SR 305 Suquamish Way Intersection Improvement Project Phase I Report

August 14, 2014

Washington State Department of Transportation

Washington State Department of Transportation
Olympic Region Planning Office
5720 Capitol Boulevard SE
Tumwater, WA 98501-5201

SR 305 Suquamish Way Intersection
Improvement Project
October 2014 Supplemental

The following identifies what steps have occurred on the SR 305/Suquamish Way Intersection Improvement project since the time when the end of Phase I (Study Phase) was completed until the decision concerning the final direction of the project was made in October 2014.

The study phase recommended the construction of a separated right-turn lane as the preferred alternative. Sufficient funds were available to move the project forward into a preliminary engineering and design phase to complete the design and environmental work on the separated right-turn lane. No construction funds were identified.

The Port Orchard Project Office started preliminary engineering and design efforts on the preferred option. Following practical design principles and considering the amount of project funds remaining, the design team recommended that the westbound right-turn lane extension option be designed and constructed with the remaining project funding as described in the Phase II portion of the study report in lieu of the separated right-turn lane.

This option was discussed with some of the stakeholders for the project. The stakeholders felt the separated right-turn lane was the best solution. A stakeholder meeting was requested to discuss the project office's recommendation.

In the meantime Kitsap Transit and the Suquamish Tribe negotiated an operating agreement for a public park and ride within the Clearwater Creek Casino property, thereby allowing WSDOT the ability to close and relocate the existing park and ride lots at the SR 305/Suquamish Way intersection. Kitsap Transit was awarded a Region Mobility grant for the SR 305 intersection to improve mobility by reducing delay for transit riders while maintaining safe operation of the highway, especially for pedestrians accessing the nearby park and ride. Kitsap Transit approached WSDOT with a proposal to use the grant funding to partner on the project to cover the construction cost of the separated right-turn lane with the placement of a shelter at the nearside transit stop as well as the construction of a right in/right out access on the south side of SR 305 in the eastbound direction to allow bus and delivery vehicle access to the Clearwater Casino parking lot.

On October 28, 2014 WSDOT met with key project stakeholders to discuss the project status. The stakeholders were informed of WSDOT and Kitsap Transit efforts to develop an agreement to allow WSDOT continue work on the separated right-turn lane and the design and construction of an eastbound right in/right out transit access. The PS&E development will use the remaining Transportation Budget funding. It was agreed to move forward with the separated right-turn lane along with the right in/right out access.

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EXECUTIVE SUMMARY

Washington State Department of Transportation (WSDOT) undertook this SR 305 Suquamish Way NE intersection improvement project as a result of a 2011 Legislative proviso. The project effort would ultimately identify and design a preferred alternative.

The project looked at potential improvements to the intersection of SR 305, the regional highway between Bainbridge Island and Poulsbo, with Suquamish Way, a county road that provides access to the Suquamish Tribal reservation. The SR 305 Suquamish Way intersection currently operates at a level of service F with an overall delay of 100.6 seconds.

WSDOT also worked with a project stakeholder group comprised of local citizens, elected officials, and other stakeholders to ensure that any recommendations are incorporated into the vision and needs of local communities in the project area. The planning effort was completed in late 2013. The design work to commence in spring 2014. The two-phased project allowed stakeholders in the committee to agree to a process, offer feedback, and weigh in on WSDOT decision-making.

The study phase of the project employed Moving Washington strategies of operating the transportation system efficiently, managing demand effectively, and increasing capacity strategically. A practical design approach ultimately dictated the preferred alternative selection.

Three alternatives were selected for further study from various conceptual solutions. These alternatives included:

1) Extending the westbound SR 305 right-turn lane
2) Building a separated right-turn lane on westbound SR 305
3) Building a custom-designed roundabout in the intersection. WSDOT considered both short-term and long term solutions in the overall analysis

In the long term, traffic simulation models indicated that a custom-designed roundabout provided the best long-term benefits by reducing SR 305 backups over the 20-year study period. In the short term, traffic models also showed congestion-relief benefits with the separated right-turn lane option.
In arriving at a recommended solution, WSDOT took into account considerations beyond the benefits to traffic. Those considerations included construction and development costs, constraints introduced by the physical location of Thompson Creek (a recognized fish barrier culvert location), and the level of public support for various alternatives.

WSDOT concluded that of the three alternatives and conditions evaluated, the separated right-turn lane provided the best potential for gaining public support and construction funding in the near term. The separated right-turn lane appears to allow for construction of a future roundabout when traffic volumes warrant consideration. Construction funds had not been secured for this project at the time of the study.

Why is WSDOT Studying the SR 305 Suquamish Way Intersection?

What are the Issues?

The SR 305 corridor, over the years, has become a corridor full of transportation challenges and what some note as unmet needs. The Suquamish Way intersection experiences delay and collisions during AM and PM peak hour periods, resulting in increased societal costs. Afternoon westbound queues originating from the intersection have become unacceptable to the traveling motorists. The congestion creates challenges for bicycles and pedestrians using the highway, as well as those accessing transit and the adjacent park and ride lots. Delays in transit service caused by this congestion also impacts bus riders and adversely affect the dependability of the transit service. Because this intersection is immediately adjacent to the Agate Pass Bridge, and is the only land route off of Bainbridge Island, congestion at this location can have a significant impact on reliability and mobility on and off the island at certain times of day.

The 2007-2026 State Highway System Plan does not identify the intersection as a deficient safety or mobility location. The Regional Transportation Plans does note the intersection as a corridor-level deficiency. This is one of the top priority locations for the Kitsap Regional Coordinating Council, and community members and leaders.

Washington State Department of Transportation (WSDOT) undertook this process as a result of a Legislative proviso [2011 Session Law ESHB 2190, Section 305, (46)] to improve intersection operations at SR 305 and Suquamish Way. The proviso appropriated $750,000 to identify and design the selected improvement. No construction funds had been identified at the time of the study.

The project looked at potential improvements to the intersection of SR 305, the regional highway between Bainbridge Island and Poulsbo, with Suquamish Way, a county road that provides access to the Suquamish Tribal reservation.

Figure 1 Project Area

Purpose and Need

Purpose

The purpose of the project is to improve mobility by reducing delays for travelers using the highway at Suquamish Way while maintaining or improving the safe operation of the highway in the process. The project will also address issues related to use of the park and ride lots near the intersection, the concerns of bicyclists and pedestrians in the vicinity of the SR 305 Suquamish Way intersection, access needs of local businesses, and other land uses in the vicinity of the intersection.

Need

Congestion at this signalized intersection, most pronounced during PM peak commute periods, imposes delays and inconvenience for motorized travelers, and creates challenges for non-motorized travelers using the state highway, as well as those accessing transit and the adjacent park and ride lot. Delays to transit service caused by this congestion also impact bus riders, and adversely affect transit route schedules. Because this intersection is immediately adjacent to the bridge representing the only land route off of Bainbridge Island, congestion at this location can have a significant impact on mobility on and off the island at certain times of the day.

How was the Study Conducted?

The project began August 2012 and was conducted in two phases – planning and preliminary engineering/design. In the planning phase, the project sought to identify alternatives that would improve the intersection operations and eventually select a preferred alternative. This document summarizes the first phase of the process and describes how this recommendation was developed.

Planning Phase

The primary goal of the planning phase was to identify a strategy, a preferred alternative to alleviate the duration and length of existing PM queuing and congestion at the SR 305 Suquamish Way intersection, particularly along westbound compass direction SR 305 during the PM peak hour.

In the planning phase, the project team interviewed stakeholders to identify current issues and concerns with the intersection. Additional interviews were conducted with special interests groups, i.e. bicycle groups and public safety agencies.

WSDOT participation included senior staff representing WSDOT Olympic Region Planning and Traffic offices, WSDOT Transportation Data & GIS Office (TDGO), Traffic, Design, and Capital Program Development & Management (CPDM). Work was performed by WSDOT Olympic Region Planning staff, with significant assistance from the WSDOT (TDGO) (traffic data collection) and the consultant services of CH2M Hill (traffic simulation and analysis). The project team also collected traffic data and five years of history on collisions in the intersection, and studied day-to-day road use. The team then developed options to improve traffic flow and analyzed those options by using computer models to simulate traffic conditions during various times of the day. Through these techniques, staff identified and developed a preliminary solution.

Preliminary Engineering/Design Phase

Phase 2 of the project, the design phase, included scoping, environmental process, design, and completion of preliminary engineering & estimate. The design phase would follow WSDOT standards and practical design principles in delivering the preferred alternative. Phase 2 of the project would be conducted by the Port Orchard Project office.

Sharing information

A public outreach process was conducted to inform, identify, and respond to jurisdictional and community concerns. The outreach process involved two areas;, public information sharing sessions and stakeholder meetings. Information sharing meetings were held at the beginning of, and near the end of the planning phase.

Stakeholder participation was achieved through the assembly of a local stakeholder group. Meetings were held on September 27, 2012 and April 19, 2013 with a technical stakeholder meeting held on March 28, 2013. Stakeholders included representatives from Kitsap County, Cities of Poulsbo and Bainbridge Island, and Kitsap Transit. The project team also worked closely with the Suquamish Tribe and other interest groups. This process was used to consider, develop, and recommend

alternatives to meet the community's needs at the lowest cost. Additional participation occurred with individual interviews of key public safety agencies, transportation providers and bicycle advocates. This process allowed the project moving forward to maintain sensitivity to the vision of the stakeholder and needs of local communities within the project area. Feedback from these meetings was considered into the development of the preferred solution.

Numerous Issues were offered by stakeholders and concerned public, however, the theme of reducing the queue was paramount. Many expressed the need to improve the operation of the intersection in an affordable manner. Other noteworthy items were;

- Public safety agencies voiced the need to reduce the impedances causing intersection backups, adequate roadway width to conduct emergency operations without complete roadway closures.
- Improve bicycle & pedestrian accommodations and continuity; i.e., add bike lanes, pedestrian lighting, and intersection crossings.
- Limit construction that may be removed for future improvements such a roundabout

Project Stakeholders

- Kitsap County
- City of Poulsbo
- City of Bainbridge Island
- Suquamish Tribe/Port Madison Enterprises(PME)
- Kitsap Transit
- Kitsap Regional Coordinating Council

Figure 2

Issues/solutions suggested and were determined to be beyond the project scope

- Agate Pass Bridge replacement
- Agate Pass Bridge accommodations for bicycle & pedestrians, i.e. sidewalks, bike lanes and bikes on bridge warning lights
- Real-time intersection cameras
- Separated bicycle & pedestrian trail
- Thompson Creek culvert replacement
- Interconnection traffic signals with those on the SR 305 corridor
- Transit queue bypasses at signalized intersections
- Installation of highway advisory radio broadcast units and electronic message signing

Project staff also provided presentations at a November 26, 2012 WSF Bainbridge Island meeting and at Suquamish Tribal member gatherings. Folios and fact sheets on the Agate Pass Bridge (Appendix A-1) were produced to provide information to the stakeholders and public. A project website was established to provide project updates and postings of materials displayed at the information sharing sessions. Interest and contradictions of facts and information on the Agate Pass Bridge was such that fact sheet was produced,

Previous Study Efforts

Two major studies have been conducted on the SR 305 corridor;

1. SR 305 Corridor Major Investment Study (April 1997) was a planning study of highway improvements that involved substantial cost and is expected to have a significant effect on capacity, traffic flow, level of service, or mode share at the transportation corridor of sub-area level.

   The 1997 SR 305 Major Investment Study involving the same primary stakeholders called for:

- Widening SR 305 to 3 or 5 lanes, with center two-way turn lane at key locations on SR 305, including Suquamish Way intersection
- Widening of SR 305 to provide left-turn pockets

2. In 2011 Kitsap Transit completed a corridor enhancement transit alternative analysis technical study. The study builds upon work done as a part of the Vision – Transportation Choices of Tomorrow – Connecting Communities (2008), which was initiated as an update, to the 1997 SR 305 Corridor Major Investment Study.

   The 2011 study in part recommended:
   - Extend the Suquamish Way westbound right-turn lane from 100' to 650 ft.
   - Convert a shared transit/right lane that continues through the intersection to a transit station/stop on the far side of the intersection
   - Bus Rapid transit operations should be further explored
   - Further monitoring and implementation of emerging transportation demand management strategies
   - Continue to build transit ridership and facilities along the SR 305 corridor

Project Constraints/Assumptions

Expectations from nearly all stakeholders envisioned an intersection improvement project that was low to mid-range in cost, have minimal impacts during construction, and eliminated the roadway congestion. The solutions considered would however, be influenced by varying constraints. The first phase of the project sought to identify alternatives that could meet functional design standards that resulted in improving the intersection operations. The project team identified both limitations and assumptions that influenced the outcome of the project scope and design.

- Presented with the decision to not seek to acquire additional property limited the number of initial solutions that would meet full design standards.
- Klebeal/Thompson creek limits the footprint of intersection possible improvements. A recognized fish barrier culvert, the Thompson Creek culvert (MP 7.39) is located approximately 300' west of the intersection. This fish barrier culvert is identified to be replaced in the distant future. Design and construction funding has not been obligated.
- The location of the Agate Pass Bridge in conjunction to the project intersection limited the length of a right-turn lane solution. Modifying, or replacing the bridge was not considered in the project scope. Bridge improvements were not considered in the 2035 traffic forecast.
- Closure of westbound WSDOT owned & operated park and ride lot be would necessary with major improvements. Accommodating the 67 stall lot elsewhere in the vicinity would be expected.
- Highway stormwater runoff would be managed within the limits of existing WSDOT right-of-way.
- Improvements to the southern leg of intersection are likely. Access improvements to the Port Madison Clearwater Casino may be required to fully facilitate intersections operations.
- To fully accommodate a 20 year traffic horizon, the improvements may require a phased approach.

Project Description

Project Area

Figure 3 Project Limits
SR 305 MP 7.05 (Agate Pass Bridge) to MP 7.19 (vicinity Thompson Creek)

The project is located in a rural setting of North Kitsap County. Bordered by Thompson Creek to the west, tribal trust lands to the north, Agate Passage to the east and Suquamish Tribal property to the south. No residential properties lie within the project area. Suquamish Tribe's Port Madison Enterprises (PME) operates multi commercial ventures via access of the south leg of the intersection. The intersection provides direct access to PME's casino, hotel, parking garages, and several other tribal facilities.

Roadway
SR 305 within the vicinity of the Suquamish Way intersection is a two lane rural highway with a posted speed limit of 45 MPH. This segment of SR 305 is designated as T-3 freight category with 300,000 to 400,000 annual tonnage. SR 305 is designated as a Highway of State Significance (HSS), and Scenic Byway. Figure 3 depicts roadway data for the project area. SR 305 serves as the only land based multimodal transportation connection between Poulsbo and Bainbridge. It is the, only land connection to Bainbridge Island and the primary route to a Washington State Ferry (WSF) terminal and the Seattle region. The intersection's weekday PM westbound flow is severely hampered by what could be described as pulsed traffic flows. This pulsing or platooning effect can be attributed to traffic signal operations along the route, off-loading operations of vehicle at the WFS Winslow terminal and commuter traffic from Bainbridge Island.

INTERSECTION DESIGN DATA		
Design Criteria	SR 305	Suquamish Way
Functional Classification	Rural Principle Arterial	Collector
Access Control	Class 2	
Terrain	Rolling	Rolling
Design Speed	45 MPH	45 MPH
Posted Speed	40 MPH	40 MPH
Design Vehicle	WB-67	WB-67
Percent Trucks	<5%	<5%

Figure 4 SR 305 Suquamish Way Intersection

The four legged intersection is controlled by a WSDOT multiphase signal with signal pre-emption opticom for fire, law enforcement and Kitsap Transit. The intersection is bordered by the Clearwater Casino to the south, tribal land and trust tracts to the east and north, and a steep slope to the Agate waterway passage is to the west. A WSDOT emergency power generator is sited in the southwest quadrant of the intersection highway right-of-way.

Suquamish Way NE is a heavily used two lane County collector with a direct route to the Suquamish community of Suquamish 4 miles north. The route is also used by many commuters destine to the Kingston area. Kitsap County Public Works improved the Suquamish Way NE intersection in 2012 by extending the length of left and right turn lanes.

The current intersection area does not have sidewalks, bike lanes or trail facilities. Kitsap County recognizes the SR 305 corridor as a bike route and includes the project section in the conceptual Sound to Olympics Trail plan. No bike lanes or trail facilities exist leading to the project area. Bicycle traffic and moderate pedestrian activity was recorded by WSDOT staff in October 2012 (Figure 5. The primary pedestrian demand is generated by transit stops in the vicinity of the intersection, specifically the westbound WSDOT Park and ride lot, and the Clearwater Casino complex. Pedestrian amenities are limited to painted crosswalks and push-button demand signals on all but the west leg of the SR 305 intersection.

SR 305 Mainline Bicycle Counts

DAY	DATE	TIME	AM/PM	BIKE COUNTS
Tues	10/2/2012	1400-1800	PM	15
Wed	10/2/2012	1400-1800	PM	12
Wed	10/3/2012	0600-1000	AM	6
Thurs	10/4/2012	0600-1000	AM	11

Intersection Pedestrian Counts

DAY	DATE	TIME	AM/PM	PED COUNTS
Tues	10/2/2012	1400-1800	PM	30
Wed	10/2/2012	1400-1800	PM	15
Wed	10/3/2012	0600-1000	AM	2
Thurs	10/4/2012	0600-1000	AM	14

Figure 5 WSDOT Recorded Bicycle & Pedestrians Counts

Review of bicycle & pedestrians counts conducted on September 5, 2012 by Don Willott, (committee member of the Bainbridge Island non-motorized committee) substantiated similar numbers of counts in Figure 5.

Kitsap Transit operates two bus stops/shelters within the project limits located on mainline SR 305. Neither location meets WSDOT full design standards for bus pullouts. The eastbound stop is essentially a farside type stop whereas the westbound stop is a significant distance east of the intersection. Project staff repeatedly observed that virtually all of the westbound park and ride lot users chose to cross the highway to the eastbound transit stop rather than use the crosswalk 400 feet away at the signal. Kitsap Transit operated AM & PM Peak express bus service to and from Poulsbo to the Winslow ferry terminal. In addition, Kitsap Transit route #91 has north and southbound stops immediately north of the project limits on Suquamish Way NE. Much of the transit ridership can be attributed to the Agate Pass park and ride lot. Kitsap Transit recorded an average of 43 AM weekday eastbound boarding and 10 off-loadings for July 2012.

WSDOT operates two park and ride lots immediately east of the intersection adjacent to SR 305. Together the two lots provide upwards of 80 stalls with direct access to the highway. Lot access and egress is commonly impeded during peak travel periods by the heavy mainline volumes and queues. Weekday utilization has been steady and remains at 70 -- 90 percent depending on the weekday. Motor vehicle origins were captured in October 2012 via a license plate survey. The greatest numbers of users was determined to be residents of Kitsap County west of the Suquamish area. See Figure 6.

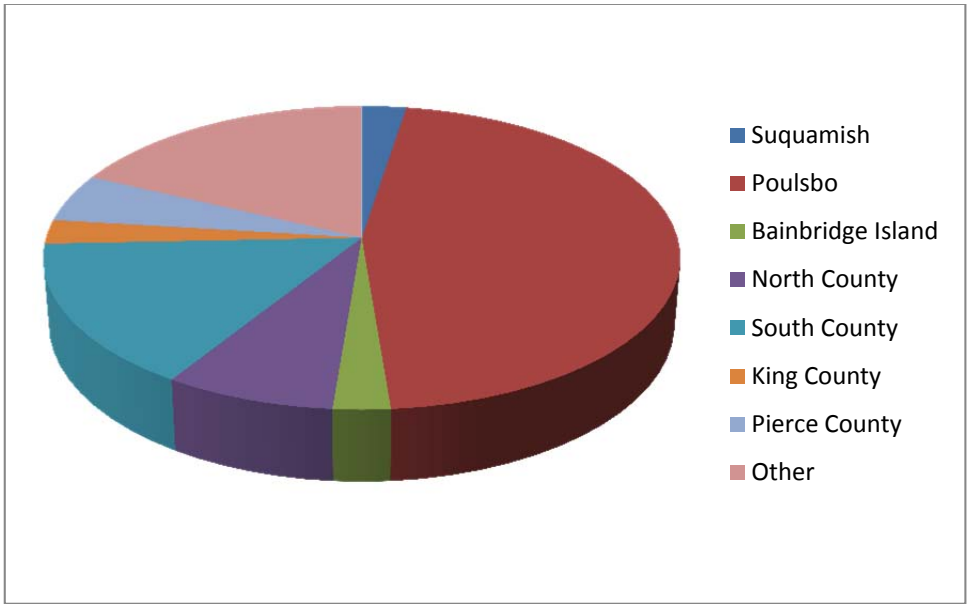

Figure 6 Agate Pass Park & Ride Lot User Origins

What is the Study Outcome?

Existing Conditions

Traffic History

SR 305 is recognized as one of the most congested corridors in Kitsap County carrying a largely commuter-based traffic and transit riders. Vehicle volumes from the WSF ferry service from Seattle have remained steady with a maximum capacity of 202 vehicles. In addition to volumes attributed to WSF Ferry service localized traffic contributes to the intersection queues. Annual Average Daily Traffic (AADT) volumes in the vicinity of the Suquamish Way intersection has remained flat over the last 10 years with 21,000 vehicles on a daily basis. Westbound traffic during the PM peak currently traffic backups 1.15 miles to Agatewood Road (vicinity MP 6.20) with a delay of 51.4 seconds.

WSDOT collected traffic volume counts over a 3-day period in October 2012. Traffic data collection limits were from SR 305, Day Road (MP 6.82) to Laura Loop (MP 7.29). Westbound SR 305 travel times were collected between Agatewood Road and Laura Loop NE. Southbound SR 305 travel times were collected between Laura Loop NE and Reitan Road. Speed data was collected at key locations along northbound and southbound SR 305 between Laura Loop NE and Day Road. Travel times were collected for both general purpose and transit (bus) vehicle types.

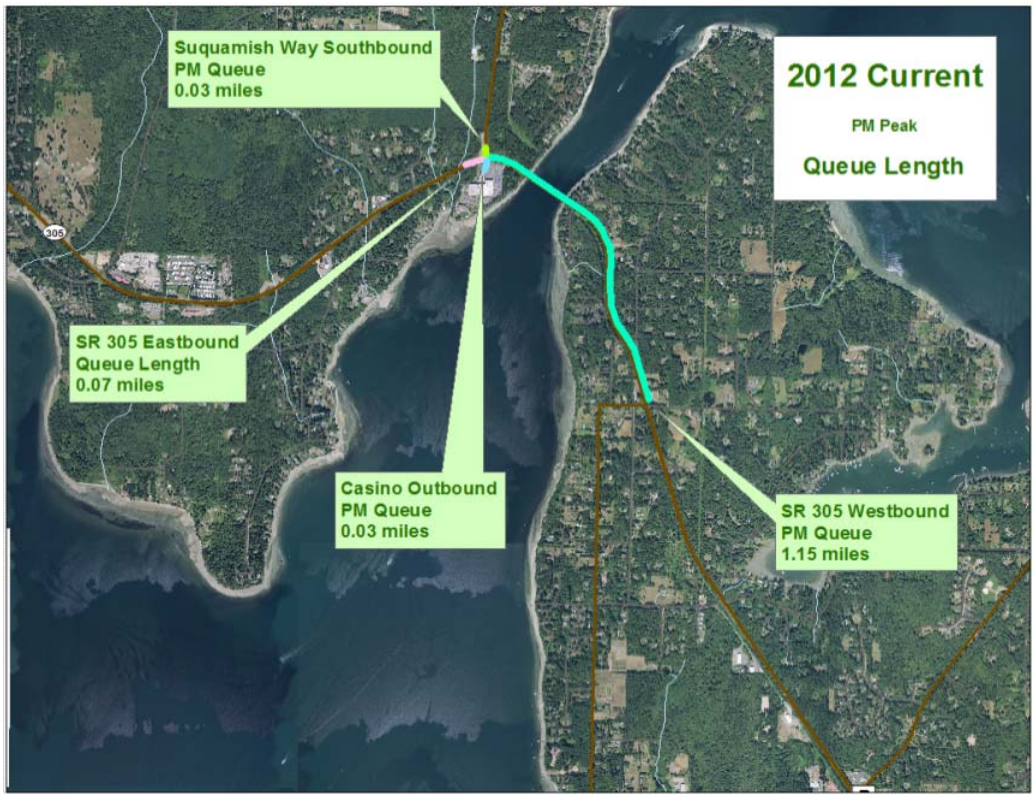

Figure 7 SR 305/Suquamish Way Intersection Queue Lengths

Traffic volumes and directional counts included the following:

Manual Turning Movement Count efforts:

- At SR 305/Suquamish Way (5:30 AM – 9:00 AM, 4:00 – 7:00 PM)
- Bicycle and pedestrian traffic counted separately during this time

Traffic Tube Counts:

- 4 sets of directional counters on each leg approximately ¼ mile apart, and set to collect volume, vehicle class, speed; with possibly more counters on the eastern leg.

License Plate Reader Camera Origin-Destination:

- Captured a percentage of vehicles that traveled through the SR 305/Suquamish intersection to and from the WSF Winslow ferry dock.

October 3, 2012 traffic volumes at the intersection during afternoon PM peak commute hours were an average over three days. Based on traffic counts taken average daily traffic along the major leg of the intersection (SR 305) was 21,886 vehicles and 8,123 vehicles at the Suquamish Way leg of the intersection. Approximately 23% to 30% of westbound SR 305 traffic turns onto northbound Suquamish Way, while more than 70% to 74% of traffic continues westbound through the intersection. Approximately 2% turn left into the Casino. From Suquamish Way, 52% of the traffic turns left onto SR 305 during the PM peak, in the AM this percentage increases to 75%. 37% of the traffic from Suquamish Way turns right onto SR 305.

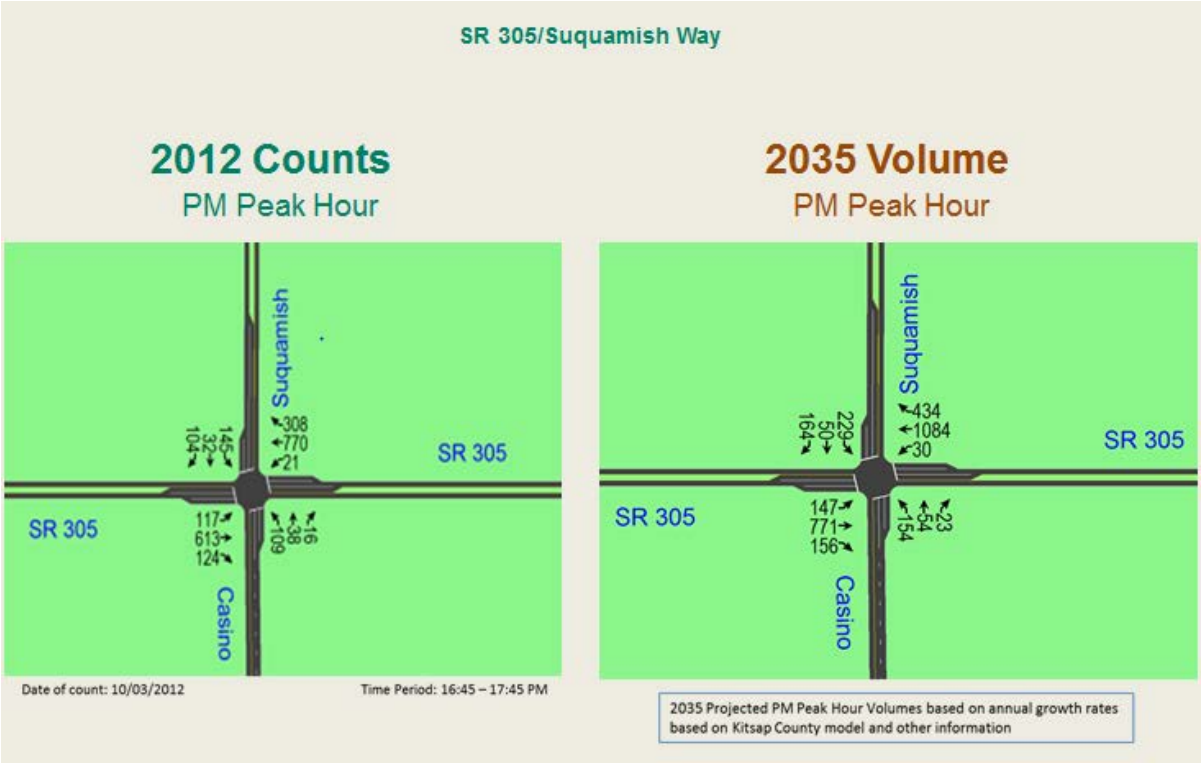

Figure 8 SR 305/Suquamish Way Intersection Traffic Volumes

The year 2035 PM peak hour volumes in Figure 8 are based on annual growth rates derived from the Kitsap County growth model. As expected the projected volumes rose, while the ratio of vehicle turning and travelling through the intersection remained the same. In 2035 the westbound PM queue is expected to stretch back beyond East Day Road (MP 4.27) with a delay of 276.9 seconds.

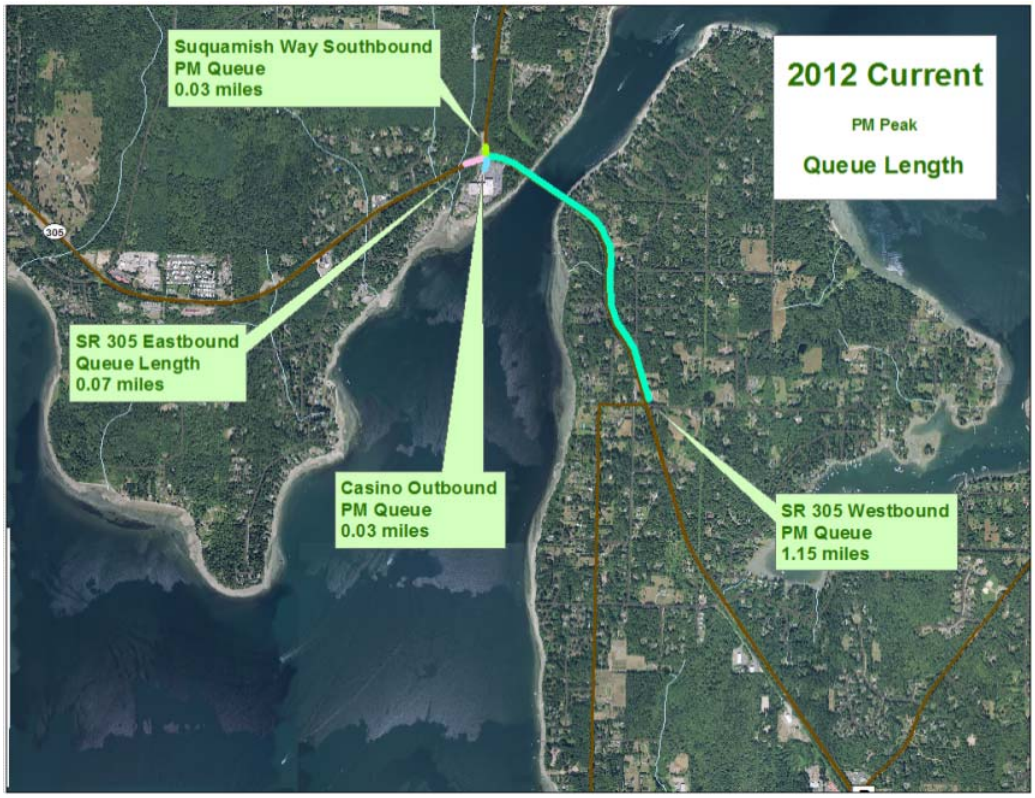

Figure 9 SR 305/Suquamish Way Intersection 2012 Queue Lengths

Collision History

Project collision data was obtained and compiled for a five year period (January 1, 2007 through December 31, 2011) from the WSDOT TDGO; safety analysis methodology was conducted per the WSDOT Highway Safety Manual.

All of the southbound collisions occurred south of the signalized intersection, and so would not be impacted by the proposed improvements. There were no fatal collisions along SR 305 within the study area during the five year period. Collision history shows the highest number of incidents occurred in 2007 with 24 total collisions, 33% of them causing injury. In 2010 there were 22 total collisions with 36% causing injury. In 2008 there were 18 collisions and in half of those crashes an injury occurred. The graph also shows the Average AADT at this location (Figure 7). The AADT decreased slightly from 2007 to 2008 and then increased in 2009 and 2010. By the end of 2011 the AADT decreased back to 20,000 vehicles which is what 2007 started with.

Collision Severity (2007-2011)

On SR 305 in the westbound direction over a five year period, 50 collisions occurred with half of them involving an injury. The green line on the graph (Figure 10) represents traffic volumes in relation to averaged counts taken on a Tuesday, Wednesday and Thursday in August 2008. As the number of vehicles increased, the number of collisions also increased.

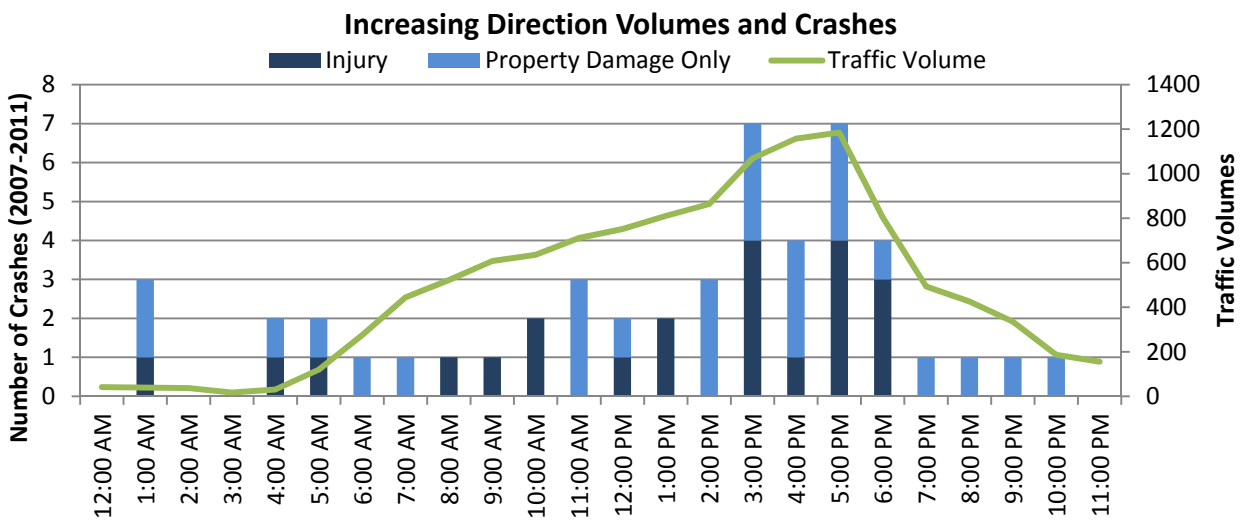

Figure 10 Westbound Volumes and Collisions

Disclaimer: Under U.S. Code, Section 409, that data cannot be used in discovery or as evidence at a trial in any action for damages against the State, Tribal, or Local Government that involves locations mentioned in this data.

Type of Collisions

Rear-end crashes account for 69% of the total number of collisions along SR 305 within the corridor. (Figure 11) Most rear-end collisions occurred near the end of Agate Pass Bridge, coming in and out of the park and ride lot and at the Suquamish Way Intersection. Angle crashes were the second most common type of collision; the most frequent ones occurred at Suquamish Way (Figure 12) and Sandy Hook Road intersections. Four crashes took place at each intersection. Fixed object crashes were also the second most common type of collision. Fixed object crashes include running into guardrail, trees, fences, sign posts and other objects. Eight fixed object crashes occurred throughout the corridor.

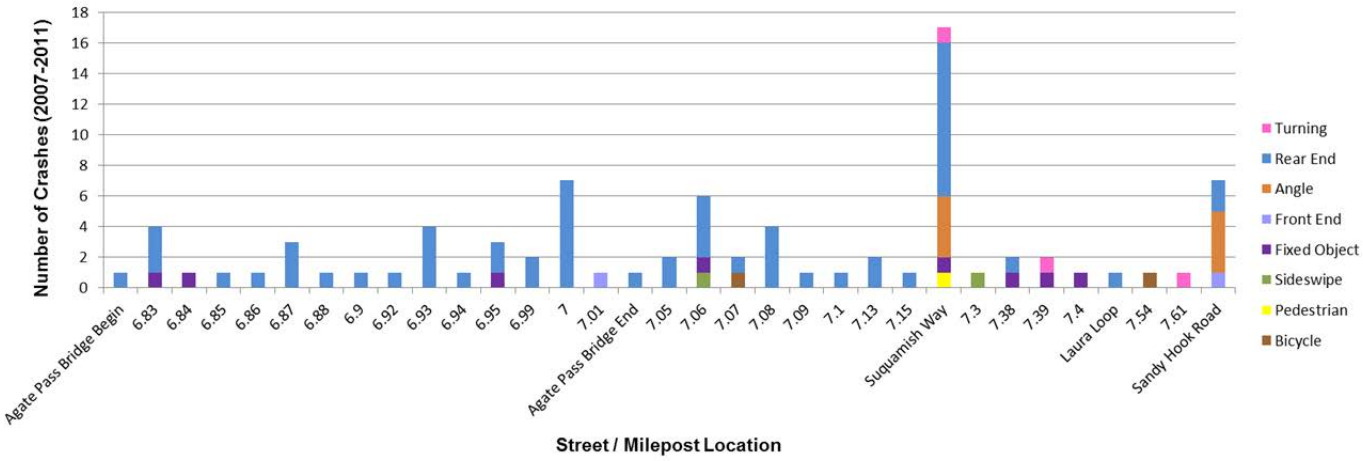

Figure 11 Types of Collisions

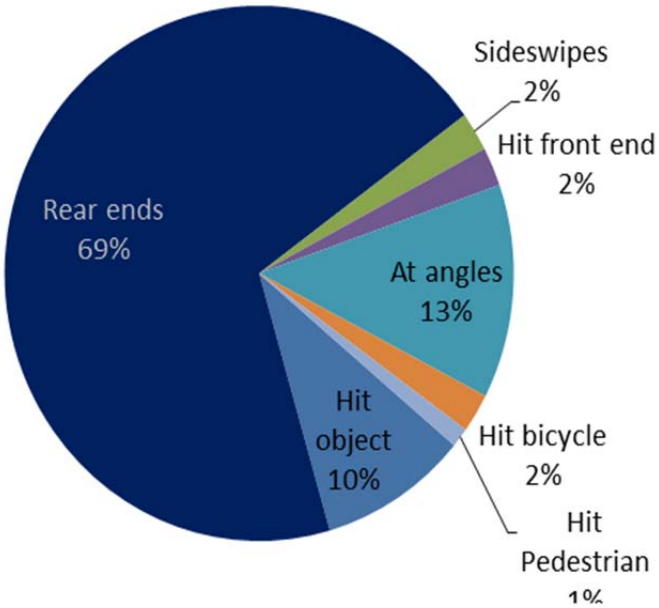

Figure 12 Type of Collision by Percentage – Suquamish Way

Disclaimer: Under U.S. Code, Section 409, that data cannot be used in discovery or as evidence at a trial in any action for damages against the State, Tribal, or Local Government that involves locations mentioned in this data.

Alternative Development

Throughout the project a number of solutions were raised with an ongoing process of evaluation. Alternatives within the project footprint that were expected to offer high value and best return on investment were considered. A wide range of additional transportation improvement solutions were recorded over the course of the project. Many of the alternatives raised by stakeholder were determined to be outside scope of what was eventually to be the preferred alternative design. While some were determined to be outside the scope of the preferred alternative there were some with merit that could be pursued in the future. Some of the alternative elements considered were:

- **Relocate the westbound Transit far side bus stop** – improve the transit stop to a full-design pullout thus reducing negative influence of Suquamish Way northbound right-turn movement. Under the roundabout alternative the location would be determined in the design phase. Under the separated right-turn lane alternative the stop would be relocated to a near-side location at the intersection.
- **Pedestrian level illumination of the Suquamish Way intersection** – install lighting that more effectively allow pedestrians to be seen by motorists. Under the roundabout alternative illuminations would be according to current standards. Under the separated right-turn lane alternative it is anticipated that only the northwest signal and luminaire pole would be relocated. Final determination would occur in the design phase.
- **Increasing pedestrian signal phase timing of the SR 305** – the east leg of the intersection. Under the roundabout alternative the signal is eliminated. Under the separated right-turn lane alternative, the signal tuning would be re-evaluated and corrected as warranted.
- **Westbound Stripe SR 305 bike lane channelization** – analysis determined that accommodations could be deigned into a separated Right-turn lane. A roundabout design would place the bicyclist with two options. 1. Remain in the flow of traffic, or 2. Exit the highway onto the dedicated bicycle & pedestrian sidewalk

The following alternatives/elements were identified in the alternative development process and did not move forward into the analysis process:

- **Replacing the westbound Suquamish Way transit stop** – design into the project a bus pullout lane configuration to eliminate in-lane stops.
- **Install Intelligent Transportation System improvements (ITS)** – provide highway travel time travel notifications, i.e., kiosks noting transit arrivals and parking lot utilization rates, variable message signs corridor wide. Travel lane condition notification detection and notification improvements, i.e., Intersection stop conditions with a westbound amber flashing beacon 500' east of intersection. Signal inter-connect was also suggested. Distance to signals exceeded the ½ spacing required for effective reoperation results. The SR 305 corridor is not presently included in WSDOT's ITS Plan. While it was determined that ITS improvements could improve the experience and reliability of the intersection operation, the improvements were deemed to be outside of the project scope not having an immediate value to the project, or extends beyond the programmed obligations of the project and WSDOT:
- **Adding Transit Queue Jump Bypass** – This option was not pursued as it would result in an extra phase cycle of the signal which would degrade the signal operation and less than available space for buses to enter into the westbound lane.
- **Eastbound mainline bike lane** leading to the **intersection**. Possible improvements to the intersection were limited to the westbound leg of SR 305 only. Adding an eastbound bike lane would have likely resulted in construction of a retaining wall and perhaps relocation of the emergency generator system powering the signal system, or right-of-way purchase.
- **Shared-use trail facility.** The additional of a Sound to Mountains separated shared-use facility was not pursued. The facility would add significant cost and required additional right-of-way. The facility, maximum of 600 feet would not connect to any existing separated trail facility. Termination at the bridge would create a midblock crossing condition of SR 305.
- **Closed circuit camera monitoring of intersection.** This ITS measure did not meet the scope of the proviso.
- **TDM/CTR Strategies and Concepts** – Transportation Demand Management (TDM) is an umbrella term for strategies that reduce vehicle trips or shift use of the roadway to off peak periods. The traffic analysis shows that applying TDM strategies, such as staggered work schedules, increased transit and vanpools, park and ride lots west of Poulsbo and telecommuting, could provide improvements over the intersection alternatives in both the AM and PM peak hour operations. It was determined that any corridor-level efforts were beyond the project scope and parameters. Efforts and investments by Kitsap Transit and other could yield some positive mode shifts. Further implementing CTR strategies (carpool-vanpool mode shifts, alternative work schedules and telecommuting) in Bainbridge Island and the greater Seattle area that may result in the 2% mode shift used in the traffic modeling exercise. While beyond the project scope creating additional park and ride lot capacity west of the intersection would be excellent long-range capital (TDM) investments. Kitsap Transit's has plans to put in a park-and-ride lot with 269 spaces and a transfer center adjacent to its bus operations base on an 8-acre site just north of SR 305 along Viking Avenue. The current park-and-ride lot in Poulsbo has 138 spaces at the corner of Hostmark Street and Eighth Avenue.
- **Driver (User) Education / Outreach Concept** – This alternative proposes driver (user) education and public outreach to better inform and educate users of the facilities. This is expected to be facilitated by WSDOT partners.

- **Accommodate bicycles and pedestrians on the Agate Pass Bridge** – add cantilever units to Agate Pass Bridge to provide bike and pedestrian travel. Further consideration was deemed to be outside the project scope.
- **Bicycle advisory devices** – install bicycle-on-bridge activation devices, signs and amber flashing beacons at each end of the bridge. Further consideration was deemed to be outside the project scope.
- **Bicycle-Pedestrian Tunnel crossing of SR 305:** Trail facility for bicycle & pedestrians from the Agate Pass Bridge to the intersection with Suquamish Way. Would require additional right of way, deemed to be outside the project scope.
- **Replacing the existing Agate Pass bridg**e – replace with a four lane bridge to include symmetrical bike and pedestrian facilities. Further consideration of replacing the bridge was deemed to be outside the project scope.
- **Interchange level improvements:** Several suggestions were fielded that raised the possibilities of improving capacity by way of building Tier 3 level interchange improvements. Limitations of the surrounding topography and land use, distance of the intersection from the Agate Pass Bridge solution to not be feasible.
- **Elevated 'Flyover' type structure:** Separating SR 305 Highway and the Suquamish Way intersection. Limitations of the surrounding topography and land use, distance of the intersection from the Agate Pass Bridge solution to not be feasible.

Alternatives Analyzed

WSDOT project team considered a range of near-term and long term options. With near term solutions are considered low costs with some measureable benefit where with long term, the results include high costs and corridor wide benefits. A No Build scenario was addressed in the study process with the conclusion that a no build option would fail to meet the intent of the proviso. Three alternatives were selected for further study from various conceptual solutions. These alternatives included:

1) **Westbound right-turn lane extension:** The alternative would extend the existing 100' right-turn lane to within approximately 100' of the Agate Pass Bridge. The eastbound park and ride lot would be closed to eliminate turning movements entering and crossing the right-turn lane.

2) **Separated Westbound (Off-Set) Right-turn lane:** The alternative extends the existing 100' right-turn lane approximately 500', to within approximately 100' of the Agate Pass Bridge. The eastbound park and ride lot would be closed to eliminate turning movements entering and crossing the right-turn lane. The separated right-turn lane offers further separation of the westbound and northbound movements and increases overall unimpeded northbound turning volumes.

3) **Hybrid non-symmetrical roundabout:** With limited highway right-of-way, this alternative creates a hybrid non-symmetrical two-lane roundabout. The roundabout could be fully constructed including the second lane. Initial striping could be limited to handle short-term volumes. Long-term capacity demand could be addressed with striping of the second lane (westbound to southbound).

Analysis Methodology

Various tools are used to determine how well the transportation systems operate today and how well it will operate in the future. The traffic analysis for this study used the VISSIM micro simulation tool to evaluate the effectiveness of the transportation improvement alternatives the project considered. In addition to VISSIM, both the Synchro and SIDRA analysis tools were used to complement the VISSIM traffic analysis tools. Synchro was used to optimize signal timings and test preliminary signalized intersection alternatives and SIDRA was used as the main analysis tool for the roundabout option. The models were calibrated and validated as described in CH2MHILL's *SR 305, Suquamish Way Traffic Analysis* Technical Memorandum (Appendix A2).

A VISSIM microscopic traffic simulation model of the SR 305/Suquamish Way intersection was developed as part of the traffic study for this area. The primary goal was to identify strategies to alleviate existing queuing and congestion at the SR 305/Suquamish Way intersection, particularly along northbound (westbound compass direction) SR 305 during the PM peak hour.

The traffic study while focused on the influence of the Suquamish Way intersection (Milepost 7.19), the simulation calibration extended east to East Day Road (MP 4.28) and Sandy Hook Intersection MP 7.63 to the west. Traffic analysis work included traffic counts taken along the SR 305 corridor in October 2012. A VISSUM travel demand model was developed by the Transpo Group in the same year. The Transpo model was used specifically for the Suquamish Way intersection. The base year model was used to build the 2035 horizon year travel demand forecasting model for the study.

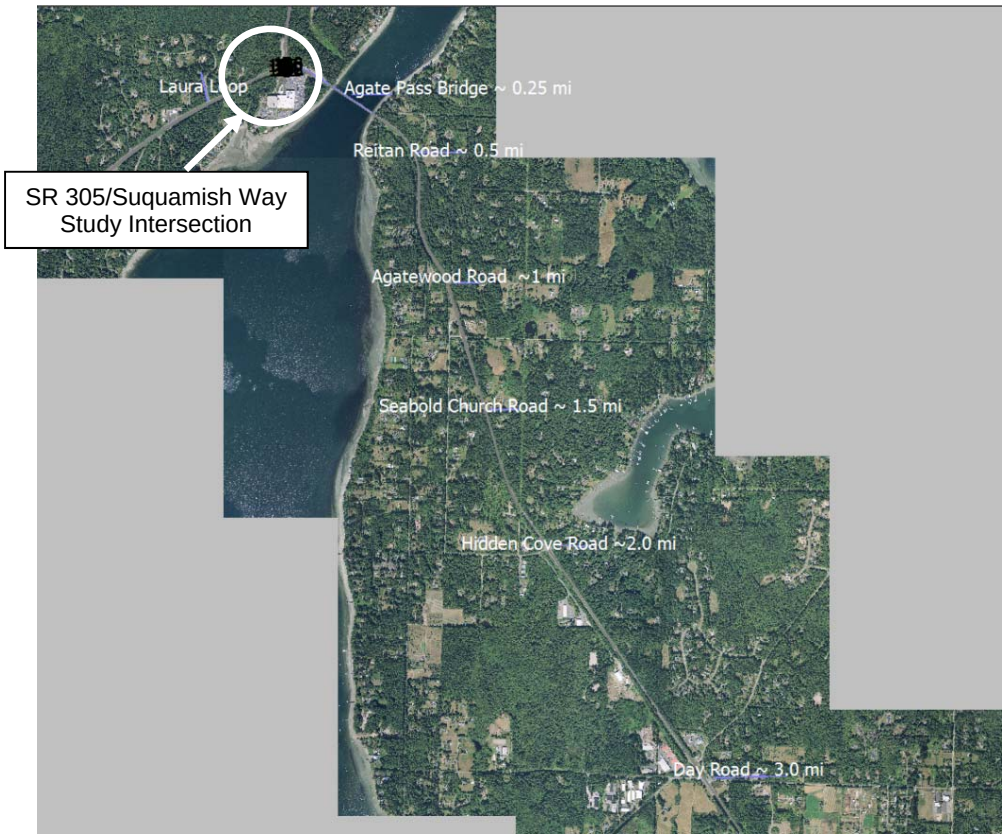

Figure 13 SR 305/Suquamish Way Simulation Study Area

The VISSIM simulation study area extends along SR 305 from Day Road (MP 4.28) on Bainbridge Island to Laura Loop NE (MP 7.48), located to the west of the Agate Pass Bridge. The key roadways in the study area include SR 305 and Suquamish Way which form the key intersection for this traffic

study. SR 305 and Suquamish Way intersect at the Suquamish Clearwater Casino. Figure 16 shows a map of the simulation study area.

Alternative Analysis Results

Highway Safety Manual Analysis

Under normal Highway Safety Manual (HSM) analysis, crash history at the immediate intersection was used. (17 crashes in 5 years) However, there has been a number of rear end type crashes in the westbound direction on the Agate Pass Bridge. Some of these crashes may be related to the less than normal roadway section of 11' lanes and 2' shoulders on the bridge. However, 28 of the 35 rear end crashes on the bridge involved at least 1 vehicle being stopped at the time of the collision. It is very possible that this type of crash is related to backups at the signalized intersection.

For the SR 305 analysis all westbound rear end crashes that involve a stopped vehicle were treated as intersection related crashes. The crash history used for the "observed crashes" for the HSM analysis is 45 crashes (17 at intersection + 28 on bridge) in 5 years (9 per year) based on HSM analysis the predicted number crashes that are expected to occur at the intersection is 4.9.

Traffic Analysis

Transportation Demand Management (TDM) efforts were considered by applying a 2% mode shift rate for volume rates of all three alternatives. By employing TDM measure by motorists, transit operation and other reductions of single occupancy vehicle rate may be realized. It was determined as a standalone measure TDM would not make significant improvements.

Corridor travel times were collected for the general purpose and bus vehicle type for the AM and PM peak periods. In general, the corridor travel times follow the same pattern as the intersection delay and queue length, with each of the alternatives offering improved travel times over the no build scenario. Appendix 2, Table 10 shows travel times for the PM peak.

Traffic alternative analysis results are provided in tables 5 through 8 in the *SR 305, Suquamish Way Traffic Analysis* Technical Memorandum (Appendix 2). The traffic analysis for the SR 305/Suquamish Way intersection shows that all of the alternatives analyzed offer some benefit over a No Build scenario. The most benefit occurred during the PM peak hour when congestion is the highest. Both the westbound right-turn lane improvements and the roundabout offer the most benefit to the No Build scenario.

Based on traffic projections the Separated (Off-set) Right-turn Lane would meet LOS E/F thresholds for five years or less (Figure 16). A two-lane roundabout was found to meet capacity needs for about 20 years, and the value in safety benefits for that 20 year period was estimated at $2.42 million. The 2035 forecast projections from Appendix 2, Table 5 and 6 is a comparison fashion below shows that the intersection solution, Alternative 3 -- the roundabout significantly outperforms the separated right-turn alternative.

Alternative	Travel Delay (Seconds)	Travel Times (Minutes)	Backup Length (Miles)	LOS
No Build	114.4	5.5	3.79	F
Separated Right-turn Lane	79.1	4.1	3.73	F
Hybrid Multi-lane Roundabout	4.3	N/A	0.06	A

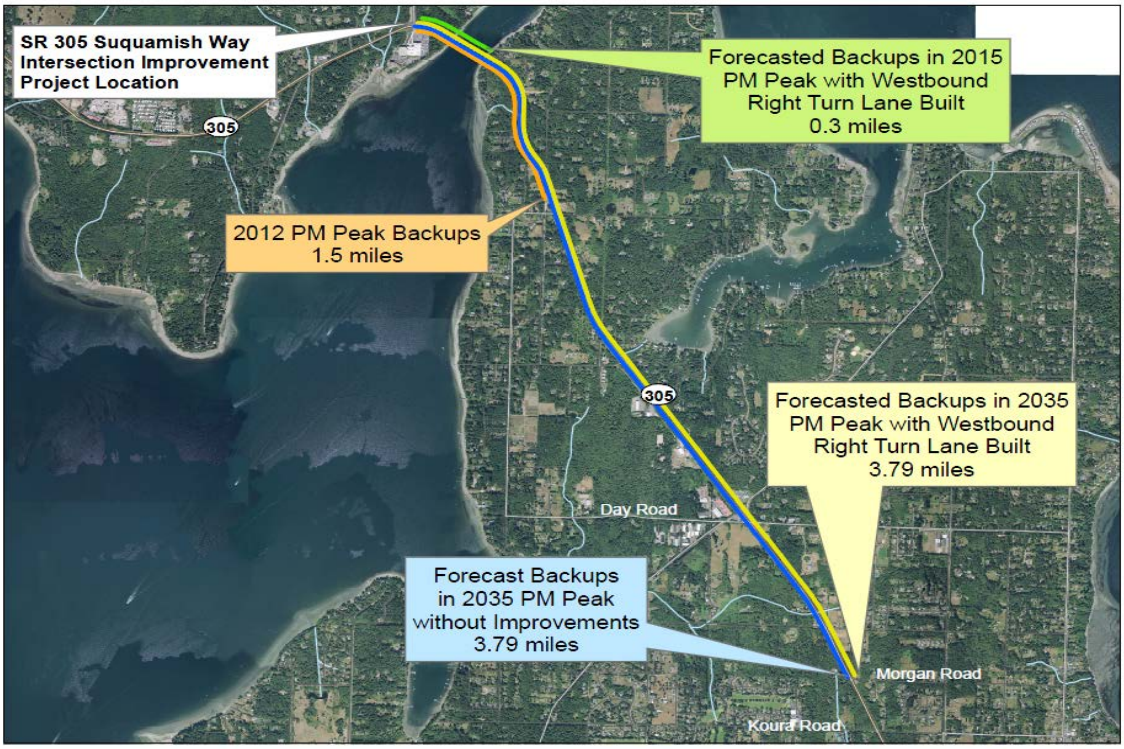

Figure 14 Projected Corridor Backups

Alternative Comparisons

Cost estimates were based on little or no design information. Therefore, many unknown factors may lead to changes in the estimate in the future. This approach was used in recording project costs. Low is 10% and high is 20% above the estimated costs.

Alternative 1 – Westbound Right-turn Lane Extension (Shared Right-turn Lane) as depicted in Figure 15. The alternative would extend the existing 100 feet right-turn lane 400 feet to within approximately 100 feet of the Agate Pass Bridge. The eastbound park and ride lot would be closed to eliminate turning movements of vehicles entering and crossing the right-turn lane into the park and ride lots.

Near term operational benefits

- Reduced PM Peak westbound queues
- May reduce the number of rear-end collisions
- Provides additional right-turn lane capacity

Alternative 1 Project Cost Summary

	Low (1000s)	High (1000s)
Preliminary Engineering	$84	$112
Right Of Way	$0	$0
Environmental Mitigation	$62	$83
Construction	$359	$479
	$505	$674

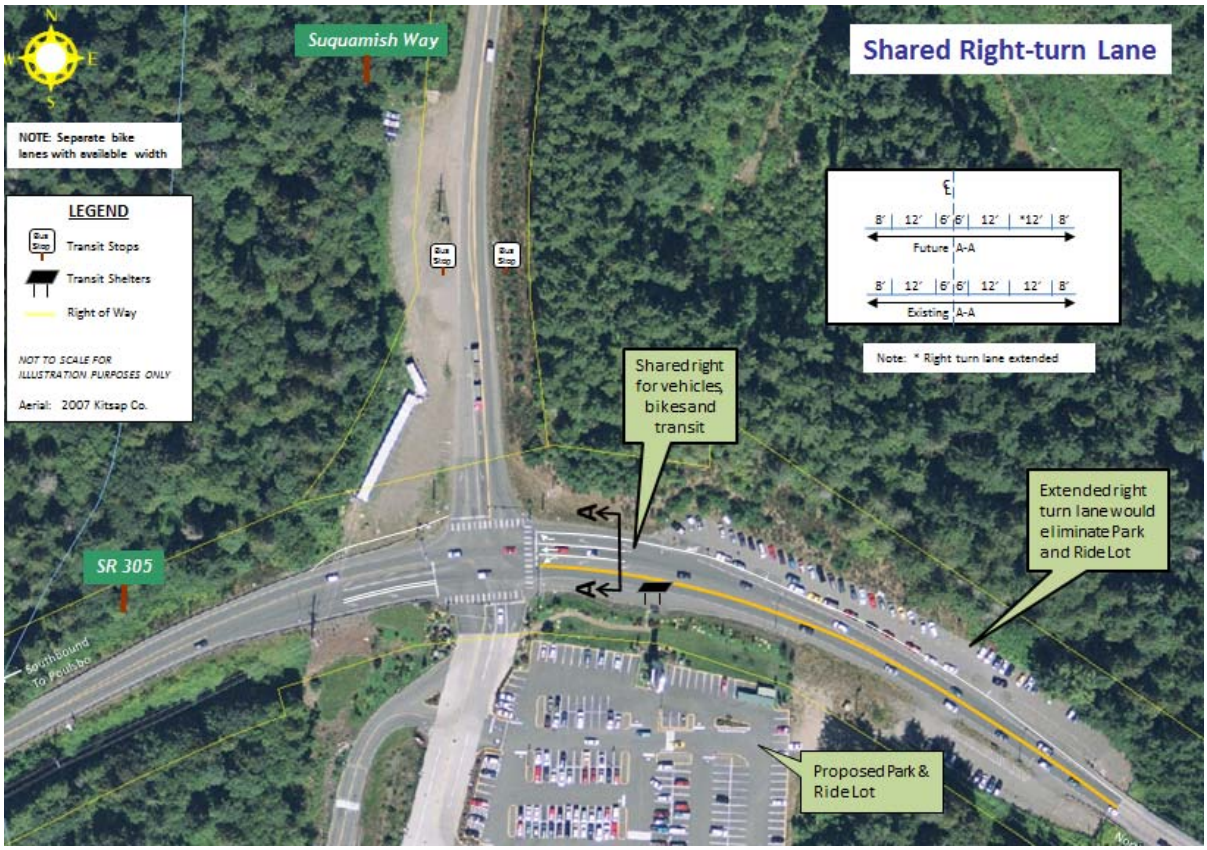

Figure 15 Alternative 1 Shared Right-turn Lane

Alternative 2 – Separated Westbound Right-turn Lane Extension shown in Figure 16 depicts a dedicated lane to accommodate bicycles and a transit nearside stop. Working in partnership Kitsap Transit has offered to partner in the project by investing resources to incorporate the placement of a shelter at the nearside bus stop. The alternative, an off-set separated right turn-lane would provide upwards of an 8' shoulder and a 100' right turn lane taper beginning at the end of the westbound guardrail terminus with an estimated 500' right turn lane. The right turn lane will have a stop condition and may provide further efficiency to the signal phases in place employed today.

The Separated Right-turn Lane Extension alternative provides nominal benefit in reducing the congestion of the queue. Based on traffic projections, both the separated right-turn lane and the off-set right-turn lane alternatives would not exceed the LOS E/F threshold capacity for five years or less. Both alternatives will likely have a five year service life and still experience stop-and-go traffic in a 1-hour PM peak operational period. The right-turn lane would substantially reduce the PM peak traffic queue length within the first five years, however by the 2035 horizon year the traffic queue would extend to the same point if no improvements were implemented (Figure 14).

Alternative analysis determined the solution provided short term practical benefit including;

- Reduced PM Peak westbound queues
- Elimination of signal time that is currently being accounted for in the westbound right-turn volumes

- Allowing for a separated lane for bicyclists to maneuver westbound up to and through the intersection
- Reducing the number of SR 305 lanes from four to three which pedestrians cross at any one time
- Allowing transit to exit the flow of traffic while serving the westbound stop
- Separating the westbound SR 305 traffic and Suquamish Way northbound traffic thus increasing traffic flows

Alternative 2 Project Cost Summary

	Low (1000s)	High (1000s)
Preliminary Engineering	$137	$182
Right Of Way	$0	$359
Environmental Mitigation	$68	$90
Construction	$318	$824
	$523	$1,455

Based on the analysis, the separated (off-set) right-turn lane was found to meet capacity needs for approximately five years, and the crash reduction estimate was at 6.1 crashes per year (down from 9.0) with the improvement including an estimated $66,000 worth of societal collision cost reduction for a 20 year net present value.

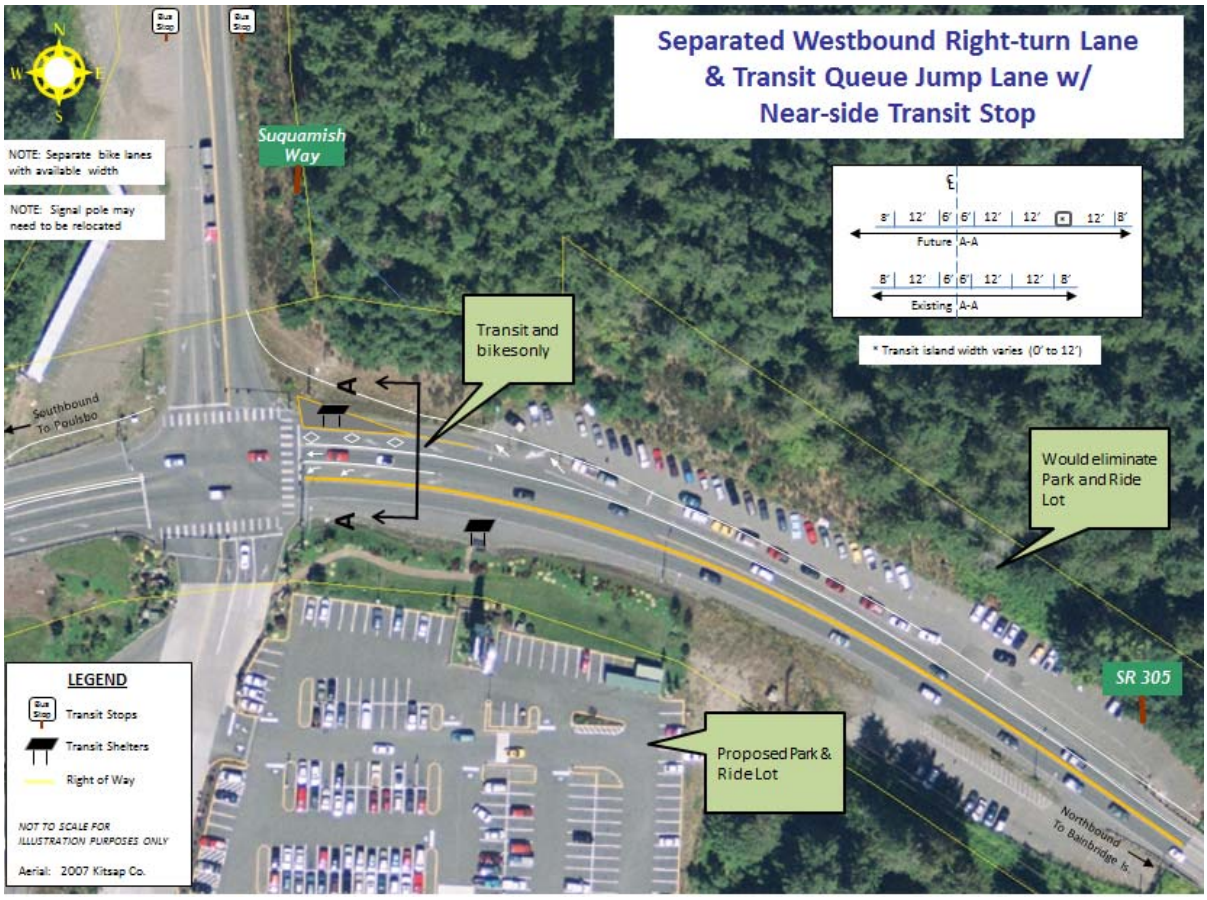

Figure 16 Alternative 2 Separated Westbound Right-turn Lane

Alternative 3 – Hybrid Non-symmetrical Multi-Lane Roundabout (Figure 17) with limited highway right-of-way, this alternative creates a hybrid non-symmetrical two-lane roundabout. Not advanced to preferred alternative status as it was determined that construction funding was not achievable and level of accommodation was unachievable with existing conditions.
Alternative analysis determined the solution provided long term pro-active benefit including;

- Significantly reducing the PM Peak westbound queues even out beyond 2035 year
- Eliminate the signal and time that is currently being accounted for in the westbound right-turn volumes
- Allowing bicyclists to maneuver westbound up to and through the intersection
- Improved pedestrian accommodations
- Reducing the number of SR 305 lanes from four to three that pedestrians cross at any one time
- Allowing transit to exit the flow of traffic while serving the westbound stop
- Separating the westbound SR 305 traffic and Suquamish Way northbound traffic
- Meeting the intent of the Legislative proviso

Alternative 3 Project Cost Summary

	Low (1000s)	High (1000s)
Preliminary Engineering	$606	$808
Right Of Way	$0	$0
Environmental Mitigation	$226	$301
Construction	$2,750	3,667
	$3,582	$4,776

Based on the 20 year capacity analysis the two-lane roundabout offered substantial capacity improvements at the intersection to accommodate the SR 305 corridor southbound AM backup. Collision reductions were estimated at 50% lower than the 2007-2011 collision history; the societal collision cost reduction was estimated to be $ 2.42 million.

Based on long-term operational performance forecasting of alternative improvements (2 and 3), to include societal cost benefits for the intersection and corridor level queue lengths, the roundabout best met the intent of the proviso over a 20 year period. Given that this project does not have obligated construction funding, neither alternative were measured with constructions costs.

Figure17 Alternative 3 Hybrid Roundabout

Recommendations

Simulation modeling of the hybrid multi-lane roundabout demonstrated the greatest long-term benefit for the intersection and corridor. In arriving at a preferred alternative, the project team took into account the stakeholders and community's significant reluctance to embrace a roundabout solution. Considering the lack of public/stakeholder support and funding issues related to the roundabout solution, the Separated Westbound (Off-Set) Right-turn Lane provided the best potential for gaining public support and construction funding for the near term. Based on traffic data and analysis, the separated right-turn lane would improve the intersection operations and reduce westbound SR 305 traffic backups for the foreseeable future. Stakeholders and the project team agreed that the roundabout solution should be revisited as traffic levels dictate. The separated right-turn lane would allow for construction of a future roundabout when traffic volumes warrant its consideration with minimal throw away work.

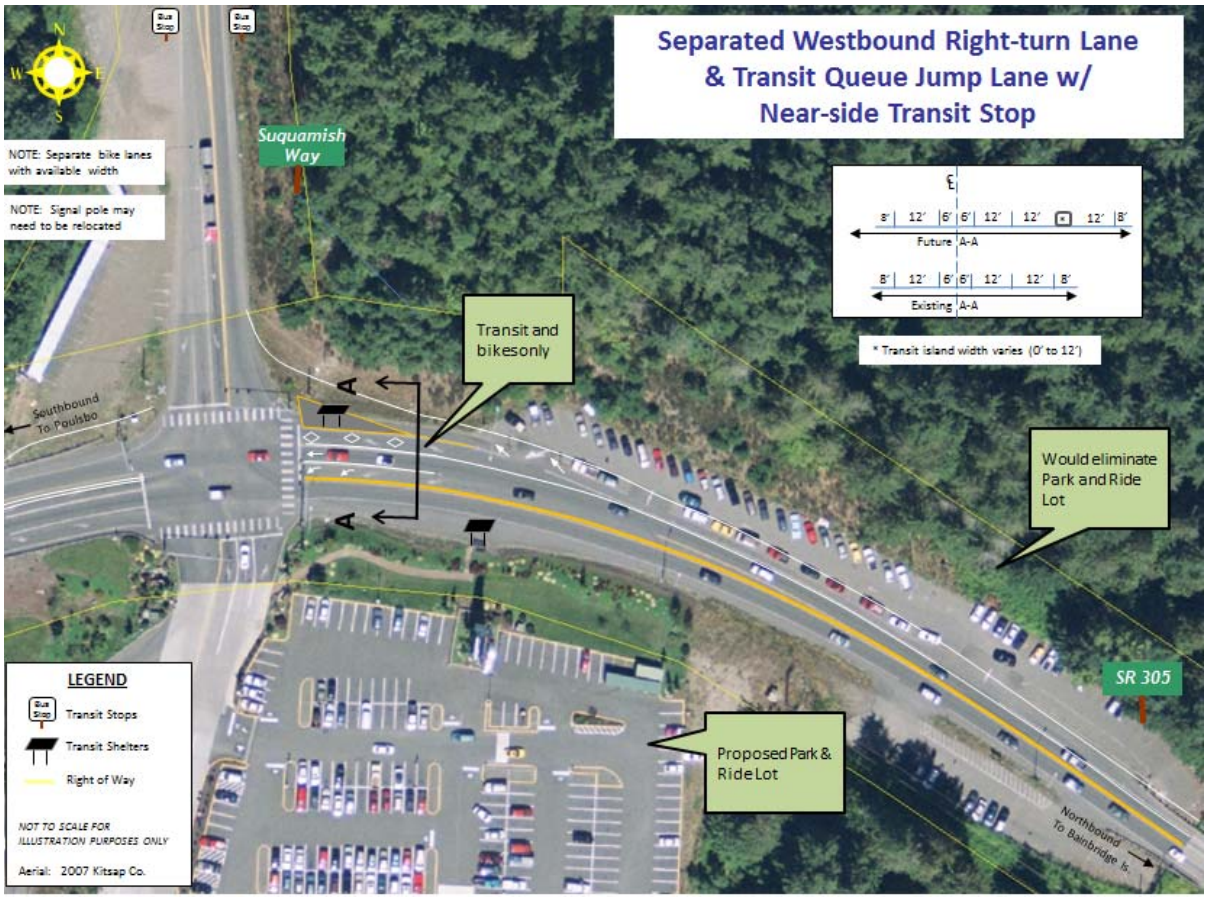

Figure 18 Preferred Alternative – Separated Westbound Right-turn Lane

Key benefits of the alternative will:

- Allow for a separated lane for bicyclists to maneuver through the intersection
- Reduce by one the number of SR 305 lanes pedestrians cross at any one time
- Allow transit to exit the flow of traffic while serving the westbound bus stop
- Better separate the westbound SR 305 traffic and Suquamish Way-northbound traffic

The planning process was completed late 2013, with the WSDOT Project office beginning the design phase with a completion scheduled for fall 2014.

Next Steps

While this report identifies a number of solutions as being most promising towards attaining congestion relief while also increasing safety at the intersection , and improving regional connectivity for the SR 305 corridor. The preferred separated Right-turn Lane alternative requires design and engineering, and an Implementation of solutions is contingent upon future funding and programming which is uncertain in the prevailing economic conditions; and no revenue for implementing improvements at this location has been identified. These solutions will need to compete statewide for future funding based on performance outcome.

Promote Public Outreach, Education, and Feedback

This report is intended to serve as a tool for public outreach and funding through partnership. Promotion of public outreach, education, and feedback is suggested as necessary first steps.

Incorporate the Study Outcome into State, Regional, and Local Plans

Another follow up step is to incorporate the study outcome into state, regional, and local plans to position the proposed improvements for future funding and implementation.

Highway System Plan
The Washington State Highway System Plan (HSP) is the state highway component of the Washington State Multimodal Transportation Plan (SMTP). The SMTP is the state's overall transportation plan that will include an analysis of facilities the state owns and those in which the state has an interest. The HSP is updated every two years and serves as the basis for the six-year highway program and the two-year biennial budget request to the State Legislature. WSDOT is dedicated to delivering an HSP that implements the Legislature's goals. This is accomplished through the coordination and integration of specific components from many statewide modal and program plans. The HSP is also aligned to the Washington Transportation Plan (WTP), which outlines the policies adopted by the Washington State Transportation Commission.

Available revenue to implement the identified improvements is very limited. Specific actions that should be taken to position the proposed improvement for future implementation include:

- Incorporate the separated right-turn lane identified in this study in the State's Highway System Plan (HSP) and the Kitsap County regional transportation plan.
- Incorporate the most preferred solutions identified in this study, as appropriate, in county comprehensive plans and transit agency plans.

Cooperative Relationship with Partners

The preferred solutions at this study location would need to compete statewide for prioritization and funding. Statewide needs are many while funds are limited. A partnership between the state and interested local and regional partners dedicated to implementing low cost improvements at this location would be a good start and is consistent with the WSDOT Moving Washington policy. Using this plan as a starting point, partners could work with funding agencies or on other initiatives intended to identify funding sources.

Agate Pass Park and Ride lot relocation. The westbound park and ride lot will be required to close to accommodate a right-turn lane solution. The closure would also eliminate collisions reported due to turning movements in and out of the lot. At present Kitsap Transit is negotiating an operating

agreement for a public park and ride lot within the Clearwater Creek Casino property. With the closure of the Agate Pass park and ride lot, WSDOT will need to take actions related to the closure and relocation of the lot. WSDOT will look to eastbound park and ride lot when accommodations available on Port Madison Enterprises (PME) property.

Collaboration with Kitsap Transit in the design phase of the project will assist in determining the best locations of the existing westbound stop that serves the #90 Poulsbo/Bainbridge, #91 Kingston/Bainbridge, and Worker/Driver Buses to PSNS routes.

Move Forward Low-Cost, Effective Solutions

Move forward most promising low-cost, effective solutions for further consideration, assessments, and implementation.
Design Phase

The design phase of the project will include completion of project scoping, necessary NEPA Environmental documentation, design package, and cost estimate. .Communications of the design phase to stakeholders would primarily rely on updates to the project website combined with email communications as necessary. Beyond the design phase, WSDOT will continue to work to identify improvements for intersections and corridor operations, such as:

- Additional measures that reduce potential collisions with widened shoulders, signage and illumination;
- With technological innovations look to incorporate ITS methods of advising motorists of traffic congestion, incidents, roadway, travel times, special events or speed limits on specific segments of the highway.
- Continue partnerships in promoting travel mode shifts to transit, carpools and vanpools and other TDM/CTR strategies.

Appendix 1

SR 305 Agate Pass Bridge Fact Sheet

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SR 305 Agate Pass Bridge
History, facts and frequently-asked questions

Agate Pass Bridge History

- Built on State Route 305 at milepost 6.82 in 1950 at a cost of $1,351,363
- Replaced a car ferry service dating from the 1920s
- 1950 construction costs were paid from state motor vehicle fund
    - Motor vehicle fund was reimbursed by a bond issue passed by the 1951 state legislature
- Operated as a toll bridge until October 1, 1951
    - Tolls repaid the construction bond in one year. The Toll Bridge Authority managed the bridge during that one year.
    - The toll was 35 cents per car plus driver and five cents per passenger.
- In 1995, the Bridge was listed on the National Register of Historic Places and the Washington Heritage Register.
    - Any modifications that result in an “adverse effect” determination to the historic characteristic of the structure would have to be justified by demonstrating no reasonable and practicable alternative exists.
- The Governor’s 2013-2015 Capital Improvement and Preservation program does not include replacement of the bridge. (Sept. 2012)

WSDOT Bridge Facts

- WSDOT owns over 3,000 bridges over 20 feet in length.
- The average age of a WSDOT-owned vehicular bridge is 40 years.
- WSDOT designs bridges with a 75-year lifespan. Many bridges continue to operate beyond 75 years due to maintenance and preservation investment measures.

Agate Pass Bridge Facts

- Steel truss with concrete T-beam approaches. WSDOT maintains 282 steel bridges.
- Agate Pass Bridge Specifications:
    - Bridge width 26 feet (curb-to-curb)
    - Vertical clearance 15 feet 1 inch minimum

    - Sidewalk width 3 feet
    - Bridge Rail Height 3 feet
- Currently one of 820 WSDOT-owned bridges classified as “functionally obsolete.”
    - 331 of the 820 are 26 feet wide or less
    - 44 of the 331 that are 26 feet wide or less are steel truss bridges
- Steel bridges require repainting on average every 15-20 years. The Agate Pass Bridge was last painted in 1991.
    - Next painting will occur within the next 10 years at a cost of $10-$12 million

Frequently-asked questions

1. *When will the bridge be replaced?*

    With good preservation and maintenance measures, the bridge will remain structurally sound for years to come. Funds are not currently identified to replace the bridge.

2. *How much would it cost to replace the bridge?*

    Actual bridge configuration and/or replacement costs have not been determined. However, the 2013 estimate to expand the current bridge to three lanes and add bike lanes and sidewalks is in the $40 to $70 million range.

3. *What is the weight limit on the bridge?*

    The bridge has an operational design rating of 60 tons. Currently no load restrictions are in place.

4. *How often is the Agate Pass Bridge inspected?*

    WSDOT’s current inspection cycle is every 24 months. The bridge was last inspected in July 2013.

5. *Why does the bridge deck move up & down when a truck goes over it?*

    All bridges deflect when carrying a load – the heavier the load, the more deflection takes place. Bridges are designed with this principle in mind.

6. *Can the bridge support a bike and pedestrian structure beneath it?* Although possible, costs for this work are high with two significant elements that would need to be addressed.

    1. ADA accommodation requirements on both ends of the bridge would cause a unique design and likely required additional Right of Way purchases.
    2. Additional strengthening the structure for increased loads and wind influences would be necessary.

7. *Can the rail height be raised or a debris screen added?*

    Although possible, costs for this work are high because the work would require retrofitting the bridge rail to current standards.

8. *Can the sidewalk be removed to accommodate a bicycle-friendly travel surface level along the travelled way?*

    The sidewalk could be removed, however the remaining space would not accommodate bicyclists and the bridge rail would need to be retrofitted to current standards.

    Since the sidewalk sections were not designed to carry vehicular loads, another added cost would be retrofitting the sidewalk area to obtain additional deck and shoulder width. The bridge approach concrete span sections would be more difficult compared to the main truss spans. Modifications would likely require additional substructure support, adding even more cost.

9. *Can cantilevered sidewalks be added to the existing bridge?*

    This idea would be extremely expensive given safety and design requirements. A similar bridge, the SR 285 George Sellar Bridge over the Columbia River in Wenatchee, added a single-side sidewalk at a cost estimated at $10-15 million. The added accommodation would require that the bridge rail be retrofitted to current standards.

10. *Can some type of barrier be placed down the center of the bridge?*

    The existing width prohibits physical barrier placement.

11. *Can bicycle activation signals be placed at both ends of the bridge?*

    This idea is an operational improvement worthy of WSDOT's consideration. Estimated cost: $91,000 (2013).

Appendix 2

SR 305-Suquamish Way VISSIM Traffic Analysis Technical Memorandum

SR 305-Suquamish Way VISSIM Traffic Analysis: Calibration and Alternatives Analysis Results

PREPARED FOR: Nazmul Alam/WSDOT
John Donahue/WSDOT
PREPARED BY: Tony Woody/CH2M HILL
DATE: March 20, 2013
March 25, 2013 - revised

Memorandum Overview

A VISSIM microscopic traffic simulation model of the SR 305/Suquamish Way intersection was developed as part of a traffic study for this area. The primary goal of this task order is to identify strategies to alleviate existing queuing and congestion at the SR 305/Suquamish Way intersection, particularly along northbound (westbound compass direction) SR 305 during the PM peak hour.

This memorandum includes an overview of the calibration results as well as a discussion of the alternatives that were analyzed as part of this study.

Analysis Methods

Network Coding and Development

The data used to build the VISSIM model was collected from a variety of WSDOT data sources. Volume inputs, vehicle compositions, and truck percentages for the VISSIM model were taken from WSDOT tube and turning movement counts conducted at selected locations along the study corridor, and from video and origin-destination survey data collected in 2012. Network geometry and speed data was based on data from field and GIS-based base maps.

Model Parameters and Techniques

VISSIM 5.40 was used to analyze the SR 305/Suquamish Way alternatives. The VISSIM models were developed for both the AM and PM peak periods. The existing models were calibrated to existing data and prevailing conditions. The future alternatives were based on the existing calibrated model. Output from the VISSIM simulation runs were aggregated using 10 simulation runs.

Both the AM and PM peak VISSIM models were developed for 3-hour time periods. The AM peak VISSIM model was developed for the 6:30-9:30 AM time period and the PM peak VISSIM model was developed for the 3:30-6:30 PM time period. The first 30 minutes of each simulation model was used as a "seeding period" and not factored into the final results.

In addition to VISSIM, both the Synchro and SIDRA analysis tools were used to complement the VISSIM traffic analysis tools. Synchro was used to optimize signal timings and test

preliminary signalized intersection alternatives and SIDRA was used as the main analysis tool for the roundabout option.

Disclaimer: Under U.S. Code, Section 409, that data cannot be used in discovery or as evidence at a trial in any action for damages against the State, Tribal, or Local Government that involves locations mentioned in this data.

Simulation Study Area

The VISSIM simulation study area extends along SR 305 from approximately Day Road on Bainbridge Island to Laura Loop NE, located to the west of the Agate Pass Bridge. The key roadways in the study area include SR 305 and Suquamish Way which form the key intersection for this traffic study. SR 305 and Suquamish Way intersect at the Suquamish Clearwater Casino. Figure 1 shows a map of the study area.

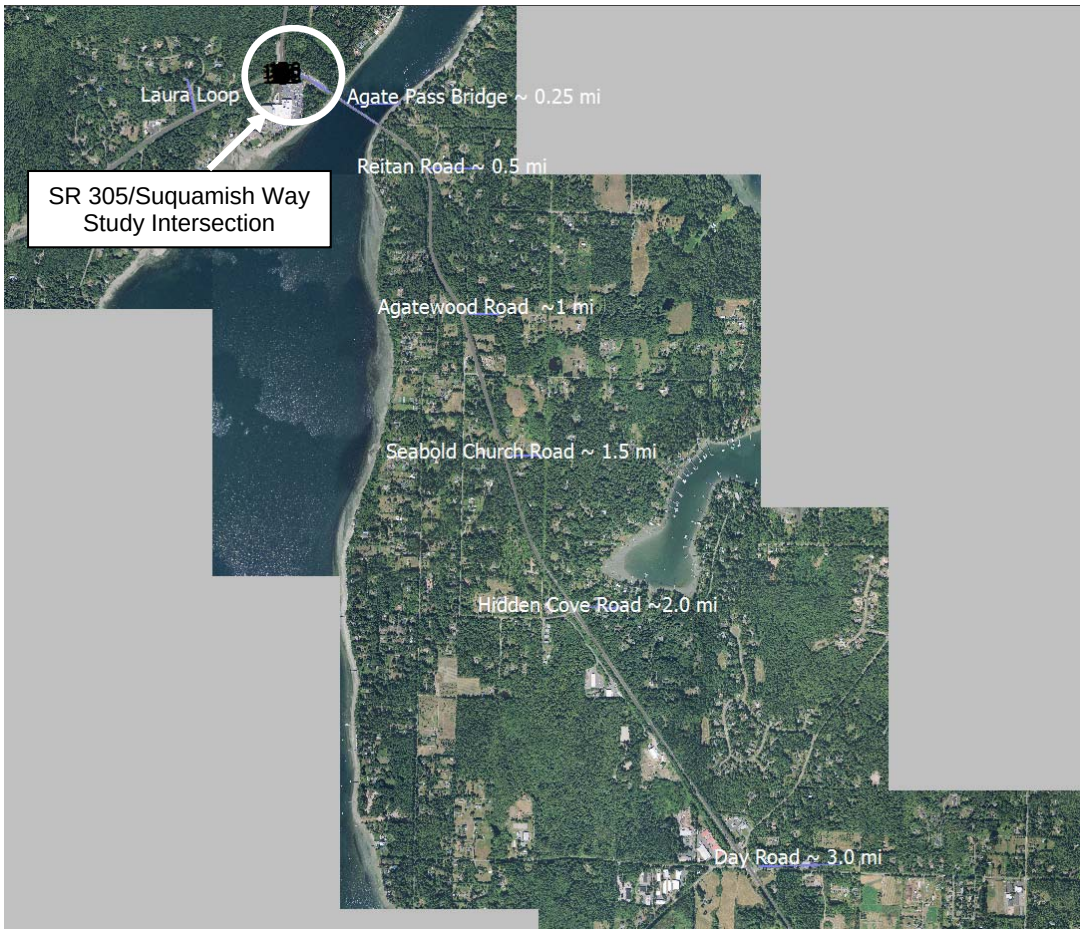


Figure 1. SR 305/Suquamish Way Simulation Study Area

Measures of Effectiveness

Four measures of effectiveness (MOE) were used to compare and contrast alternatives. The MOEs are shown below:

- Average intersection delay

- Average and 95th percentile queue lengths
- Speed profile graphics

The northbound SR 305 travel times were collected between Agatewood Road and Laura Loop NE. Southbound SR 305 travel times were collected between Laura Loop NE and Reitan Road. Speed data was collected at key locations along northbound and southbound SR 305 between Laura Loop NE and Day Road. Travel times were collected for both general purpose and transit (bus) vehicle types.

Model Calibration and Validation

Calibration Overview

The AM and PM peak traffic operations of the SR 305 corridor and SR 305/Suquamish Way VISSIM model was calibrated using predominately speed data collected from the field. In addition volume throughput data was used as a secondary calibration parameter.

Calibration Parameter Adjustments

In order to replicate the existing driver behavior for the VISSIM study area modifications were made to specific roadway links along SR 305. Table 1 shows the link types and driver behavior parameters that were utilized within the VISSIM model. Each of the separate link types enables the model to specify roadways capacity reductions and bottlenecks that contribute to an accurate calibration of the model.

Table 1. VISSIM Vehicle Driver Behavior Adjustments

Location/Link Type	Average Standstill Distance	Additive Safety	Multiplicative Safety	Lane Change Deceleration
1 – Urban (Default) SR 305, Suquamish Way	7.45	2.45	3.45	-13.0/-10.0
6 – Agate Pass Bridge NB SR 305 at Agate Pass	8.25	2.70	3.70	-13.0/-10.0

* VISSIM Driver behavior represents Wiedemann 74 parameters.
^Own/Trailing represents the VISSIM lane changing behavior for the merging and trailing vehicle.

Model Validation Results

The SR 305/Suquamish Way VISSIM model results were predominately compared to speed and volume throughput data collected from the field. The following validation targets are based on FHWA traffic microsimulation guidelines and were set for the VISSIM modeling results.

- *Speed Data:* Visual inspection of speed-temporal maps between VISSIM and field data that show similar queuing and congestion patterns.
- *Volume Data:* Volume throughput for VISSIM within 15% of field data

All output from microscopic traffic simulation tools like VISSIM require averaging the output data for multiple simulation runs to account for the randomness in the model. All calibration results from VISSIM are based on 10 simulation runs.

The sections on pages 4, 5 and 6 provide a discussion of the model validation results.

SR 305 Speed Data Validation

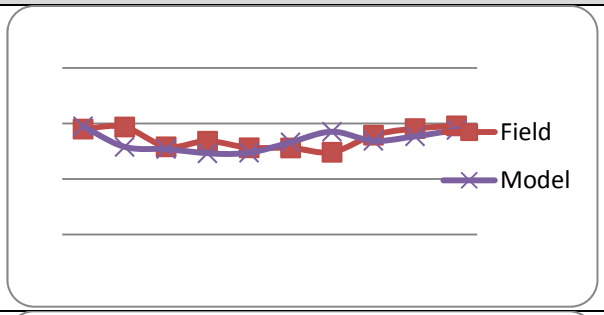
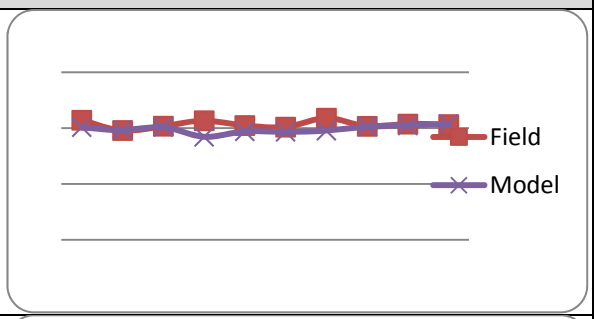
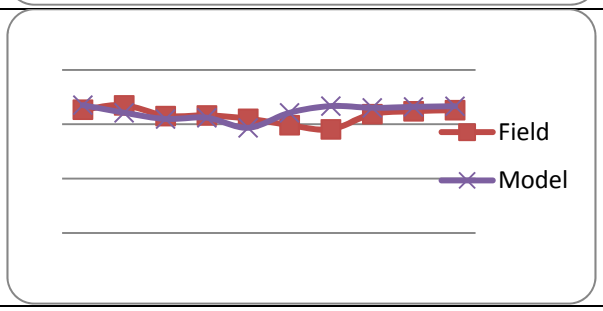
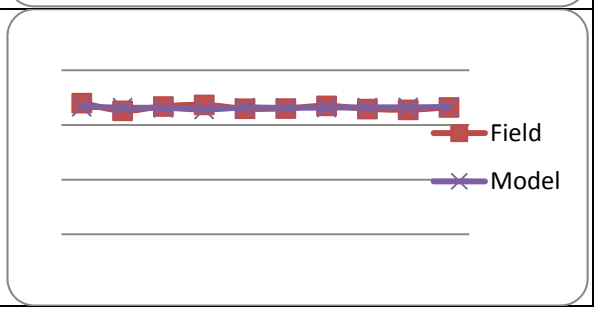
Speed data was validated using speed –temporal maps that display speed at key corridor locations over the peak period. For the northbound SR 305 direction, speeds were reported over the 2.5 hour peak period between 7:00 and 9:30 for the AM peak at 2 locations and between 4:00 and 6:30 during the PM peak at 5 locations.

The locations where speed data was collected along southbound SR 305 are listed below:

- West of Suquamish Way (~0.25 miles west of Suquamish Way)
- Laura Loop NE (~0.50 miles west of Suquamish Way)

All VISSIM speeds in the southbound SR 305 matched within the calibration range when compared to the field data. Table 2 provides the speed-temporal graphs for the southbound SR 305 direction.

Table 2. Speed-Temporal Graphs – Southbound SR 305

Location	AM Peak	PM Peak
West of Suquamish Way		
Laura Loop NE		

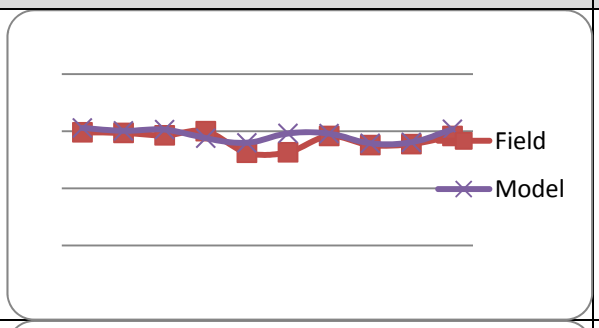
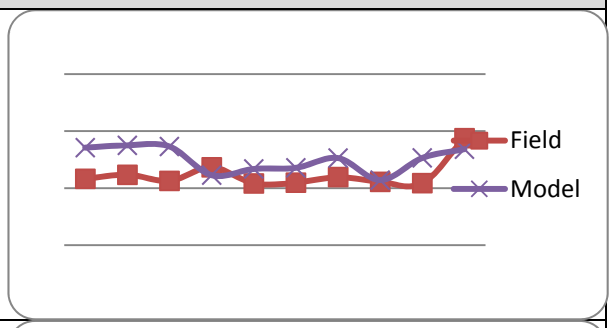
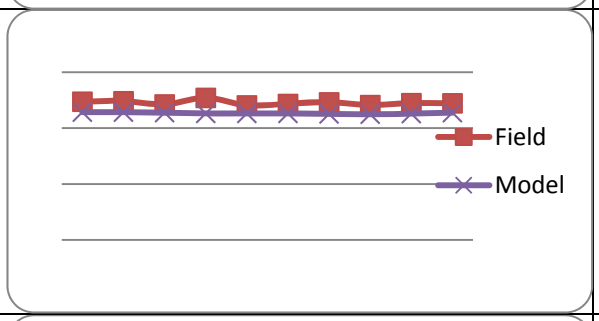
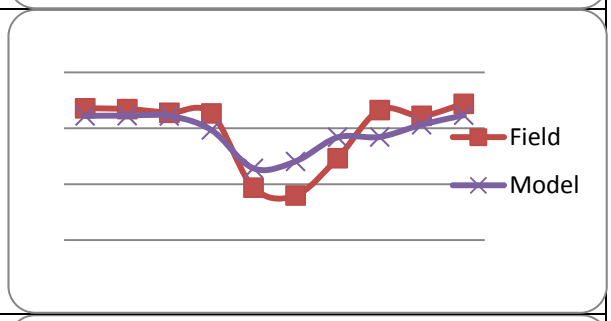
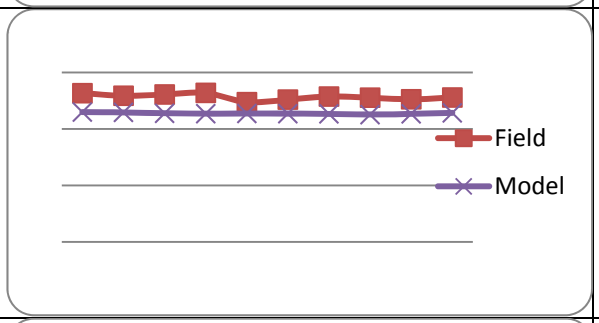
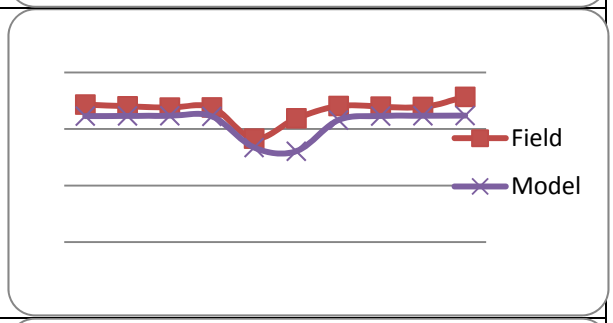
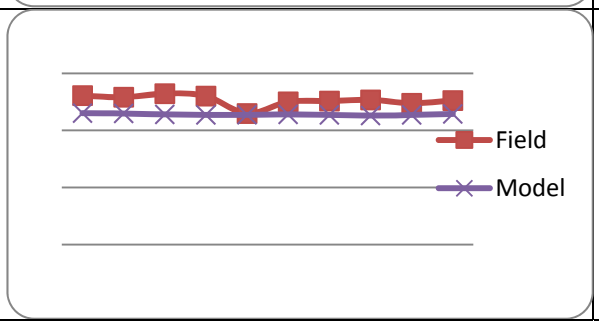
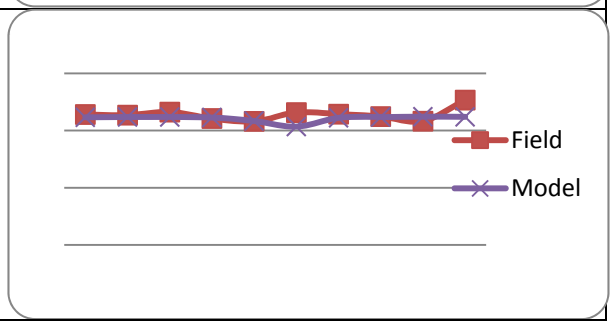
Note: All speeds reported in miles per hour

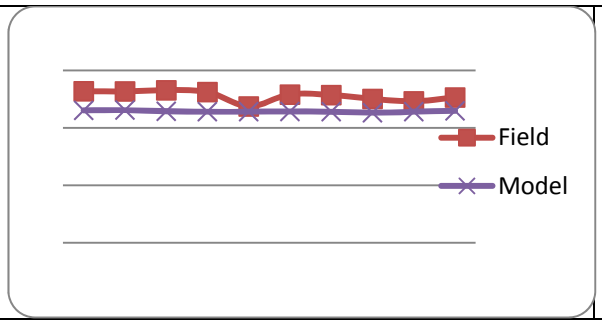
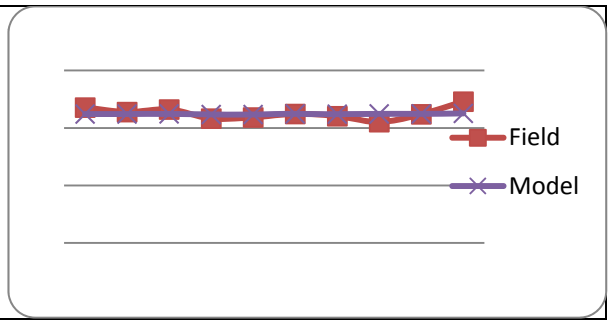
The locations where speed data was collected along nortbhound SR 305 are listed below:

- Agate Pass Bridge (~0.25 miles south of Suquamish Way)
- Reitan Road (~0.50 miles south of Suquamish Way)
- Agatewood Road (~1.0 miles south of Suquamish Way)
- Seabold Church Road (~1.5 miles south of Suquamish Way)
- Hidden Cove Road (~2.0 miles south of Suquamish Way)

All VISSIM speeds in the northbound SR 305 matched within the calibration range when compared to the field data. Table 3 provides the speed-temporal graphs for the northbound SR 305 direction.

Table 3. Speed-Temporal Graphs – Northbound SR 305

Location	AM Peak	PM Peak
Agate Pass		
Reitan Road		
Agatewood Road		
Seabold Church Road		

Hidden Cove Road		

Note: All speeds reported in miles per hour

Throughput Volume Data Validation

Northbound and southbound SR 305 throughput volume data was compared between the VISSIM and field results at the following four data collection locations:

- Southbound SR 305 at Laura Loop NE
- Southbound SR 305 at Reitan Road
- Northbound SR 305 at Reitan Road
- Northbound SR 305 at Agatewood Road

The total peak period throughput for 2.5 hours was compared between the VISSIM model data and the field data for both the AM and PM peaks. All peak period VISSIM throughput volumes were within 15% of the field volumes and meet FHWA calibration guidelines

Table 4 provides a summary of the volume throughput comparison.

Table 4: Volume Throughput Calibration Results – AM and PM Peak

Description	AM Peak Period				PM Peak Period			
	Field Volume (veh)	VISSIM Volume (veh)	Delta (veh)	% Delta	Field Volume (veh)	VISSIM Volume (veh)	(veh)	% Delta
SB SR 305 at Laura Loop NE	1841	1808	-33	-1.8%	2364	2687	323	13.6%
SB SR 305 at Reitan Road	1886	1808	-78	-4.2%	2594	2686	92	3.5%
NB SR 305 at Reitan Road	1412	1439	27	1.9%	1940	1948	8	0.0%
NB SR 305 at Agatewood Road	1420	1440	20	1.3%	1959	1948	-11	0.0%

* VISSIM results based on 10 simulation runs

Analysis Alternatives

In addition to the 2012 Existing conditions scenario, several other traffic analysis scenarios were developed within VISSIM to assess operations. Each alternative was developed for 3 forecasts years; 2015, 2020, and 2035. The sections below describe each of the main alternatives that were analyzed within VISSIM.

No Build Scenario

The *No Build* scenario is based on the calibrated VISSIM model and utilizes existing channelization and geometric conditions. Transit routes and headways implemented in the *No Build* scenario are the same as the existing conditions scenario.

Scenario 1: Westbound Improvements at SR 305/Suquamish Way

Scenario 1 – WB Improvements includes improvements to the westbound approach of SR 305/Suquamish Way. Improvements include a channelized right-turn lane, a 550 foot right-turn pocket, and an exclusive bus lane and queue jump lane with transit signal priority through the intersection.

Figure 2 shows a conceptual layout of Scenario 1.

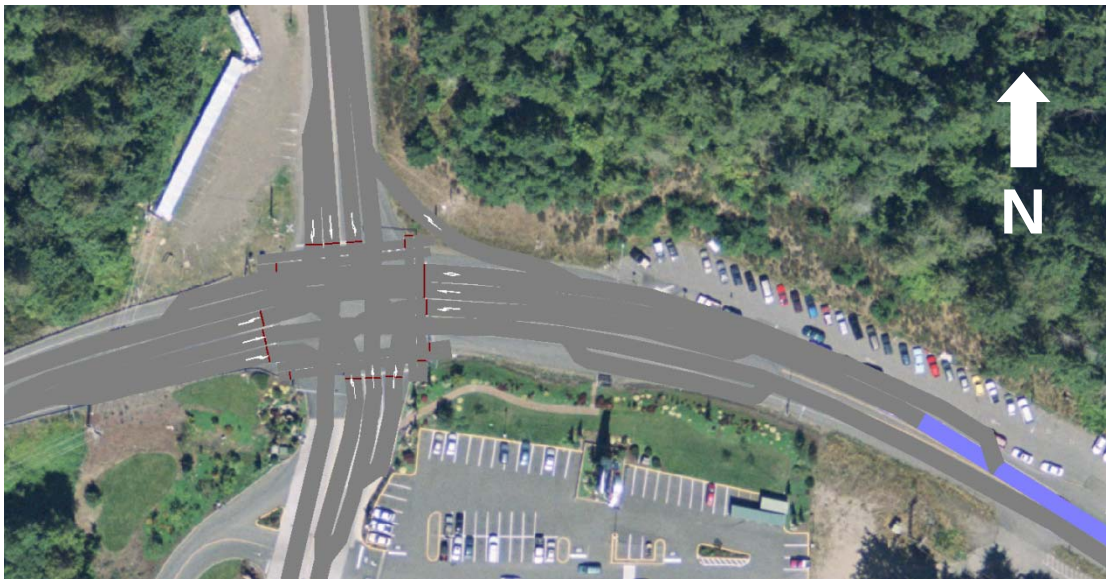


Figure 2. Scenario 1: WB Improvements - Geometry and Channelization

Scenario 2: SR 305/Suquamish Way Roundabout

Scenario 2 – Roundabout removes the signal at SR 305/Suquamish Way and replaces it with a roundabout. The proposed roundabout includes two lane entry approaches on the eastbound, westbound, and southbound approaches and two lane exit approaches on the eastbound and westbound approaches.

Figure 3 shows a conceptual layout of the geometry and channelization of the proposed roundabout.

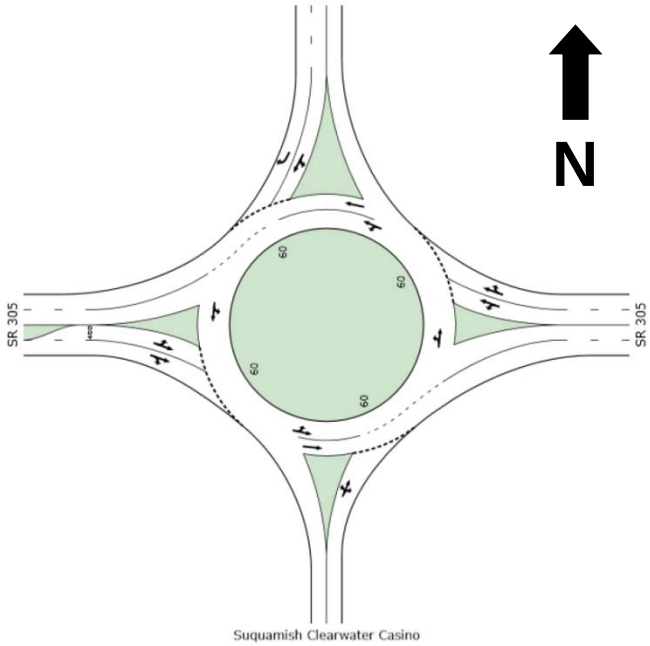


Figure 3. Scenario 2: Roundabout - Geometry and Channelization

Scenario 3: No Build with Travel Demand Management (TDM)

Scenario 3 is the same as the *No Build* scenario, but includes a 2% reduction in vehicular demand. It was assumed that methods for reducing demand include increased transit ridership, increased usage of park and rides, and increased telecommuting.

Traffic Analysis Results

For the *Existing Conditions*, *No Build*, *Scenario 1 – WB Improvements* and *Scenario 3 – TDM* alternatives, the VISSIM traffic simulation software package was used to assess traffic operations. For the *Scenario 2 – Roundabout* alternative, the SIDRA software package was used to analyze traffic operations.

Because WSDOT prefers the SIDRA analysis over VISSIM when analyzing roundabouts, all results presented in this section for *Scenario 2 – Roundabout* will be reported from the SIDRA software package.

The traffic analysis results for average intersection delay, queue lengths, and speed-temporal speed profiles are presented in the sections below.

Average Intersection Delay & Queue Length

Average intersection delay and 95th percentile queue lengths were collected from VISSIM for each approach of the intersection of SR 305/Suquamish Way. The results of the analysis for the AM peak hour are presented in tables 5 and 6 and for the PM peak hour in tables 7 and 8.

Based on the results of the analysis, each of the alternatives offers some benefit over the *No Build* scenario in both the AM and PM peak hour. During the PM peak when congestion is highest, both Scenarios 1 and 2 offer the most improvement over the *No Build* scenario.

Table 5: Average Intersection Delay and Level-of-Service – AM Peak

Approach	MOE	2012	2015				2020				2035			
		Existing	No Build	Scen 1 WB Mods	Scen 2 Rndbt^	Scen 3 TDM	No Build	Scen 1 WB Mods	Scen 2 Rndbt^	Scen 3 TDM	No Build	Scen 1 WB Mods	Scen 2 Rndbt^	Scen 3 TDM
Overall	**Delay (s)**	**51.4**	**58.4**	**58.8**	**8.8**	**52.4**	**107.1**	**106.3**	**9.4**	**85.6**	**276.9**	**274.5**	**15.6**	**267.2**
	LOS	**D**	**E**	**E**	**A**	**D**	**F**	**F**	**A**	**F**	**F**	**F**	**B**	**F**
Westbound – SR 305	Delay (s)	52.4	56.7	56.9	4.1	53.5	60.8	59.0	4.1	60.0	114.4	79.1	4.3	99.5
	LOS	D	E	E	A	D	E	E	A	E	F	E	A	F
Northbound – Suquamish Way	Delay (s)	59.3	60.7	61.0	13.5	59.8	58.2	58.5	13.9	59.4	62.9	59.7	16.1	60.3
	LOS	E	E	E	B	E	E	E	B	E	E	E	B	E
Eastbound - SR 305	Delay (s)	56.9	68.2	68.9	8.9	57.0	175.8	170.5	10.0	126.8	401.6	406.7	21.6	402.6
	LOS	E	E	E	A	E	F	F	B	F	F	F	C	F
Southbound - Suquamish Way	Delay (s)	39.3	41.6	41.5	16.3	41.0	46.0	44.9	17.4	44.9	307.9	292.6	24.9	285.8
	LOS	D	D	D	B	D	D	D	B	D	F	F	C	F

^ All Scenario 2 - Roundabout results are based on SIDRA

Table 6: 95th Percentile Queue Length in Feet – AM Peak

Approach	2012	2015				2020				2035			
	Existing	No Build	Scen 1 WB Mods	Scen 2 Rndbt^	Scen 3 TDM	No Build	Scen 1 WB Mods	Scen 2 Rndbt^	Scen 3 TDM	No Build	Scen 1 WB Mods	Scen 2 Rndbt^	Scen 3 TDM
WB – SR 305	671	776	581	40	714	1002	714	45	856	2576	1686	60	2215
NB – Suquamish Way	49	49	49	60	49	49	49	75	50	65	52	150	61
EB - SR 305	1043	1403	1430	100	1096	3760	3645	125	2749	5942	5941	385	5941
SB - Suquamish Way	367	408	399	15	385	513	500	15	488	2876	2876	40	2873

^ All Scenario 2 - Roundabout results are based on SIDRA

Table 7: Average Intersection Delay and Level-of-Service – PM Peak

Approach	MOE	2012	2015				2020				2035			
		Existing	No Build	Scen 1 WB Mods	Scen 2 Rndbt^	Scen 3 TDM	No Build	Scen 1 WB Mods	Scen 2 Rndbt^	Scen 3 TDM	No Build	Scen 1 WB Mods	Scen 2 Rndbt^	Scen 3 TDM
Overall	**Delay (s)**	**100.6**	**140.6**	**43.1**	**8.3**	**115.5**	**237.9**	**59.8**	**8.7**	**208.7**	**522.9**	**318.8**	**12.0**	**511.6**
	LOS	**F**	**F**	**D**	**A**	**F**	**F**	**E**	**A**	**F**	**F**	**F**	**B**	**F**
Westbound – SR 305	Delay (s)	181.1	269.6	64.3	5.8	212.5	494.7	102.7	6.3	424.8	1252	801.3	10.7	1209.8
	LOS	F	F	E	A	F	F	F	A	F	F	F	B	F
Northbound – Suquamish Way	Delay (s)	50.8	50.5	51.7	14.1	50.6	55.2	55.1	14.6	52.1	57.1	60.8	20.0	56.4
	LOS	D	D	D	B	D	E	E	B	E	E	E	B	E
Eastbound - SR 305	Delay (s)	21.3	21.5	20.2	8.0	21.2	22.6	21.8	8.2	22.0	30.9	29.9	9.0	28.6
	LOS	C	C	C	A	C	C	C	A	C	C	C	A	C
Southbound - Suquamish Way	Delay (s)	44.0	42.6	44.0	15.6	43.2	47.2	47.5	16.1	44.9	137.4	145.6	19.1	143.6
	LOS	D	D	D	B	D	D	D	B	D	F	F	B	F

^ All Scenario 2 - Roundabout results are based on SIDRA

Table 8: 95th Percentile Queue Length in Feet – PM Peak

Approach	2012	2015				2020				2035			
	Existing	No Build	Scen 1 WB Mods	Scen 2 Rndbt^	Scen 3 TDM	No Build	Scen 1 WB Mods	Scen 2 Rndbt^	Scen 3 TDM	No Build	Scen 1 WB Mods	Scen 2 Rndbt^	Scen 3 TDM
WB – SR 305	6054	8587	1562	115	6831	16632	4199	135	14320	20029	20016	300	20026
NB – Suquamish Way	168	168	170	40	170	209	210	50	191	289	295	115	277
EB - SR 305	358	347	347	75	338	393	371	80	409	771	773	115	664
SB - Suquamish Way	174	186	188	35	178	216	214	40	207	993	974	75	994

^ All Scenario 2 - Roundabout results are based on SIDRA

Speed-Temporal Graphics

Speed-Temporal diagrams were developed for each of the alternatives based on the VISSIM models. No speed-temporal graphics were created for Scenario 2 because SIDRA is not able to produce speed temporal data.

The diagrams are included in **Tables A.1-A.6** in **Appendix B**.

Evaluation of Other Concepts

One other concept was considered for this location but was dismissed during the screening process. The concept dismissed considered removing the eastbound left movement (EBL) at the intersection of SR 305/Suquamish Way. By removing the EBL movement, the signal phasing would be simplified and would allow additional green time to be reallocated to the heavily congested PM peak westbound movement. The alternative was ultimately dismissed due to the potential for significant rerouting of vehicles that would otherwise use the EBL at SR 305/Suquamish Way and would now have to use the intersection of SR 305/Totten Road, which is approximately 1.5 miles to the west of Suquamish Way.

Summary and Conclusions

The traffic analysis for the SR 305/Suquamish Way intersection shows that all of the alternatives analyzed offer some benefit over the *No Build* scenario. The most benefit occurs during the PM peak hour when congestion is the highest. *Both Scenario 1 – WB Improvements* and *Scenario 2 –Roundabout* offer the most benefit over the *No Build* scenario. *Scenario 3 – TDM* offers only a marginal improvement over the *No Build* scenario.

Based on the analysis results, the roundabout option appears to offer substantial improvements over all the other alternatives. Since the roundabout option was analyzed using SIDRA and all other scenarios were analyzed in VISSIM, additional considerations, including safety, environmental impacts, right-of-way impacts, and costs, should be taken into account when comparing results between the roundabout options and other options.