, 2013, and December 31, 2016, were reviewed. During this period, there were ten total crashes reported involving 16 vehicles and seven apparent or possible injuries. Of the ten crashes, four were single vehicle crashes, five were rear-end crashes, and one involved a vehicle turning left being struck by a vehicle going straight in the opposite direction.

Table 1. 2013-2016 Crashes and Crash Rates by Location

Intersections	Total 2013-2016 Crashes	Average Annual Crashes	Crash Rate per MEV*
SR 3 @Log Yard Road	10	2.5	0.39

Table 2 presents a summary of crashes by year.

Table 2. 2013- 2016 Crashes by Year

Intersections	2013	2014	2015	2016	Total
SR 3 @Log Yard Road	2	0	5	3	10

2.4.3 Crash Severity

As shown in **Table 3**, a summary of four-year crash experience for the study intersection has been prepared by severity. There were no crashes involving fatalities or serious injuries in the study area during the analysis period. There were five crashes with possible injuries and only one crash with evident (non-disabling) injuries. The remaining crashes all involved property damage only.

Table 3. 2013-2016 Crash Severity by Location

Intersections	Fatal	Serious Injury	Evident Injury	Possible Injury	Property Damage Only	Total
SR 3 @Log Yard Road	0	0	1	5	4	10

2.4.4 Types of Crashes

As shown in **Table 4**, the prevalent crash type (rear-end crashes) all involved vehicles headed southbound on SR 3 and all occurred between 3:45 PM and 6:00 PM. This seems to be symptomatic of the rolling slowdowns that occur on SR 3 through Belfair during the peak period.

Table 4. 2013-2016 Crashes by Type

Intersections	Angle	Rear End	Fixed Object	Other	Total
SR 3 @Log Yard Road	1	5	2	2	10

3. TRAFFIC VOLUME FORECAST

Analysis was conducted for the opening year of 2020 and the horizon year of 2025. Both AM and PM peak hours were evaluated for three intersection control alternatives, enhanced two-way stop control, roundabout, and traffic signal. This section documents the development of future-year forecasts for both time periods and analysis alternatives.

Additional volume scenarios were prepared for sensitivity testing, including a 2040 forecast that included completion of the Belfair Bypass and an alternate 2025 horizon evaluating a peak seasonal and truck traffic scenario.

A description of the travel forecasting methods and assumptions and projected turning movements for the SR 3/Log Yard Road intersection is provided below:

3.1 OPENING YEAR 2020

Traffic volume forecasts for the project completion year of 2020 were prepared that include the estimated traffic generation from the proposed park-and-ride and gas station with convenience store as well as background traffic growth.

3.1.1 Development Traffic

Vehicle trip generation was calculated using the trip generation rates contained in the current edition of the Trip Generation Report (9th Edition) as published by the Institute of Transportation Engineers (ITE). Trip rates associated with a Park-and-Ride Lot with Bus Service (LU 090) and a Gasoline/Service Station with Convenience Market (LU 945) were used to estimate peak hour trip generation.

Trip generation for a park-and-ride lot is based on the number of occupied stalls. For this study, the number of occupied stalls for the new park-and-ride location was estimated using historical data on park-and-ride lot occupancy of the two existing lots in Belfair. Summing the occupancy of the two lots, the 85th percentile value, 40 vehicles, was used as the estimated occupancy of the new park-and-ride lot. The park-and-ride trip generation calculations are included in **Appendix C**.

The AM and PM peak hour trip rates, inbound/outbound percentages, and daily trip rates used for this analysis are shown in **Table 5**.

Table 5. Trip Generation Characteristics

		AM PEAK HOUR			PM PEAK HOUR		
LAND USE (LU)	UNIT	TRIP RATE	ENTER	EXIT	TRIP RATE	ENTER	EXIT
Park-and-Ride Lot with Bus Service (LU 090)	Occupied Stalls	1.26	69%	31%	0.81	28%	72%
Gasoline/Service Station with Convenience Market (LU 945)	Vehicle Fuel Pumps	10.16	50%	50%	13.51	50%	50%

Some of the trips associated with the new gas station are expected to be pass-by trips and diverted trips, or trips made as an intermediate stop during another trip passing by or near the site. Non-primary rates (pass-by and diverted) for gas stations are particularly high, since buying gas is not often the primary purpose of a trip. The ITE Trip Generation Handbook (3rd Edition) indicates an occurrence of 82%

non-primary trips during the AM peak hour and 88% during the PM peak hour for a gas station. Park-and-ride lots are assumed to have a pass-by rate of zero. The overall trip generation calculations are included in **Appendix C**.

The AM and PM peak hour trip generation and pass-by rate calculations used for the study are shown in **Table 6** and **Table 7**.

Table 6. 2020 Trip Generation – AM Peak Hour

LAND USE (LU)	SIZE	TOTAL TRIPS	NON-PRIMARY RATE	NON-PRIMARY TRIPS	NEW-TO-NETWORK TOTAL	NEW-TO-NETWORK ENTER	NEW-TO-NETWORK EXIT
Park-and-Ride Lot with Bus Service (LU 090)	40	50	0%	0	50	34	16
Gasoline/Service Station with Convenience Market (LU 945)	18	183	82%	150	33	17	16
Project Total		**233**	-	**150**	**83**	**51**	**32**

Table 7. 2020 Trip Generation – PM Peak Hour

LAND USE (LU)	SIZE	TOTAL TRIPS	NON-PRIMARY RATE	NON-PRIMARY TRIPS	NEW-TO-NETWORK TOTAL	NEW-TO-NETWORK ENTER	NEW-TO-NETWORK EXIT
Park-and-Ride Lot with Bus Service (LU 090)	40	32	0%	0	32	9	23
Gasoline/Service Station with Convenience Market (LU 945)	18	243	88%	214	29	15	14
Project Total		**275**	-	**214**	**61**	**24**	**37**

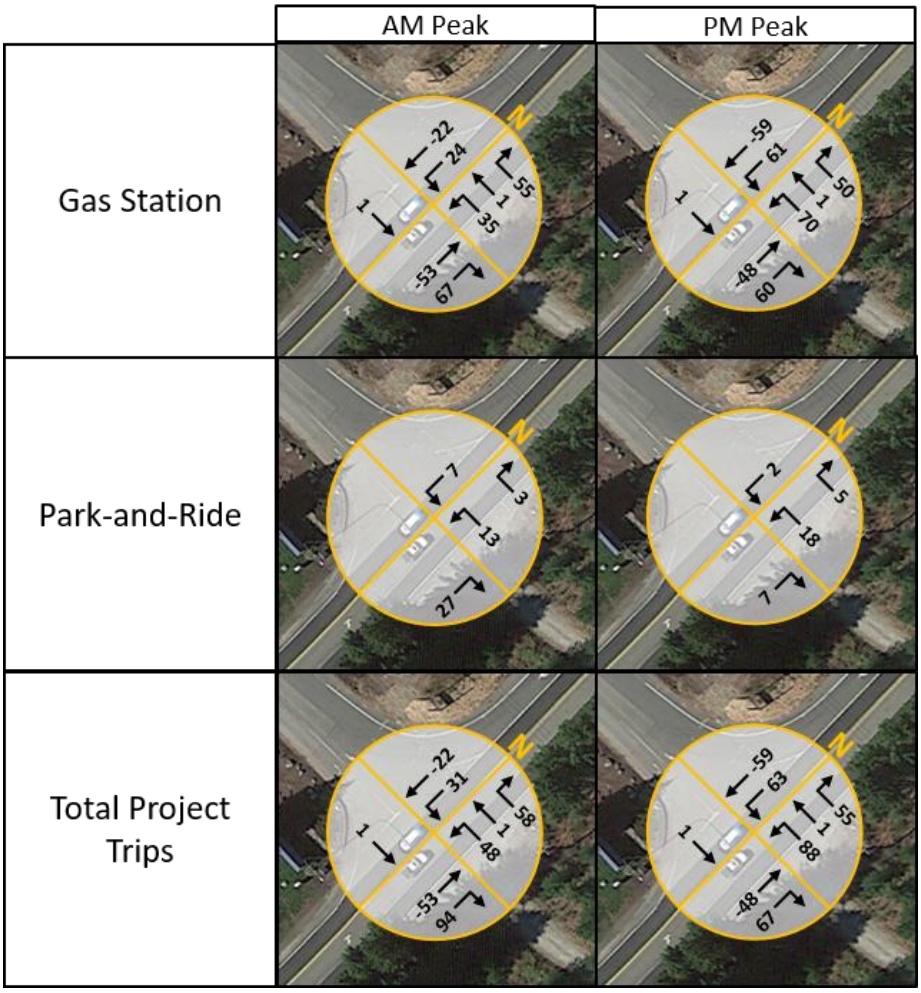
3.1.2 Trip Distribution and Assignment

The trip distribution and assignment for the new developments were estimated separately based on the characteristics of each individual use. The predicted distribution of park-and-ride traffic was based on the usage characteristics of the Belfair park-and-ride lots. The primary user base is south of Log Yard Road, and 80% of the traffic would be predicted to arrive from and depart to the south; the remaining 20% would arrive from and depart to the north.

For the gas station, the primary trips were assumed to be relatively evenly distributed to the north (50%) and south (45%), with an estimated 5% to/from Log Yard Road, west of SR 3. The pass-by trips were estimated based on the existing directional splits on SR 3. The pass-by trips for the AM were calculated to be 70% entering and exiting northbound and 30% southbound. For the PM peak hour, the split was estimated to be 45% entering and exiting northbound and 55% southbound. These splits reflect the prevailing commute traffic characteristics of the area toward Bremerton in the morning and returning from the Bremerton area in the evening.

The estimated project traffic distribution and assignment for the MTA park-and-ride lot and the gas station are shown in **Figure 3**. The traffic volume calculations are included in **Appendix D**.

Figure 3. Estimated Project Trips – Distribution and Assignment

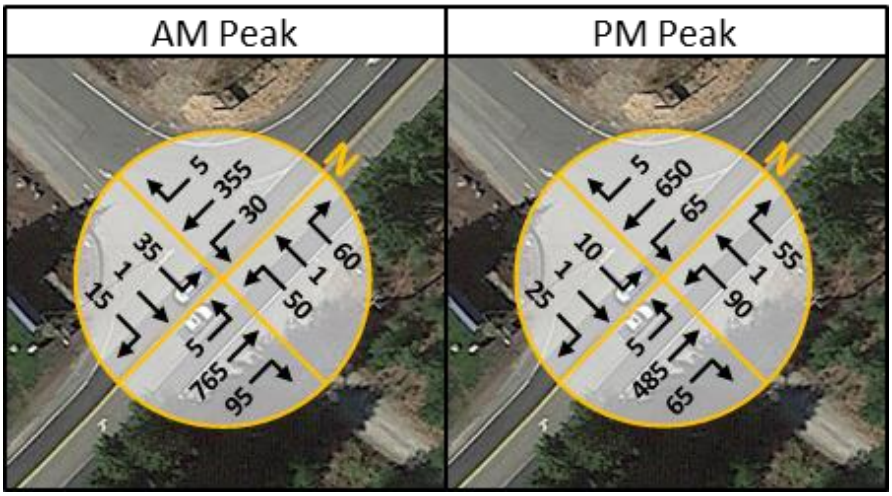


3.1.3 Background Traffic Growth

It is assumed background traffic growth will occur within the study area. An annual growth rate (uncompounded) of 2% per year was applied to the existing volumes on SR 3 to represent the background traffic growth. This growth represents the historic average over the last 20 years. An annual growth rate (uncompounded) of 1% was assumed on the existing west leg of Log Yard Road.

The forecasted 2020 peak hour volumes for the intersection including existing traffic, development traffic, and background traffic growth are shown in **Figure 4** for the AM and PM peak hours.

Figure 4. SR 3 and Log Yard Road – 2020 Peak Hour Volumes



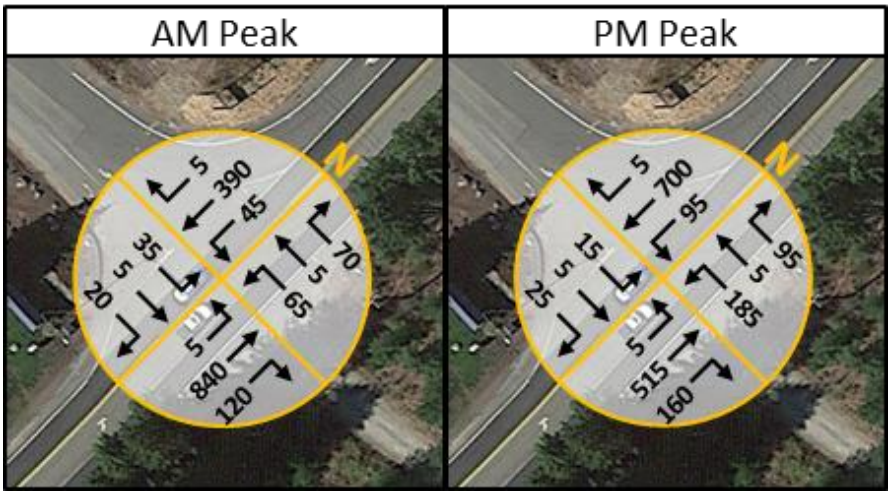
Horizon Year 2025 – The 2025 forecast was generated using the historic growth rates along SR 3 and Log Yard Road for the background growth and additional commercial development along the east leg of Log Yard Road. The additional development elements are described in more detail below:

3.1.4 Commercial Development

In addition to the background growth rates along SR 3 and the west leg of Log Yard Road, development of the commercially zoned properties in the immediate vicinity of the proposed east leg of Log Yard Road was assumed. A preliminary plat of this property includes 90 acres of potential development. It was assumed that half of this property would develop by 2040. A trip generation of this property was done using the ITE land use Shopping Center (LU 820). It was assumed that the 45 acres would have a 15% building coverage, which would equal 295,000 square feet of commercial development. It was then assumed that this growth would occur gradually between 2020 and 2040, with 25% of the development included in the 2025 horizon year forecast.

The forecasted 2025 peak hour volumes for the intersection are shown in **Figure 5** for the AM and PM peak hours.

Figure 5. SR 3 and Log Yard Road – 2025 Peak Hour Volumes



3.1.5 Sensitivity Analysis

During the first public open house, concerns were raised over how this intersection would operate during peak summer conditions and during peak freight times. The analysis also includes sensitivity testing for both a summer peak and a summer peak with a truck peak to see how much additional capacity might remain during both peak periods in the 2025 horizon.

To analyze a peak summer condition an adjustment factor of 1.12 was calculated using WSDOT seasonal adjustment data for SR 3. Additional truck trips were added to the analysis based on conversations with local business owners. Business owners estimated in the height of summer operations that Log Yard Road might see up to 600 truck hauls in a day. This represents approximately 1,200 truck trips (600 entering and 600 exiting). Eighty truck trips (40 trips in and 40 trips out) were added to the documented traffic counts in each peak hour to evaluate how these trucks would impact the intersection.

The sensitivity volumes for peak summer conditions and peak freight times are provided in the forecast calculation table in **Appendix D**.

3.2 LONG-RANGE 2040 FORECAST

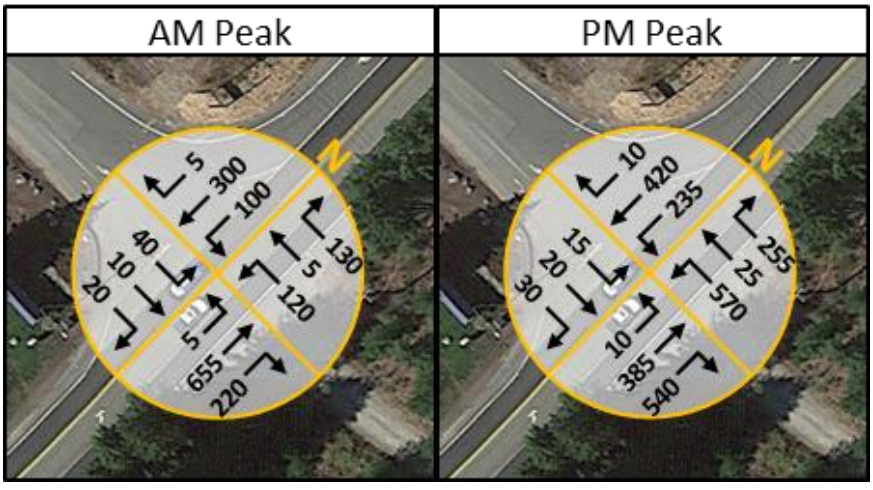
In addition to analysis of each of the control alternatives in the 2025 horizon, an analysis of the modern roundabout and traffic signal control alternatives in the long-range 2040 horizon was performed. For the 2040 forecast the same background growth percentages were used, and the 20-year buildout potential of the commercial properties as described above. Also included in the 2040 forecast is an estimate of the traffic shift associated with completion of the Belfair Bypass.

3.2.1 Belfair Bypass

The Belfair Bypass is a planned parallel north-south route to provide an alternative to SR 3 in the Belfair area. This project is funded and expected to be constructed within the next ten years. Based on information contained in the SR 3 Belfair Bypass Transportation Discipline Report, we estimated the bypass would draw 625 vehicles off SR 3 in the AM and PM peak hours offsetting most of the anticipated traffic growth in the area.

The forecasted 2040 peak hour volumes for the intersection are shown in **Figure 6** for the AM and PM peak hours.

Figure 6. SR 3 and Log Yard Road – 2040 Peak Hour Volumes



4. IDENTIFICATION OF ALTERNATIVES

4.1 PROJECT OBJECTIVES

The development and evaluation of improvement alternatives that accommodate traffic growth in the study area is intended to accomplish several specific objectives including:

- Provide functional access to the MTA park-and-ride lot proposed for construction east of SR 3
- Provide safe and efficient access to existing and future businesses along Log Yard Road
- Accommodate the geometric and capacity requirements of the large truck traffic that uses Log Yard Road
- Maintain good progression of through-traffic on SR 3

Improvement alternatives were assessed based on success in achieving these objectives.

4.2 IMPROVEMENT ALTERNATIVES

Three alternatives have been considered in the context of this ICA. They are:

1) Two-way stop control with left-turn lanes and acceleration lanes on SR 3
2) Single-lane roundabout
3) Traffic signal

The WSDOT Design Manual requires that the analysis of any intersection on a limited access highway must evaluate if a single-lane roundabout will successfully meet performance objectives given the expected traffic volumes forecasted for the area. The analysis documented in this ICA demonstrates that a single-lane roundabout or traffic signal would operate at an acceptable level of service much further into the future than a two-way stop-controlled intersection. During the first public open house, concerns were raised over how this intersection would operate during peak summer conditions and during peak freight times. The analysis also included sensitivity testing for both a summer peak and a summer peak with a truck peak to see how much additional capacity might remain during both peak periods in the 2025 horizon.

5. INTERSECTION DELAY ANAYSIS

This section presents the results of delay analysis for the 2020 opening year and 2025 horizon year conditions for the three intersection control alternatives. This section also identifies the relevant traffic operational performance standards.

5.1 LEVEL OF SERVICE STANDARDS

In this study, signalized and stop sign-controlled intersection analysis was performed using Synchro/SimTraffic 10, while roundabout analysis was conducted using Sidra Intersection 6. The analysis was performed using the parameters outlined in the WSDOT Traffic Analysis Guidebook.

Capacity analysis results are described in terms of Level of Service (LOS). Level of service calculations for intersections determine the amount of “control delay” (in seconds) that drivers will experience while proceeding through an intersection. Control delay includes all deceleration delay, stopped delay and

acceleration delay caused by the traffic control device. The LOS is directly related to the amount of delay experienced.

For signalized and roundabout controlled intersections, the LOS grade is provided for each approach and the intersection as a whole. **Table 8** shows the Level of Service criteria for the different control types assessed in this report.

Table 8. Level of Service Criteria

Level of Service	Stop-Controlled Intersection Average Control Delay (seconds/vehicle)	Signalized/Roundabout Intersection Average Control Delay (seconds/vehicle)
A	≤10	≤10
B	>10-15	>10-20
C	>15-25	>20-35
D	>25-35	>35-55
E	>35-50	>55-80
F	>50	>80

WSDOT has established Level of Service C during the peak hour as the minimum LOS standard of acceptable operation for any intersection approach on state highways outside of Mason County's only incorporated urban growth area in Shelton[

5.2 OPERATIONAL ANALYSIS

For the operational analysis, three different intersection control alternatives were evaluated as follows:

1) Two-way stop control with left-turn lanes and acceleration lanes on SR 3
2) Single-lane roundabout
3) Traffic signal

For the two-way stop-controlled alternative it is assumed that NB and SB right-turn lanes would be required on SR 3. Intersection geometry and channelization details of control alternatives 1, 2, and 3, are included in **Appendix E**.

5.2.1 2020 Opening Year Analysis Results

For the 2020 opening year, each of the intersection control alternatives would operate at LOS D or better, with the roundabout and traffic signal operating at LOS B or better. The results of the operational analysis are summarized in **Table 9**. The capacity analysis worksheets are included in **Appendix F**.

Table 9. 2020 Operational Analysis Summary – SR 3 and Log Yard Road

		PROJECTED 2020 - LOS (Delay) by intersection control alternative		
PEAK PERIOD	APPROACH	Two-way Stop w/ Left-turn and Acceleration Lanes (1)	Single-lane Roundabout	Traffic Signal
AM	EB	C (23.2)	A (10.0)	C (28.5)
	WB	C (18.6)	B (12.2)	C (28.4)
	NB	A (8.0)	A (5.8)	B (16.4)
	SB	A (9.8)	A (5.4)	A (7.3)
	Intersection	**C (23.2)**	**A (6.3)**	**B (15.3)**
PM	EB	C (19.3)	B (11.3)	B (14.8)
	WB	D (25.2)	B (10.1)	B (15.8)
	NB	A (8.9)	A (5.3)	B (10.8)
	SB	A (8.8)	A (6.1)	B (10.3)
	Intersection	**D (25.2))**	**A (6.3)**	**B (11.2)**

5.2.2 2025 Horizon Year Analysis Results

For the 2025 horizon year, the roundabout and traffic signal alternatives are forecasted to continue to operate at LOS B or better for both peak periods. The stop control alternative would operate at LOS D for the AM peak period and LOS F for the PM peak period. The results of the operational analysis are summarized in **Table 10**.

Table 10. 2025 Operational Analysis Summary – SR 3 and Log Yard Road

		PROJECTED 2025 - LOS (Delay) by intersection control alternative		
PEAK PERIOD	APPROACH	Two-way Stop w/ Left-turn and Acceleration Lanes	Single-lane Roundabout	Traffic Signal
AM	EB	D (30.3)	A (9.7)	C (27.1)
	WB	C (22.1)	B (12.6)	C (27.5)
	NB	A (8.1)	A (5.8)	B (14.7)
	SB	B (10.4)	A (5.5)	A (7.9)
	Intersection	**D (30.3)**	**A (6.5)**	**B (14.4)**
PM	EB	C (24.2)	B (13.3)	B (18.4)
	WB	F (62.4)	B (10.5)	C (20.6)
	NB	A (9.0)	A (5.5)	B (14.4)
	SB	C (15.4)	A (7.4)	B (13.1)
	Intersection	**F (62.4)**	**A (7.3)**	**B (14.9)**

As discussed above, concerns were raised during the first public open house regarding how this intersection would operate during peak summer conditions and during peak freight conditions. Sensitivity analysis volumes were created to assess peak summer conditions and peak summer conditions with peak freight conditions. This sensitivity analysis was performed for both the roundabout and traffic signal alternatives. Because the stop-control alternative operates at a LOS F during the PM peak hour, it was not carried into this sensitivity analysis.

The roundabout is projected to remain at a LOS A during both peak periods for the summer peak and the summer peak with freight peak scenarios. The traffic signal is projected to remain at a LOS B for the summer peak scenario and operate at LOS C for the summer peak plus freight peak scenario.

The operational results for both sensitivity scenarios are provided below in **Table 11** and **Table 12**.

Table 11. 2025 Roundabout Sensitivity – SR 3 and Log Yard Road

		PROJECTED 2025 - LOS (Delay) Sensitivity Analysis		
PEAK PERIOD	APPROACH	Average Non-seasonal	Peak Summer	Peak Summer Plus Peak Truck
AM	EB	A (9.7)	B (10.0)	B (12.4)
	WB	B (12.6)	B (14.1)	B (16.8)
	NB	A (5.8)	A (6.2)	B (10.3)
	SB	A (5.5)	A (5.5)	A (5.8)
	Intersection	**A (6.5)**	**A (6.8)**	**A (9.7)**
PM	EB	B (13.3)	B (14.8)	C (23.3)
	WB	B (10.5)	B (10.9)	B (11.6)
	NB	A (5.5)	A (5.6)	A (6.2)
	SB	A (7.4)	A (8.3)	B (11.2)
	Intersection	**A (7.3)**	**A (7.8)**	**A (9.9)**

Table 12. 2025 Traffic Signal Sensitivity – SR 3 and Log Yard Road

		PROJECTED 2025 - LOS (Delay) Sensitivity Analysis		
PEAK PERIOD	APPROACH	Average Non-seasonal	Peak Summer	Peak Summer Plus Peak Truck
AM	EB	C (27.1)	C (31.2)	C (32.1)
	WB	C (27.5)	C (31.6)	C (31.4)
	NB	B (14.7)	C (20.6)	C (32.1)
	SB	A (7.9)	A (8.0)	A (9.4)
	Intersection	**B (14.4)**	**B (18.3)**	**C (25.8)**
PM	EB	B (18.4)	C (20.3)	C (26.7)
	WB	C (20.6)	C (22.8)	C (29.4)
	NB	B (14.4)	B (15.7)	D (36.1)
	SB	B (13.1)	B (13.8)	C (22.1)
	Intersection	**B (14.9)**	**B (16.0)**	**C (28.6)**

5.2.3 Long-Range 2040 Analysis Results

In addition to the 2025 horizon year analysis, WSDOT requested that a long-term assessment be performed to predict if the recommended intersection control alternative could be expected to function acceptably long-term. The 2025 horizon year analysis indicates that the stop-control alternative will not operate sufficiently, so just the roundabout and traffic signal alternatives were assessed for 2040 conditions.

The roundabout is projected to remain at a LOS A during the AM peak hour and operate at a LOS C during the PM peak hour. The traffic signal is projected to operate at a LOS C in the AM peak hour and a LOS F in the PM peak hour.

The operational results for the long-range 2040 analysis are provided below in **Table 13**.

Table 13. Long-Range 2040 Analysis Results – SR 3 and Log Yard Road

		PROJECTED 2040 - LOS (Delay)	PROJECTED 2040 - LOS (Delay)
PEAK PERIOD	APPROACH	Roundabout	Traffic Signal
AM	EB	A (9.5)	C (28.6)
	WB	B (10.8)	C (29.2)
	NB	A (5.6)	B (19.9)
	SB	A (5.6)	B (14.7)
	Intersection	**A (6.3)**	**C (20.5)**
PM	EB	B (19.2)	B (14.8)
	WB	C (24.1)	C (26.9)
	NB	B (13.2)	F (192.1)
	SB	C (24.9)	D (39.3)
	Intersection	**C (20.1)**	**F (91.3)**

5.2.4 Operational Analysis Summary

The following is a summary of the anticipated operation of each of the intersection control alternatives:

1) Two-way stop control with left-turn lanes and acceleration lanes on SR 3

This alternative would provide NB and SB left-turn lanes on SR 3 as well as acceleration lanes for vehicles turning left from Log Yard Road onto SR 3. For the 2020 opening year the intersection is forecasted to operate at a LOS D in the AM peak hour and LOS C in the PM peak hour. The service standard for the intersection is LOS C, so this alternative does not provide acceptable operation during the AM peak hour; however, the LOS C and D conditions indicate that the intersection will function.

For the 2025 horizon the intersection is projected to operate at LOS D in the AM peak hour and LOS F in the PM peak hour, indicating that this control alternative will not function well at or beyond the 2025 horizon.

2) Single-lane roundabout

As a single circulating lane roundabout with single lane approaches, the intersection would operate at an LOS A during the AM and PM peak hours for both the 2020 opening year and 2025 horizon year. A sensitivity analysis was performed to assess the horizon year during peak summer conditions and peak summer conditions with peak freight activity. The roundabout remained at LOS A for both peak periods under both sensitivity scenarios.

3) Traffic signal

Under traffic signal control, with minimal geometric changes, the intersection would operate at an LOS B condition during the AM and PM peak hour for both the 2020 opening year and 2025 horizon year. A sensitivity analysis was performed to assess the horizon year during peak summer conditions and peak summer conditions with peak freight activity. The traffic signal remained at LOS B for both peak periods for the peak summer scenarios and operated at LOS C for the peak summer plus peak freight scenario.

5.3 TRAFFIC SIGNAL WARRANT ANALYSIS

A preliminary traffic signal warrant was prepared for the intersection for projected 2020 conditions. The analysis was based on criteria identified in the FHWA Manual on Uniform Traffic Control Devices (MUTCD). The forecasted traffic volumes on the new westbound approach of Log Yard Road were the higher minor approach volumes and were used in the analysis. Based on the three-day tube counts collected at the intersection, the fourth-hour and eighth-hour volumes were estimated as 88.6% and 78.5% of the PM peak hour volumes, respectively.

There are nine traffic signal warrants provided in the MUTCD. Of these nine warrants, four were selected for consideration for the study location and are the predominant warrants that WSDOT considers. These warrants focus on the volume of vehicles and accident data. Below is a description of each warrant analyzed for this location. The traffic volumes and results of warrants 1, 2, and 3 are shown on **Table 14**. The signal warrant analysis summary is included in **Appendix G**.

5.3.1 Warrant 1 – Eight-Hour Vehicular Volume

*"The Minimum Vehicular Volume, **Condition A**, is intended for application at locations where a large volume of intersecting traffic is the principal reason to consider installing a traffic control signal. The Interruption of Continuous Traffic, **Condition B**, is intended for application at locations where Condition A is not satisfied and where the traffic volume on a major street is so heavy that traffic on a minor intersecting street suffers excessive delay or conflict in entering or crossing the major street."*

Based upon the volumes shown in Table 14, Warrant 1 Condition A and Condition B are met.

5.3.2 Warrant 2 – Four-Hour Vehicular Volume

"The Four-Hour Vehicular Volume signal warrant conditions are intended to be applied where the volume of intersecting traffic is the principal reason to consider installing a traffic control signal."

Based upon the forecasted volumes shown in Table 14, Warrant 2 is met based upon Table 4C-2.

5.3.3 Warrant 3 – Peak Hour Vehicular Volume

"The Peak Hour signal warrant is intended for use at a location where traffic conditions are such that for a minimum of 1 hour of an average day, the minor-street traffic suffers undue delay when entering or crossing the major street."

Using the forecasted 2020 PM peak hour volumes shown on Figure 4, Warrant 3 is met based upon the criteria in Table 4C-4.

Table 14. Traffic Signal Warrant Analysis Summary

	PROJECTED 2020 WITH PROJECT			WARRANT 1	WARRANT 1	WARRANT 2	WARRANT 3
	Peak Hour (VPH)	4th Hour (VPH)	8th Hour (VPH)	8-Hour Vehicular Volume	8-Hour Vehicular Volume	4-Hour Vehicular Volume	Peak Hour Vehicle Volume
		88.6% Factor	78.5% Factor	Condition A	Condition B		
STATE ROUTE 3							
Southbound	698	618	548	-	-	See Table 4C-2	See Table 4C-4
Northbound	545	483	428	-	-		
Combined	**1243**	**1101**	**976**	**350**	**525**		
LOG YARD ROAD							
Eastbound	36	32	28	-	-	See Table 4C-2	See Table 4C-4
Westbound	**144**	**128**	**113**	**105**	**53**		
Minimum Volume Warrants Satisfied?				Yes	Yes	Yes	Yes

5.3.4 Warrant 7 – Crash Experience

"The Crash Experience signal warrant conditions are intended for application where the severity and frequency of crashes are the principal reasons to consider installing a traffic control signal."

Accident data was obtained from the Washington State Department of Transportation, and ten recorded accidents occurred at the intersection within the past four years. Most of the crashes were not intersection related and were caused by driver error, equipment failure, or congestion on SR 3. The MUTCD Traffic Signal Warrant 7 identifies that a warrant is met if five or more reported crashes, of types susceptible to correction by a traffic control signal, have occurred within a 12-month period.

Based on the analysis of crash history, Warrant 7 is not met.

5.4 PREDICTIVE SAFETY ANALYSIS

In addition to an operation analysis of the intersection control alternatives, a predictive crash analysis was performed. This analysis was conducted using the methods described in the Highway Safety Manual (HSM). For this portion of SR 3 the rural two-lane highway spreadsheet model was used to assess each of the intersection control alternatives for the 2025 horizon year volume scenario. The stop-control and traffic signal conditions were assessed using the spreadsheet model. To assess the roundabout alternative the stop-control alternative was adjusted using crash modification factors taken from WSDOT's crash modification factor "short list". The predictive crash results for each control alternative are provided in **Table 15**. The predictive crash analysis worksheets are provided in **Appendix H**.

Table 15. 2025 Horizon Year Predictive Crash Summary

	Stop-Control Alternative	Roundabout Alternative	Traffic Signal Alternative
Property Damage Only Crashes	4.3	2.1	2.0
Fatal and Injury Crashes	6.5	0.7	1.8
Total Crashes	10.9	2.8	3.8

As shown in Table 15, the signalized and roundabout control types are both expected to operate with fewer crashes than the stop-control condition, with the roundabout predicted to have the fewest crashes.

6. COST/SAVINGS

6.1 COST ESTIMATE

A comparison of the intersection control alternatives is provided below in **Table 16** with planning-level cost estimate ranges for design and construction, and maintenance for each alternative.

Table 16. Planning Level Cost Estimates

CONTROL TYPE	ESTIMATED DESIGN & CONSTRUCTION COST	ADDITIONAL ESTIMATED ANNUAL OPERATIONS & MAINTENANCE COSTS*
Two-way stop control with left-turn lanes and acceleration lanes on SR 3	$1,000,000 – 1,500,000	$0
Single-lane Roundabout	$1,300,000-1,600,000	$0
Traffic Signal	$500,00 - $750,000	$3,500

*Operations and Maintenance Cost over and above a four-way stop controlled intersection.

6.2 SOCIETAL COST SAVINGS

As reported above, the roundabout is the safest alternative. The roundabout has approximately one less injury crashes per year than the traffic signal from 2020 to 2025 per Table 15. WSDOT Societal Costs for crashes are the following:

- Fatal crash: $2,900,000
- Serious injury crash: $2,900,000
- Evident injury crash: $155,000
- Possible injury crash: $60,000
- Property Damage Only Crash: $10,000

Based on WSDOT historical crash data the distribution of injury crashes is the following:

- Fatal crash: 1.3%

- Serious injury crash: 5.5%
- Evident injury crash: 26.0%
- Possible injury crash: 67.3%

Table 17. Societal Costs

CONTROL TYPE	SOCIETAL COSTS
Two-way stop control with left-turn lanes and acceleration lanes on SR 3	$11,095,320
Single-lane Roundabout	$1,293,096
Traffic Signal	$3,121,104

Using the above costs and injury crash distribution, a roundabout would have a cost savings of $304,668 per year. Between 2020 and 2025, a period of six years, this would yield a societal cost savings of $1,828,008.

7. CONTEXT SENSITIVE/SUSTAINABLE DESIGN

The intersection of SR 3 and Log Yard Road is in unincorporated Mason County within the Belfair Urban Growth Area (UGA). The current zoning of the MTA project site is General Commercial while west of SR 3 is zoned for General Commercial and Business Industrial uses. The proposed intersection improvement is consistent with the planned growth of commercial and industrial uses and supports proposed community development plans and economic vitality activities. The proposed project offers an improvement in the multimodal transportation system in this area by adding a larger park-and-ride lot with improved security features.

While construction of this new facility will be disruptive to the existing corridor traffic, a Traffic Management Plan will be developed during design that will seek to minimize impacts, particularly to commuters, freight movement along the highway, and nearby businesses.

8. COMMUNITY ENGAGEMENT

Any change of access on SR 3 requires community engagement, which is consistent with WSDOT requirements. This engagement is being achieved with public open houses in the Belfair community.

8.1 MARCH 7, 2018, PUBLIC OPEN HOUSE

A public open house was held on March 7, 2018. Notice of the meeting was distributed by MTA. Flyers were sent to the community, MTA displayed flyers at facilities and on buses, the meeting was advertised in news media, and notice of the meeting was emailed to everyone on the project's distribution list. About 22 people attended the meeting, including residents, business owners, and property owners.

Information provided at the open house included details of the proposed new intersection alternatives and generic information about the benefits of roundabouts. The opportunity for public comment and questions was provided. Public comments are compiled in **Appendix I**.

Attendees shared concerns about the potential intersection alternatives. Concerns raised by attendees ranged as follows:

- The corridor is congested.
- The corridor is dangerous.
- The project is costly. Will it take away money from the Bypass/Freight Mobility Corridor?
- There are many trucks traveling the corridor and using Log Yard Road.
- The timing of the project. Can this be done after or at the same time as the Bypass/Freight Mobility Corridor?
- WSDOT coordination and inclusion.
- Input from adjacent business and property owners.
- Process of the decision.

A summary of comments and concerns received was compiled and distributed back to the community. Information and analysis is included below to review each concern and outline how it is addressed within the ICA or ICA process. This information flyer is included in **Appendix I**.

The majority of the concerns were focused around congestion, freight, and relationship of the future Bypass/Freight Mobility corridor.

Congestion

SR 3 and the Belfair area does suffer from regional congestion. The scope of this project is to create a safe and operational intersection at Log Yard Road and SR 3.

The construction of a controlled intersection at Log Yard Road and SR 3 will not address or impact this regional congestion. A controlled intersection at Log Yard Road and SR 3 will split or break up the queue that currently builds at the Clifton Road signal. There are no large traffic generators between Clifton Road and Log Yard Road that would add cars to the queue.

Traffic in the summer increases due to tourism and to seasonal business/industrial contracts. This summer increase was evaluated in the Operational Analysis above. Both a traffic signal and roundabout would continue to perform well with the increase in summer traffic.

Freight

Any controlled intersection that is constructed would be designed for the truck/freight traffic that uses the intersections. Signals and roundabouts can both be designed for large trucks. Property and business owners have shared the type of trucks that frequent this intersection with SCJ Alliance.

Once an intersection control type is selected, SCJ Alliance will work with the business owners to confirm the proper design vehicle to ensure the design will work with the current business/industrial traffic.

Adjacent business owners had concerns about how an intersection would address spikes in freight traffic during the summer. Increased freight traffic was evaluated in the Operational Analysis above. Both a traffic signal and roundabout could accommodate spikes in freight trips, with the roundabout operating at an LOS A and a signal operating at LOS C.

Relationship to the Belfair Bypass/Freight Mobility Corridor

MTA is scheduled to construct a park-and-ride near this intersection in 2019. This new park-and-ride will consolidate their two existing lots in Belfair and address increased park-and-ride use. Buses and users will be using this location, and it is important that it has safe and functioning ingress and egress. The Bypass/Freight Mobility Corridor is not scheduled for completion until 2023-2025. Waiting to provide a safe intersection until that time is not an option.

This project is an MTA project and not a Mason County or WSDOT project. Priority of Mason County and WSDOT projects sit with those agencies. MTA cannot provide funding or priority to projects that are not theirs and not transit related.

WSDOT is intending to begin design of the Belfair Bypass/Freight Mobility Corridor in 2019. In a 2007 Alternatives Analysis for that project all of the north end alternatives were either a traffic signal or a roundabout. A traffic signal or roundabout at Log Yard Road would be forward compatible as a bypass terminus or connection at that location.

8.2 APRIL 24, 2018, PUBLIC OPEN HOUSE

A second open house was held on April 24, 2018. At this meeting, SCJ Alliance outlined public concerns received, showed how the ICA process addresses those concerns, and presented the recommendation in the ICA: a single-lane roundabout.

At this meeting, the public raised similar concerns mentioned above. There were no new concerns presented from the public at this meeting. This ICA provides additional analysis beyond what is typically required to review and address particular public concerns, specifically regarding summer peak hour and freight/truck trips.

9. RECOMMENDATIONS

Development of the MTA Belfair park-and-ride will modify the existing Log Yard Road and SR 3 intersection to include a fourth leg, making the intersection a four-way intersection. The new traffic of this fourth leg will warrant revised intersection control for safety and operations. WSDOT requires an ICA to evaluate revised intersection control on a state route. The WSDOT Design Manuals states that a roundabout is the preferred intersection control type and is required to be evaluated. Three alternatives were evaluated: two-way stop control with left turn lanes and accelerations lanes, a single-lane roundabout, and a traffic signal. The roundabout and traffic signal would both operate effectively in the 2025 horizon year; whereas, the two-way stop control would fail. The single lane roundabout is the safest alternative with less predicted crashes based on an HSM predictive safety analysis. The traffic signal costs less to design and construct; however, the societal savings of less crashes exceeds the cost differential within the horizon period. The roundabout is the recommended intersection control type based on a comprehensive analysis including operations, safety, cost, contexts, and public concerns.