I-5, Mounts Road to Thorne Lane – Corridor Improvements

Exit 119 Interchange Alternatives Analysis – Feasibility Report

September 2017

Washington State Department of Transportation

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Federal Highway Administration

I-5, Mounts Road to Thorne Lane – Corridor Improvements

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1 INTRODUCTION AND BACKGROUND

1.1 What is the Purpose and Context of this Report?

The Washington State Department of Transportation (WSDOT) is implementing improvements along Interstate 5 (I-5) in the vicinity of Joint Base Lewis-McChord (JBLM) in southern Pierce County to reduce traffic congestion and improve person and freight mobility. The improvements, collectively known as the I-5, Mounts Road to Thorne Lane – Corridor Improvement Project, are being constructed in stages including:

- **Steilacoom-DuPont Road to Thorne Lane** – includes improvements to the I-5 mainline that lie between the Thorne Lane interchange (Exit 123) to the north and the Steilacoom- DuPont Road interchange (Exit 119) to the south. An Environmental Assessment (EA) has been completed and a Finding of No Significant Impact (FONSI) has been approved for the recommended improvements in this area. These improvements are currently in design.
- **Mounts Road to Steilacoom-DuPont Road** – includes potential improvements to the I-5/Steilacoom-DuPont Road interchange (Exit 119) and surrounding area.

Figure 1-1 is a map of the Project Corridor showing the north and south end project areas and surrounding vicinity.

The purpose of this report is to identify and evaluate a range of improvement options at Exit 119. This evaluation will

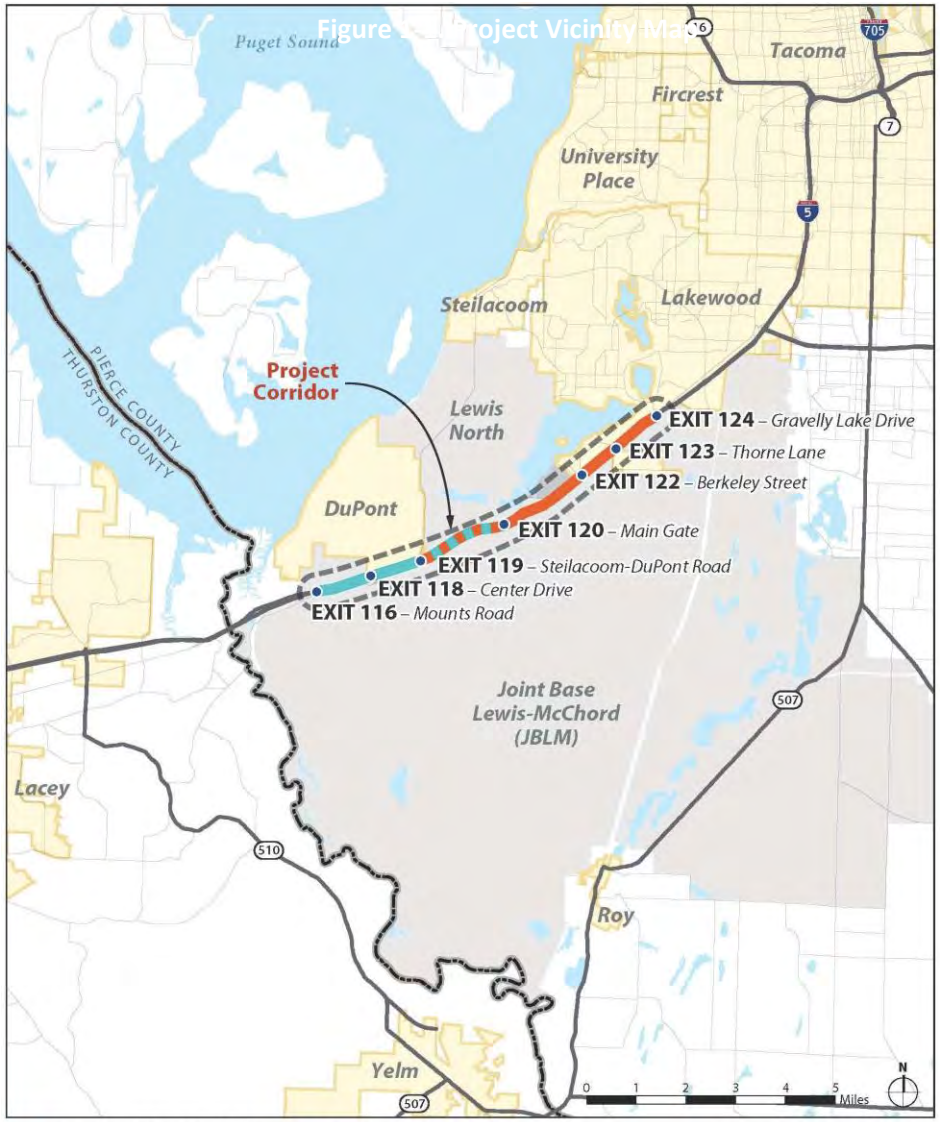


Figure 1-1
Project Vicinity Map

Exit 119 Interchange Alternatives Analysis Feasibility Study

determine the implementation feasibility and qualitative performance of each option leading to identification of a recommended course of action. This Feasibility Study builds on prior analyses conducted for the full I-5 JBLM project area and will be further refined through preparation of an Interchange Justification Report (IJR) and Environmental Assessment (EA) for the recommended option.

1.2 What is the Background of the Study and What Recent Actions have Occurred?

1.2.1 Study Background

The history of recent transportation planning along the I-5 corridor goes back more than a decade. Key studies providing both context for the current planning effort and guidance in the exploration of reasonable improvement options are presented in Table 1-1. The table begins with a list of study area reports produced for the *I-5 JBLM Vicinity Congestion Relief Study* (Congestion Relief Study) that led to development of the Build Alternative in the North End Project Area, and provides the basis for moving forward with an approach for the South End Study Area. Relevant studies identified a broad strategy for the I-5 mainline including both highway improvements and multimodal alternatives. Additionally, as a part of the Congestion Relief Study, an environmental scan was conducted using data collected from the resources agencies, other sources and field reconnaissance. As decisions were made during the planning process, potential environmental impacts or issues have been identified and considered in the screening and evaluation of options. The table concludes with a list of other studies conducted in the Project area that have relevance to the development and evaluation of improvement options at the I-5/ Steilacoom Road- DuPont interchange.

Table 1-1. History of Transportation Planning in the I-5 JBLM Corridor

Previous Studies & Documents	Relationship to the Project Area
***I-5 JBLM Vicinity Congestion Relief Project, Revised Environmental Assessment/FONSI* – FHWA/WSDOT (May 2017)**	This document provides a tiered environmental review of improvements to I-5 between Gravelly Lake Drive (Exit 124) and Mounts Road (Exit 116). This means a corridor level analysis is provided for the portion of the project in which a specific construction footprint has not yet been determined (the South Study Area) and project specific impacts are evaluated for the portion of the project in which a construction footprint is known (the North Study Area). When reading the document, it is important to keep in mind that project specific analysis is only presented for the North Study Area Build Alternative.
***I-5 JBLM Vicinity Congestion Relief Study – Multimodal Alternatives Analysis and Updated Environmental Scan* – WSDOT (March 2015)**	The primary purpose of this report was to document the multimodal alternatives analysis process including key findings, conclusions and recommendations. Analysis focused on packaging the most promising highway, multimodal, and local connectivity options into comprehensive alternatives; screening these alternatives against evaluation criteria; and determining what options should be carried forward into the NEPA and IJR phase of the study. The report included expanded analysis of environmental resources and potential environmental impacts of the alternatives.

Table 1-1 Continued. History of Transportation Planning in the I-5 JBLM Corridor

Previous Studies & Documents	Relationship to the Project Area
***I-5 JBLM Vicinity IJR & Environmental Documentation, Corridor Plan Feasibility Study* – WSDOT (January 2014)**	This report documented a vision and improvement strategy or "framework plan" for the I-5 corridor to meet 2040 travel demand. This framework plan was essential to provide context for a long-range I-5 strategy to help guide the decision-making process for interchange improvements. Accurately identifying the number and type of lanes needed on I-5 is a necessary precursor to designing interchange ramps and bridges.
***Existing Conditions Report (I-5 JBLM Vicinity Congestion Relief Study Reports)* – WSDOT (December 2013)**	This report documented the multimodal transportation planning context for the corridor as well as existing facilities, services and operational performance.
Other Relevant Studies	**Relationship to the Project Area**
***Point Defiance Bypass Project, Environmental Assessment & Finding of No Significant Impact* – WSDOT Rail Division (2013)**	This project involves relocation of Amtrak rail services to the rail line immediately west of I-5 in the study area. Scheduled for 2017, service would impact traffic at each I-5 interchange.
***I-5 Transportation Alternatives Report* – City of Lakewood (2010)**	This study of the project area was initiated by City of Lakewood to address chronic congestion on I-5 in the vicinity of the City. The report ultimately led to funding by the Washington State Legislature for the *I-5 JBLM Vicinity Congestion Relief Study*.
***Joint Base Lewis-McChord (JBLM) Joint Coordination Plan* – City of Lakewood (2010)**	This study evaluated a wide array of community and infrastructure impacts associated with JBLM growth including transportation.
***I-5/Fort Lewis Congestion Study* – WSDOT Planning Office (2005)**	This Legislative study focused on I-5 congestion in the vicinity of Fort Lewis. The study identified several short-term improvements, but concluded that it would be necessary to widen the Interstate highway to adequately address existing and future congestion.

1.2.2 Project Purpose

Potential improvements at the I-5/Exit 119 interchange are intended to address relieving congestion on I-5 during peak traffic periods, while maintaining access to JBLM and the neighboring communities. The evaluation of options in this feasibility study focuses on the Steilacoom-DuPont Road interchange and is intended to facilitate the increase in I-5 capacity.

At the Steilacoom-DuPont Road interchange (Exit 119), the existing bridge over I-5 was built in 1957. The openings under this bridge for the north and southbound lanes of I-5 are just over 50 feet wide and are limiting factors for adding lanes to the freeway. The overpass also does not meet current vertical clearance standards from I-5. In addition, traffic flow is constrained by the close proximity of the ramp intersections with

public surface streets, JBLM's DuPont Access Control Point (ACP), the Sound Transit railroad, and the intersection of Wilmington Drive and Barksdale Avenue. Reconfiguration of this interchange would allow for improved traffic movement.

Previous studies (see Table 1-1) recommended re-construction of the Steilacoom-DuPont Road interchange approximately 1,000 feet north of its existing location. This option was recommended because it would allow for grade-separation of the interchange roadway with the Sound Transit railroad. Associated with the recommended interchange was construction of a reconfigured JBLM DuPont ACP (gate) that was conceptually designed jointly by WSDOT and the Army Corps of Engineers. The reconfiguration of the ACP was necessary because the new interchange design was not compatible with the existing ACP location. In October of 2015, JBLM informed WSDOT that the proposed reconfiguration of the ACP was undesirable due to concerns regarding JBLM base security, historic resource impacts and land use concerns. JBLM expressed an interest in relocating the ACP to connect at the Center Drive interchange. The scope of this request has necessitated further evaluation of options and impacts in collaboration with project stakeholders. Consultation conducted during late 2016 and early 2017 resulted in focusing interchange modifications on the I-5 interchange at Steilacoom-DuPont Road.

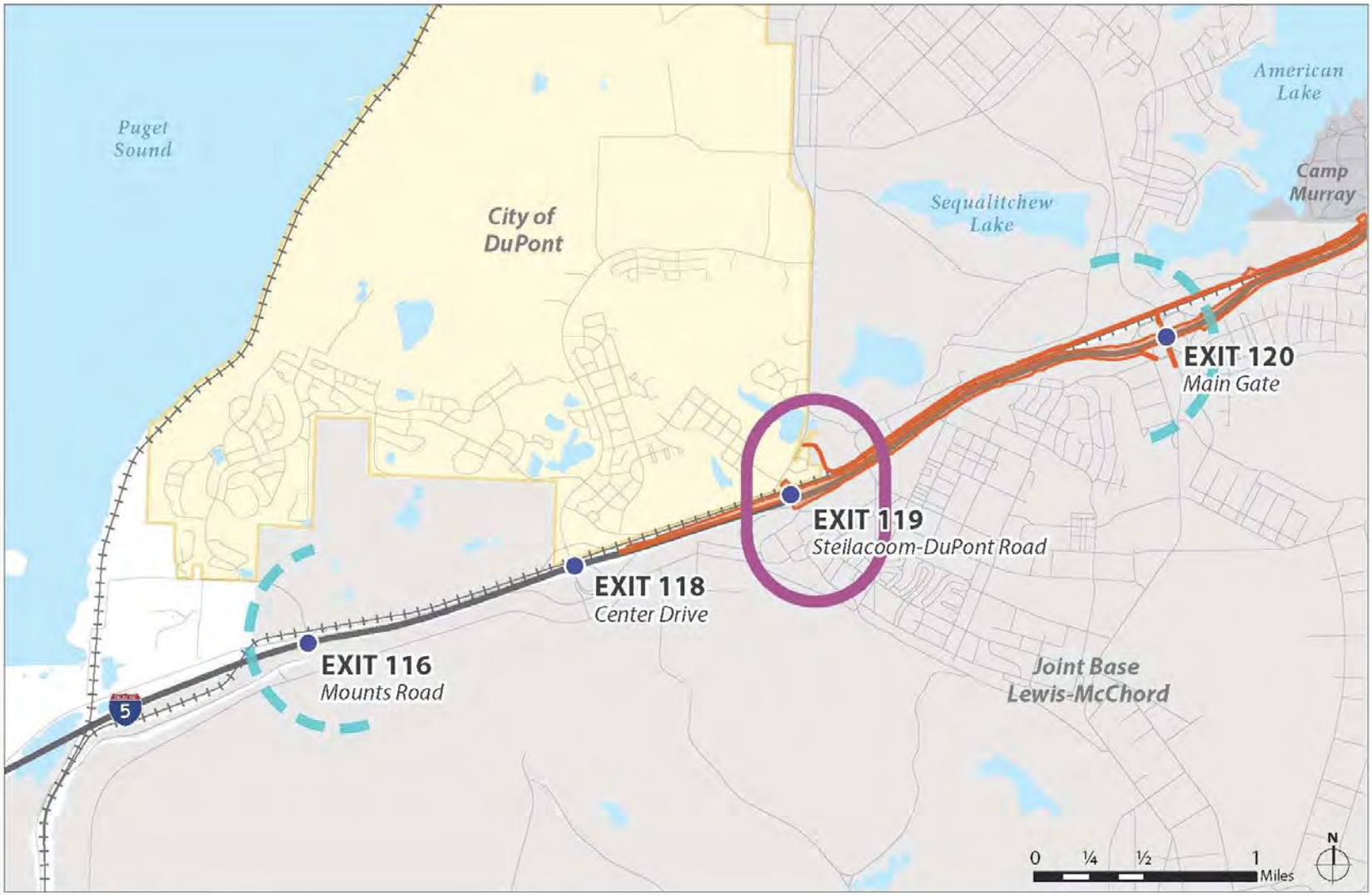
1.3 What is the Study Area?

As shown in Figure 1-2, the focus of this feasibility study is on the Steilacoom-DuPont Road interchange (Exit 119). To provide context for analysis of improvement options at this interchange a larger study area has been identified as required for upcoming technical reports including an Interchange Justification Report and appropriate environmental documentation. This larger study area generally includes the I-5 corridor between the Mounts Road interchange (Exit 116) on the south and the Main Gate interchange (Exit 120) on the north, a distance of over four miles.

1.4 How is this Report and its Content Organized?

This report is organized into seven chapters, the first of which is this Introduction.

Chapter 2 presents existing highway, traffic and environmental conditions within the study area. The information included in this chapter focuses on changes in the physical characteristics of the I-5 corridor since the original Congestion Relief Study was prepared in 2013 and 2014. 2017 AM and PM peak hour traffic volumes at two interchanges and other key intersections are shown and compared to the 2013 volumes used in the earlier transportation analysis. Baseline conditions for the built and natural environment that are potentially affected by the various interchange improvement options are also described. Information presented includes: wetlands, wildlife, noise, visual quality, cultural/historic resources, Section 4(f) resources and land use.



Existing I-5 Mainline
Existing Interchange
Mounts Road – Steilacoom-DuPont Road Project Area
Feasibility Study Area
Steilacoom-DuPont Road – Thorne Lane Project Area

Figure 1-2
South End Project Area

Exit 119 Interchange Alternatives Analysis Feasibility Study

Chapter 3 includes a description of the six interchange improvement options that were identified and studied in addition to the No Build Alternative. Each option is also graphically illustrated.

Chapter 4 documents a screening assessment of potential traffic impacts associated with each interchange option. This assessment is largely based on earlier analysis documented in prior reports which has been adapted to reflect potential traffic issues associated with each improvement option. The methods used to conduct this qualitative evaluation are presented, as well as key results that reflect potential impacts and/or benefits related to freight activity, traffic operational and queuing issues, non-motorized facilities and circulation, and driver expectations with respect to the design of each option.

Chapter 5 discusses development of an evaluation process to rank each design option by criteria that were judged critical in differentiating between the options and in identifying a preferred course of action. Specific evaluation criteria are identified, and the scoring and weighting process for the options is presented.

Chapter 6 summarizes the results of the evaluation process for each improvement option including the No Build condition. All options have been given a quantitative score and are compared with each other to identify the options that would be most effective in meeting both the purpose and goals of the I-5, Mounts Road to Thorne Lane – Corridor Improvement Project and could be most efficiently implemented.

Chapter 7 identifies the recommended improvement option and outlines next steps in the further evaluation and implementation of that option.

2 EXISTING CONDITIONS

The purpose of this chapter is to document and/or update the discussion of existing transportation and environmental conditions in the in the vicinity of Exit 119 since initiation of the *I-5 JBLM Vicinity Congestion Relief Study* in 2013. Included is a summary of recent or pending transportation improvements in or near the Exit 119 Study Area, updated traffic turning movement data, and existing environmental baseline conditions.

2.1 What Changes have occurred in the Corridor since the Original Study?

Since 2013, there have been a number of changes to the baseline transportation system identified and discussed during the early stages of the Congestion Relief Study. These changes have included both recent and/or pending highway and local roadway improvements that directly affect I-5, and have altered traffic patterns and volumes over the four-year period. This section discusses these changes and is intended to serve as an update to the documentation of existing transportation conditions as described in the earlier project reports.

Additionally, in July of 2015, the Washington State Legislature included $495 million in the Connecting Washington revenue package to fund I-5 corridor improvements between the Mounts Road and Thorne Lane interchanges. The project is funded through a 10-year period from 2015 to 2025.

2.1.1 Recent and/or Pending Improvements to I-5 in the Study Area and Vicinity

Recent and/or pending improvement projects that affect traffic operations along I-5 in the corridor study area include:

- I-5, SR 510 to SR 512 – Congestion Management (TIGER III Grant) Projects
- Madigan Gate Access improvements
- I-5 - Mounts Road to Center Drive Auxiliary Lane Extension
- I-5 , Steilacoom-DuPont Road to Thorne Lane – Corridor Improvement

2.1.1.1 I-5, SR 510 to SR 512 – Congestion Management (TIGER III Grant) Projects

In 2011, the Washington State Department of Transportation was awarded a $20 million federal grant to provide congestion management improvements along a 15-mile section of I-5 between SR 510 and SR 512. Improvements included signage, ramp metering, congestion monitoring, a southbound auxiliary lane between the Thorne Lane and Berkeley Street interchanges, and a traffic signal with turn lanes on Old

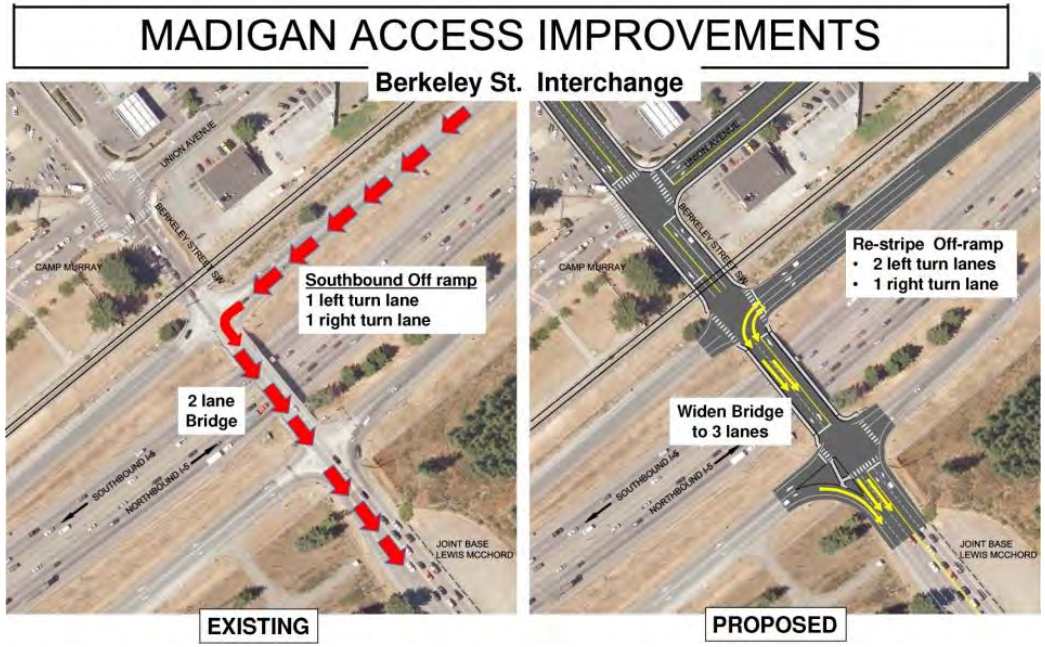
Nisqually Road at the JBLM Mounts Road Gate. Easing congestion in this area allows more efficient movement through the I-5 corridor, including freight delivery. Improvements on Old Nisqually Road allow motorists to exit JBLM from this gate. Figure 2-1 shows the location and type of improvements that were funded by the TIGER III grant. Construction of these improvements was completed in 2015.

Figure 2-1. SR 510 to SR 512 Congestion Management (TIGER III) and Madigan Access Improvements

2.1.1.2 Madigan Gate Access Improvements

The City of Lakewood was awarded a $5.7 million grant from the Department of Defense to reconfigure the Freedom Bridge (Berkeley Street) that connects JBLM to Camp Murray and Tillicum. The project included adding a second left turn lane on the I-5 southbound off-ramp at Berkeley Street and bridge widening to add a third travel lane to accommodate the dual left turns. Madigan Medical Center on the base sees more than 1.4 million visitors per year and is directly served by this interchange. This improvement was completed in 2016, and is providing travel time savings for JBLM access. Figure 2-2 illustrates the improvements.

Figure 2-2. Madigan Gate Access Improvements



2.1.1.3 I-5 Mounts Road to Center Drive Auxiliary Lane Extension

As the first construction stage of the Connecting Washington funded corridor improvements, in the spring of 2017, WSDOT initiated construction to extend the existing northbound I-5 auxiliary lane from Center Drive to Steilacoom-DuPont Road south by 1.5 miles to Mounts Road near DuPont's southern city limits.

2.1.1.4 Pending Improvements Defined in the Build Alternative of the Revised Environmental Assessment for the I-5 JBLM Vicinity Congestion Relief

Improvements identified in the Revised NEPA Environmental Assessment (May 2017) and Interchange Justification Report are illustrated in Figure 2-3 and include:

- A fourth through lane on I-5 from south of Gravelly Lake Drive southbound to Center Drive and from Steilacoom-DuPont Road northbound to Thorne Lane as GP (General Purpose) lanes.
- A northbound auxiliary lane from the Berkeley Street northbound on-ramp and the Thorne Lane northbound off-ramp.
- A northbound auxiliary lane between the Thorne Lane and Gravelly Lake Drive interchanges.

- Reconstruction of the Thorne Lane interchange with a new bridge approximately 350 feet south of the existing bridge. The new bridge would grade-separate Thorne Lane over I-5, the adjacent rail line and Union Avenue. Ramp intersections would be built as multi-lane roundabouts.
- Reconstruction of the Berkeley Street interchange with a new bridge approximately 120 feet south of the existing bridge. The new bridge would grade-separate Jackson Avenue over I-5, the adjacent rail lane, and Militia Drive, tying into Berkeley Street at Washington Avenue. Ramp intersections would be built as multi-lane roundabouts.

The following improvements included in the Revised Environmental Assessment's Build Alternative would be built in the final stage of construction:

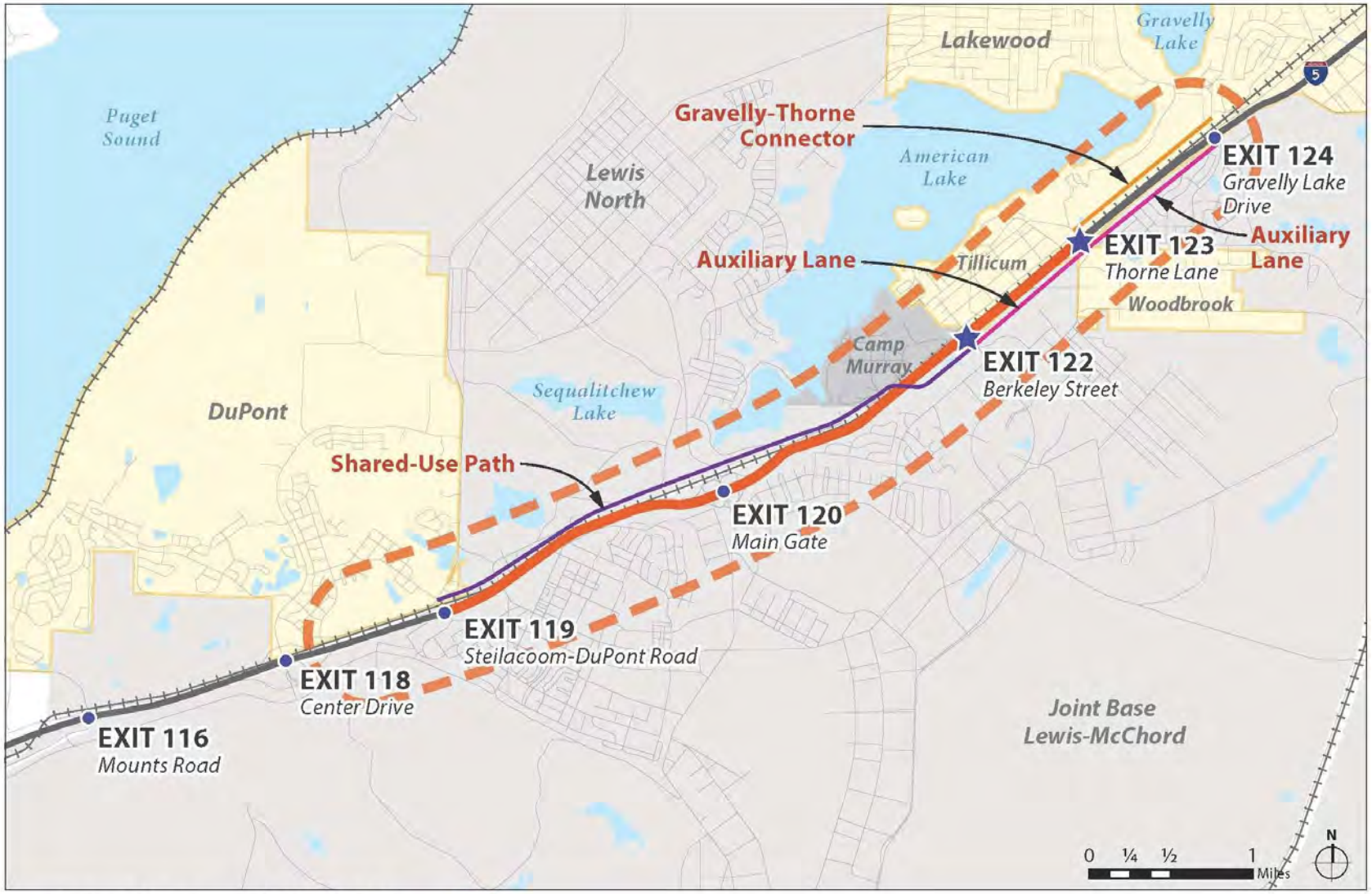
- Gravelly-Thorne Connector local road between Gravelly Lake Drive and Thorne Lane to carry local trips that may otherwise use I-5. This improvement includes a southbound vehicle lane and two-way shared used path.
- A shared use path for pedestrians and bicyclists from Berkeley Street to Steilacoom-DuPont Road.

2.2 What Are the Key Transportation Issues in the Project Area

2.2.1 2017 AM and PM Peak Hour Traffic Volumes in the Project Area?

In the spring of 2017, AM and PM peak hour turning movement counts were taken at key intersections in the vicinity of Exit 119. The location of these counts is illustrated in Figure 2-4 and includes not only the I-5 interchange at Steilacoom-DuPont Road and nearby intersections, but also the adjacent interchange of I-5 at Center Drive. Data at the I-5/Steilacoom-DuPont Road intersection will form the basis of the traffic assessment prepared for this feasibility study. Data at other locations will be considered in the future during development of an Interchange Justification Report and environmental documentation for the selected Build Alternative.

Table 2-1 presents a comparison of 2017 AM and PM peak hour total intersection approach volumes (sum of all turning movements) with counts taken at some of the same locations in 2013. The earlier counts formed the basis of the travel demand forecasts and subsequent transportation analysis conducted for the *I-5 JBLM Vicinity Congestion Relief Study* reports identified in Table 1-1. This comparison is useful in drawing qualitative conclusions about potential traffic impacts associated with the design options. This will be further discussed in Chapter 4.

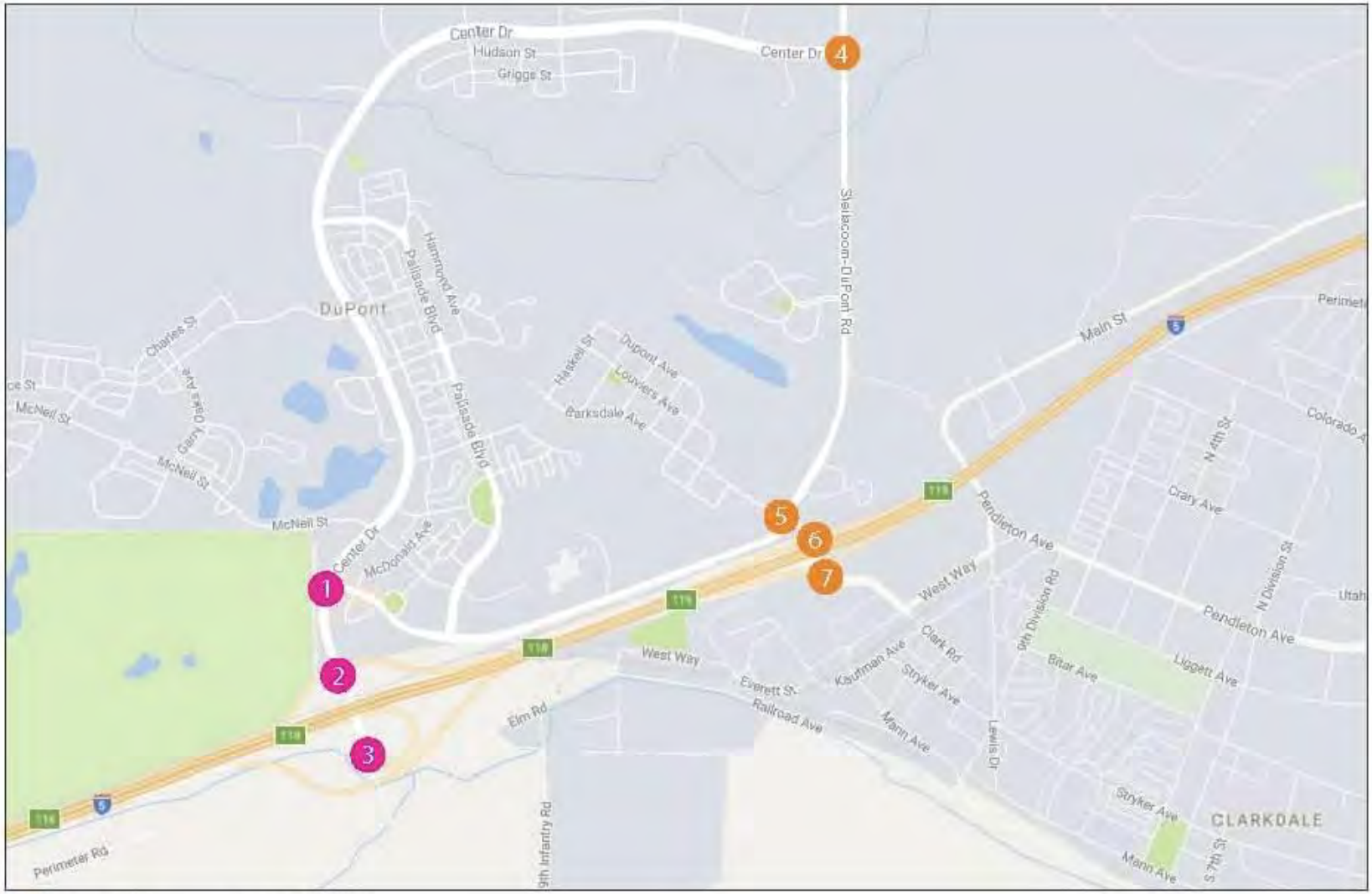


Existing I-5 Mainline
Existing Interchange – No Proposed Changes

NEPA EA AREA – BUILD ALTERNATIVE
Add One Lane Each Direction
Shared-Use Path
Auxiliary Lane
Gravelly-Thorne Connector
Rebuild Interchange

Figure 2-3
Steilacoom-DuPont Road to Thorne Lane Build Alternative

Exit 119 Interchange Alternatives Analysis Feasibility Study



Intersection in Feasibility Study Area

Intersection in Area of Influence

LOCATIONS

1 Center/Wilmington
2 Center SB Ramps
3 Center NB Ramps & access from JBLM
4 Center/Steilacoom-DuPont
5 Wilmington/Barksdale/ Steilacoom-DuPont
6 Steilacoom-DuPont SB Ramps
7 Steilacoom-DuPont NB Ramps

Figure 2-4
Traffic Count Locations

Exit 119 Interchange Alternatives Analysis Feasibility Study

As noted in Table 2-1, total 2017 AM and PM peak hourly approach volumes at the key intersections in the vicinity of Exit 119 have uniformly dropped in comparison with the AM ad PM peak hours in 2013. Figures 2-5 and 2-6 present a more detailed comparison of changes in peak hour link volumes approaching and departing from both the Steilacoom-DuPont Road and Center Drive interchanges with I-5.

Table 2-1. Comparison of 2013 and 2017 AM and PM Peak Hour Total Intersection Approach Volumes

		AM Peak Hour			PM Peak Hour		
No.	Intersection	2013	2017	Difference	2013	2017	Difference
4	Center Drive @ Steilacoom-DuPont Road	--	1,589	--	--	1,865	--
5	Wilmington/Barksdale @ Steilacoom-DuPont Road	1,710	1,535	(175)	1,815	1,685	(130)
6	I-5 @ Steilacoom-DuPont Road SB Ramps	1,900	1,640	(260)	2,090	1,820	(270)
7	I-5 @ Steilacoom-DuPont Road NB Ramps	1,820	1,450	(370)	2,020	1,535	(485)

Source: SCJ Alliance, 2013 and 2017 intersection turning movement counts. Data represents total approach volumes at each intersection.

2.2.2 Existing Circulation and Mobility Issues

Figure 2-7 summarizes some of the key issues related to traffic circulation and access in the vicinity of Exit 119. These include locations with heavy traffic volumes resulting in existing or expected congestion and/or extensive traffic queuing, pedestrian and bicycle circulation and safety needs, effects of the existing at-grade rail crossings, and traffic circulation and access needs that are specific to JBLM.

2.3 What are the Environmental Features in the Study Area?

2.3.1 Introduction

This section presents a synopsis of existing environmental features in the vicinity of the I-5/Exit 119 interchange. This information was initially developed for an environmental scan conducted as part of the I-5 JBLM Corridor Study and further refined as part of the May 2017 Revised EA for corridor improvements. The information has been used to conduct a planning level screening of potential environmental impacts associated with the I-5/ Steilacoom-DuPont Road interchange design options.

The discussion in this section does not include a comprehensive summary of all environmental conditions in the corridor. Rather, it focuses on the key elements of the built and natural environment that help to differentiate between the interchange design options. Included are:

- Wetlands
- Wildlife

Figure 2-5. 2013 and 2017 AM Peak Hour Link Volume Comparisons

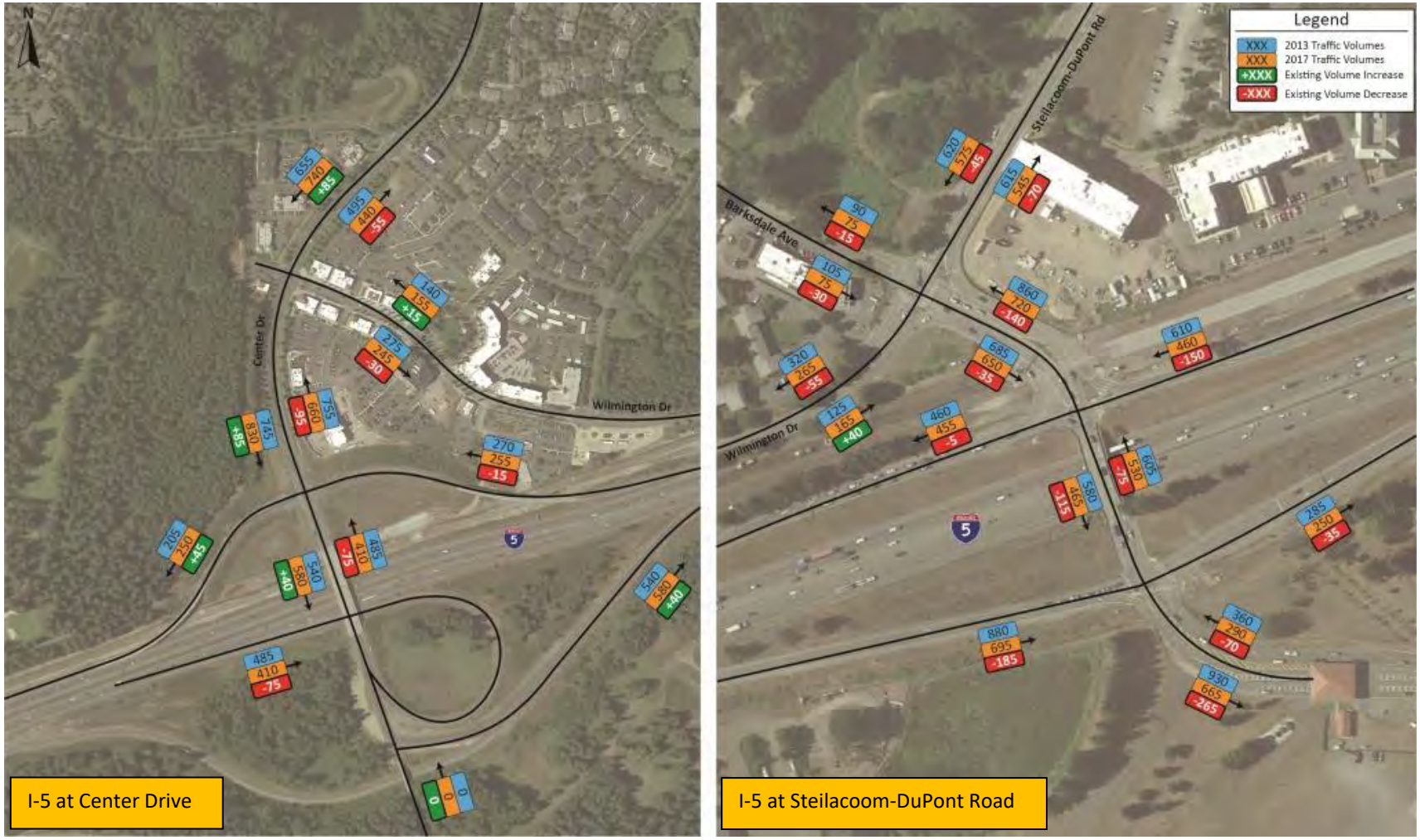
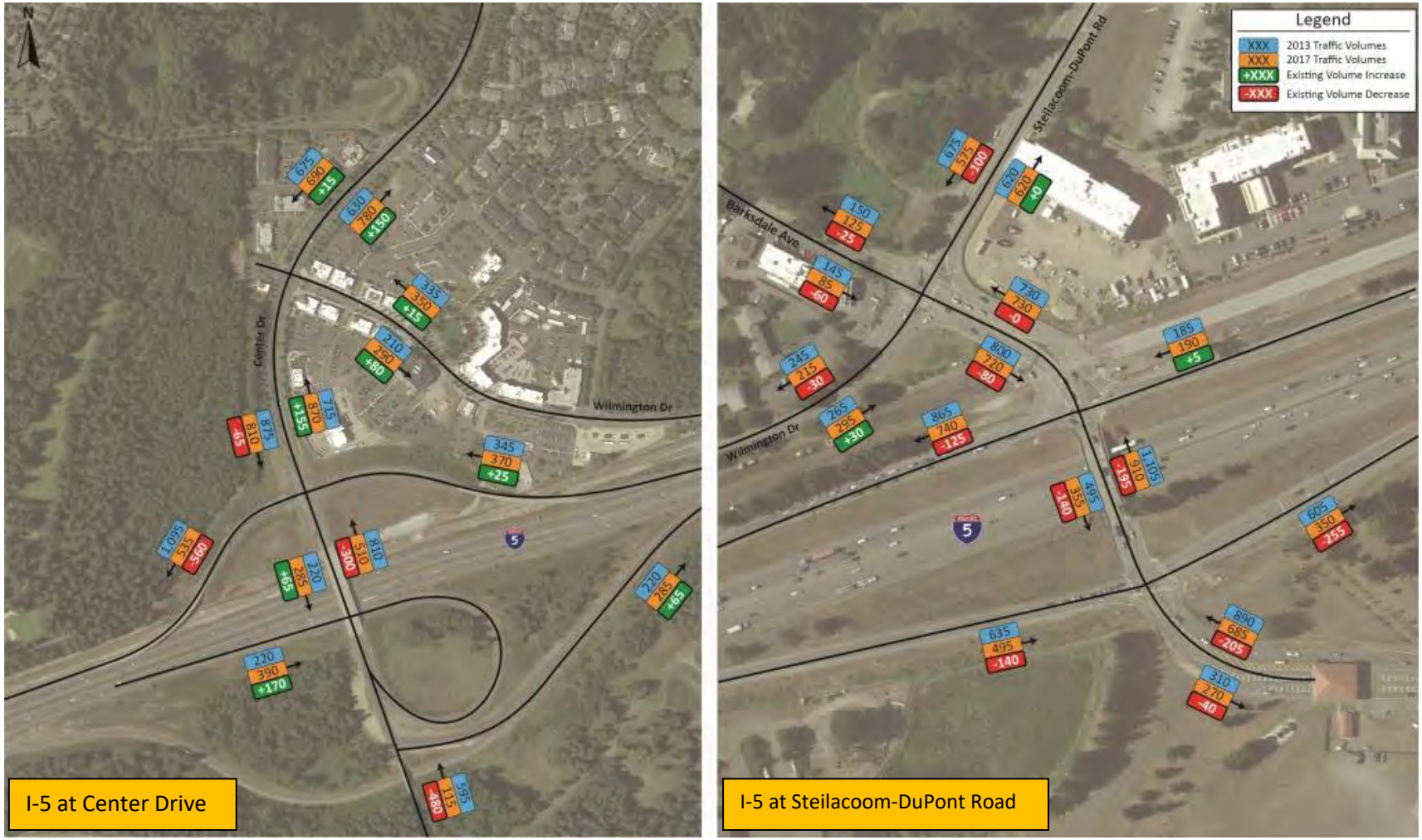


Figure 2-6. 2013 and 2017 PM Peak Hour Link Volume Comparisons



■ TRANSPORTATION ISSUES

1. Steilacoom-DuPont Road is only 2 lanes and carries heavy vehicle traffic
2. Insufficient queuing at interchange; congested
3. Interchange is major commercial traffic route into DuPont/JBLM
4. Foot/bike traffic over bridge
5. No setback capacity at existing ACP; insufficient queuing
6. Pendleton underpass – main combat vehicle access; limited clearance
7. At-grade rail crossing (Point Defiance Bypass = more frequent service)
8. Friday traffic along I-5
9. Combat vehicle trail – from Lewis North and then south to training areas
10. On-base road network south of I-5 needs improvement

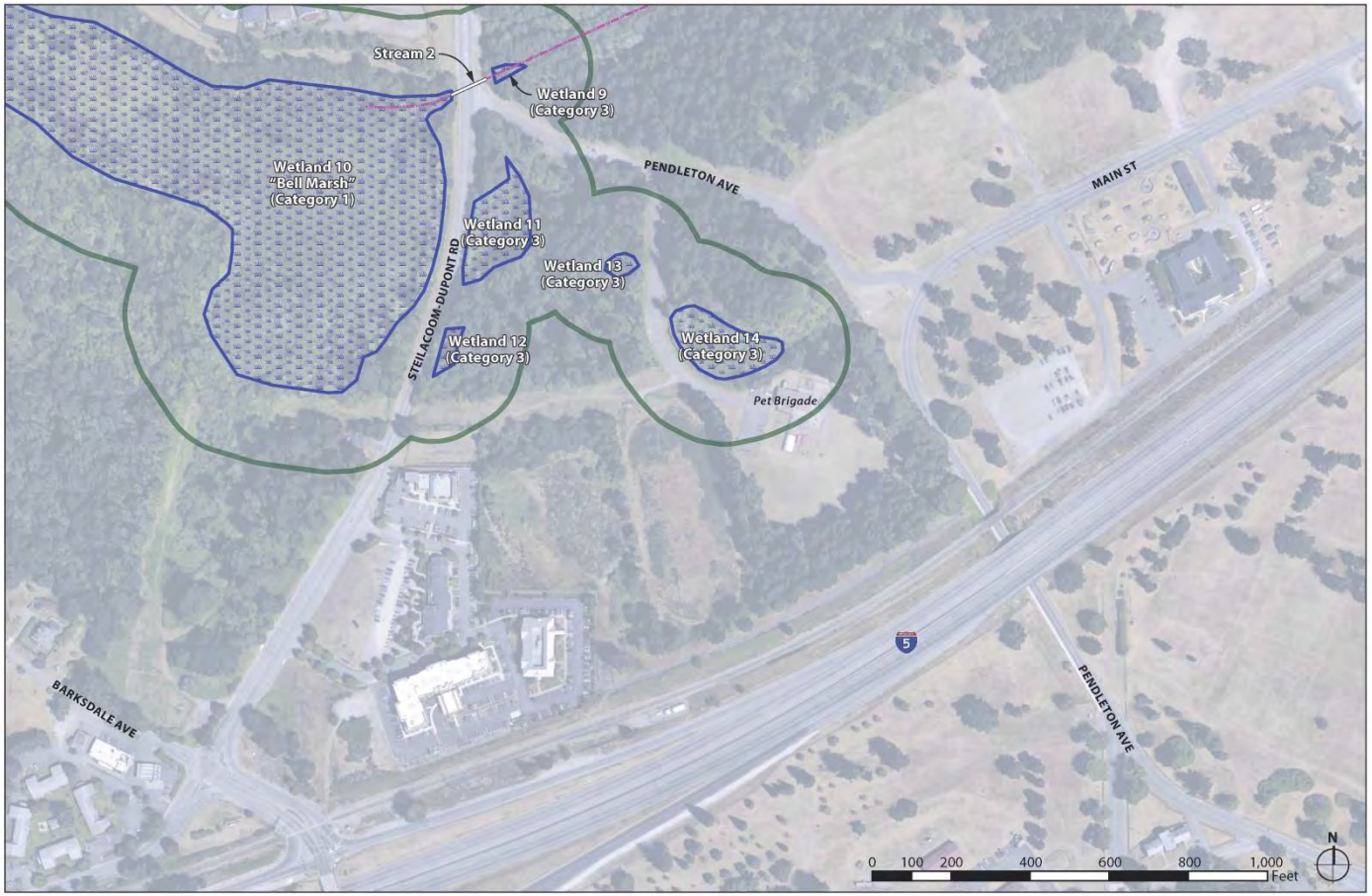
Figure 2-7
Transportation Issues

Exit 119 Interchange Alternatives
Analysis Feasibility Study

- Noise
- Visual Impacts
- Cultural Resources (Section 106) and Section 4(f) Resources
- Land Use

2.3.2 Wetlands

There are six wetlands located within the vicinity of the I-5/Steilacoom-DuPont Interchange (Exit 119). These wetlands and their surrounding buffer areas are depicted in Figure 2-8 and identified as Wetlands 9 through 14 (out of a total of 14 wetlands identified in the I-5 JBLM Vicinity Congestion Relief Project EA). These wetlands include areas that are located in topographic depressions and riverine wetlands that receive over bank flooding from adjacent streams. Wetlands within the study area have a combination of forested, shrub, and herbaceous vegetation. Wetland 10 in the vicinity of Exit 119 is Bell Marsh, a Category I wetland. All other wetlands in the vicinity of Exit 119 are identified as Category III wetlands.



Stream
Culverted Stream
Wetland Buffer
Wetland

Figure 2-8
Wetlands and Streams in the Vicinity of the I-5 / Steilacoom-DuPont Road Interchange

Exit 119 Interchange Alternatives Analysis Feasibility Study

Each of the wetlands and wetland buffers near Exit 119 are relatively undisturbed by surrounding urban development. The impact of design options on wetlands may vary slightly due to the location of the overcrossing structure and the alignment of its approach roads. For some options, impacts to wetland buffers, particularly Wetland 10 (Bell Marsh) and Wetland 12 are anticipated.

In addition to the wetlands identified in Figure 2-8, McKay Marsh lies northeast of the I-5/Steilacoom-DuPont Road interchange and may potentially be affected by one or more design options. In addition to direct wetland and/or wetland buffer impacts, both Bell Marsh and McKay Marsh may be impacted by water runoff from adjacent land and transportation facilities. Figure 2-9 illustrates the location of Bell and McKay Marshes and identifies potential outfall issues.

Figure 2-9. Water Quality Outfalls in Vicinity of Exit 119

2.3.3 Wildlife

There are three WDFW priority habitats that occur within the study area: (a) riparian habitats, (b) instream habitats, and (c) Oregon white oak woodlands. The first two habitat categories are, by definition, the on-site streams and their associated wetlands and vegetative communities. Several State and Federal Threatened or Endangered Species have either been observed in the vicinity of the I-5/Steilacoom-DuPont Road interchange or suitable habitat is present. McKay Marsh and various locations on JBLM were specifically identified in the EA for the I-5 JBLM Vicinity Congestion Relief Project. As indicated in the discussion of wetlands, some impact may accrue to wildlife associated with affected wetland buffers as a result of various design options.

Oregon white oak is present in the memorial grove to the south and east of the existing interchange. Oregon white oak is a priority habitat in stands where the canopy coverage of oak is greater than 25 percent, or in stands with less than 25 percent canopy coverage where the oak makes up at least half of the tree canopy. In urban areas, a single native oak tree may be classified as priority. Oak trees and stands of oak trees provide an important source of food, cover, nest sites, and arboreal movement routes for more than 200 species of vertebrate wildlife.

2.3.4 Noise

Highway congestion relief projects have the potential to create noise impacts on the surrounding community. The potential for adverse impacts is greatest where there are noise sensitive land uses (or "noise receptors"). Noise sensitive receptors include residential development and a variety of non-residential land uses that could be impacted by highway noise such as parks and golf courses.

2.3.5 Visual

Visual quality impacts are determined by assessing changes to visual resources and the predicted viewer response to changes. Potential impacts of the design options include four primary long-term changes to visual character in the study area: added retaining walls, increased pavement width/modified geometry, number of structures, and loss of existing trees and other vegetation. Impacts would occur largely around the modified interchange and its access roads. The additional heights, widths, ramps and retaining walls associated with each design option could affect visual quality in different ways because some options may dominate views to and from the freeway and its surrounding area more than others. Bridge width and height varies among the options, as does the presence of retaining walls. Loss of existing tree cover also varies among the design options although this is expected to be minimal for all options.

2.3.6 Cultural (Section 106) and Section 4f Resources

Section 106 of the National Historic Preservation Act, as amended, requires federal agencies take into account the effects of federally-funded or permitted projects on historic resources, archaeological sites and traditional cultural properties. Similarly, Section 4f of the US Department of Transportation Act of 1966 and Section 6f of the Land and Water Conservation Funds Act require a review of transportation projects for potential impacts on publicly-owned parks, recreational areas, wildlife and waterfowl refuges, or public and private historical sites. As illustrated in Figure 2-10, the presence of cultural and/or historic resources is largely concentrated in the vicinity of the Steilacoom-DuPont Road interchange (Exit 119). Properties currently listed on the National Register of Historic Places (NRHP) include:

- The Fort Lewis Garrison Historic District (45DT00190) was listed on the NRHP in 2004. The district is significant for its military park landscaping, which includes picturesque landscaping, formal spatial relationships, and period vegetation and plantings.
- The Salvation Army Red Shield Inn (Building #4320) was listed on the NRHP in 1979. The Salvation Army Red Shield Inn was constructed in 1919, as a recreation and guest facility for Camp Lewis soldiers. The building is significant for its architecture, association with Fort Lewis and Salvation Army history, and its influence on the Greene Park amusement area.
- DuPont Village Historic District was listed on the NRHP in 1987 and is located west of the interchange.

SECTION 4(F) RESOURCES – PARK & RECREATION RESOURCES
1. Robinson Park
2. Iafrati Park

SECTION 106 / 4(F) RESOURCES – HISTORIC DISTRICTS
- DuPont Village Historic District
- Fort Lewis Garrison Historic District

SECTION 106 / 4(F) RESOURCES – HISTORIC PROPERTIES
1. Red Cross Hostess House / Family Resource Center (JBLM Building 4274)
2. Salvation Army Red Shield Inn / Lewis Army Museum (JBLM Building 4320)
3. Red Cross Field House (JBLM Building 4201)
4. Warehouse (WWI Facility) (JBLM Building 4170)
5. Quarter Master Gasoline Filling Station / Stone Station (JBLM Building 4176)
6. Northern Pacific Railway

Figure 2-10
Cultural and Section 106 / 4(f) Resources

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The Northern Pacific Railway was also determined eligible for the NRHP. The rail line was constructed in 1873, and is considered eligible for its influence on the economic and residential development of the Pacific Northwest.

The effect of future improvements on historic properties in the vicinity of the I-5 interchange at Steilacoom-DuPont Road on these facilities will need to be further considered in the development of a build alternative for the I-5/Exit 119 interchange.

Figure 2-10 also shows the location of parks and recreational resources in the vicinity of the I-5/Steilacoom-DuPont Road interchange. These resources include: Robinson Park and Iafrati Park in the City of DuPont.

2.3.7 Land Use

Land use within the study area is characterized by a mix of urbanizing residential and commercial land uses, as well as extensive military lands that are part of JBLM. The City of DuPont is located on the west side of I-5 and was incorporated in 1951. As illustrated in Figure 2-11, the City of DuPont is composed of residential areas, business/industrial areas, and open space. While residential areas currently make up the majority of the developed areas, the city has large land areas designated for future commercial and business/industrial development. Land use in the immediate vicinity of Exit 119 is largely commercial, open space (i.e., Bell Marsh and other wetlands and wetland buffers) and residential.

JBLM is located on the west side of I-5 north of Steilacoom-DuPont Road and east of I-5 through the study area. The size, population, and services offered on JBLM make it comparable to a fully-functioning city. While most of JBLM is composed of open range lands for military maneuvers and training, an extensive network of urban services such as military offices, residential areas, and other operational support features are located close to I-5. Exit 119 provides access to one of JBLM's busiest access control points, the DuPont Gate.

Potential land use impacts in the study area may relate to property acquisition and effects on future interchange development associated with modifications to existing access.

Figure 2-12 identifies several features related to existing land use and facilities in the area of the Exit 119 interchange. A key issue is the location of leased housing property on the base which raises challenges to project implementation costs and schedule. Other issues include properties that could have historic importance but not included as Section 106 or 4f facilities at this time, or are important to JBLM's training function.

Improvement options to the I-5 interchange with Steilacoom-DuPont Road may require the acquisition of additional right-of-way and/or additional easements from JBLM. There is no leased housing on JBLM in the immediate vicinity of this interchange, but there is property identified for future leased housing to the east of the interchange on the east side of the freeway. A further assessment of property acquisition and Environmental Justice impacts will be necessary as part of the environmental documentation of the Mounts Road to Steilacoom-DuPont Road Project Area's preferred alternative.

Land Use Study Area
City Limits

DUPONT LAND USE
- Commercial
- Office
- Mixed Use
- Open Space / Sensitive Areas
- Neighborhood Park
- Community Park
- Manufacturing & Research
- Residential 12
- Residential 5
- Residential 4
- Residential 3

PIERCE COUNTY LAND USE
- Rural Military Land
- Urban Military Lands

INTERCHANGES
- 116 Mounts Road interchange
- 118 Center Drive interchange
- 119 Steilacoom-DuPont Road interchange
- 120 Main Gate interchange

Figure 2-11
Land Use: City of DuPont and Pierce County

Exit 119 Interchange Alternatives Analysis Feasibility Study

OFF-BASE FACILITIES AND LAND USE ISSUES
1. Barksdale Station

ON-BASE FACILITIES AND LAND USE ISSUES
1. Privatized housing land – long-term lease
2. Dog kennel – JBLM
3. Hudson Bay Trail & Historic Marker (historic)
4. Historic Property Viewshed
5. Memorial Arboretum (historic)
6. Emergency Response Buildings (historic; security concern – close to ACP)
7. Training Facility – close to I-5
8. MWR Auto Craft Shop (historic) – if impacted would have to be replaced
9. Railroad Tracks on Base (historic; defunct – JBLM has no authority to remove)
10. World War I/World War II Facilities (historic)
11. Integrity Gate
12. Hanna Lake retention pond

Figure 2-12
Land Use Issues

Exit 119 Interchange Alternatives Analysis Feasibility Study

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3 DESCRIPTION OF INTERCHANGE OPTIONS

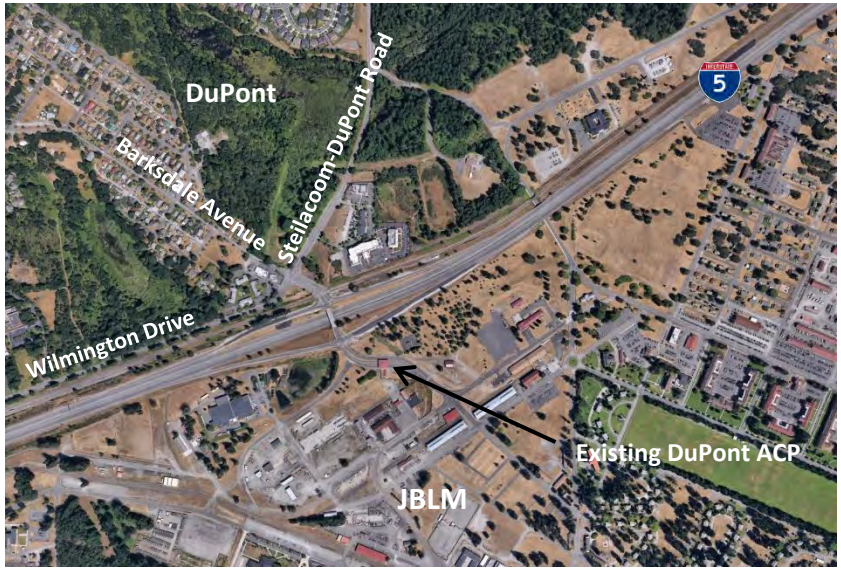
This chapter presents a synopsis of the key features of the options for improving the I-5 interchange at Steilacoom-DuPont Road that have been considered. These options include:

- **No Build Option** which would keep the existing interchange configuration and leave adjacent intersections unimproved.
- Original but Rejected Concept from the earlier analysis of interchange design options conducted as part of the Congestion Relief Study Phase 1 planning process.
- **Skewed Alignment Concept**
- **Exit 119 Couplet Concept**
- **Exit 119 A-B Couplet Concept with Split Ramps**
- **Wilmington Flyover Concept**
- **Exit 119 A-B Split Ramp Concept with New ACP**
- **Local Crossing with At-Grade Rail Concept**

3.1 No Build Option

As shown in Figure 3-1, the existing Steilacoom-DuPont Road interchange (Exit 119) is a traditional diamond configuration with traffic signals for the north and southbound ramps terminals. Immediately west of the southbound ramp is the signalized intersection of Steilacoom-DuPont Road with Wilmington Drive and Barksdale Avenue. The rail line that parallels I-5 crosses Steilacoom-DuPont Road at-grade between this intersection and the southbound ramps. West of the freeway, Steilacoom-DuPont Road serves the eastern portion of DuPont and the JBLM Lewis North area including the new Integrity Gate. To the east of I-5, Steilacoom-DuPont Road becomes Clark Road and accesses JBLM through the DuPont Gate. Steilacoom-DuPont Road provides two eastbound lanes and a single westbound lane on a bridge over I-5.

Figure 3-1. I-5 at Steilacoom-DuPont Road with No Build Alternative (Existing Interchange)



3.2 Original but Rejected Build Alternative

The original Build Alternative identified for this interchange was an offset tight diamond configuration located over I-5 north of the existing interchange (see Figure 3-2). Modern roundabouts were proposed at each ramp termini intersection. Compared to the No Build option, this alternative would increase spacing to the Barksdale Avenue intersection, grade-separate Steilacoom-DuPont Road over the railroad, increase spacing to the Center Drive interchange, provide more storage space from the interchange to the relocated DuPont Gate, provide an opportunity for transit service in the vicinity of the Stone Station building, and increase the vertical clearance under the overpass. The existing interchange would be removed. This concept was rejected by JBLM due primarily to concerns about the proposed reconfiguration of the DuPont ACP and force protection considerations. There were also concerns about impacts to cultural/historic features and better land use options. This alternative is no longer being considered.

Figure 3-2. Original but Rejected Concept

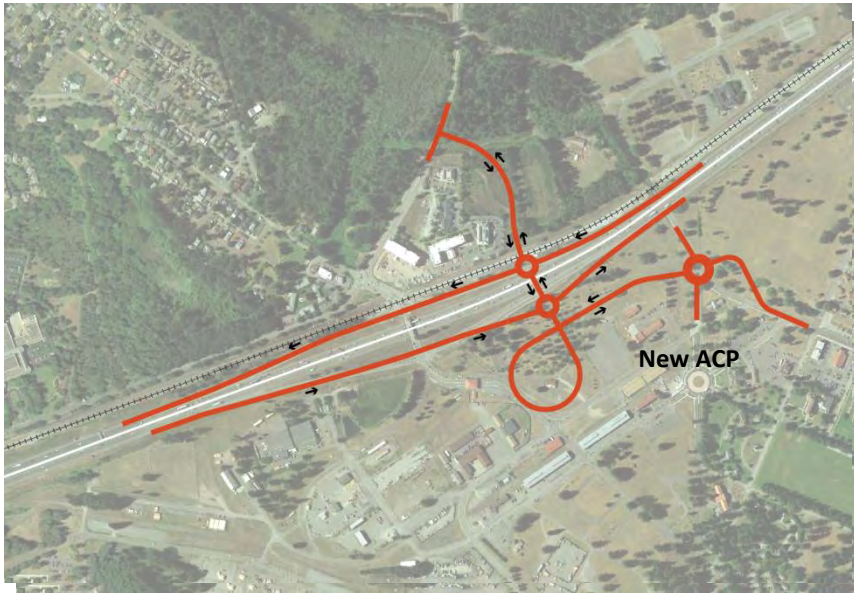
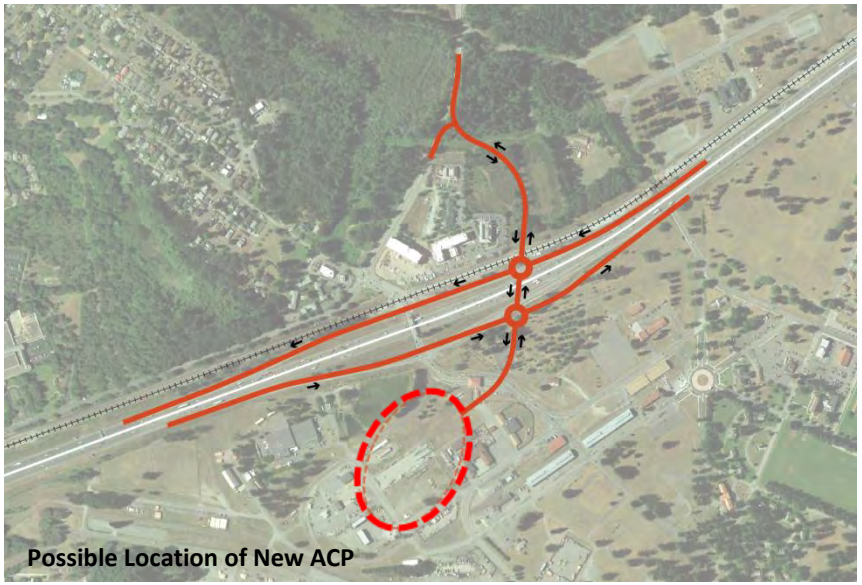


Figure 3-3. Skewed Alignment Concept



3.3 Skewed Alignment Concept

The Skewed Alignment Concept is a hybrid of the Original but Rejected Concept. With this concept, the bridge crossing over I-5 is in the same location on the west side of the freeway as the prior concept but orients further south on the east side of I-5. The connection onto JBLM is also further south and would require rebuilding the DuPont ACP (gate). The connection to Steilacoom-DuPont Road on the west side of I-5 would be positioned at the same location as with the Original Build Alternative. The Skewed Alignment Concept is illustrated in Figure 3-3.

3.4 Exit 119 Couplet Concept

With the Exit 119 Couplet Concept (Figure 3-4), the interchange would consist of two half diamond intersections and two freeway overcrossing structures connected by one-way frontage roads. It is anticipated that this improvement could be constructed with nominal need for additional easements from JBLM on the Lewis Main side of I-5. Easements would be needed on the Lewis North side of I-5.

All traffic exiting I-5 either northbound or southbound must pass through the first intersection after leaving the freeway to reach its ultimate destination. Right-turning traffic can directly access either DuPont (for southbound traffic) or JBLM (for northbound traffic). Left-turning traffic must pass through the first intersection and then continue straight on the frontage road and turn left at the second intersection to reach DuPont (for northbound traffic) or JBLM (for southbound traffic). This traffic must then pass through the opposite direction ramp terminal intersection from I-5 before reaching the local street system. Thus, left-turning traffic is required to pass through three intersections in order to reach local off-freeway destinations from I-5.

Traffic entering I-5 in the northbound direction from JBLM must pass through two intersections before reaching the on-ramp, while northbound entering traffic from DuPont must pass through the intersection with the southbound off-ramp and then turn left at the northbound on-ramp intersection. Southbound on-ramp traffic would operate in a similar manner in the opposite direction. The connection to Steilacoom-DuPont Road on the west side of I-5 would be positioned at the same location as with the preceding concepts.

3.5 Exit 119 A-B Couplet Concept with Split Ramps

This concept is similar to the Exit 119 Couplet Concept but it adds two grade-separated ramps that provide direct connections between the freeway and local destinations for both right and left-turning traffic (see Figure 3-5). In both the northbound and southbound directions the off-ramps would split at some distance beyond the freeway gore point. Northbound traffic heading to JBLM would exit I-5 and then take the right-hand ramp to reach the local street that connects with the DuPont ACP. Northbound traffic heading to DuPont would take the left-hand ramp, pass under the southerly bridge over I-5 and then turn left at the second (northerly) intersection to connect with Steilacoom-DuPont Road. Southbound off-ramp traffic would operate in a similar manner in the reverse direction. This traffic must then pass through the opposite direction ramp terminal intersection from I-5 before reaching the local street system. Thus, with this option left-turning traffic from the freeway is required to pass through only two intersections before reaching the local street system.

Northbound and southbound on-ramp traffic from JBLM or DuPont must pass through two intersections before entering the freeway. The same is true for traffic from JBLM and DuPont heading in the southbound direction.

3.6 Wilmington Flyover Concept

As illustrated in Figure 3-6, the Wilmington Flyover Concept would relocate the existing interchange slightly to the south with a two – intersection tight diamond configuration. As with the two couplet options, the intent of this option is to provide I-5 access largely within the existing highway right-of-way. This would minimize the need for

Figure 3-5. Exit 119 A-B Couplet Concept with Split Ramps

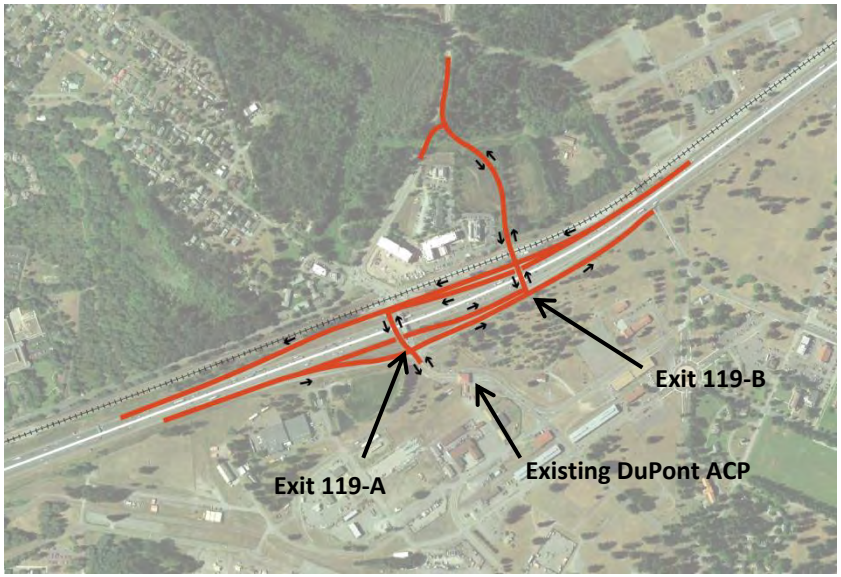
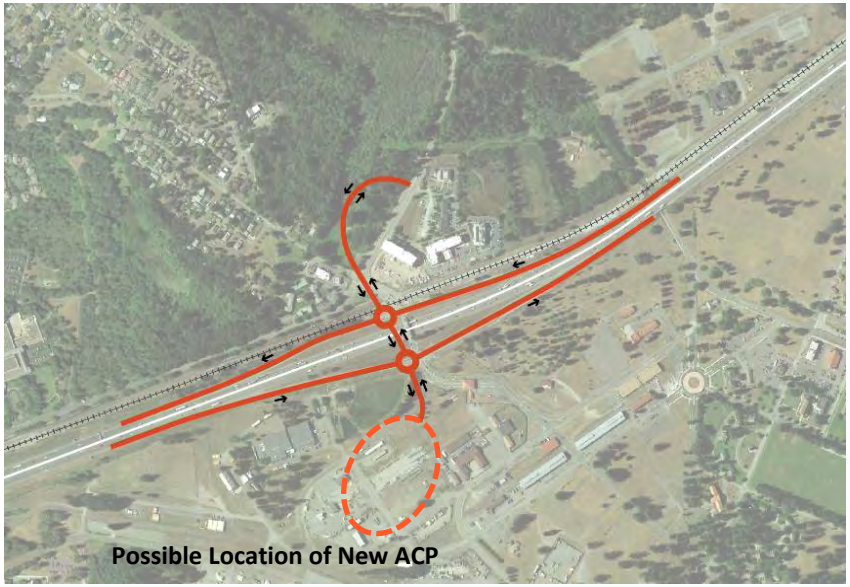


Figure 3-6. Wilmington Flyover Concept



property acquisition and/or JBLM easements for interchange improvements. Right-of-way acquisition would still be necessary for the access road between the interchange and Steilacoom-DuPont Road. As with all other options beyond the No Build condition, this option would provide grade-separation over the Sound Transit railroad line. This option would also provide an extended interchange bridge structure for a flyover of Wilmington Drive which would loop northeastward and come to grade at Steilacoom-DuPont Road. This interchange option would require re-building JBLM's DuPont Gate.

3.7 Exit 119 A-B Split Ramp Concept with New ACP

This interchange option provides a split diamond concept similar to the Exit 119 A-B Couplet with Split Ramps Concept illustrated in Figure 3-5. As shown in Figure 3-7, this option would include two bridges over I-5. One of the two bridges would be located in the same general position as proposed in the two prior couplet concepts. However, unlike the other two concepts, with the A/B Split Ramp Concept, the entire interchange would be shifted north and this bridge would provide I-5 access to and from the south, rather than to/from the north. Access to the interchange to and from the north would be provided by a bridge located slightly north of Pendleton Avenue on JBLM. As with the Skewed Alignment and Wilmington Flyover design options, this option would require rebuilding the DuPont ACP at a location north of Pendleton Avenue.

3.8 Local Crossing with At-Grade Rail Concept

As shown in Figure 3-8, with this interchange option access to and from I-5 would be concentrated at a single location to the north of the existing Steilacoom-DuPont Road bridge. To provide local connectivity between

Figure 3-7. Exit 119 A/B Split Ramp Concept with New ACP

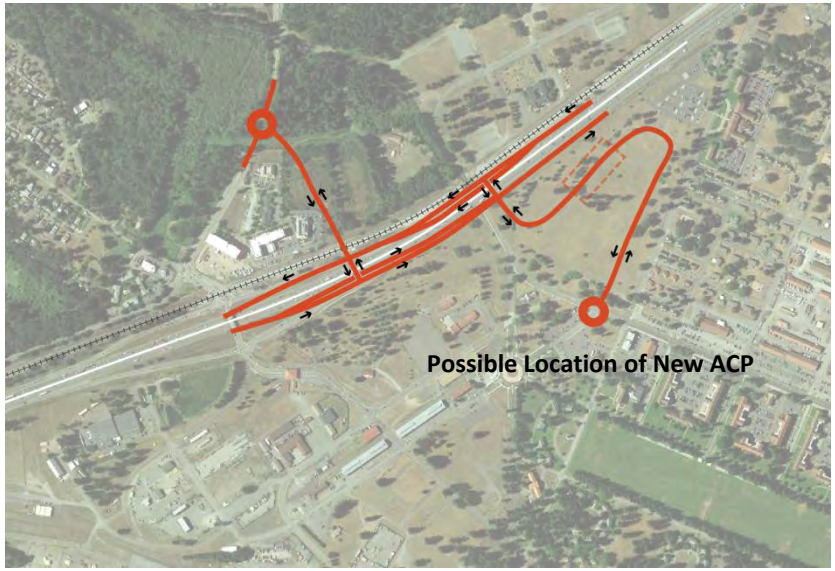
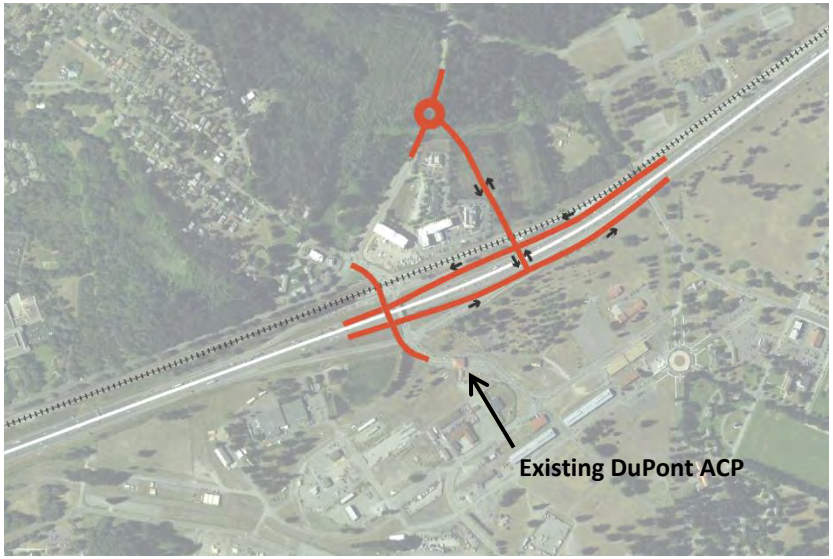


Figure 3-8. Local Crossing with At-Grade Rail Concept



JBLM and the City of DuPont, the existing Steilacoom-DuPont Road bridge would be reconstructed to provide a local access-only road. Direct access from this bridge would be provided to the existing DuPont ACP. There would be no I-5 ramps to the bridge connecting to the DuPont Gate.

Traffic from northbound I-5 destined for JBLM would be required to exit at the new interchange, and then use Steilacoom-DuPont Road to connect back across the freeway on the reconstructed bridge to the ACP. Traffic for all other destinations would use the new interchange to reach the freeway.

4 TRAFFIC FEASIBILITY CHECK

4.1 What Traffic Analysis Methodology was Used?

The analysis of AM and PM peak hour traffic impacts associated with each design option relied on a two-pronged analysis approach. First, to the maximum extent possible, design options at the I-5/ Steilacoom-DuPont Road interchange with elements similar to those previously developed for the original concept at this location were assumed to operate in a manner similar to that concept. Second, where Exit 119 design options were considerably different from the original design option, new peak hour intersection capacity analysis was specifically conducted for this feasibility study. Analysis includes both the AM and PM peak hours for 2020 and 2040 and is based on traffic projections for the I-5 /Steilacoom-DuPont Road interchange prepared for the I-5 JBLM Vicinity Congestion Relief Project. The results of this analysis are described below.

4.2 How Do Design Options Compare from a Traffic Perspective?

4.2.1 Design Options with Elements Similar to the Original but Rejected Interchange Concept

Two of the design options under consideration (Skewed Alignment and Wilmington Flyover) are assumed to include roundabouts at ramp termini intersections, similar to the original concept studied at the I-5/Steilacoom-DuPont Road interchange. As shown in Table 4-1, with the original concept the roundabouts were expected to operate exceptionally well during AM and PM peak hours to the planning horizon year of 2020. Level of Service (LOS) A or B is expected at the ramp termini intersections. Thus, it is anticipated that the options with ramp termini roundabouts that are similar in design to the original interchange concept would also operate acceptably over the long-term planning period. In addition, the 2040 conditions were also evaluated and would operate acceptability.

Table 4-1. Exit 119 - 2020 Intersection Operations Analysis Results for Roundabout Concepts – AM and PM Peak Hours

			AM Peak Hour [1]			PM Peak Hour [1]		
Design Option	**Intersection**	**Control**	**Total Volumes (vph)**	**LOS**	**Delay (sec)**	**Total Volumes (vph)**	**LOS**	**Delay (sec)**
Concepts with Roundabout Intersections	I-5 SB Ramps/Steilacoom-DuPont Rd	RBT	2,701	A	4.7	2,806	A	5.0
	I-5 NB Ramps/Steilacoom-DuPont Rd	RBT	2,225	B	12.1	2,175	A	8.1

4.2.2 Design Options That Substantively Differ from the Original but Rejected Interchange Concept

Traffic operations for the two couplet options in close proximity to the existing Exit 119 interchange were evaluated using the Synchro and Sim-Traffic software, similar to the analysis conducted for the Build Alternative's EA. This analysis used the same interchange ramp volumes as produced for the EA at Exit 119, but the volumes were redistributed to accommodate the lane configuration and connections of these two new options. Table 4-2 presents the summary of projected 2020 AM and PM peak hourly operations for the Couplet Concept and Couplet Concept with Split Ramps. As noted in the table, all intersections for both options would operate at LOS C or better.

Table 4-2. 2020 Intersection Operations Analysis Results for Couplet Concepts – AM and PM Peak Hours

			AM Peak Hour [1]			PM Peak Hour [1]		
Design Option	**Intersection**	**Control**	**Total Volumes (vph)**	**LOS**	**Delay (sec)**	**Total Volumes (vph)**	**LOS**	**Delay (sec)**
Couplet	I-5 SB Ramps/Steilacoom-DuPont Rd	Signal	2,540	B	19.9	2,530	B	15.1
	I-5 NB Ramps/Steilacoom-DuPont Rd	Signal	1,290	B	19.0	1,440	C	21.0
	I-5 SB Ramps/JBLM Entrance	Signal	675	C	26.8	985	C	21.0
	I-5 NB Ramps/JBLM Entrance	Signal	1,635	B	16.6	1,490	B	11.4
Couplet with Split Ramps	I-5 SB Ramps/Steilacoom-DuPont Rd	Signal	2,385	A	0.4	2,475	A	0.8
	I-5 NB Ramps/Steilacoom-DuPont Rd	Signal	1,220	A	0.0	1,215	A	0.0
	I-5 SB Ramps/JBLM Entrance	Signal	400	A	0.0	535	A	0.0
	I-5 NB Ramps/JBLM Entrance	Signal	990	A	3.4	1,105	A	2.1

[1] Data in table reflects overall intersection performance for signalized intersections. Volumes in this table are the sum of all intersection approach movements during the time period specified. VPH means vehicles per hour.

Table 4-3 presents a summary of traffic queuing analysis results for the 2020 AM and PM peak hours. The results in this table were developed based on the same traffic volume assignments as noted in Table 4-1, and were prepared using the Sim-Traffic analysis software. Only the intersection traffic movements with either significant volumes or which are useful in understanding overall intersection performance are included in the table. Traffic queuing data is presented in feet and can be compared to the estimated vehicle storage space for each movement. While none of the design options are sufficiently developed to precisely measure available vehicle storage space, general estimates were prepared using preliminary layout drawings.

As indicated in the table, it is expected that all vehicle queuing demand can be served by either design option. Of particular interest are the off-ramp movements in both the northbound and southbound directions where a determination of the potential for interference with mainline freeway traffic can be assessed. Left or right turn vehicle storage is assumed to be sufficient to accommodate expected demand.

Traffic operations analysis and queuing worksheets that document the information contained in Tables 4-1, 4-2 and 4-3 are included in Appendix A.

Table 4-3. 2020 Vehicle Queuing at Intersections with Couplet Concepts – AM and PM Peak Hours

Design Option	Intersection	Critical Movement	Vehicle Storage (ft)	95th Percentile Queue (ft) [1]	
				AM Peak	PM Peak
Couplet	I-5 SB Ramps/Steilacoom-DuPont Rd	NBT	200	100	24
		SBT	>1,000	196	238
		WBR [2]	850	260	197
	I-5 NB Ramps/Steilacoom-DuPont Rd	SBL	200	85	17
		EBT	950	59	131
		EBL	300	196	146
	I-5 SB Ramps/JBLM Entrance	NBL	330	79	112
		WBT	1,000	153	209
		WBL	250	148	134
	I-5 NB Ramps/JBLM Entrance	SBT	330	47	125
		NBR	200	96	136
		EBT [2]	2,100	339	195
		EBR [2]	“	246	95
Couplet with Split Ramps	I-5 SB Ramps/Steilacoom-DuPont Rd	NBT	200	27	
		SBT	>1,000	139	167
		WBR [2]	850	192	264
	I-5 NB Ramps/Steilacoom-DuPont Rd	SBL	200	79	107
		EBL	300	186	153
	I-5 SB Ramps/JBLM Entrance	NBL	330	46	85
		WBL	250	89	103
	I-5 NB Ramps/JBLM Entrance	SBT	330	24	68
		NBR	200	69	88
		EBR [2]	2,100	218	138

1 Vehicle queuing analysis conducted based on multiple simulations using Sim-Traffic.
2 I-5 Off-ramp.
Note: NB=northbound, SB=southbound, EB=eastbound, WB=westbound; T=through, L=left, and R=right.

Table 4-4 presents the summary of projected 2040 AM and PM peak hourly operations for the couplet and couplet with split ramp concepts. As noted in the table, all intersections for both options would operate at LOS C or better.

Table 4-4. 2040 Intersection Operations Analysis Results for Couplet Concepts – AM and PM Peak Hours

			AM Peak Hour [1]			PM Peak Hour [1]		
Design Option	**Intersection**	**Control**	**Total Volumes (vph)**	**LOS**	**Delay (sec)**	**Total Volumes (vph)**	**LOS**	**Delay (sec)**
Couplet	I-5 SB Ramps/Steilacoom-DuPont Rd	Signal	2,835	C	26.4	2,835	B	12.1
	I-5 NB Ramps/Steilacoom-DuPont Rd	Signal	1,405	B	18.6	1,830	C	20.8
	I-5 SB Ramps/JBLM Entrance	Signal	730	C	26.8	1,380	C	22.3
	I-5 NB Ramps/JBLM Entrance	Signal	1,720	B	17.2	1,900	B	12.5
Couplet with Split Ramps	I-5 SB Ramps/Steilacoom-DuPont Rd	Signal	2,680	A	0.4	2,620	A	1.2
	I-5 NB Ramps/Steilacoom-DuPont Rd	Signal	1,345	A	0.0	1,560	A	0.0
	I-5 SB Ramps/JBLM Entrance	Signal	435	A	0.0	850	A	0.0
	I-5 NB Ramps/JBLM Entrance	Signal	1,015	A	3.0	1,470	A	1.7

[1] Data in table reflects overall intersection performance for signalized intersections. Volumes in this table are the sum of all intersection approach movements during the time period specified. VPH means vehicles per hour.

Table 4-5 presents a summary of traffic queuing analysis results for the 2040 AM and PM peak hours. The results in this table were developed based on the same traffic volume assignments as noted in Table 4-3, and were prepared using the Sim-Traffic analysis software. As with the data presented for 2020 peak hour conditions, only the intersection traffic movements with either significant volumes or which are useful in understanding overall intersection performance are included in the table. Traffic queuing data is presented in feet and can be compared to the estimated vehicle storage space for each movement. While none of the design options are sufficiently developed to precisely measure available vehicle storage space, general estimates were prepared using preliminary layout drawings.

As indicated in the table, it is expected that all vehicle queuing demand can be served by either design option. Of particular interest are the off-ramp movements in both the northbound and southbound directions where a determination of the potential for interference with mainline freeway traffic can be assessed. In some instances, left or right turn vehicle storage is assumed to be sufficient to accommodate expected demand.

Traffic operations analysis and queuing worksheets that document the information contained in Tables 4-4 and 4-5 are included in Appendix B.

Table 4-5. 2040 Vehicle Queuing at Intersections with Couplet Concepts – AM and PM Peak Hours

Design Option	Intersection	Critical Movement	Vehicle Storage (ft)	95th Percentile Queue (ft) [1]	
				AM Peak	PM Peak
Couplet	I-5 SB Ramps/Steilacoom-DuPont Rd	NBT	200	113	0
		SBT	>1,000	207	244
		WBR [2]	850	546	137
	I-5 NB Ramps/Steilacoom-DuPont Rd	SBL	200	41	64
		EBT	950	131	147
		EBL	300	216	161
	I-5 SB Ramps/JBLM Entrance	NBL	330	84	162
		WBT	1,000	155	246
		WBL	250	155	189
	I-5 NB Ramps/JBLM Entrance	SBT	330	48	137
		NBR	200	108	174
		EBT [2]	2,100	430	214
		EBR [2]	“	247	91
Couplet with Split Ramps	I-5 SB Ramps/Steilacoom-DuPont Rd	NBT	200	47	6
		SBT	>1,000	155	216
		WBR [2]	850	217	213
	I-5 NB Ramps/Steilacoom-DuPont Rd	SBL	200	86	257
		EBL	300	203	191
	I-5 SB Ramps/JBLM Entrance	NBL	330	45	149
		WBL	250	99	124
	I-5 NB Ramps/JBLM Entrance	SBT	330	27	106
		NBR	200	67	87
		EBR [2]	2,100	208	138

1 Vehicle queuing analysis conducted based on multiple simulations using Sim-Traffic.
2 I-5 Off-ramp.
Note: NB=northbound, SB=southbound, EB=eastbound, WB=westbound; T=through, L=left, and R=right.

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5 EVALUATION METHODOLOGY AND RESULTS

5.1 What Evaluation Method was used to Assess Design Options?

The evaluation of design options for the I-5 interchange at Steilacoom-DuPont Road was based on a screening process that considered and weighed a variety of factors to differentiate the benefits and disadvantages associated with each. Options were compared to each other, rather than the No Build condition, to identify the most advantageous and reasonable concept to carry forward for further analysis through the IJR and NEPA processes. The evaluation process relied on both qualitative and quantitative measures that were largely based on data available from the Congestion Relief Study's earlier reports including the Project's Environmental Assessment.

This chapter documents the factors and process used to conduct the screening and evaluation of design options. Included is identification of evaluation criteria, an explanation of how criteria were weighted and how options were scored to identify the preferred concept, and a summary of the evaluation results.

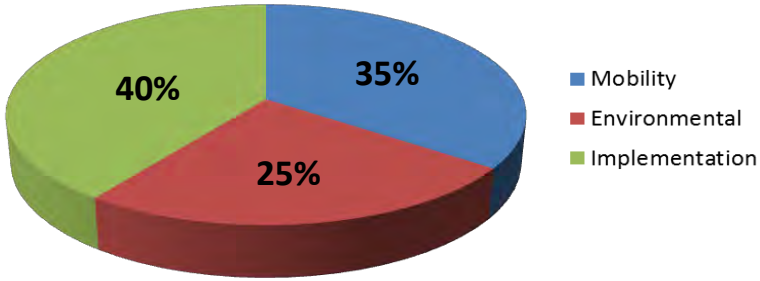
5.2 What Criteria Were used to Assess Design Options?

The criteria used to conduct the screening of design options were organized into three major categories:

- Mobility and Connectivity (including several factors that represent 35 percent of the total score of each option)
- Environmental (represent 25 percent of the total score)
- Implementation Characteristics (represent 40 percent of the total score)

These categories and their individual weighting out of 100 percent are illustrated in Figure 5-1. More specific criteria that define the key elements of each major category are presented below.

Figure 5-1. Categories of Criteria and Weighting used to Evaluate Design Options



5.2.1 Mobility and Connectivity

The mobility and connectivity benefits and impacts associated with each design option were assessed based on the following:

- ***I-5 Performance*** as measured in terms of the impact of each option on mainline traffic operations and safety focusing on:
  - Introduction of additional merge and/or diverge points on the freeway
  - Conversion of merge/diverge point to an add or drop lane

- Relocation of merge/diverge points closer to the Center Drive interchange where an existing or future heavy weaving movement may be affected
- Modifications to vertical clearance of the overpass(es)

All of the options are comparable for this criterion with the exception of the Wilmington Flyover, which would be closer to the Center Drive interchange

- ***Access to local systems and communities***

  This interchange serves two distinct geographic areas. Considerations for accessing each are described below:
  - Access to DuPont, Steilacoom, and Lewis North which was evaluated based on:
    - Length of trip to/from I-5 and local commercial areas
    - Length of trip to/from I-5 and local residential areas
    - Number of controlled intersections between I-5 and the local roadway system
    - Grade separation of railroad
  - Access to JBLM (Lewis Main)
    - Length of trip to/from I-5 and the DuPont ACP
    - Number of controlled intersections between I-5 and the local roadway system

  The Couplet Concept contains more controlled intersections (4) than all the other options. All options provide grade separation over the Sound Transit railroad, with the exception of the Local Crossing with At-Grade Rail Concept.

- ***Ability of the interchange to accommodate different modes*** including:
  - Freight/Trucks
    - Length of trip from I-5 to industrial areas
    - Number of controlled intersections between I-5 and local system
  - Driver expectations about where and how to gain access and egress from I-5
    - Does the interchange provide a common/typical configuration (defined as having the on-ramp and off-ramp meeting at the same location)
    - Does the interchange create the potential for driver confusion

    Both couplet options have non-typical interchange configuration and would need to be effectively signed to avoid drive confusion.
  - Non-motorized connectivity and ease of use

    - Which option provides the most direct path to/from JBLM and the commercial development west of I-5
    - How well do the options provide access to the proposed shared-use path
    - Number of controlled intersections between JBLM and commercial development north of I-5

  The Local Crossing with At-Grade Rail and Wilmington Flyover Concepts provide the most direct connection across I-5. The Couplet Concept contains more controlled intersections than all the other options. All of the options provide equal access to the proposed shared use bicycle/pedestrian path.

  - Traffic operations and queuing capacity
    - The traffic operations assessment uses either new analysis or earlier and relevant analysis to determine if the interchange would operate acceptability. Changes in intersection spacing along Barksdale Drive and Steilacoom-DuPont Road were also considered.
    - The adequacy of queuing capacity is measured in terms of the length of proposed off-ramps, as well as the length of the road between the interchange and the ACP.

  All options have been shown to function acceptably in the 2040 volume horizon. Both the Couplet Concept and the Couplet Concept with Split Ramps would include additional controlled intersections, but each of these would operate with fewer movements, likely improving performance. The Couplet Concept with Split Ramps would provide the most roadway length for potential queue storage. The Couplet Concept could potentially provide the least amount of ramp storage. All of the options are expected to provide more queue storage to the existing and/or a reconfigured ACP.

5.2.2 Environmental Impact

The environmental benefits and impacts associated with each design option were assessed based on their possible effects on:

- ***Wetlands/Wildlife*** including:
  - Magnitude of potential impacts to existing wetlands and/or wetland buffers
  - Proximity of design option to stream and outfall to Bell and McKay marshes.
  - Magnitude of potential impact to riparian and instream habitats and associated Threatened & Endangered (T&E) species
  - Magnitude of potential impact to T&E species in Oregon white oak habitat
- ***Noise/Visual impacts*** which were evaluated based on the following:
  - Proximity of design option footprint to previously identified receptors
  - Proximity of sensitive noise receptors to design option footprint

  - Magnitude of long-term impacts on visual character (i.e., added retaining walls, increased pavement width/modified geometry, number of structures, and loss of existing trees and other vegetation)

- ***Cultural/Historic Resources*** (Section 106 and Section 4f) focusing on:
  - Magnitude of potential impact to properties listed on National Register of Historic Places (NRHP)
  - Potential impacts on properties eligible for listing on the NRHP
  - Potential impacts to existing park resources (Robinson Park and Iafrati Park in DuPont)

- ***Land Use*** (planned future improvements) factors including:
  - Relationship of design option to existing/planned commercial area near Exit 119
  - Relationship of design option to existing/planned residential areas in vicinity of Exit 119 and/or along Steilacoom-DuPont Road
  - Potential impacts to land use on JBLM including leased housing, potentially historic properties and/or JBLM training facilities

5.2.3 Implementation Characteristics

The characteristics and issues associated with implementation of each design option were assessed based on their effects on:

- ***Project Schedule*** which is influenced by:
  - The need to acquire additional right-of-way or easements including private land acquisition or easements from the Department of Defense. Potential impacts to areas identified for existing or future leased housing on JBLM also heavily influence project schedule.
  - Requirements for environmental documentation under NEPA
    - A Documented Categorical Exclusion or DCE (estimated to take approximately 12 months)
    - Supplemental EA (18-24 months)
  - Project Development
    - Potential issues related to design and the development/approval of the required Interchange Justification Report (IJR)
- ***Cost*** of each option relative to all other options
- ***Project Acceptability*** to stakeholders including WSDOT, JBLM and the City of DuPont
- ***Constructability/Maintenance of Traffic (MOT)*** effects relative to all other options

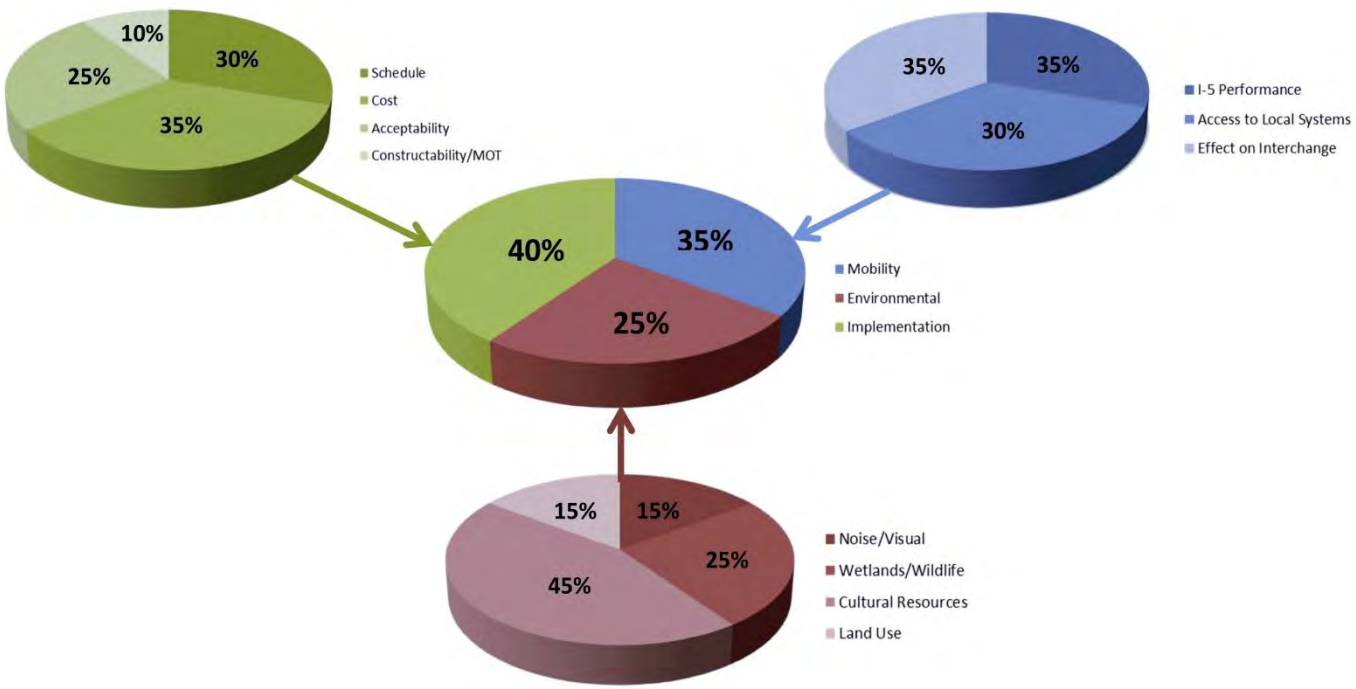
5.3 How Were Design Options Weighted and Scored?

There were two major steps in the evaluation and screening of design options for the I-5 interchange at Steilacoom/DuPont Road. The first step involved identification of the relative importance of the various evaluation criteria identified in Section 5.2. This was accomplished by weighting each criterion as discussed in Section 5.3.1 below. The second step involved scoring each option relative to the evaluation criteria on a scale from 0 to 100. Scores were then multiplied by relative weights for each criterion and a final combined score was determined for each option. This process is discussed in Section 5.3.2.

5.3.1 Weighting of Evaluation Criteria

The evaluation of design options was conducted using the criteria identified and detailed in Section 5.2. As noted, the three major categories of criteria were weighted based their relative importance to key project stakeholders. As shown in Figure 5-2, a collective weight of 40 percent out of 100 was assigned to the factors related to ***Implementation Characteristics***. A weighting of 35 percent out of 100 was assigned to considerations related to ***Mobility and Connectivity***, while ***Environmental Impacts*** were assigned a collective weight of 25 percent. These weightings are not meant to imply that there is a lower value placed on mobility or environmental impacts than on implementation. Any selected option will need to provide meaningful benefits in meeting the mobility goals of the overall project, while

Figure 5-2. Weighting of Design Option Evaluation Factors



avoiding or minimizing adverse environmental impacts. However, implementation considerations were ranked highest because of the project's schedule and cost constraints.

As illustrated in Figure 5-2, each of the evaluation sub-criteria categories were further weighted based on the relative importance of their component elements. For example, within the mobility category, I-5 performance, local community access, and interchange accommodation of various modes and functions were also weighted to help define the relative importance of each of these factors in differentiating among design options. I-5 performance was weighted at 35 percent out of 100, local community access was weighted at 30 percent out of 100, and interchange accommodations were weighted at 35 percent out of 100. A similar weighting was conducted for the component elements of the environmental and implementation categories using the more detailed criteria discussed in Section 5.2. These weightings are also presented in Figure 5-2.

In some instances, the evaluation criteria under each major category were defined at an even finer level of detail to reflect the most relevant set of considerations in differentiating one design option from another. This finer level of detail is illustrated in Table 5-1.

Table 5-1. Weighting of Evaluation Criteria

Criteria	Proportion of Points
Mobility and Connectivity (35% of All Points)	
• I-5 Performance	30%
• Access to Local Streets and Communities	
o DuPont/Steilacoom/Lewis North	17.5%
o JBLM (Lewis Main)	17.5%
	35%
• Interchange Accommodations	
o Freight/Truck	10%
o Driver Expectations	5%
o Non-motorized Connectivity/Ease	5%
o Traffic Operations/Queue Capacity	15%
	35%
Total Mobility and Connectivity	*100 points max.*

Criteria	Proportion of Points
Implementation Characteristics (40% of All Points)	
• Schedule	
o Right of Way	12.5%
o NEPA	12.5%
o Project Development	5%
	30%
• Cost	35%
• Project Acceptability	25%
• Constructability/MOT	10%
Total Mobility and Connectivity	*100 points max.*
Environmental Impacts (25% of All Points)	
Noise/Visual	15%
Wetlands/Wildlife	25%
Cultural/Historic Resources & Section 4f	45%
Land Use	15%
Total Environmental	*100 points max.*

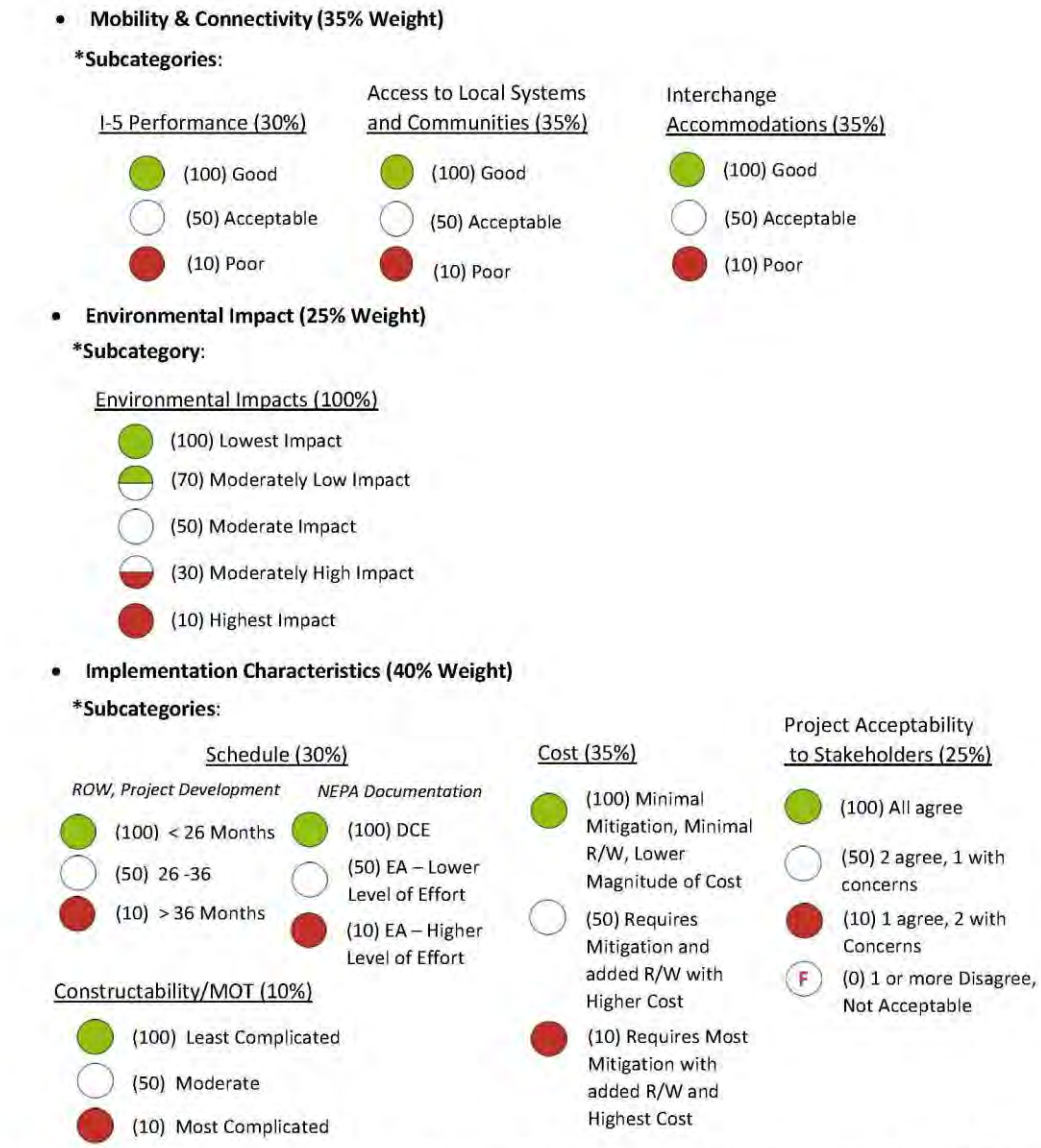
5.3.2 Scoring of Design Options

The second step in the process of evaluating design options for Exit 119 focused on scoring options based on the magnitude of their benefits or adverse impacts relative to each other for each evaluation criterion. As illustrated in Figure 5-3, scoring was based on the assignment of points (from zero to 100) for each unique criterion to indicate how well a particular option would meet project objectives and minimize adverse effects.

For example, when the potential environmental impacts of an option were scored, criteria including effect on wetland/wildlife, cultural/historic resources, land use, and noise and visual context were all considered individually. Scores were assigned ranging from 10 (reflected the highest impact in relation to all other options) to 100 (reflecting the lowest impact). For mobility and connectivity criteria such as I-5 performance, scores ranged from 100 (reflecting the best performance) to 10 (reflecting the poorest performance). Unique to this scoring system were the values assigned to the criterion labeled Project Acceptability to Stakeholders. The criterion included a score of zero to accommodate a complete rejection of an option by any one or more of the three primary stakeholders (WSDOT, JBLM and/or City of DuPont).

The scoring of design options was accomplished by a sub-committee of the project's Technical Support

Figure 5-3. Scoring of Design Options



* Subcategory weights will be applied to the primary category weight. For example, the score for I-5 Performance will be multiplied by its subcategory weight of 30%, then multiplied by the primary category weight of 35% for Mobility and Connectivity.

Group. This committee included three stakeholder agencies, and was supported by consultant staff familiar with the project and its analysis history. Four meetings of this sub-committee were held. The first meeting was held on June 26, 2017 to determine the evaluation criteria and initial weighting. The second meeting was held on July 6, 2017 to refine the weighting and approve the scoring mechanism. Scoring of the Wilmington Flyover option was also accomplished at this meeting. The third meeting was held on July 11, 2017 where all of the remaining options with one exception were evaluated and scored. The fourth meeting was held on August 2, 2017 at which the final option was scored (Local Road with At-Grade Railroad).

All scoring for each design option was documented in an Excel spreadsheet. Copies of these spreadsheets are included in Appendix C. These spreadsheets allowed for easy calculation of the total score of each option taking into consideration the assigned weighting of each evaluation criterion and the points assigned to the option by project stakeholders.

5.4 Results of the Design Option Scoring Process

The results of the scoring process for each interchange design option under consideration are presented in this section along with a brief explanation of how scores were assigned for each evaluation criterion. The full scores for each design option when evaluated against the criteria, weighting and scoring system described above are presented in the matrices in Appendix C. The rationale for each scoring decision is summarized below.

5.4.1 Skewed Alignment Concept

5.4.1.1 Mobility and Connectivity

Overall Mobility and Connectivity Score: 73 points out of a possible 100

I-5 Performance: This option would move the interchange farther north and provide greater separation from the Center Drive ramps. This could potentially improve weaving and merging activity on I-5 resulting in an improved level of performance.

Local Access: This option doesn't separate traffic to/from various destinations on the west side of I-5 as well as the Exit 119 A-B Couplet Concept with Split Ramps. On the east side, this interchange concept would have accessibility impacts internal to JBLM requiring backtracking from the potential location of a new ACP to the heart of Lewis Main. The height of the overcrossing would require a long transition from the I-5 bridge to rejoin the grade of the local street system.

Interchange Accommodations: This option would provide great access for trucks, which would move smoothly through the interchange area. The standard design of the interchange would minimize driver confusion with freeway access and egress occurring in the same proximity. While the design would include full bicycle and pedestrian facilities, walkers and bicyclists would have to travel further between the base and

neighboring commercial and residential areas than they do today. The interchange would be designed to ensure that traffic operations and queuing would all be within acceptable parameters for the 2020 and 2040 AM and PM peak hours.

5.4.1.2 Environmental Impact

Overall Environmental Score: 41 points out of a possible 100

Wetlands and Wildlife: This option may slightly impact Wetland 12 as illustrated in Figure 2-8. Furthermore, there may be some impact to Threated and Endangered Species in the Oregon White Oak habitat on the east side of I-5.

Cultural/Historic Resources: This option would pass through a corner of the Garrison Historic District and memorial grove (a Section 106 and 4f resource) which lies on the east side of I-5 to the north of the existing interchange. The location of this district is shown in Figure 2-10. No Section 4f park resource impacts are anticipated.

Land Use: This option would have a relatively large footprint (including the reconfigured ACP) on JBLM which would affect the ability of the base to use land in the vicinity of the interchange for other purposes. The ACP reconfiguration may result in relatively inefficient localized traffic circulation and property access would require some out-of-direction travel to reach the heart of the base.

Noise/Visual: Noise impacts are expected to be low due to limited noise-sensitive receptors in the area. Noise impacts from the I-5 mainline are expected to dominate the ambient noise environment. There would be some visual impacts associated with the design option but these are expected to be less than some of the other options.

5.4.1.3 Implementation Characteristics

Overall Implementation Score: 42.5 points out of a possible 100

Schedule: Effects on project schedule are measured in terms of the extent of right-of-way acquisition (or easement) needs, the type of NEPA approval process expected, potential project development issues, and constructability/maintenance of traffic effects. With this design option an additional easement would be needed from JBLM and the project could potentially impact a small corner of the on-base leased housing area which would have significant schedule implications. The NEPA process would likely require a Supplemental Environmental Assessment (EA) which could potentially double the project approval process in comparison to options requiring only a Documented Categorical Exclusion (DCE). The possible impacts to the Garrison Historic District may make this option difficult to implement from a NEPA standpoint. This option would also have several project development challenges in that it would necessitate construction of a new ACP on JBLM to replace the existing DuPont gate. As JBLM's plans for gate replacement are not expected to be finalized for several years, the time needed to come to agreement on where WSDOT should build a new ACP may impact the schedule of improvements at this interchange. Additionally, WSDOT would need to build an

internal street system on JBLM to serve the reconfigured ACP and agreement on street layout, alignment and connections would also affect project schedule.

Cost: The design option is expected to be less expensive than the Wilmington Flyover Concept, but does have the added costs of a reconfigured ACP, internal JBLM roads and the displacement of current on-base land uses where the reconfigured ACP would be located.

Project Acceptability: The design option is acceptable to WSDOT and the City of DuPont. During the screening process JBLM raised concerns about visual issues (i.e., line-of-sight to building 1010), potential need to upgrade the on-base 911 center, and effects on the historical area, all of which would require mitigation. While the concept could nominally be acceptable to JBLM consensus is unlikely or difficult.

Constructability/MOT: The ability to keep the existing interchange in operation during construction of most project elements would make this option one of the easiest to construct while maintaining existing traffic patterns. Stages of construction would need to accommodate continued operation of the existing DuPont ACP during the transition from the old gate to a new gate.

TOTAL WEIGHTED SCORE FOR THE SKEWED ALGNMENT CONCEPT WOULD BE 52.8 OUT OF 100.

5.4.2 Exit 119 Couplet Concept (Couplet)

5.4.2.1 Mobility and Connectivity

Overall Mobility and Connectivity Score: 67.5 points out of a possible 100

I-5 Performance: This option would retain ramps to/from the south in approximately the same location as today while the distance to/from the north to the Main Gate interchange would be slightly reduced. However, there is more than adequate distance between the proposed Steilacoom-DuPont Road ramps and the Main Gate ramps to accommodate any expected weaving or merging activity. This design option is not expected to substantively change I-5 performance in comparison to the other options.

Local Access: This option doesn't separate traffic to/from various destinations as well as the Exit 119 A-B Couplet Concept with Split Ramps. On the east side, this interchange concept would provide the same access to JBLM to/from the south as today. However, access to/from the north would require traveling through an additional set of intersections.

Interchange Accommodations: This option would be less accommodating of truck traffic heading to DuPont due to the added intersections which add delay and require more turning movements. This option would be a little more complex in terms of driver expectations, and would require signing to direct motorists to appropriate destinations. However, this option is more straight-forward for drivers than the Exit 119 A-B Couplet Concept with Split Ramps. Full bicycle and pedestrian facilities would be provided. Traffic operations and queuing analysis was

conducted for this option as documented in Chapter 4. As indicated in the 2020 and 2040 AM and PM peak hourly data all interchange area intersections are expected to operate at LOS C or better with no substantive queuing issues observed.

5.4.2.2 Environmental Impact

Overall Environmental Score: 87.5 points out of a possible 100

Wetlands and Wildlife: Potential impacts on wetlands on the west side of I-5 would be similar to those described for the Skewed Alignment Concept. Potential impacts to Hanna Lake on JBLM are not expected, nor are impacts to the Oregon White Oak trees.

Cultural/Historic Resources: This option has the smallest footprint of all design options, so it is expected to have the lowest impact on cultural or Section 4f park resources of any option. Some small impact to a corner of the Garrison Historic District may occur to accommodate the northbound on-ramp.

Land Use: The alignment of the access road between I-5 and Steilacoom-DuPont Road would affect future land development opportunities on JBLM behind the Barksdale Station commercial area in DuPont. As no new ACP would be required with this option, land use impacts to JBLM on the Lewis Main side of I-5 are expected to be nominal.

Noise/Visual: Due to its relatively low profile and minimal footprint in comparison to some of the other design options, this option is expected to have the least impact on noise and visual resources.

5.4.2.3 Implementation Characteristics

Overall Implementation Score: 95 points out of a possible 100

Schedule: With this design option an additional easement would be needed from JBLM on Lewis North. The project could potentially impact a small corner of the on-base leased housing area north of Pendleton Avenue which would have schedule implications. As most of the proposed improvement would be located within existing highway right-of-way, NEPA approval may only require a Documented Categorical Exclusion (DCE) which would shorten project schedule considerably in comparison to preparing a Supplemental EA. This option does not necessitate development of a new ACP for JBLM or reconfiguration of JBLM's internal roadway system to accommodate the ACP. However, the option does include the development of two freeway overcrossing structures with traffic signal-controlled intersections. Nevertheless, the complexity of project development is expected to be less than options that include a new ACP and roundabouts which require added right-of-way.

Cost: This design option is expected to be the least costly of all options under consideration.

Project Acceptability: This option is acceptable to all three project stakeholders (WSDOT, JBLM and the City of DuPont).

Constructability/MOT: With two bridges to construct, this option would likely be more complex in terms of construction staging and Maintenance of Traffic than the non-couplet options. It would be similar to the Exit 119 A-B Couplet Concept with Split Ramps.

TOTAL WEIGHTED SCORE FOR THE EXIT 119 COUPLET CONCEPT WOULD BE 83.51 OUT OF 100.

5.4.3 Exit 119 A-B Couplet Concept with Split Ramps (A-B Concept)

5.4.3.1 Mobility and Connectivity

Overall Mobility and Connectivity Score: 93 points out of a possible 100

I-5 Performance: This option would be similar to the Couplet Concept described above in terms of expected effects on I-5 performance.

Local Access: This option would separate traffic to/from various destinations on both sides of I-5. Access between I-5 south of Exit 119 and destinations west of I-5 (DuPont, Steilacoom and Lewis North) would pass through two intersections, as compared to three in the northbound direction with the Couplet Concept. On the east side, this concept would provide similar access to JBLM to/from the south as today. Access to/from the north would pass through two intersections as compared with three intersections from the north with the Couplet Concept.

Interchange Accommodations: Freight movement through this interchange is expected to be easier than with the Couplet Concept due to having one fewer signalized intersection for drivers coming from the north to JBLM and coming from the south to DuPont. The interchange design option would be more complicated from the perspective of driver expectations than the Couplet Concept and would need appropriate signing to/from destinations. Drivers would need signing instructing them as to whether to take the first exit on the off-ramp or to use the second exit. The non-motorized connections would not be as user-friendly as the Couplet Concept as walkers and bicyclists would need to avoid the vehicular bypass route created by the split ramps in order to make good connections between JBLM and DuPont. This concept would work extremely well from a traffic operations perspective, particularly due to the elimination of heavy through-moving traffic from the initial northbound and southbound off-ramp intersections.

5.4.3.2 Environmental Impact

Overall Environmental Score: 74 points out of a possible 100

Wetlands and Wildlife: Potential impacts on wetlands on the north side of I-5 would be identical to those described for the Skewed Alignment Concept. Potential impacts to Hanna Lake on JBLM are not expected, nor are possible impacts to the Oregon White Oak trees.

Cultural/Historic Resources: As this option has a slightly larger footprint than the Couplet Concept. It is expected to have a slightly larger impact on cultural or Section 4f resources. However, this impact would likely be less than any of the other options. A small impact to the Garrison Historic District may occur.

Land Use: Land use impacts are expected to be the same as the Couplet Concept, primarily focused on the access road between I-5 and Steilacoom-DuPont Road that would affect future land development opportunities on JBLM behind the Barksdale Station commercial area in DuPont.

Noise/Visual: Due to its relatively low profile in comparison to some of the other design options and minimal footprint, this design option is expected to have one of the lowest impacts on noise and visual resources. Impacts are expected to be comparable to the Couplet Concept.

5.4.3.3 Implementation Characteristics

Overall Implementation Score: 88.75 points out of a possible 100

Schedule: This option would require slightly more right-of-way than the Couplet Concept and could impact the JBLM leased housing property adjacent to the northbound on-ramp. This could affect project schedule. This option could also require a DCE to satisfy NEPA. Project development efforts would be similar to the Couplet Concept.

Cost: Costs are not expected to be substantively different from the Couplet Concept except for the addition of the two bypass ramps which require slightly longer bridges over I-5.

Project Acceptability: This option is acceptable to all three project stakeholders (WSDOT, JBLM and the City of DuPont).

Constructability/MOT: With two bridges to construct, this option would likely be more complex in terms of construction staging and Maintenance of Traffic than the non-couplet options. It would be similar to the Couplet Concept.

TOTAL WEIGHTED SCORE FOR THE EXIT 119 A-B COUPLET CONCEPT WITH SPLIT RAMPS WOULD BE 86.55 OUT OF 100.

5.4.4 Wilmington Flyover Concept

5.4.4.1 Mobility and Connectivity

Overall Mobility and Connectivity Score: 53 points out of a possible 100

I-5 Performance: This option would provide slightly less separation between the I-5 interchanges at Steilacoom-DuPont Road and Center Drive than exist today resulting in less than one mile spacing between freeway merge points. This would require a design exception and may affect traffic weaving and merging operations on the I-5 mainline unless mitigated.

Local Access: This option provides access to/from Steilacoom-DuPont Road at a point slightly closer to I-5 than the other options which is a minor plus for commercial area access, as well as circulation along Barksdale Avenue and Wilmington Drive. However, distances would be longer to residential, industrial and military destinations to the north. This option would be aligned directly through an area zoned commercial in the

City's Barksdale Station retail node. To accommodate access to JBLM, a reconfigured ACP would be required which has circulation issues similar to the Skewed Alignment Concept.

Interchange Accommodations: The physical configuration for this option requires a long grade associated with the extensive overcrossing structure and 90-degree turns to/from Steilacoom-DuPont Road rather than a direct connection as would be provided with most other options. This would result in poorer freight mobility to/from the industrial areas of DuPont than the other options. The proposed option would have a standard interchange configuration which would be clear and easily comprehensible to drivers. While bicycle and pedestrian facilities would be provided with this option, the steep overcrossing may reduce its attractiveness. As traffic movement would be similar to the four-lane bridge concept previously studied, operations and queueing impacts are expected to be acceptable.

5.4.4.2 Environmental Impact

Overall Environmental Score: 41 points out of a possible 100

Wetlands and Wildlife: No wetland impact is expected to the Bell Marsh buffer. Impacts could occur in the area designated as Hanna Lake on JBLM that may require mitigation. There may also be a slight impact to the memorial grove white oak habitat.

Cultural/Historic Resources: This option could slightly touch a corner of the Garrison Historic District and the memorial grove. Due to its location between Barksdale Avenue and Steilacoom-DuPont Road, this option may have some impact on Section 4f park resources in DuPont and may also affect the Old DuPont historic area.

Land Use: This option would have a large impact to undeveloped, commercially-zoned property in the DuPont Historic Village commercial node. The reconfigured ACP on JBLM would affect the ability of the base to use land for other purposes in the vicinity of the interchange. The ACP reconfiguration might result in relatively inefficient localized traffic circulation, and property access would require some out-of-direction travel to reach the heart of the base.

Noise/Visual: This project could have a substantial visual impact due to the height of the overcrossing structure above Wilmington Drive. It is expected that this structure would be approximately 30-feet above the existing Wilmington Drive/Barksdale Avenue intersection. Added noise impacts are also expected due to the height and proximity of the structure, particularly to nearby parks and residential areas.

5.4.4.3 Implementation Characteristics

Overall Implementation Score: 19.5 points out of a possible 100

Schedule: With this option, it is expected that the interchange would not need additional easement from JBLM on the north side of Clark Road, and there would be no impacts to leased housing areas on JBLM. Some displacements within both JBLM (for the reconfigured ACP) and the City

of DuPont could be necessary which may lengthen the project schedule. Due to the location and magnitude of the new road alignment between I-5 and Steilacoom-DuPont Road, it is likely that this project would require a Supplemental EA which would also adversely affect project schedule. Project development challenges would include the need to provide a reconfigured ACP and JBLM internal roadway system to serve this gate. Similar to the Skewed Alignment Concept, the new ACP could also adversely affect project schedule.

Cost: This option includes a number of very expensive project elements such as a long and high structure that would require a bridge deck large enough to accommodate the two ramp termini roundabout intersections. The project would require a new ACP on JBLM and revisions to the base's internal street system. The project would also require right-of-way acquisition of commercially-zoned property to build the new road connecting I-5 to Steilacoom-DuPont Road. This option is expected to be the most expensive of all options under consideration.

Project Acceptability: This option was identified as unacceptable to the City of DuPont.

Constructability/MOT: This option may be one of the most challenging to construct. It would be very disruptive to traffic circulation and have potential economic impacts.

TOTAL WEIGHTED SCORE FOR THE WILMINGTON FLYOVER CONCEPT WOULD BE 36.6 OUT OF 100.

5.4.5 Exit A-B Split Ramps Concept with New ACP

5.4.5.1 Mobility and Connectivity

Overall Mobility and Connectivity Score: 84.25 points out of a possible 100

I-5 Performance: This option would have similar impacts as the Skewed Alignment Concept with little measurable impact to traffic performance on the I-5 mainline.

Local Access: This option separates traffic to/from various destinations on the both sides of I-5. The option would provide access comparable to the Exit 119 A-B Couplet Concept with Split Ramps with relatively good access between DuPont and destinations to/from the south, as well as from the north. Travel from DuPont to northerly destinations would be slightly more circuitous requiring motorists to pass through multiple intersections. Access to/from JBLM on the east side of I-5 would be good except for access to southbound I-5 which would require traveling through multiple signalized intersections. Travel between JBLM and DuPont is circuitous.

Interchange Accommodations: Accessibility for freight traffic would be similar to the Exit 119 A-B Couplet Concept which includes a good separation of traffic movements on both sides of I-5. This option would be similar to the Couplet Concept with Split Ramps in terms of driver expectations and would require very good directional signage. There exists a potential for driver confusion in accessing JBLM where there is some potential for non-military drivers to inadvertently end up at the access point. Similar to the Couplet Concept with Split Ramps, this option

would require bicyclists and pedestrians to travel through multiple intersections when moving between JBLM and destinations in DuPont. Additionally, this route would be longer and more circuitous that any other option. Traffic operations and queuing are expected to be acceptable.

5.4.5.2 Environmental Impact

Overall Environmental Score: 20 points out of a possible 100

Wetlands and Wildlife: Wetland impacts on the west side of I-5 are expected to be identical to other options with an impact on existing Wetland 12. The presence and/or extent of Oregon White Oak habitat on JBLM in the vicinity of the new ACP would need to be evaluated.

Cultural/Historic Resources: This option would result in impacts to the Garrison Historic District on JBLM, particularly in the vicinity of the Family Resource Center which contributes to the listing of the Historic District on the National Register of Historic Places and which is eligible for listing in its own right. The proximity of the proposed road between the northerly I-5 interchange and the reconfigured ACP included in this option is expected to directly impact parking and landscaping in front this building. It would be very difficult to secure NEPA approval to build this road.

Land Use: This option would impact the leased housing property on JBLM.

Noise/Visual: The presence of the northerly portion of the interchange and the access road between I-5 and the new ACP would likely have noise and visual impacts on the Historic District, and the Family Resource Center in particular. In addition, as the southbound off-ramp would begin to rise to meet the grade of the I-5 overcrossing structure, visibility of the Fort Lewis Museum from the freeway and from Lewis Main would be reduced.

5.4.5.3 Implementation Characteristics

Overall Implementation Score: 32.5 points out of a possible 100

Schedule: This option would require right-of-way (JBLM easements) similar to the Couplet Concept with Split Ramps with the addition of new internal roads on JBLM and the relocated ACP. This option would also impact leased housing property on JBLM. Both the development of a fully-compliant ACP and mitigation for leased housing property impacts could substantively lengthen the project's schedule. Additionally, the potential cultural resource impacts (including the Garrison Historic District and the Family Resource Center) would require a Supplemental EA which would also lengthen the project schedule.

Cost: The design option is expected to be less expensive than the Wilmington Flyover concept, but does have the added costs of two bridges over I-5, a new ACP, internal JBLM roads and the internal displacement of the on-base leased housing property.

Project Acceptability: WSDOT expressed concern that the project could not be achieved because of cultural resource and Section 4(f) impacts for which approval by other state and Federal Agencies would be very challenging and possibly prohibitive. JBLM also expressed concern about securing FHWA approval for this option based on cultural resource impacts.

Constructability/MOT: In comparison to several of the other options where construction activity would occur in immediate proximity of the existing interchange, construction of and maintenance of traffic for this option would be relatively straight-forward.

TOTAL WEIGHTED SCORE FOR THE A-B SPLIT RAMP CONCEPT WITH NEW ACP WOULD BE 47.49 OUT OF 100.

5.4.6 Local Crossing with At-Grade Rail Concept

5.4.6.1 Mobility and Connectivity

Overall Mobility and Connectivity Score: 60.5 points out of a possible 100

I-5 Performance: This option would provide a new diamond interchange north of the existing Exit 119 interchange and would replace the existing interchange with a local access-only bridge and road connection between the City of DuPont and JBLM. Due to the circuitous routing for northbound traffic destined to JBLM, this option may result in a diversion of this traffic away from Exit 119 to another exit such as Mounts Road or Main Gate. This could have implications for traffic on the I-5 mainline including approaching the Mounts Road interchange or continuing from Exit 119 to Exit 120 (Main Gate). Diversion of JBLM traffic to other interchanges could also stress or exceed the capacity of those interchanges, however the presence or extent of such an impact is unknown at the present time. Accordingly, this design option is not expected to substantively change I-5 performance in comparison to the other options.

Local Access: This option doesn't separate traffic to/from various destinations on either side of I-5. There would be no substantive change in access to/from DuPont in comparison with the couplet options. Access to/from most DuPont residential and industrial areas would be direct, but would have to compete with JBLM destined traffic on the west side of I-5. It is anticipated that there could be more traffic on Steilacoom-DuPont Road between the new access road to I-5 and the intersection with Wilmington Drive and Barksdale Avenue. Access to JBLM from the south would be more circuitous. This option would provide a direct local street connection between the Base and DuPont. The new (replacement) at-grade rail crossing is a concern.

Interchange Accommodations: This option would provide relatively easy access for freight traffic heading to DuPont although there would be greater interaction with JBLM traffic than with most other options. This option could also be more confusing for drivers, particularly with making route choice decisions after leaving I-5. Where access from the south to JBLM currently requires one right turn, with this option it would require three left turns. Good and repeated directional signage would be necessary, and the interchange would be designed to accommodate

operational and queuing needs. Pedestrian and bicyclist connections between DuPont and JBLM would be via a local street, making this option the best of all options for these travel modes. However, the direct connection would require that pedestrians and bicyclists cross the rail trackage at-grade.

5.4.6.2 Environmental Impact

Overall Environmental Score: 83 points out of a possible 100

Wetlands and Wildlife: Potential impacts on wetlands on the west side of I-5 would be identical to those described for the Skewed Alignment and Couplet Concepts. Potential impacts to Hanna Lake on JBLM are possible but might be avoided. Impacts to the Oregon White Oak trees would likely be minimal.

Cultural/Historic Resources: As this option has one of the smallest footprints of all design options, it is expected to have among the lowest impact on cultural or Section 4f resources. Similar to the Couplet Concept, some impact to the Garrison Historic District may occur.

Land Use: The alignment of the access road between I-5 and Steilacoom-DuPont Road would affect future land development opportunities on JBLM behind the Barksdale Station commercial area in DuPont. As no new ACP would be required with this option, land use impacts to JBLM on the east side of I-5 are expected to be negligible. It is anticipated that this option might attract higher traffic volumes adjacent to the commercial area at Barksdale Station.

Noise/Visual: The relatively low profile and minimal footprint of this option would likely minimize noise and visual impacts associated with the freeway interchange. However, the inclusion of the local street connection with an at-grade rail crossing would result in continuation of existing train horn noise.

5.4.6.3 Implementation Characteristics

Overall Implementation Score: 57.25 points out of a possible 100

Schedule: With this design option an additional easement would be needed from JBLM on Lewis Main, but the project is not expected to impact the on-base leased housing areas. As most of the proposed improvement is located within existing highway right-of-way, NEPA approval may only require a Documented Categorical Exclusion (DCE) which would shorten project schedule considerably in comparison to preparing a Supplemental EA. This option does not include development of a new ACP for JBLM or reconfiguration of JBLM's internal roadway system to accommodate an ACP which would also have beneficial impacts on the project schedule. However, the option does include the development of two freeway overcrossing structures and would require building a new at-grade rail crossing for the access to the local street bridge. The existing bridge cannot be retained as the proposed improvements on I-5 require both a higher and wider structure than currently exists. To maintain traffic operations at the existing interchange during construction of the new improvements, the local bridge must be built slightly offset from the

existing structure. This would require a new rail crossing with all its associated permitting from the state Utilities and Transportation Commission and Sound Transit. This could have significant schedule implications. Additionally, there may be substantial design challenges in developing the street connection between the new bridge abutment and the rail crossing due to the differential in height.

Cost: Project costs are expected to be similar to the couplet options.

Project Acceptability: The permitting issues associated with rebuilding the at-grade rail crossing represent a project risk that cannot currently be quantified. The magnitude of these issues may make the project difficult to achieve. Retaining (rebuilding) an at-grade railroad crossing while also investing in a grade-separated railroad crossing within 1,000 feet is not likely to be acceptable to WSDOT. Additionally, the City of DuPont expressed concern that there would still be an at-grade rail crossing in the project area even after a substantial expenditure of resources. This may be unacceptable to the general public.

C***onstructability/MOT:*** The new local street bridge would be higher and longer, and would be close to the existing structure. Construction staging would be challenging and would need to occur while maintaining existing traffic, particularly to and from the DuPont ACP. This would result in substantial local traffic circulation challenges and potential economic impacts.

TOTAL WEIGHTED SCORE FOR THE LOCAL CROSSING WITH AT-GRADE RAIL CONCEPT WOULD BE 64.83 OUT OF 100.

5.5 Conclusions

Table 5-3 and Figure 5-4 summarize and graphically illustrate the results of the scoring analysis process for the Exit 119 design options under consideration. As indicated in the graphic, the Wilmington Flyover Concept scored the lowest of all options (with 36.6 points out of 100) followed by the A-B Ramp Concept with New ACP (47.49 points) and the Skewed Alignment Concept (52.8 points). The two couplet options (with and without split ramps) scored the highest, with 83.51 points out of 100 for the Couplet Concept and 86.55 points out of 100 for the Couplet Concept with Split Ramps. The concept with the local street bridge and at-grade rail crossing scored in the middle with 64.83 points out of 100.

Figure 5-4. Summary of Evaluation Results

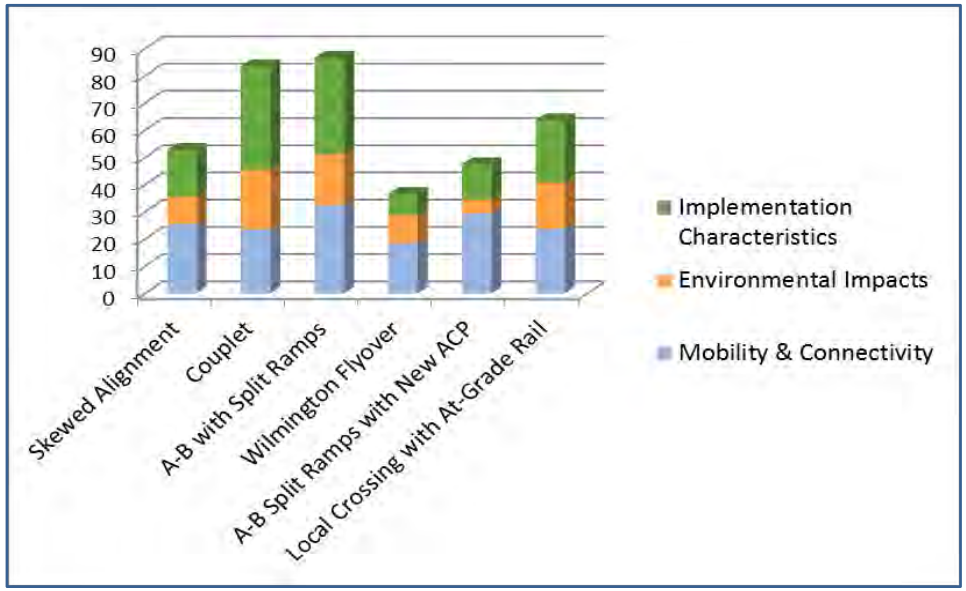


Table 5-2. Summary of Evaluation Results for Exit 119 Design Options

Design Option	Mobility and Connectivity	Environmental Impacts	Implementation Characteristics	Total Score
Skewed Alignment Concept	25.55	10.25	17.0	52.8
Exit 119 Couplet Concept	23.63	21.88	38.0	**83.51**
Exit A-B Couplet Concept with Split Ramps	32.55	18.5	35.5	**86.55**
Wilmington Flyover Concept	18.55	10.25	7.8	36.6
A-B Split Ramp Concept with New ACP	29.49	5.0	13.0	47.49
Local Crossing with At-Grade Rail Concept	21.18	20.75	22.9	64.83

Note: More detailed information about scoring and weighting of evaluation results for each design option can be found in Appendix C.

6 RECOMMENDED INTERCHANGE OPTION AND NEXT STEPS

6.1 What Design Option is Recommended for Further Consideration?

Based on the analysis discussed in Chapter 5, the Exit 119 Couplet Concept and Exit 119 A-B Couplet Concept with Split Ramps are recommended to be carried forward for more detailed, in-depth analysis during preliminary design and the IJR and NEPA evaluation processes. A final decision regarding the configuration of the ramps will made as part of the IJR and NEPA effort.

6.2 What are the Next Steps in the Study Process?

After review and endorsement of this report by the project stakeholders involved in this feasibility study, the next steps in the process of developing a new interchange at Exit 119 include the following:

- Initiate preliminary engineering of the Build Alternative to identify the project's footprint.
- Conduct analysis of traffic operations/safety and the built and natural environment to complete the requirements for NEPA documentation and an Interchange Justification Report.

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APPENDIX A

2020 INTERSECTION OPERATIONS AND QUEUING ANALYSIS WORKSHEETS

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	5	150	665	0	775	0	0	440	505
Future Volume (veh/h)	0	0	0	5	150	665	0	775	0	0	440	505
Number				3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln				1863	1863	1863	0	1863	0	0	1863	1863
Adj Flow Rate, veh/h				5	163	723	0	842	0	0	478	141
Adj No. of Lanes				1	1	1	0	2	0	0	2	1
Peak Hour Factor				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %				2	2	2	0	2	0	0	2	2
Cap, veh/h				949	997	847	0	1115	0	0	1115	499
Arrive On Green				0.53	0.53	0.53	0.00	0.31	0.00	0.00	0.31	0.31
Sat Flow, veh/h				1774	1863	1583	0	3725	0	0	3632	1583
Grp Volume(v), veh/h				5	163	723	0	842	0	0	478	141
Grp Sat Flow(s),veh/h/ln				1774	1863	1583	0	1770	0	0	1770	1583
Q Serve(g_s), s				0.1	2.7	23.4	0.0	12.8	0.0	0.0	6.4	4.0
Cycle Q Clear(g_c), s				0.1	2.7	23.4	0.0	12.8	0.0	0.0	6.4	4.0
Prop In Lane				1.00		1.00	0.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h				949	997	847	0	1115	0	0	1115	499
V/C Ratio(X)				0.01	0.16	0.85	0.00	0.76	0.00	0.00	0.43	0.28
Avail Cap(c_a), veh/h				949	997	847	0	1115	0	0	1115	499
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	1.00	1.00	0.00	0.71	0.00	0.00	1.00	1.00
Uniform Delay (d), s/veh				6.5	7.1	11.9	0.0	18.5	0.0	0.0	16.3	15.5
Incr Delay (d2), s/veh				0.0	0.4	10.7	0.0	3.4	0.0	0.0	1.2	1.4
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				0.0	1.5	12.5	0.0	6.7	0.0	0.0	3.3	2.0
LnGrp Delay(d),s/veh				6.5	7.5	22.6	0.0	21.9	0.0	0.0	17.5	16.9
LnGrp LOS				A	A	C		C			B	B
Approach Vol, veh/h					891			842			619	
Approach Delay, s/veh					19.7			21.9			17.3	
Approach LOS					B			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		8
Phs Duration (G+Y+Rc), s		23.4				23.4		36.6
Change Period (Y+Rc), s		4.5				4.5		4.5
Max Green Setting (Gmax), s		18.9				18.9		32.1
Max Q Clear Time (g_c+I1), s		14.8				8.4		25.4
Green Ext Time (p_c), s		3.0				6.5		2.4

Intersection Summary	
HCM 2010 Ctrl Delay	19.9
HCM 2010 LOS	B

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	775	70	0	0	445	0
Future Volume (veh/h)	775	70	0	0	445	0
Number	7	4			1	16
Initial Q (Qb), veh	0	0			0	0
Ped-Bike Adj(A_pbT)	1.00				1.00	1.00
Parking Bus, Adj	1.00	1.00			1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863			1863	0
Adj Flow Rate, veh/h	842	76			484	0
Adj No. of Lanes	2	1			2	0
Peak Hour Factor	0.92	0.92			0.92	0.92
Percent Heavy Veh, %	2	2			2	0
Cap, veh/h	1304	576			0	0
Arrive On Green	0.31	0.31			0.00	0.00
Sat Flow, veh/h	3442	1863			0	
Grp Volume(v), veh/h	842	76			0.0	
Grp Sat Flow(s),veh/h/ln	1721	1863				
Q Serve(g_s), s	13.4	1.8				
Cycle Q Clear(g_c), s	13.4	1.8				
Prop In Lane	1.00					
Lane Grp Cap(c), veh/h	1304	576				
V/C Ratio(X)	0.65	0.13				
Avail Cap(c_a), veh/h	1875	885				
HCM Platoon Ratio	1.00	1.00				
Upstream Filter(I)	0.70	0.70				
Uniform Delay (d), s/veh	19.0	14.9				
Incr Delay (d2), s/veh	0.4	0.1				
Initial Q Delay(d3),s/veh	0.0	0.0				
%ile BackOfQ(50%),veh/ln	6.4	0.9				
LnGrp Delay(d),s/veh	19.3	15.0				
LnGrp LOS	B	B				
Approach Vol, veh/h		918				
Approach Delay, s/veh		19.0				
Approach LOS		B				

Timer	1	2	3	4	5	6	7	8
Assigned Phs				4				
Phs Duration (G+Y+Rc), s				23.0				
Change Period (Y+Rc), s				4.5				
Max Green Setting (Gmax), s				28.5				
Max Q Clear Time (g_c+I1), s				15.4				
Green Ext Time (p_c), s				3.1				

Intersection Summary	
HCM 2010 Ctrl Delay	19.0
HCM 2010 LOS	B

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	230	275	170	0
Future Volume (veh/h)	0	0	230	275	170	0
Number			3	8	5	12
Initial Q (Qb), veh			0	0	0	0
Ped-Bike Adj(A_pbT)			1.00		1.00	1.00
Parking Bus, Adj			1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln			1863	1863	1863	0
Adj Flow Rate, veh/h			250	299	185	0
Adj No. of Lanes			1	1	1	0
Peak Hour Factor			0.92	0.92	0.92	0.92
Percent Heavy Veh, %			2	2	2	0
Cap, veh/h			523	423	0	0
Arrive On Green			0.07	0.07	0.00	0.00
Sat Flow, veh/h			1774	1863	0	
Grp Volume(v), veh/h			250	299	0.0	
Grp Sat Flow(s),veh/h/ln			1774	1863		
Q Serve(g_s), s			8.2	9.4		
Cycle Q Clear(g_c), s			8.2	9.4		
Prop In Lane			1.00			
Lane Grp Cap(c), veh/h			523	423		
V/C Ratio(X)			0.48	0.71		
Avail Cap(c_a), veh/h			904	823		
HCM Platoon Ratio			0.33	0.33		
Upstream Filter(I)			0.84	0.84		
Uniform Delay (d), s/veh			25.3	25.8		
Incr Delay (d2), s/veh			0.6	1.8		
Initial Q Delay(d3),s/veh			0.0	0.0		
%ile BackOfQ(50%),veh/ln			4.1	5.1		
LnGrp Delay(d),s/veh			25.8	27.7		
LnGrp LOS			C	C		
Approach Vol, veh/h				549		
Approach Delay, s/veh				26.8		
Approach LOS				C		

Timer	1	2	3	4	5	6	7	8
Assigned Phs								8
Phs Duration (G+Y+Rc), s								18.1
Change Period (Y+Rc), s								4.5
Max Green Setting (Gmax), s								26.5
Max Q Clear Time (g_c+I1), s								11.4
Green Ext Time (p_c), s								2.2

Intersection Summary	
HCM 2010 Ctrl Delay	26.8
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	645	390	0	0	0	0	165	200	0	230	0
Future Volume (veh/h)	5	645	390	0	0	0	0	165	200	0	230	0
Number	7	4	14				5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863				0	1863	1863	0	1863	0
Adj Flow Rate, veh/h	5	701	212				0	179	76	0	250	0
Adj No. of Lanes	1	1	1				0	1	1	0	1	0
Peak Hour Factor	0.92	0.92	0.92				0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2				0	2	2	0	2	0
Cap, veh/h	780	819	696				0	765	650	0	765	0
Arrive On Green	0.44	0.44	0.44				0.00	0.41	0.41	0.00	0.41	0.00
Sat Flow, veh/h	1774	1863	1583				0	1863	1583	0	1863	0
Grp Volume(v), veh/h	5	701	212				0	179	76	0	250	0
Grp Sat Flow(s),veh/h/ln	1774	1863	1583				0	1863	1583	0	1863	0
Q Serve(g_s), s	0.1	20.3	5.2				0.0	3.8	1.8	0.0	5.5	0.0
Cycle Q Clear(g_c), s	0.1	20.3	5.2				0.0	3.8	1.8	0.0	5.5	0.0
Prop In Lane	1.00		1.00				0.00		1.00	0.00		0.00
Lane Grp Cap(c), veh/h	780	819	696				0	765	650	0	765	0
V/C Ratio(X)	0.01	0.86	0.30				0.00	0.23	0.12	0.00	0.33	0.00
Avail Cap(c_a), veh/h	961	1009	858				0	765	650	0	765	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00				0.00	1.00	1.00	0.00	0.83	0.00
Uniform Delay (d), s/veh	9.4	15.1	10.9				0.0	11.5	11.0	0.0	12.0	0.0
Incr Delay (d2), s/veh	0.0	6.2	0.2				0.0	0.7	0.4	0.0	0.9	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	11.7	2.3				0.0	2.1	0.8	0.0	3.0	0.0
LnGrp Delay(d),s/veh	9.5	21.3	11.1				0.0	12.3	11.3	0.0	13.0	0.0
LnGrp LOS	A	C	B					B	B		B	
Approach Vol, veh/h		918						255			250	
Approach Delay, s/veh		18.9						12.0			13.0	
Approach LOS		B						B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		
Phs Duration (G+Y+Rc), s		29.1		30.9		29.1		
Change Period (Y+Rc), s		4.5		4.5		4.5		
Max Green Setting (Gmax), s		18.5		32.5		18.5		
Max Q Clear Time (g_c+I1), s		5.8		22.3		7.5		
Green Ext Time (p_c), s		2.3		4.1		2.1		

Intersection Summary	
HCM 2010 Ctrl Delay	16.6
HCM 2010 LOS	B

Queuing and Blocking Report

Intersection: 5: JBLM & I-5 NB Ramps

Movement	EB	EB	EB	NB	NB	SB
Directions Served	L	T	R	T	R	T
Maximum Queue (ft)	103	431	275	127	110	89
Average Queue (ft)	7	208	115	53	53	11
95th Queue (ft)	47	339	246	103	96	47
Link Distance (ft)		1108		612	612	327
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)	100		250			
Storage Blk Time (%)	0	23	0			
Queuing Penalty (veh)	0	92	0			

Intersection: 7: JBLM & I-5 SB Ramps

Movement	WB	WB	NB
Directions Served	L	T	L
Maximum Queue (ft)	178	191	111
Average Queue (ft)	93	90	25
95th Queue (ft)	148	153	79
Link Distance (ft)		1183	327
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)	350		
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 8: I-5 NB Ramps & Steilacoom

Movement	EB	EB	EB	SB	SB
Directions Served	L	L	T	L	L
Maximum Queue (ft)	248	250	86	83	85
Average Queue (ft)	93	119	20	28	53
95th Queue (ft)	176	196	59	64	85
Link Distance (ft)			1192	329	329
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)	250	250			
Storage Blk Time (%)	0	0			
Queuing Penalty (veh)	0	0			

Queuing and Blocking Report

Intersection: 9: Steilacoom & I-5 SB Ramps

Movement	WB	WB	WB	NB	NB	SB	SB	SB
Directions Served	L	T	R	T	T	T	T	R
Maximum Queue (ft)	31	87	311	118	117	173	232	162
Average Queue (ft)	4	39	163	48	45	48	119	81
95th Queue (ft)	19	76	260	100	95	139	196	141
Link Distance (ft)	966	966	966	329	329		759	759
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)						150		
Storage Blk Time (%)						0	3	
Queuing Penalty (veh)						0	6	

Network Summary

Network wide Queuing Penalty: 99

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	0	0	665	0	775	0	0	440	505
Future Volume (veh/h)	0	0	0	0	0	665	0	775	0	0	440	505
Number				3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln				0	0	1863	0	1863	0	0	1863	1863
Adj Flow Rate, veh/h				0	0	609	0	842	0	0	478	256
Adj No. of Lanes				0	0	2	0	2	0	0	2	1
Peak Hour Factor				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %				0	0	2	0	2	0	0	2	2
Cap, veh/h				0	0	0	0	3221	0	0	3221	1441
Arrive On Green				0.00	0.00	0.00	0.00	0.91	0.00	0.00	0.91	0.91
Sat Flow, veh/h					0		0	3725	0	0	3632	1583
Grp Volume(v), veh/h					0.0		0	842	0	0	478	256
Grp Sat Flow(s),veh/h/ln							0	1770	0	0	1770	1583
Q Serve(g_s), s							0.0	1.4	0.0	0.0	0.7	0.9
Cycle Q Clear(g_c), s							0.0	1.4	0.0	0.0	0.7	0.9
Prop In Lane							0.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h							0	3221	0	0	3221	1441
V/C Ratio(X)							0.00	0.26	0.00	0.00	0.15	0.18
Avail Cap(c_a), veh/h							0	3221	0	0	3221	1441
HCM Platoon Ratio							1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)							0.00	0.65	0.00	0.00	1.00	1.00
Uniform Delay (d), s/veh							0.0	0.3	0.0	0.0	0.2	0.2
Incr Delay (d2), s/veh							0.0	0.1	0.0	0.0	0.1	0.3
Initial Q Delay(d3),s/veh							0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln							0.0	0.6	0.0	0.0	0.4	0.5
LnGrp Delay(d),s/veh							0.0	0.4	0.0	0.0	0.3	0.5
LnGrp LOS								A			A	A
Approach Vol, veh/h								842			734	
Approach Delay, s/veh								0.4			0.4	
Approach LOS								A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		
Phs Duration (G+Y+Rc), s		50.0				50.0		
Change Period (Y+Rc), s		4.5				4.5		
Max Green Setting (Gmax), s		22.3				22.3		
Max Q Clear Time (g_c+I1), s		3.4				2.9		
Green Ext Time (p_c), s		10.0				10.2		

Intersection Summary	
HCM 2010 Ctrl Delay	0.4
HCM 2010 LOS	A

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	775	0	0	0	445	0
Future Volume (veh/h)	775	0	0	0	445	0
Number	7	4			1	16
Initial Q (Qb), veh	0	0			0	0
Ped-Bike Adj(A_pbT)	1.00				1.00	1.00
Parking Bus, Adj	1.00	1.00			1.00	1.00
Adj Sat Flow, veh/h/ln	1863	0			1863	0
Adj Flow Rate, veh/h	842	0			484	0
Adj No. of Lanes	2	0			2	0
Peak Hour Factor	0.92	0.92			0.92	0.92
Percent Heavy Veh, %	2	0			2	0
Cap, veh/h	0	0			0	0
Arrive On Green	0.00	0.00			0.00	0.00
Sat Flow, veh/h		0			0	
Grp Volume(v), veh/h		0.0			0.0	
Grp Sat Flow(s),veh/h/ln						
Q Serve(g_s), s						
Cycle Q Clear(g_c), s						
Prop In Lane						
Lane Grp Cap(c), veh/h						
V/C Ratio(X)						
Avail Cap(c_a), veh/h						
HCM Platoon Ratio						
Upstream Filter(I)						
Uniform Delay (d), s/veh						
Incr Delay (d2), s/veh						
Initial Q Delay(d3),s/veh						
%ile BackOfQ(50%),veh/ln						
LnGrp Delay(d),s/veh						
LnGrp LOS						
Approach Vol, veh/h						
Approach Delay, s/veh						
Approach LOS						

Timer	1	2	3	4	5	6	7	8
Assigned Phs								
Phs Duration (G+Y+Rc), s								
Change Period (Y+Rc), s								
Max Green Setting (Gmax), s								
Max Q Clear Time (g_c+I1), s								
Green Ext Time (p_c), s								

Intersection Summary	
HCM 2010 Ctrl Delay	0.0
HCM 2010 LOS	A

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	230	0	170	0
Future Volume (veh/h)	0	0	230	0	170	0
Number			3	8	5	12
Initial Q (Qb), veh			0	0	0	0
Ped-Bike Adj(A_pbT)			1.00		1.00	1.00
Parking Bus, Adj			1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln			1863	0	1863	0
Adj Flow Rate, veh/h			250	0	185	0
Adj No. of Lanes			2	0	1	0
Peak Hour Factor			0.92	0.92	0.92	0.92
Percent Heavy Veh, %			2	0	2	0
Cap, veh/h			0	0	0	0
Arrive On Green			0.00	0.00	0.00	0.00
Sat Flow, veh/h				0	0	
Grp Volume(v), veh/h				0.0	0.0	
Grp Sat Flow(s),veh/h/ln						
Q Serve(g_s), s						
Cycle Q Clear(g_c), s						
Prop In Lane						
Lane Grp Cap(c), veh/h						
V/C Ratio(X)						
Avail Cap(c_a), veh/h						
HCM Platoon Ratio						
Upstream Filter(I)						
Uniform Delay (d), s/veh						
Incr Delay (d2), s/veh						
Initial Q Delay(d3),s/veh						
%ile BackOfQ(50%),veh/ln						
LnGrp Delay(d),s/veh						
LnGrp LOS						
Approach Vol, veh/h						
Approach Delay, s/veh						
Approach LOS						

Timer	1	2	3	4	5	6	7	8
Assigned Phs								
Phs Duration (G+Y+Rc), s								
Change Period (Y+Rc), s								
Max Green Setting (Gmax), s								
Max Q Clear Time (g_c+I1), s								
Green Ext Time (p_c), s								

Intersection Summary	
HCM 2010 Ctrl Delay	0.0
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	0	390	0	0	0	0	165	200	0	230	0
Future Volume (veh/h)	5	0	390	0	0	0	0	165	200	0	230	0
Number	7	4	14				5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	0	1863				0	1863	1863	0	1863	0
Adj Flow Rate, veh/h	5	0	38				0	179	135	0	250	0
Adj No. of Lanes	1	0	1				0	1	1	0	2	0
Peak Hour Factor	0.92	0.92	0.92				0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	0	2				0	2	2	0	2	0
Cap, veh/h	80	0	71				0	1444	1227	0	2743	0
Arrive On Green	0.04	0.00	0.04				0.00	0.78	0.78	0.00	0.78	0.00
Sat Flow, veh/h	1774	0	1583				0	1863	1583	0	3725	0
Grp Volume(v), veh/h	5	0	38				0	179	135	0	250	0
Grp Sat Flow(s),veh/h/ln	1774	0	1583				0	1863	1583	0	1770	0
Q Serve(g_s), s	0.1	0.0	1.2				0.0	1.2	1.0	0.0	0.9	0.0
Cycle Q Clear(g_c), s	0.1	0.0	1.2				0.0	1.2	1.0	0.0	0.9	0.0
Prop In Lane	1.00		1.00				0.00		1.00	0.00		0.00
Lane Grp Cap(c), veh/h	80	0	71				0	1444	1227	0	2743	0
V/C Ratio(X)	0.06	0.00	0.53				0.00	0.12	0.11	0.00	0.09	0.00
Avail Cap(c_a), veh/h	692	0	617				0	1444	1227	0	2743	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00				0.00	1.00	1.00	0.00	0.92	0.00
Uniform Delay (d), s/veh	22.9	0.0	23.4				0.0	1.4	1.4	0.0	1.4	0.0
Incr Delay (d2), s/veh	0.3	0.0	6.1				0.0	0.2	0.2	0.0	0.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.6				0.0	0.7	0.5	0.0	0.4	0.0
LnGrp Delay(d),s/veh	23.2	0.0	29.4				0.0	1.6	1.6	0.0	1.4	0.0
LnGrp LOS	C		C					A	A		A	
Approach Vol, veh/h		43						314			250	
Approach Delay, s/veh		28.7						1.6			1.4	
Approach LOS		C						A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		
Phs Duration (G+Y+Rc), s		43.3		6.7		43.3		
Change Period (Y+Rc), s		4.5		4.5		4.5		
Max Green Setting (Gmax), s		21.5		19.5		21.5		
Max Q Clear Time (g_c+I1), s		3.2		3.2		2.9		
Green Ext Time (p_c), s		3.0		0.1		3.0		

Intersection Summary	
HCM 2010 Ctrl Delay	3.4
HCM 2010 LOS	A

Queuing and Blocking Report

Intersection: 5: JBLM & I-5 NB Ramps

Movement	EB	EB	NB	NB	SB	SB
Directions Served	L	R	T	R	T	T
Maximum Queue (ft)	49	257	101	83	32	22
Average Queue (ft)	4	141	38	37	6	1
95th Queue (ft)	30	218	77	69	24	12
Link Distance (ft)		1096	617	617	314	314
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)	100					
Storage Blk Time (%)		19				
Queuing Penalty (veh)		1				

Intersection: 7: JBLM & I-5 SB Ramps

Movement	WB	WB	NB
Directions Served	L	L	L
Maximum Queue (ft)	76	98	64
Average Queue (ft)	28	61	13
95th Queue (ft)	63	89	46
Link Distance (ft)	1188	1188	314
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 8: I-5 NB Ramps & Steilacoom

Movement	EB	EB	SB	SB
Directions Served	L	L	L	L
Maximum Queue (ft)	202	192	88	97
Average Queue (ft)	129	108	15	37
95th Queue (ft)	186	166	50	79
Link Distance (ft)	1198	1198	336	336
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Queuing and Blocking Report

Intersection: 9: Steilacoom & I-5 SB Ramps

Movement	WB	WB	NB	NB	SB	SB	SB
Directions Served	R	R	T	T	T	T	R
Maximum Queue (ft)	217	211	44	32	108	160	133
Average Queue (ft)	135	105	6	5	18	85	75
95th Queue (ft)	192	174	27	22	67	139	123
Link Distance (ft)	967	967	336	336		766	766
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)					150		
Storage Blk Time (%)						0	
Queuing Penalty (veh)						1	

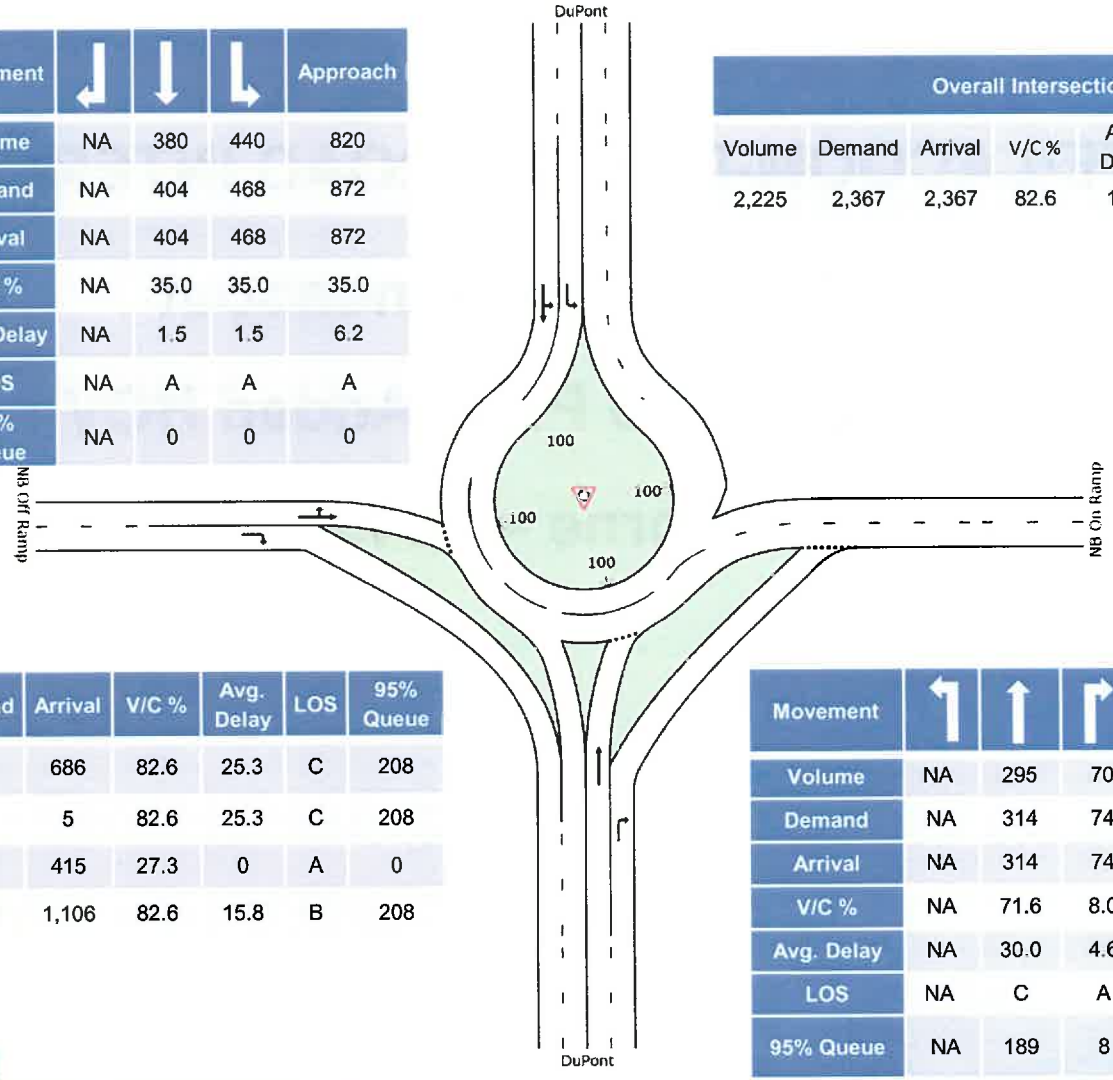
Network Summary

Network wide Queuing Penalty: 2

Steilacoom-DuPont Road NB Ramps Roundabout
2020 AM Peak Hour

Movement				Approach
Volume	NA	380	440	820
Demand	NA	404	468	872
Arrival	NA	404	468	872
V/C %	NA	35.0	35.0	35.0
Avg. Delay	NA	1.5	1.5	6.2
LOS	NA	A	A	A
95% Queue	NA	0	0	0

Overall Intersection						
Volume	Demand	Arrival	V/C %	Avg. Delay	LOS	95% Queue
2,225	2,367	2,367	82.6	12.1	B	208



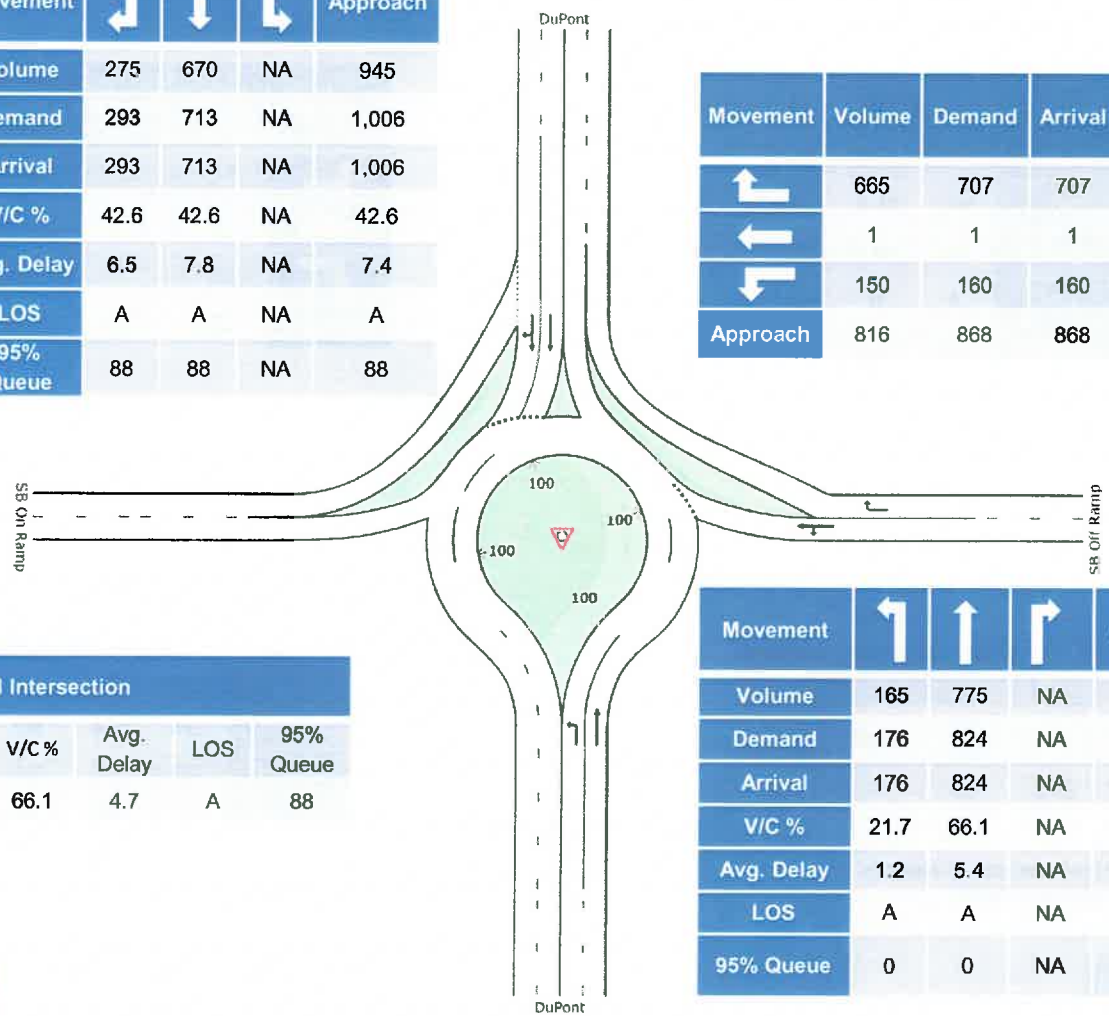
Movement	Volume	Demand	Arrival	V/C %	Avg. Delay	LOS	95% Queue
	645	686	686	82.6	25.3	C	208
	5	5	5	82.6	25.3	C	208
	390	415	415	27.3	0	A	0
Approach	1,040	1,106	1,106	82.6	15.8	B	208

Movement				Approach
Volume	NA	295	70	365
Demand	NA	314	74	388
Arrival	NA	314	74	388
V/C %	NA	71.6	8.0	71.6
Avg. Delay	NA	30.0	4.6	25.1
LOS	NA	C	A	C
95% Queue	NA	189	8	189

Steilacoom-DuPont Road SB Ramps Roundabout
2020 AM Peak Hour

Movement				Approach
Volume	275	670	NA	945
Demand	293	713	NA	1,006
Arrival	293	713	NA	1,006
V/C %	42.6	42.6	NA	42.6
Avg. Delay	6.5	7.8	NA	7.4
LOS	A	A	NA	A
95% Queue	88	88	NA	88

Movement	Volume	Demand	Arrival	V/C %	Avg. Delay	LOS	95% Queue
	665	707	707	46.5	0	A	0
	1	1	1	22.1	7.5	A	26
	150	160	160	22.1	7.5	A	26
Approach	816	868	868	46.5	1.5	A	26



Overall Intersection						
Volume	Demand	Arrival	V/C %	Avg. Delay	LOS	95% Queue
2,701	2,874	2,874	66.1	4.7	A	88

Movement				Approach
Volume	165	775	NA	940
Demand	176	824	NA	1,000
Arrival	176	824	NA	1,000
V/C %	21.7	66.1	NA	66.1
Avg. Delay	1.2	5.4	NA	10.8
LOS	A	A	NA	B
95% Queue	0	0	NA	0

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	5	50	615	0	530	0	0	680	650
Future Volume (veh/h)	0	0	0	5	50	615	0	530	0	0	680	650
Number				3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln				1863	1863	1863	0	1863	0	0	1863	1863
Adj Flow Rate, veh/h				5	53	558	0	558	0	0	716	231
Adj No. of Lanes				1	1	1	0	2	0	0	2	1
Peak Hour Factor				0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %				2	2	2	0	2	0	0	2	2
Cap, veh/h				798	838	712	0	1310	0	0	1310	586
Arrive On Green				0.45	0.45	0.45	0.00	0.37	0.00	0.00	0.37	0.37
Sat Flow, veh/h				1774	1863	1583	0	3725	0	0	3632	1583
Grp Volume(v), veh/h				5	53	558	0	558	0	0	716	231
Grp Sat Flow(s),veh/h/ln				1774	1863	1583	0	1770	0	0	1770	1583
Q Serve(g_s), s				0.1	0.8	15.0	0.0	5.9	0.0	0.0	8.0	5.4
Cycle Q Clear(g_c), s				0.1	0.8	15.0	0.0	5.9	0.0	0.0	8.0	5.4
Prop In Lane				1.00		1.00	0.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h				798	838	712	0	1310	0	0	1310	586
V/C Ratio(X)				0.01	0.06	0.78	0.00	0.43	0.00	0.00	0.55	0.39
Avail Cap(c_a), veh/h				798	838	712	0	1310	0	0	1310	586
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	1.00	1.00	0.00	0.83	0.00	0.00	1.00	1.00
Uniform Delay (d), s/veh				7.6	7.8	11.7	0.0	11.8	0.0	0.0	12.4	11.6
Incr Delay (d2), s/veh				0.0	0.1	8.4	0.0	0.8	0.0	0.0	1.6	2.0
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				0.0	0.4	8.0	0.0	3.0	0.0	0.0	4.2	2.6
LnGrp Delay(d),s/veh				7.6	7.9	20.1	0.0	12.6	0.0	0.0	14.1	13.6
LnGrp LOS				A	A	C		B			B	B
Approach Vol, veh/h					616			558			947	
Approach Delay, s/veh					18.9			12.6			14.0	
Approach LOS					B			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		8
Phs Duration (G+Y+Rc), s		23.0				23.0		27.0
Change Period (Y+Rc), s		4.5				4.5		4.5
Max Green Setting (Gmax), s		18.5				18.5		22.5
Max Q Clear Time (g_c+I1), s		7.9				10.0		17.0
Green Ext Time (p_c), s		6.5				5.5		1.3

Intersection Summary	
HCM 2010 Ctrl Delay	15.1
HCM 2010 LOS	B

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	530	225	0	0	685	0
Future Volume (veh/h)	530	225	0	0	685	0
Number	7	4			1	16
Initial Q (Qb), veh	0	0			0	0
Ped-Bike Adj(A_pbT)	1.00				1.00	1.00
Parking Bus, Adj	1.00	1.00			1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863			1863	0
Adj Flow Rate, veh/h	558	237			721	0
Adj No. of Lanes	2	1			2	0
Peak Hour Factor	0.95	0.95			0.95	0.95
Percent Heavy Veh, %	2	2			2	0
Cap, veh/h	1141	461			0	0
Arrive On Green	0.08	0.08			0.00	0.00
Sat Flow, veh/h	3442	1863			0	
Grp Volume(v), veh/h	558	237			0.0	
Grp Sat Flow(s),veh/h/ln	1721	1863				
Q Serve(g_s), s	7.9	6.1				
Cycle Q Clear(g_c), s	7.9	6.1				
Prop In Lane	1.00					
Lane Grp Cap(c), veh/h	1141	461				
V/C Ratio(X)	0.49	0.51				
Avail Cap(c_a), veh/h	1630	726				
HCM Platoon Ratio	0.33	0.33				
Upstream Filter(I)	0.82	0.82				
Uniform Delay (d), s/veh	20.9	20.1				
Incr Delay (d2), s/veh	0.3	0.7				
Initial Q Delay(d3),s/veh	0.0	0.0				
%ile BackOfQ(50%),veh/ln	3.8	3.2				
LnGrp Delay(d),s/veh	21.1	20.8				
LnGrp LOS	C	C				
Approach Vol, veh/h		795				
Approach Delay, s/veh		21.0				
Approach LOS		C				

Timer	1	2	3	4	5	6	7	8
Assigned Phs				4				
Phs Duration (G+Y+Rc), s				16.9				
Change Period (Y+Rc), s				4.5				
Max Green Setting (Gmax), s				19.5				
Max Q Clear Time (g_c+I1), s				9.9				
Green Ext Time (p_c), s				2.5				

Intersection Summary	
HCM 2010 Ctrl Delay	21.0
HCM 2010 LOS	C

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	250	450	285	0
Future Volume (veh/h)	0	0	250	450	285	0
Number			3	8	5	12
Initial Q (Qb), veh			0	0	0	0
Ped-Bike Adj(A_pbT)			1.00		1.00	1.00
Parking Bus, Adj			1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln			1863	1863	1863	0
Adj Flow Rate, veh/h			263	474	300	0
Adj No. of Lanes			1	1	1	0
Peak Hour Factor			0.95	0.95	0.95	0.95
Percent Heavy Veh, %			2	2	2	0
Cap, veh/h			736	621	0	0
Arrive On Green			0.11	0.11	0.00	0.00
Sat Flow, veh/h			1774	1863	0	
Grp Volume(v), veh/h			263	474	0.0	
Grp Sat Flow(s),veh/h/ln			1774	1863		
Q Serve(g_s), s			6.9	12.4		
Cycle Q Clear(g_c), s			6.9	12.4		
Prop In Lane			1.00			
Lane Grp Cap(c), veh/h			736	621		
V/C Ratio(X)			0.36	0.76		
Avail Cap(c_a), veh/h			917	812		
HCM Platoon Ratio			0.33	0.33		
Upstream Filter(I)			0.74	0.74		
Uniform Delay (d), s/veh			17.9	20.3		
Incr Delay (d2), s/veh			0.2	2.3		
Initial Q Delay(d3),s/veh			0.0	0.0		
%ile BackOfQ(50%),veh/ln			3.5	6.8		
LnGrp Delay(d),s/veh			18.1	22.7		
LnGrp LOS			B	C		
Approach Vol, veh/h				737		
Approach Delay, s/veh				21.0		
Approach LOS				C		

Timer	1	2	3	4	5	6	7	8
Assigned Phs								8
Phs Duration (G+Y+Rc), s								21.2
Change Period (Y+Rc), s								4.5
Max Green Setting (Gmax), s								21.8
Max Q Clear Time (g_c+I1), s								14.4
Green Ext Time (p_c), s								2.3

Intersection Summary	
HCM 2010 Ctrl Delay	21.0
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	385	200	0	0	0	0	280	370	0	250	0
Future Volume (veh/h)	5	385	200	0	0	0	0	280	370	0	250	0
Number	7	4	14				5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863				0	1863	1863	0	1863	0
Adj Flow Rate, veh/h	5	405	64				0	295	226	0	263	0
Adj No. of Lanes	1	1	1				0	1	1	0	1	0
Peak Hour Factor	0.95	0.95	0.95				0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2				0	2	2	0	2	0
Cap, veh/h	489	514	437				0	1013	861	0	1013	0
Arrive On Green	0.28	0.28	0.28				0.00	0.54	0.54	0.00	0.54	0.00
Sat Flow, veh/h	1774	1863	1583				0	1863	1583	0	1863	0
Grp Volume(v), veh/h	5	405	64				0	295	226	0	263	0
Grp Sat Flow(s),veh/h/ln	1774	1863	1583				0	1863	1583	0	1863	0
Q Serve(g_s), s	0.1	10.1	1.5				0.0	4.3	3.8	0.0	3.7	0.0
Cycle Q Clear(g_c), s	0.1	10.1	1.5				0.0	4.3	3.8	0.0	3.7	0.0
Prop In Lane	1.00		1.00				0.00		1.00	0.00		0.00
Lane Grp Cap(c), veh/h	489	514	437				0	1013	861	0	1013	0
V/C Ratio(X)	0.01	0.79	0.15				0.00	0.29	0.26	0.00	0.26	0.00
Avail Cap(c_a), veh/h	727	764	649				0	1013	861	0	1013	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00				0.00	1.00	1.00	0.00	0.92	0.00
Uniform Delay (d), s/veh	13.1	16.7	13.7				0.0	6.2	6.1	0.0	6.1	0.0
Incr Delay (d2), s/veh	0.0	3.3	0.2				0.0	0.7	0.7	0.0	0.6	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	5.6	0.7				0.0	2.3	1.8	0.0	2.1	0.0
LnGrp Delay(d),s/veh	13.2	20.1	13.8				0.0	6.9	6.8	0.0	6.6	0.0
LnGrp LOS	B	C	B					A	A		A	
Approach Vol, veh/h		474						521			263	
Approach Delay, s/veh		19.1						6.9			6.6	
Approach LOS		B						A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		
Phs Duration (G+Y+Rc), s		31.7		18.3		31.7		
Change Period (Y+Rc), s		4.5		4.5		4.5		
Max Green Setting (Gmax), s		20.5		20.5		20.5		
Max Q Clear Time (g_c+I1), s		6.3		12.1		5.7		
Green Ext Time (p_c), s		3.6		1.8		3.7		

Intersection Summary	
HCM 2010 Ctrl Delay	11.4
HCM 2010 LOS	B

Queuing and Blocking Report

Intersection: 5: JBLM & I-5 NB Ramps

Movement	EB	EB	EB	NB	NB	SB
Directions Served	L	T	R	T	R	T
Maximum Queue (ft)	49	233	140	145	167	155
Average Queue (ft)	3	125	50	61	72	63
95th Queue (ft)	23	195	95	114	136	125
Link Distance (ft)		1108		612	612	327
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)	100		250			
Storage Blk Time (%)		13	0			
Queuing Penalty (veh)		26	0			

Intersection: 7: JBLM & I-5 SB Ramps

Movement	WB	WB	NB
Directions Served	L	T	L
Maximum Queue (ft)	161	240	151
Average Queue (ft)	84	134	54
95th Queue (ft)	134	209	112
Link Distance (ft)		1183	327
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)	350		
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 8: I-5 NB Ramps & Steilacoom

Movement	EB	EB	EB	SB	SB
Directions Served	L	L	T	L	L
Maximum Queue (ft)	153	167	157	25	32
Average Queue (ft)	75	100	72	3	3
95th Queue (ft)	125	146	131	16	17
Link Distance (ft)			1192	329	329
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)	250	250			
Storage Blk Time (%)					
Queuing Penalty (veh)					

Queuing and Blocking Report

Intersection: 9: Steilacoom & I-5 SB Ramps

Movement	WB	WB	WB	NB	NB	SB	SB	SB
Directions Served	L	T	R	T	T	T	T	R
Maximum Queue (ft)	31	56	239	15	35	174	310	259
Average Queue (ft)	3	17	122	1	6	88	147	102
95th Queue (ft)	19	46	197	8	24	187	238	183
Link Distance (ft)	966	966	966	329	329		759	
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)						150		250
Storage Blk Time (%)						0	5	0
Queuing Penalty (veh)						2	52	0

Network Summary

Network wide Queuing Penalty: 80

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	0	0	615	0	530	0	0	680	650
Future Volume (veh/h)	0	0	0	0	0	615	0	530	0	0	680	650
Number				3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln				0	0	1863	0	1863	0	0	1863	1863
Adj Flow Rate, veh/h				0	0	125	0	576	0	0	739	457
Adj No. of Lanes				0	0	2	0	2	0	0	1	1
Peak Hour Factor				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %				0	0	2	0	2	0	0	2	2
Cap, veh/h				0	0	0	0	3221	0	0	1695	1441
Arrive On Green				0.00	0.00	0.00	0.00	0.91	0.00	0.00	0.91	0.91
Sat Flow, veh/h					0		0	3725	0	0	1863	1583
Grp Volume(v), veh/h					0.0		0	576	0	0	739	457
Grp Sat Flow(s),veh/h/ln							0	1770	0	0	1863	1583
Q Serve(g_s), s							0.0	0.9	0.0	0.0	3.0	1.8
Cycle Q Clear(g_c), s							0.0	0.9	0.0	0.0	3.0	1.8
Prop In Lane							0.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h							0	3221	0	0	1695	1441
V/C Ratio(X)							0.00	0.18	0.00	0.00	0.44	0.32
Avail Cap(c_a), veh/h							0	3221	0	0	1695	1441
HCM Platoon Ratio							1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)							0.00	0.58	0.00	0.00	1.00	1.00
Uniform Delay (d), s/veh							0.0	0.2	0.0	0.0	0.3	0.3
Incr Delay (d2), s/veh							0.0	0.1	0.0	0.0	0.8	0.6
Initial Q Delay(d3),s/veh							0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln							0.0	0.4	0.0	0.0	1.6	0.9
LnGrp Delay(d),s/veh							0.0	0.3	0.0	0.0	1.2	0.9
LnGrp LOS								A			A	A
Approach Vol, veh/h								576			1196	
Approach Delay, s/veh								0.3			1.0	
Approach LOS								A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		
Phs Duration (G+Y+Rc), s		50.0				50.0		
Change Period (Y+Rc), s		4.5				4.5		
Max Green Setting (Gmax), s		31.5				31.5		
Max Q Clear Time (g_c+I1), s		2.9				5.0		
Green Ext Time (p_c), s		13.8				13.3		

Intersection Summary	
HCM 2010 Ctrl Delay	0.8
HCM 2010 LOS	A

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	530	0	0	0	685	0
Future Volume (veh/h)	530	0	0	0	685	0
Number	7	4			1	16
Initial Q (Qb), veh	0	0			0	0
Ped-Bike Adj(A_pbT)	1.00				1.00	1.00
Parking Bus, Adj	1.00	1.00			1.00	1.00
Adj Sat Flow, veh/h/ln	1863	0			1863	0
Adj Flow Rate, veh/h	576	0			745	0
Adj No. of Lanes	2	0			1	0
Peak Hour Factor	0.92	0.92			0.92	0.92
Percent Heavy Veh, %	2	0			2	0
Cap, veh/h	0	0			0	0
Arrive On Green	0.00	0.00			0.00	0.00
Sat Flow, veh/h		0			0	
Grp Volume(v), veh/h		0.0			0.0	
Grp Sat Flow(s),veh/h/ln						
Q Serve(g_s), s						
Cycle Q Clear(g_c), s						
Prop In Lane						
Lane Grp Cap(c), veh/h						
V/C Ratio(X)						
Avail Cap(c_a), veh/h						
HCM Platoon Ratio						
Upstream Filter(I)						
Uniform Delay (d), s/veh						
Incr Delay (d2), s/veh						
Initial Q Delay(d3),s/veh						
%ile BackOfQ(50%),veh/ln						
LnGrp Delay(d),s/veh						
LnGrp LOS						
Approach Vol, veh/h						
Approach Delay, s/veh						
Approach LOS						

Timer	1	2	3	4	5	6	7	8
Assigned Phs								
Phs Duration (G+Y+Rc), s								
Change Period (Y+Rc), s								
Max Green Setting (Gmax), s								
Max Q Clear Time (g_c+I1), s								
Green Ext Time (p_c), s								

Intersection Summary	
HCM 2010 Ctrl Delay	0.0
HCM 2010 LOS	A

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	250	0	285	0
Future Volume (veh/h)	0	0	250	0	285	0
Number			3	8	5	12
Initial Q (Qb), veh			0	0	0	0
Ped-Bike Adj(A_pbT)			1.00		1.00	1.00
Parking Bus, Adj			1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln			1863	0	1863	0
Adj Flow Rate, veh/h			272	0	310	0
Adj No. of Lanes			2	0	1	0
Peak Hour Factor			0.92	0.92	0.92	0.92
Percent Heavy Veh, %			2	0	2	0
Cap, veh/h			0	0	0	0
Arrive On Green			0.00	0.00	0.00	0.00
Sat Flow, veh/h				0	0	
Grp Volume(v), veh/h				0.0	0.0	
Grp Sat Flow(s),veh/h/ln						
Q Serve(g_s), s						
Cycle Q Clear(g_c), s						
Prop In Lane						
Lane Grp Cap(c), veh/h						
V/C Ratio(X)						
Avail Cap(c_a), veh/h						
HCM Platoon Ratio						
Upstream Filter(I)						
Uniform Delay (d), s/veh						
Incr Delay (d2), s/veh						
Initial Q Delay(d3),s/veh						
%ile BackOfQ(50%),veh/ln						
LnGrp Delay(d),s/veh						
LnGrp LOS						
Approach Vol, veh/h						
Approach Delay, s/veh						
Approach LOS						

Timer	1	2	3	4	5	6	7	8
Assigned Phs								
Phs Duration (G+Y+Rc), s								
Change Period (Y+Rc), s								
Max Green Setting (Gmax), s								
Max Q Clear Time (g_c+I1), s								
Green Ext Time (p_c), s								

Intersection Summary	
HCM 2010 Ctrl Delay	0.0
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	0	200	0	0	0	0	280	370	0	250	0
Future Volume (veh/h)	5	0	200	0	0	0	0	280	370	0	250	0
Number	7	4	14				5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	0	1863				0	1863	1863	0	1863	0
Adj Flow Rate, veh/h	5	0	16				0	304	261	0	272	0
Adj No. of Lanes	1	0	1				0	1	1	0	2	0
Peak Hour Factor	0.92	0.92	0.92				0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	0	2				0	2	2	0	2	0
Cap, veh/h	45	0	40				0	1480	1258	0	2813	0
Arrive On Green	0.03	0.00	0.03				0.00	0.79	0.79	0.00	0.79	0.00
Sat Flow, veh/h	1774	0	1583				0	1863	1583	0	3725	0
Grp Volume(v), veh/h	5	0	16				0	304	261	0	272	0
Grp Sat Flow(s),veh/h/ln	1774	0	1583				0	1863	1583	0	1770	0
Q Serve(g_s), s	0.1	0.0	0.5				0.0	2.0	2.0	0.0	0.9	0.0
Cycle Q Clear(g_c), s	0.1	0.0	0.5				0.0	2.0	2.0	0.0	0.9	0.0
Prop In Lane	1.00		1.00				0.00		1.00	0.00		0.00
Lane Grp Cap(c), veh/h	45	0	40				0	1480	1258	0	2813	0
V/C Ratio(X)	0.11	0.00	0.40				0.00	0.21	0.21	0.00	0.10	0.00
Avail Cap(c_a), veh/h	514	0	459				0	1480	1258	0	2813	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00				0.00	1.00	1.00	0.00	0.90	0.00
Uniform Delay (d), s/veh	23.8	0.0	24.0				0.0	1.3	1.3	0.0	1.1	0.0
Incr Delay (d2), s/veh	1.1	0.0	6.3				0.0	0.3	0.4	0.0	0.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.3				0.0	1.1	1.0	0.0	0.4	0.0
LnGrp Delay(d),s/veh	24.9	0.0	30.3				0.0	1.6	1.6	0.0	1.2	0.0
LnGrp LOS	C		C					A	A		A	
Approach Vol, veh/h		21						565			272	
Approach Delay, s/veh		29.0						1.6			1.2	
Approach LOS		C						A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		
Phs Duration (G+Y+Rc), s		44.2		5.8		44.2		
Change Period (Y+Rc), s		4.5		4.5		4.5		
Max Green Setting (Gmax), s		26.5		14.5		26.5		
Max Q Clear Time (g_c+I1), s		4.0		2.5		2.9		
Green Ext Time (p_c), s		4.7		0.0		4.7		

Intersection Summary	
HCM 2010 Ctrl Delay	2.1
HCM 2010 LOS	A

Queuing and Blocking Report

Intersection: 5: JBLM & I-5 NB Ramps

Movement	EB	EB	NB	NB	SB	SB
Directions Served	L	R	T	R	T	T
Maximum Queue (ft)	35	168	98	113	87	74
Average Queue (ft)	4	87	42	49	28	28
95th Queue (ft)	20	138	84	88	68	66
Link Distance (ft)		1096	617	617	314	314
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)	100					
Storage Blk Time (%)		5				
Queuing Penalty (veh)		0				

Intersection: 7: JBLM & I-5 SB Ramps

Movement	WB	WB	NB
Directions Served	L	L	L
Maximum Queue (ft)	96	122	108
Average Queue (ft)	37	69	39
95th Queue (ft)	78	103	85
Link Distance (ft)	1199	1199	314
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 8: I-5 NB Ramps & Steilacoom

Movement	EB	EB	SB
Directions Served	L	L	L
Maximum Queue (ft)	163	174	127
Average Queue (ft)	93	103	57
95th Queue (ft)	142	153	107
Link Distance (ft)	1205	1205	337
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Queuing and Blocking Report

Intersection: 9: Steilacoom & I-5 SB Ramps

Movement	WB	WB	SB	SB
Directions Served	R	R	T	R
Maximum Queue (ft)	306	268	206	190
Average Queue (ft)	183	148	100	76
95th Queue (ft)	264	238	167	139
Link Distance (ft)	967	967	766	766
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 0

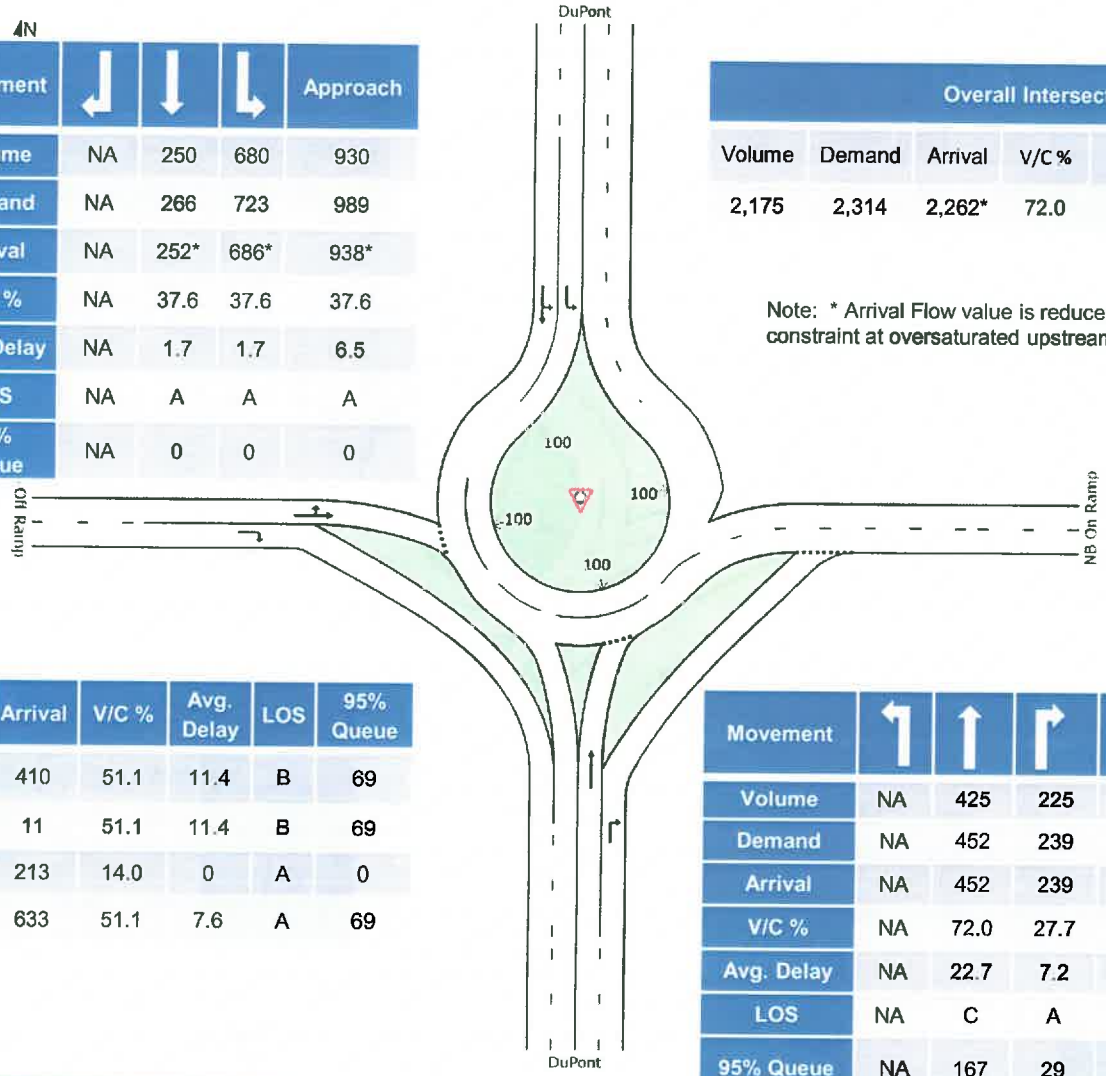
Steilacoom-DuPont Road NB Ramps Roundabout
2020 PM Peak Hour

N

Movement				Approach
Volume	NA	250	680	930
Demand	NA	266	723	989
Arrival	NA	252*	686*	938*
V/C %	NA	37.6	37.6	37.6
Avg. Delay	NA	1.7	1.7	6.5
LOS	NA	A	A	A
95% Queue	NA	0	0	0

Overall Intersection						
Volume	Demand	Arrival	V/C %	Avg. Delay	LOS	95% Queue
2,175	2,314	2,262*	72.0	8.1	A	167

Note: * Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes



Movement	Volume	Demand	Arrival	V/C %	Avg. Delay	LOS	95% Queue
	385	410	410	51.1	11.4	B	69
	10	11	11	51.1	11.4	B	69
	200	213	213	14.0	0	A	0
Approach	595	633	633	51.1	7.6	A	69

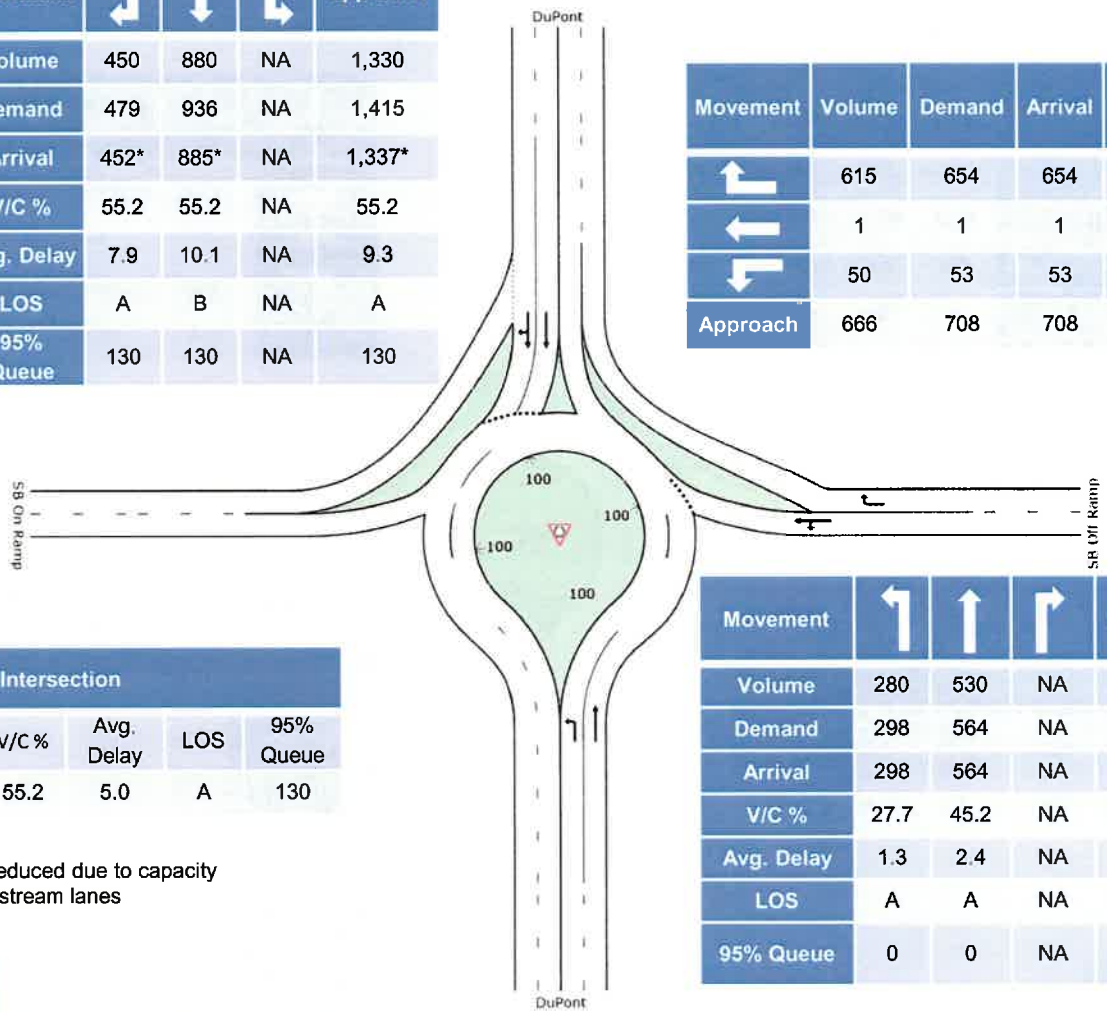
Movement				Approach
Volume	NA	425	225	650
Demand	NA	452	239	691
Arrival	NA	452	239	691
V/C %	NA	72.0	27.7	72.0
Avg. Delay	NA	22.7	7.2	17.3
LOS	NA	C	A	B
95% Queue	NA	167	29	167

Washington State Department of Transportation

Steilacoom-DuPont Road SB Ramps Roundabout
2020 PM Peak Hour

Movement				Approach
Volume	450	880	NA	1,330
Demand	479	936	NA	1,415
Arrival	452*	885*	NA	1,337*
V/C %	55.2	55.2	NA	55.2
Avg. Delay	7.9	10.1	NA	9.3
LOS	A	B	NA	A
95% Queue	130	130	NA	130

Movement	Volume	Demand	Arrival	V/C %	Avg. Delay	LOS	95% Queue
	615	654	654	43.0	0	A	0
	1	1	1	6.6	5.1	A	6
	50	53	53	6.6	5.1	A	6
Approach	666	708	708	43.0	0.5	A	6



Overall Intersection						
Volume	Demand	Arrival	V/C %	Avg. Delay	LOS	95% Queue
2,806	2,985	2,907*	55.2	5.0	A	130

Note: * Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes

Movement				Approach
Volume	280	530	NA	810
Demand	298	564	NA	862
Arrival	298	564	NA	862
V/C %	27.7	45.2	NA	45.2
Avg. Delay	1.3	2.4	NA	7.0
LOS	A	A	NA	A
95% Queue	0	0	NA	0

APPENDIX B

2040 INTERSECTION OPERATIONS AND QUEUING ANALYSIS WORKSHEETS

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	5	150	780	0	855	0	0	485	560
Future Volume (veh/h)	0	0	0	5	150	780	0	855	0	0	485	560
Number				3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln				1863	1863	1863	0	1863	0	0	1863	1863
Adj Flow Rate, veh/h				5	158	821	0	900	0	0	511	168
Adj No. of Lanes				1	1	1	0	2	0	0	2	1
Peak Hour Factor				0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %				2	2	2	0	2	0	0	2	2
Cap, veh/h				931	978	831	0	1150	0	0	1150	515
Arrive On Green				0.52	0.52	0.52	0.00	0.32	0.00	0.00	0.32	0.32
Sat Flow, veh/h				1774	1863	1583	0	3725	0	0	3632	1583
Grp Volume(v), veh/h				5	158	821	0	900	0	0	511	168
Grp Sat Flow(s),veh/h/ln				1774	1863	1583	0	1770	0	0	1770	1583
Q Serve(g_s), s				0.1	2.6	30.7	0.0	13.8	0.0	0.0	6.8	4.8
Cycle Q Clear(g_c), s				0.1	2.6	30.7	0.0	13.8	0.0	0.0	6.8	4.8
Prop In Lane				1.00		1.00	0.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h				931	978	831	0	1150	0	0	1150	515
V/C Ratio(X)				0.01	0.16	0.99	0.00	0.78	0.00	0.00	0.44	0.33
Avail Cap(c_a), veh/h				931	978	831	0	1150	0	0	1150	515
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	1.00	1.00	0.00	0.69	0.00	0.00	1.00	1.00
Uniform Delay (d), s/veh				6.8	7.4	14.1	0.0	18.3	0.0	0.0	16.0	15.3
Incr Delay (d2), s/veh				0.0	0.4	28.4	0.0	3.7	0.0	0.0	1.2	1.7
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				0.0	1.5	19.8	0.0	7.2	0.0	0.0	3.5	2.3
LnGrp Delay(d),s/veh				6.8	7.8	42.4	0.0	22.1	0.0	0.0	17.2	17.0
LnGrp LOS				A	A	D		C			B	B
Approach Vol, veh/h					984			900			679	
Approach Delay, s/veh					36.7			22.1			17.2	
Approach LOS					D			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		8
Phs Duration (G+Y+Rc), s		24.0				24.0		36.0
Change Period (Y+Rc), s		4.5				4.5		4.5
Max Green Setting (Gmax), s		19.5				19.5		31.5
Max Q Clear Time (g_c+I1), s		15.8				8.8		32.7
Green Ext Time (p_c), s		2.8				7.0		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	26.4
HCM 2010 LOS	C

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	855	60	0	0	490	0
Future Volume (veh/h)	855	60	0	0	490	0
Number	7	4			1	16
Initial Q (Qb), veh	0	0			0	0
Ped-Bike Adj(A_pbT)	1.00				1.00	1.00
Parking Bus, Adj	1.00	1.00			1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863			1863	0
Adj Flow Rate, veh/h	900	63			516	0
Adj No. of Lanes	2	1			2	0
Peak Hour Factor	0.95	0.95			0.95	0.95
Percent Heavy Veh, %	2	2			2	0
Cap, veh/h	1360	606			0	0
Arrive On Green	0.33	0.33			0.00	0.00
Sat Flow, veh/h	3442	1863			0	
Grp Volume(v), veh/h	900	63			0.0	
Grp Sat Flow(s),veh/h/ln	1721	1863				
Q Serve(g_s), s	14.3	1.4				
Cycle Q Clear(g_c), s	14.3	1.4				
Prop In Lane	1.00					
Lane Grp Cap(c), veh/h	1360	606				
V/C Ratio(X)	0.66	0.10				
Avail Cap(c_a), veh/h	1875	885				
HCM Platoon Ratio	1.00	1.00				
Upstream Filter(I)	0.66	0.66				
Uniform Delay (d), s/veh	18.5	14.1				
Incr Delay (d2), s/veh	0.4	0.0				
Initial Q Delay(d3),s/veh	0.0	0.0				
%ile BackOfQ(50%),veh/ln	6.8	0.7				
LnGrp Delay(d),s/veh	18.9	14.2				
LnGrp LOS	B	B				
Approach Vol, veh/h		963				
Approach Delay, s/veh		18.6				
Approach LOS		B				

Timer	1	2	3	4	5	6	7	8
Assigned Phs				4				
Phs Duration (G+Y+Rc), s				24.0				
Change Period (Y+Rc), s				4.5				
Max Green Setting (Gmax), s				28.5				
Max Q Clear Time (g_c+I1), s				16.3				
Green Ext Time (p_c), s				3.2				

Intersection Summary	
HCM 2010 Ctrl Delay	18.6
HCM 2010 LOS	B

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	265	295	170	0
Future Volume (veh/h)	0	0	265	295	170	0
Number			3	8	5	12
Initial Q (Qb), veh			0	0	0	0
Ped-Bike Adj(A_pbT)			1.00		1.00	1.00
Parking Bus, Adj			1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln			1863	1863	1863	0
Adj Flow Rate, veh/h			279	311	179	0
Adj No. of Lanes			1	1	1	0
Peak Hour Factor			0.95	0.95	0.95	0.95
Percent Heavy Veh, %			2	2	2	0
Cap, veh/h			538	439	0	0
Arrive On Green			0.08	0.08	0.00	0.00
Sat Flow, veh/h			1774	1863	0	
Grp Volume(v), veh/h			279	311	0.0	
Grp Sat Flow(s),veh/h/ln			1774	1863		
Q Serve(g_s), s			9.2	9.8		
Cycle Q Clear(g_c), s			9.2	9.8		
Prop In Lane			1.00			
Lane Grp Cap(c), veh/h			538	439		
V/C Ratio(X)			0.52	0.71		
Avail Cap(c_a), veh/h			904	823		
HCM Platoon Ratio			0.33	0.33		
Upstream Filter(I)			0.82	0.82		
Uniform Delay (d), s/veh			25.4	25.7		
Incr Delay (d2), s/veh			0.6	1.8		
Initial Q Delay(d3),s/veh			0.0	0.0		
%ile BackOfQ(50%),veh/ln			4.6	5.3		
LnGrp Delay(d),s/veh			26.0	27.4		
LnGrp LOS			C	C		
Approach Vol, veh/h				590		
Approach Delay, s/veh				26.8		
Approach LOS				C		

Timer	1	2	3	4	5	6	7	8
Assigned Phs								8
Phs Duration (G+Y+Rc), s								18.6
Change Period (Y+Rc), s								4.5
Max Green Setting (Gmax), s								26.5
Max Q Clear Time (g_c+I1), s								11.8
Green Ext Time (p_c), s								2.4

Intersection Summary	
HCM 2010 Ctrl Delay	26.8
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	705	370	0	0	0	0	165	210	0	265	0
Future Volume (veh/h)	5	705	370	0	0	0	0	165	210	0	265	0
Number	7	4	14				5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863				0	1863	1863	0	1863	0
Adj Flow Rate, veh/h	5	742	210				0	174	100	0	279	0
Adj No. of Lanes	1	1	1				0	1	1	0	1	0
Peak Hour Factor	0.95	0.95	0.95				0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2				0	2	2	0	2	0
Cap, veh/h	813	854	726				0	730	620	0	730	0
Arrive On Green	0.46	0.46	0.46				0.00	0.39	0.39	0.00	0.39	0.00
Sat Flow, veh/h	1774	1863	1583				0	1863	1583	0	1863	0
Grp Volume(v), veh/h	5	742	210				0	174	100	0	279	0
Grp Sat Flow(s),veh/h/ln	1774	1863	1583				0	1863	1583	0	1863	0
Q Serve(g_s), s	0.1	21.5	5.0				0.0	3.8	2.5	0.0	6.4	0.0
Cycle Q Clear(g_c), s	0.1	21.5	5.0				0.0	3.8	2.5	0.0	6.4	0.0
Prop In Lane	1.00		1.00				0.00		1.00	0.00		0.00
Lane Grp Cap(c), veh/h	813	854	726				0	730	620	0	730	0
V/C Ratio(X)	0.01	0.87	0.29				0.00	0.24	0.16	0.00	0.38	0.00
Avail Cap(c_a), veh/h	961	1009	858				0	730	620	0	730	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00				0.00	1.00	1.00	0.00	0.79	0.00
Uniform Delay (d), s/veh	8.8	14.6	10.2				0.0	12.2	11.8	0.0	13.1	0.0
Incr Delay (d2), s/veh	0.0	7.3	0.2				0.0	0.8	0.6	0.0	1.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	12.7	2.2				0.0	2.1	1.2	0.0	3.5	0.0
LnGrp Delay(d),s/veh	8.8	21.9	10.4				0.0	13.0	12.4	0.0	14.3	0.0
LnGrp LOS	A	C	B					B	B		B	
Approach Vol, veh/h		957						274			279	
Approach Delay, s/veh		19.3						12.8			14.3	
Approach LOS		B						B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		
Phs Duration (G+Y+Rc), s		28.0		32.0		28.0		
Change Period (Y+Rc), s		4.5		4.5		4.5		
Max Green Setting (Gmax), s		18.5		32.5		18.5		
Max Q Clear Time (g_c+I1), s		5.8		23.5		8.4		
Green Ext Time (p_c), s		2.5		4.0		2.2		

Intersection Summary	
HCM 2010 Ctrl Delay	17.2
HCM 2010 LOS	B

Queuing and Blocking Report

Intersection: 5: JBLM & I-5 NB Ramps

Movement	EB	EB	EB	NB	NB	SB
Directions Served	L	T	R	T	R	T
Maximum Queue (ft)	67	590	275	112	136	90
Average Queue (ft)	6	226	111	52	57	9
95th Queue (ft)	33	430	247	98	108	48
Link Distance (ft)		1108		612	612	327
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)	100		250			
Storage Blk Time (%)		23	0			
Queuing Penalty (veh)		85	0			

Intersection: 7: JBLM & I-5 SB Ramps

Movement	WB	WB	NB
Directions Served	L	T	L
Maximum Queue (ft)	177	181	113
Average Queue (ft)	93	97	32
95th Queue (ft)	155	155	84
Link Distance (ft)		1183	327
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)	350		
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 8: I-5 NB Ramps & Steilacoom

Movement	EB	EB	EB	SB	SB
Directions Served	L	L	T	L	L
Maximum Queue (ft)	258	269	241	54	43
Average Queue (ft)	113	132	30	16	28
95th Queue (ft)	201	216	131	40	41
Link Distance (ft)			1192	329	329
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)	250	250			
Storage Blk Time (%)	0	1			
Queuing Penalty (veh)	0	0			

Queuing and Blocking Report

Intersection: 9: Steilacoom & I-5 SB Ramps

Movement	WB	WB	WB	NB	NB	SB	SB	SB
Directions Served	L	T	R	T	T	T	T	R
Maximum Queue (ft)	24	267	593	144	159	174	231	252
Average Queue (ft)	2	58	276	66	57	68	131	104
95th Queue (ft)	15	189	546	113	111	170	207	201
Link Distance (ft)	966	966	966	329	329		759	759
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)						150		
Storage Blk Time (%)						0	5	
Queuing Penalty (veh)						0	11	

Network Summary

Network wide Queuing Penalty: 97

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	0	0	780	0	855	0	0	485	560
Future Volume (veh/h)	0	0	0	0	0	780	0	855	0	0	485	560
Number				3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln				0	0	1863	0	1863	0	0	1863	1863
Adj Flow Rate, veh/h				0	0	761	0	929	0	0	527	261
Adj No. of Lanes				0	0	2	0	2	0	0	2	1
Peak Hour Factor				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %				0	0	2	0	2	0	0	2	2
Cap, veh/h				0	0	0	0	3221	0	0	3221	1441
Arrive On Green				0.00	0.00	0.00	0.00	0.91	0.00	0.00	0.91	0.91
Sat Flow, veh/h					0		0	3725	0	0	3632	1583
Grp Volume(v), veh/h					0.0		0	929	0	0	527	261
Grp Sat Flow(s),veh/h/ln							0	1770	0	0	1770	1583
Q Serve(g_s), s							0.0	1.6	0.0	0.0	0.8	0.9
Cycle Q Clear(g_c), s							0.0	1.6	0.0	0.0	0.8	0.9
Prop In Lane							0.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h							0	3221	0	0	3221	1441
V/C Ratio(X)							0.00	0.29	0.00	0.00	0.16	0.18
Avail Cap(c_a), veh/h							0	3221	0	0	3221	1441
HCM Platoon Ratio							1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)							0.00	0.62	0.00	0.00	1.00	1.00
Uniform Delay (d), s/veh							0.0	0.3	0.0	0.0	0.2	0.2
Incr Delay (d2), s/veh							0.0	0.1	0.0	0.0	0.1	0.3
Initial Q Delay(d3),s/veh							0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln							0.0	0.7	0.0	0.0	0.4	0.5
LnGrp Delay(d),s/veh							0.0	0.4	0.0	0.0	0.3	0.5
LnGrp LOS								A			A	A
Approach Vol, veh/h								929			788	
Approach Delay, s/veh								0.4			0.4	
Approach LOS								A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		
Phs Duration (G+Y+Rc), s		50.0				50.0		
Change Period (Y+Rc), s		4.5				4.5		
Max Green Setting (Gmax), s		22.5				22.5		
Max Q Clear Time (g_c+I1), s		3.6				2.9		
Green Ext Time (p_c), s		11.0				11.3		

Intersection Summary	
HCM 2010 Ctrl Delay	0.4
HCM 2010 LOS	A

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	855	0	0	0	490	0
Future Volume (veh/h)	855	0	0	0	490	0
Number	7	4			1	16
Initial Q (Qb), veh	0	0			0	0
Ped-Bike Adj(A_pbT)	1.00				1.00	1.00
Parking Bus, Adj	1.00	1.00			1.00	1.00
Adj Sat Flow, veh/h/ln	1863	0			1863	0
Adj Flow Rate, veh/h	929	0			533	0
Adj No. of Lanes	2	0			2	0
Peak Hour Factor	0.92	0.92			0.92	0.92
Percent Heavy Veh, %	2	0			2	0
Cap, veh/h	0	0			0	0
Arrive On Green	0.00	0.00			0.00	0.00
Sat Flow, veh/h		0			0	
Grp Volume(v), veh/h		0.0			0.0	
Grp Sat Flow(s),veh/h/ln						
Q Serve(g_s), s						
Cycle Q Clear(g_c), s						
Prop In Lane						
Lane Grp Cap(c), veh/h						
V/C Ratio(X)						
Avail Cap(c_a), veh/h						
HCM Platoon Ratio						
Upstream Filter(I)						
Uniform Delay (d), s/veh						
Incr Delay (d2), s/veh						
Initial Q Delay(d3),s/veh						
%ile BackOfQ(50%),veh/ln						
LnGrp Delay(d),s/veh						
LnGrp LOS						
Approach Vol, veh/h						
Approach Delay, s/veh						
Approach LOS						

Timer	1	2	3	4	5	6	7	8
Assigned Phs								
Phs Duration (G+Y+Rc), s								
Change Period (Y+Rc), s								
Max Green Setting (Gmax), s								
Max Q Clear Time (g_c+I1), s								
Green Ext Time (p_c), s								

Intersection Summary	
HCM 2010 Ctrl Delay	0.0
HCM 2010 LOS	A

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	265	0	170	0
Future Volume (veh/h)	0	0	265	0	170	0
Number			3	8	5	12
Initial Q (Qb), veh			0	0	0	0
Ped-Bike Adj(A_pbT)			1.00		1.00	1.00
Parking Bus, Adj			1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln			1863	0	1863	0
Adj Flow Rate, veh/h			288	0	185	0
Adj No. of Lanes			2	0	1	0
Peak Hour Factor			0.92	0.92	0.92	0.92
Percent Heavy Veh, %			2	0	2	0
Cap, veh/h			0	0	0	0
Arrive On Green			0.00	0.00	0.00	0.00
Sat Flow, veh/h				0	0	
Grp Volume(v), veh/h				0.0	0.0	
Grp Sat Flow(s),veh/h/ln						
Q Serve(g_s), s						
Cycle Q Clear(g_c), s						
Prop In Lane						
Lane Grp Cap(c), veh/h						
V/C Ratio(X)						
Avail Cap(c_a), veh/h						
HCM Platoon Ratio						
Upstream Filter(I)						
Uniform Delay (d), s/veh						
Incr Delay (d2), s/veh						
Initial Q Delay(d3),s/veh						
%ile BackOfQ(50%),veh/ln						
LnGrp Delay(d),s/veh						
LnGrp LOS						
Approach Vol, veh/h						
Approach Delay, s/veh						
Approach LOS						

Timer	1	2	3	4	5	6	7	8
Assigned Phs								
Phs Duration (G+Y+Rc), s								
Change Period (Y+Rc), s								
Max Green Setting (Gmax), s								
Max Q Clear Time (g_c+I1), s								
Green Ext Time (p_c), s								

Intersection Summary	
HCM 2010 Ctrl Delay	0.0
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	0	370	0	0	0	0	165	210	0	265	0
Future Volume (veh/h)	5	0	370	0	0	0	0	165	210	0	265	0
Number	7	4	14				5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	0	1863				0	1863	1863	0	1863	0
Adj Flow Rate, veh/h	5	0	32				0	179	141	0	288	0
Adj No. of Lanes	1	0	1				0	1	1	0	2	0
Peak Hour Factor	0.92	0.92	0.92				0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	0	2				0	2	2	0	2	0
Cap, veh/h	71	0	64				0	1453	1235	0	2760	0
Arrive On Green	0.04	0.00	0.04				0.00	0.78	0.78	0.00	0.78	0.00
Sat Flow, veh/h	1774	0	1583				0	1863	1583	0	3725	0
Grp Volume(v), veh/h	5	0	32				0	179	141	0	288	0
Grp Sat Flow(s),veh/h/ln	1774	0	1583				0	1863	1583	0	1770	0
Q Serve(g_s), s	0.1	0.0	1.0				0.0	1.2	1.1	0.0	1.0	0.0
Cycle Q Clear(g_c), s	0.1	0.0	1.0				0.0	1.2	1.1	0.0	1.0	0.0
Prop In Lane	1.00		1.00				0.00		1.00	0.00		0.00
Lane Grp Cap(c), veh/h	71	0	64				0	1453	1235	0	2760	0
V/C Ratio(X)	0.07	0.00	0.50				0.00	0.12	0.11	0.00	0.10	0.00
Avail Cap(c_a), veh/h	656	0	586				0	1453	1235	0	2760	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00				0.00	1.00	1.00	0.00	0.90	0.00
Uniform Delay (d), s/veh	23.1	0.0	23.5				0.0	1.3	1.3	0.0	1.3	0.0
Incr Delay (d2), s/veh	0.4	0.0	6.0				0.0	0.2	0.2	0.0	0.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.5				0.0	0.7	0.5	0.0	0.5	0.0
LnGrp Delay(d),s/veh	23.5	0.0	29.5				0.0	1.5	1.5	0.0	1.4	0.0
LnGrp LOS	C		C					A	A		A	
Approach Vol, veh/h		37						320			288	
Approach Delay, s/veh		28.7						1.5			1.4	
Approach LOS		C						A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		
Phs Duration (G+Y+Rc), s		43.5		6.5		43.5		
Change Period (Y+Rc), s		4.5		4.5		4.5		
Max Green Setting (Gmax), s		22.5		18.5		22.5		
Max Q Clear Time (g_c+I1), s		3.2		3.0		3.0		
Green Ext Time (p_c), s		3.3		0.1		3.3		

Intersection Summary	
HCM 2010 Ctrl Delay	3.0
HCM 2010 LOS	A

Queuing and Blocking Report

Intersection: 5: JBLM & I-5 NB Ramps/NB Couplet

Movement	EB	EB	NB	NB	SB	SB
Directions Served	L	R	T	R	T	T
Maximum Queue (ft)	49	234	102	78	27	16
Average Queue (ft)	3	140	36	37	8	1
95th Queue (ft)	25	208	78	67	27	7
Link Distance (ft)		1096	617	617	314	314
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)	100					
Storage Blk Time (%)		18				
Queuing Penalty (veh)		1				

Intersection: 7: JBLM & I-5 SB Ramps/SB Couplet

Movement	WB	WB	NB
Directions Served	L	L	L
Maximum Queue (ft)	92	108	65
Average Queue (ft)	36	67	15
95th Queue (ft)	75	99	45
Link Distance (ft)	1188	1188	314
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 8: NB Couplet/I-5 NB Ramps & Steilacoom

Movement	EB	EB	SB	SB
Directions Served	L	L	L	L
Maximum Queue (ft)	243	224	83	109
Average Queue (ft)	139	118	20	51
95th Queue (ft)	203	185	56	86
Link Distance (ft)	1198	1198	336	336
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Queuing and Blocking Report

Intersection: 9: Steilacoom & SB Couplet/I-5 SB Ramps

Movement	WB	WB	NB	NB	SB	SB	SB
Directions Served	R	R	T	T	T	T	R
Maximum Queue (ft)	254	233	69	66	126	184	156
Average Queue (ft)	152	121	19	16	25	94	78
95th Queue (ft)	217	192	50	47	83	155	124
Link Distance (ft)	967	967	336	336		766	766
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)					150		
Storage Blk Time (%)					0	1	
Queuing Penalty (veh)					0	1	

Network Summary

Network wide Queuing Penalty: 2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	5	210	370	0	620	0	0	935	695
Future Volume (veh/h)	0	0	0	5	210	370	0	620	0	0	935	695
Number				3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln				1863	1863	1863	0	1863	0	0	1863	1863
Adj Flow Rate, veh/h				5	221	278	0	653	0	0	984	448
Adj No. of Lanes				1	1	1	0	2	0	0	2	1
Peak Hour Factor				0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %				2	2	2	0	2	0	0	2	2
Cap, veh/h				642	674	573	0	1621	0	0	1621	725
Arrive On Green				0.36	0.36	0.36	0.00	0.46	0.00	0.00	0.46	0.46
Sat Flow, veh/h				1774	1863	1583	0	3725	0	0	3632	1583
Grp Volume(v), veh/h				5	221	278	0	653	0	0	984	448
Grp Sat Flow(s),veh/h/ln				1774	1863	1583	0	1770	0	0	1770	1583
Q Serve(g_s), s				0.1	4.3	6.8	0.0	6.1	0.0	0.0	10.4	10.7
Cycle Q Clear(g_c), s				0.1	4.3	6.8	0.0	6.1	0.0	0.0	10.4	10.7
Prop In Lane				1.00		1.00	0.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h				642	674	573	0	1621	0	0	1621	725
V/C Ratio(X)				0.01	0.33	0.49	0.00	0.40	0.00	0.00	0.61	0.62
Avail Cap(c_a), veh/h				642	674	573	0	1621	0	0	1621	725
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	1.00	1.00	0.00	0.78	0.00	0.00	1.00	1.00
Uniform Delay (d), s/veh				10.2	11.5	12.3	0.0	9.0	0.0	0.0	10.2	10.2
Incr Delay (d2), s/veh				0.0	1.3	2.9	0.0	0.6	0.0	0.0	1.7	3.9
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				0.0	2.5	3.4	0.0	3.1	0.0	0.0	5.4	5.4
LnGrp Delay(d),s/veh				10.2	12.8	15.3	0.0	9.6	0.0	0.0	11.9	14.2
LnGrp LOS				B	B	B		A			B	B
Approach Vol, veh/h					504			653			1432	
Approach Delay, s/veh					14.2			9.6			12.6	
Approach LOS					B			A			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		8
Phs Duration (G+Y+Rc), s		27.4				27.4		22.6
Change Period (Y+Rc), s		4.5				4.5		4.5
Max Green Setting (Gmax), s		22.9				22.9		18.1
Max Q Clear Time (g_c+I1), s		8.1				12.7		8.8
Green Ext Time (p_c), s		10.7				7.9		1.6

Intersection Summary	
HCM 2010 Ctrl Delay	12.1
HCM 2010 LOS	B

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	620	270	0	0	940	0
Future Volume (veh/h)	620	270	0	0	940	0
Number	7	4			1	16
Initial Q (Qb), veh	0	0			0	0
Ped-Bike Adj(A_pbT)	1.00				1.00	1.00
Parking Bus, Adj	1.00	1.00			1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863			1863	0
Adj Flow Rate, veh/h	653	284			989	0
Adj No. of Lanes	2	1			2	0
Peak Hour Factor	0.95	0.95			0.95	0.95
Percent Heavy Veh, %	2	2			2	0
Cap, veh/h	1235	513			0	0
Arrive On Green	0.09	0.09			0.00	0.00
Sat Flow, veh/h	3442	1863			0	
Grp Volume(v), veh/h	653	284			0.0	
Grp Sat Flow(s),veh/h/ln	1721	1863				
Q Serve(g_s), s	9.2	7.3				
Cycle Q Clear(g_c), s	9.2	7.3				
Prop In Lane	1.00					
Lane Grp Cap(c), veh/h	1235	513				
V/C Ratio(X)	0.53	0.55				
Avail Cap(c_a), veh/h	1561	689				
HCM Platoon Ratio	0.33	0.33				
Upstream Filter(I)	0.73	0.73				
Uniform Delay (d), s/veh	20.7	19.8				
Incr Delay (d2), s/veh	0.3	0.7				
Initial Q Delay(d3),s/veh	0.0	0.0				
%ile BackOfQ(50%),veh/ln	4.4	3.9				
LnGrp Delay(d),s/veh	20.9	20.5				
LnGrp LOS	C	C				
Approach Vol, veh/h		937				
Approach Delay, s/veh		20.8				
Approach LOS		C				

Timer	1	2	3	4	5	6	7	8
Assigned Phs				4				
Phs Duration (G+Y+Rc), s				18.3				
Change Period (Y+Rc), s				4.5				
Max Green Setting (Gmax), s				18.5				
Max Q Clear Time (g_c+I1), s				11.2				
Green Ext Time (p_c), s				2.6				

Intersection Summary	
HCM 2010 Ctrl Delay	20.8
HCM 2010 LOS	C

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	375	530	475	0
Future Volume (veh/h)	0	0	375	530	475	0
Number			3	8	5	12
Initial Q (Qb), veh			0	0	0	0
Ped-Bike Adj(A_pbT)			1.00		1.00	1.00
Parking Bus, Adj			1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln			1863	1863	1863	0
Adj Flow Rate, veh/h			395	558	500	0
Adj No. of Lanes			1	1	1	0
Peak Hour Factor			0.95	0.95	0.95	0.95
Percent Heavy Veh, %			2	2	2	0
Cap, veh/h			798	686	0	0
Arrive On Green			0.12	0.12	0.00	0.00
Sat Flow, veh/h			1774	1863	0	
Grp Volume(v), veh/h			395	558	0.0	
Grp Sat Flow(s),veh/h/ln			1774	1863		
Q Serve(g_s), s			10.6	14.6		
Cycle Q Clear(g_c), s			10.6	14.6		
Prop In Lane			1.00			
Lane Grp Cap(c), veh/h			798	686		
V/C Ratio(X)			0.50	0.81		
Avail Cap(c_a), veh/h			871	764		
HCM Platoon Ratio			0.33	0.33		
Upstream Filter(I)			0.72	0.72		
Uniform Delay (d), s/veh			18.5	20.3		
Incr Delay (d2), s/veh			0.3	4.5		
Initial Q Delay(d3),s/veh			0.0	0.0		
%ile BackOfQ(50%),veh/ln			5.3	8.4		
LnGrp Delay(d),s/veh			18.8	24.8		
LnGrp LOS			B	C		
Approach Vol, veh/h				953		
Approach Delay, s/veh				22.3		
Approach LOS				C		

Timer	1	2	3	4	5	6	7	8
Assigned Phs								8
Phs Duration (G+Y+Rc), s								22.9
Change Period (Y+Rc), s								4.5
Max Green Setting (Gmax), s								20.5
Max Q Clear Time (g_c+I1), s								16.6
Green Ext Time (p_c), s								1.8

Intersection Summary	
HCM 2010 Ctrl Delay	22.3
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	430	160	0	0	0	0	470	460	0	375	0
Future Volume (veh/h)	5	430	160	0	0	0	0	470	460	0	375	0
Number	7	4	14				5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863				0	1863	1863	0	1863	0
Adj Flow Rate, veh/h	5	453	52				0	495	352	0	395	0
Adj No. of Lanes	1	1	1				0	1	1	0	1	0
Peak Hour Factor	0.95	0.95	0.95				0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2				0	2	2	0	2	0
Cap, veh/h	527	554	471				0	974	828	0	974	0
Arrive On Green	0.30	0.30	0.30				0.00	0.52	0.52	0.00	0.52	0.00
Sat Flow, veh/h	1774	1863	1583				0	1863	1583	0	1863	0
Grp Volume(v), veh/h	5	453	52				0	495	352	0	395	0
Grp Sat Flow(s),veh/h/ln	1774	1863	1583				0	1863	1583	0	1863	0
Q Serve(g_s), s	0.1	11.3	1.2				0.0	8.6	6.8	0.0	6.4	0.0
Cycle Q Clear(g_c), s	0.1	11.3	1.2				0.0	8.6	6.8	0.0	6.4	0.0
Prop In Lane	1.00		1.00				0.00		1.00	0.00		0.00
Lane Grp Cap(c), veh/h	527	554	471				0	974	828	0	974	0
V/C Ratio(X)	0.01	0.82	0.11				0.00	0.51	0.43	0.00	0.41	0.00
Avail Cap(c_a), veh/h	692	726	617				0	974	828	0	974	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00				0.00	1.00	1.00	0.00	0.79	0.00
Uniform Delay (d), s/veh	12.4	16.3	12.8				0.0	7.8	7.3	0.0	7.2	0.0
Incr Delay (d2), s/veh	0.0	5.6	0.1				0.0	1.9	1.6	0.0	1.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	6.6	0.5				0.0	4.9	3.3	0.0	3.6	0.0
LnGrp Delay(d),s/veh	12.4	21.9	12.9				0.0	9.7	8.9	0.0	8.2	0.0
LnGrp LOS	B	C	B					A	A		A	
Approach Vol, veh/h		510						847			395	
Approach Delay, s/veh		20.9						9.3			8.2	
Approach LOS		C						A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		
Phs Duration (G+Y+Rc), s		30.6		19.4		30.6		
Change Period (Y+Rc), s		4.5		4.5		4.5		
Max Green Setting (Gmax), s		21.5		19.5		21.5		
Max Q Clear Time (g_c+I1), s		10.6		13.3		8.4		
Green Ext Time (p_c), s		5.2		1.6		5.8		

Intersection Summary	
HCM 2010 Ctrl Delay	12.5
HCM 2010 LOS	B

Queuing and Blocking Report

Intersection: 5: JBLM & I-5 NB Ramps/NB Couplet

Movement	EB	EB	EB	NB	NB	SB
Directions Served	L	T	R	T	R	T
Maximum Queue (ft)	68	261	128	201	201	168
Average Queue (ft)	4	138	45	102	99	53
95th Queue (ft)	31	214	91	177	174	137
Link Distance (ft)		1108		612	612	327
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)	100		250			
Storage Blk Time (%)		16	0			
Queuing Penalty (veh)		26	0			

Intersection: 7: JBLM & I-5 SB Ramps/SB Couplet

Movement	WB	WB	NB
Directions Served	L	T	L
Maximum Queue (ft)	241	305	206
Average Queue (ft)	116	151	78
95th Queue (ft)	189	246	162
Link Distance (ft)		1183	327
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)	350		
Storage Blk Time (%)		0	
Queuing Penalty (veh)		0	

Intersection: 8: NB Couplet/I-5 NB Ramps & Steilacoom

Movement	EB	EB	EB	SB	SB
Directions Served	L	L	T	L	L
Maximum Queue (ft)	161	169	176	54	66
Average Queue (ft)	98	122	90	18	38
95th Queue (ft)	143	161	147	45	64
Link Distance (ft)			1192	329	329
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)	250	250			
Storage Blk Time (%)					
Queuing Penalty (veh)					

Queuing and Blocking Report

Intersection: 9: Steilacoom & SB Couplet/I-5 SB Ramps

Movement	WB	WB	WB	SB	SB	SB
Directions Served	L	T	R	T	T	R
Maximum Queue (ft)	35	136	156	175	314	266
Average Queue (ft)	3	67	82	109	159	132
95th Queue (ft)	18	117	137	208	244	230
Link Distance (ft)	966	966	966		759	
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)				150		250
Storage Blk Time (%)				0	5	0
Queuing Penalty (veh)				2	59	2

Network Summary

Network wide Queuing Penalty: 90

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	0	0	370	0	620	0	0	935	695
Future Volume (veh/h)	0	0	0	0	0	370	0	620	0	0	935	695
Number				3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln				0	0	1863	0	1863	0	0	1863	1863
Adj Flow Rate, veh/h				0	0	76	0	674	0	0	1016	559
Adj No. of Lanes				0	0	2	0	2	0	0	1	1
Peak Hour Factor				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %				0	0	2	0	2	0	0	2	2
Cap, veh/h				0	0	0	0	3274	0	0	1723	1465
Arrive On Green				0.00	0.00	0.00	0.00	0.93	0.00	0.00	0.93	0.93
Sat Flow, veh/h					0		0	3725	0	0	1863	1583
Grp Volume(v), veh/h					0.0		0	674	0	0	1016	559
Grp Sat Flow(s),veh/h/ln							0	1770	0	0	1863	1583
Q Serve(g_s), s							0.0	1.1	0.0	0.0	5.4	2.5
Cycle Q Clear(g_c), s							0.0	1.1	0.0	0.0	5.4	2.5
Prop In Lane							0.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h							0	3274	0	0	1723	1465
V/C Ratio(X)							0.00	0.21	0.00	0.00	0.59	0.38
Avail Cap(c_a), veh/h							0	3274	0	0	1723	1465
HCM Platoon Ratio							1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)							0.00	0.36	0.00	0.00	1.00	1.00
Uniform Delay (d), s/veh							0.0	0.2	0.0	0.0	0.4	0.3
Incr Delay (d2), s/veh							0.0	0.1	0.0	0.0	1.5	0.8
Initial Q Delay(d3),s/veh							0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln							0.0	0.5	0.0	0.0	3.0	1.2
LnGrp Delay(d),s/veh							0.0	0.3	0.0	0.0	1.9	1.0
LnGrp LOS								A			A	A
Approach Vol, veh/h								674			1575	
Approach Delay, s/veh								0.3			1.6	
Approach LOS								A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		
Phs Duration (G+Y+Rc), s		60.0				60.0		
Change Period (Y+Rc), s		4.5				4.5		
Max Green Setting (Gmax), s		44.5				44.5		
Max Q Clear Time (g_c+I1), s		3.1				7.4		
Green Ext Time (p_c), s		24.4				22.8		

Intersection Summary	
HCM 2010 Ctrl Delay	1.2
HCM 2010 LOS	A

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	620	0	0	0	940	0
Future Volume (veh/h)	620	0	0	0	940	0
Number	7	4			1	16
Initial Q (Qb), veh	0	0			0	0
Ped-Bike Adj(A_pbT)	1.00				1.00	1.00
Parking Bus, Adj	1.00	1.00			1.00	1.00
Adj Sat Flow, veh/h/ln	1863	0			1863	0
Adj Flow Rate, veh/h	674	0			1022	0
Adj No. of Lanes	2	0			1	0
Peak Hour Factor	0.92	0.92			0.92	0.92
Percent Heavy Veh, %	2	0			2	0
Cap, veh/h	0	0			0	0
Arrive On Green	0.00	0.00			0.00	0.00
Sat Flow, veh/h		0			0	
Grp Volume(v), veh/h		0.0			0.0	
Grp Sat Flow(s),veh/h/ln						
Q Serve(g_s), s						
Cycle Q Clear(g_c), s						
Prop In Lane						
Lane Grp Cap(c), veh/h						
V/C Ratio(X)						
Avail Cap(c_a), veh/h						
HCM Platoon Ratio						
Upstream Filter(I)						
Uniform Delay (d), s/veh						
Incr Delay (d2), s/veh						
Initial Q Delay(d3),s/veh						
%ile BackOfQ(50%),veh/ln						
LnGrp Delay(d),s/veh						
LnGrp LOS						
Approach Vol, veh/h						
Approach Delay, s/veh						
Approach LOS						

Timer	1	2	3	4	5	6	7	8
Assigned Phs								
Phs Duration (G+Y+Rc), s								
Change Period (Y+Rc), s								
Max Green Setting (Gmax), s								
Max Q Clear Time (g_c+I1), s								
Green Ext Time (p_c), s								

Intersection Summary	
HCM 2010 Ctrl Delay	0.0
HCM 2010 LOS	A

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	375	0	475	0
Future Volume (veh/h)	0	0	375	0	475	0
Number			3	8	5	12
Initial Q (Qb), veh			0	0	0	0
Ped-Bike Adj(A_pbT)			1.00		1.00	1.00
Parking Bus, Adj			1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln			1863	0	1863	0
Adj Flow Rate, veh/h			408	0	516	0
Adj No. of Lanes			2	0	1	0
Peak Hour Factor			0.92	0.92	0.92	0.92
Percent Heavy Veh, %			2	0	2	0
Cap, veh/h			0	0	0	0
Arrive On Green			0.00	0.00	0.00	0.00
Sat Flow, veh/h				0	0	
Grp Volume(v), veh/h				0.0	0.0	
Grp Sat Flow(s),veh/h/ln						
Q Serve(g_s), s						
Cycle Q Clear(g_c), s						
Prop In Lane						
Lane Grp Cap(c), veh/h						
V/C Ratio(X)						
Avail Cap(c_a), veh/h						
HCM Platoon Ratio						
Upstream Filter(I)						
Uniform Delay (d), s/veh						
Incr Delay (d2), s/veh						
Initial Q Delay(d3),s/veh						
%ile BackOfQ(50%),veh/ln						
LnGrp Delay(d),s/veh						
LnGrp LOS						
Approach Vol, veh/h						
Approach Delay, s/veh						
Approach LOS						

Timer	1	2	3	4	5	6	7	8
Assigned Phs								
Phs Duration (G+Y+Rc), s								
Change Period (Y+Rc), s								
Max Green Setting (Gmax), s								
Max Q Clear Time (g_c+I1), s								
Green Ext Time (p_c), s								

Intersection Summary	
HCM 2010 Ctrl Delay	0.0
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	0	160	0	0	0	0	470	460	0	375	0
Future Volume (veh/h)	5	0	160	0	0	0	0	470	460	0	375	0
Number	7	4	14				5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	0	1863				0	1863	1863	0	1863	0
Adj Flow Rate, veh/h	5	0	6				0	511	364	0	408	0
Adj No. of Lanes	1	0	1				0	1	1	0	2	0
Peak Hour Factor	0.92	0.92	0.92				0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	0	2				0	2	2	0	2	0
Cap, veh/h	25	0	22				0	1557	1324	0	2959	0
Arrive On Green	0.01	0.00	0.01				0.00	0.84	0.84	0.00	0.84	0.00
Sat Flow, veh/h	1774	0	1583				0	1863	1583	0	3725	0
Grp Volume(v), veh/h	5	0	6				0	511	364	0	408	0
Grp Sat Flow(s),veh/h/ln	1774	0	1583				0	1863	1583	0	1770	0
Q Serve(g_s), s	0.2	0.0	0.2				0.0	3.7	2.9	0.0	1.3	0.0
Cycle Q Clear(g_c), s	0.2	0.0	0.2				0.0	3.7	2.9	0.0	1.3	0.0
Prop In Lane	1.00		1.00				0.00		1.00	0.00		0.00
Lane Grp Cap(c), veh/h	25	0	22				0	1557	1324	0	2959	0
V/C Ratio(X)	0.20	0.00	0.27				0.00	0.33	0.27	0.00	0.14	0.00
Avail Cap(c_a), veh/h	399	0	356				0	1557	1324	0	2959	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00				0.00	1.00	1.00	0.00	0.79	0.00
Uniform Delay (d), s/veh	29.3	0.0	29.3				0.0	1.1	1.0	0.0	0.9	0.0
Incr Delay (d2), s/veh	3.9	0.0	6.4				0.0	0.6	0.5	0.0	0.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	0.1				0.0	2.1	1.4	0.0	0.7	0.0
LnGrp Delay(d),s/veh	33.2	0.0	35.7				0.0	1.7	1.6	0.0	1.0	0.0
LnGrp LOS	C		D					A	A		A	
Approach Vol, veh/h		11						875			408	
Approach Delay, s/veh		34.6						1.6			1.0	
Approach LOS		C						A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		
Phs Duration (G+Y+Rc), s		54.7		5.3		54.7		
Change Period (Y+Rc), s		4.5		4.5		4.5		
Max Green Setting (Gmax), s		37.5		13.5		37.5		
Max Q Clear Time (g_c+I1), s		5.7		2.2		3.3		
Green Ext Time (p_c), s		8.9		0.0		9.1		

Intersection Summary	
HCM 2010 Ctrl Delay	1.7
HCM 2010 LOS	A

Queuing and Blocking Report

Intersection: 5: JBLM & I-5 NB Ramps

Movement	EB	EB	NB	NB	SB	SB
Directions Served	L	R	T	R	T	T
Maximum Queue (ft)	54	164	140	98	115	118
Average Queue (ft)	6	85	60	49	58	55
95th Queue (ft)	31	138	118	87	106	106
Link Distance (ft)		1096	617	617	314	314
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)	100					
Storage Blk Time (%)		5				
Queuing Penalty (veh)		0				

Intersection: 7: JBLM & I-5 SB Ramps

Movement	WB	WB	NB
Directions Served	L	L	L
Maximum Queue (ft)	140	148	179
Average Queue (ft)	62	85	80
95th Queue (ft)	106	124	149
Link Distance (ft)	1199	1199	314
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 8: I-5 NB Ramps & Steilacoom

Movement	EB	EB	SB
Directions Served	L	L	L
Maximum Queue (ft)	203	220	314
Average Queue (ft)	121	133	130
95th Queue (ft)	183	191	257
Link Distance (ft)	1205	1205	337
Upstream Blk Time (%)			0
Queuing Penalty (veh)			0
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Queuing and Blocking Report

Intersection: 9: Steilacoom & I-5 SB Ramps

Movement	WB	WB	NB	SB	SB
Directions Served	R	R	T	T	R
Maximum Queue (ft)	232	189	9	270	144
Average Queue (ft)	153	120	0	124	72
95th Queue (ft)	213	189	6	216	117
Link Distance (ft)	967	967	337	766	766
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Network Summary

Network wide Queuing Penalty: 1

APPENDIX C

SCORING WORKSHEETS FOR EXIT 119 INTERCHANGE DESIGN OPTION ANALYSIS

I-5, Mounts Road to Thorne Lane Corridor Improvements
Exit 119 Interchange Alternative Scoring

Interchange Alternative	Mobility & Connectivity			Environmental Impact			Implementation Characteristics		
	Score	Weight	Total Score	Score	Weight	Total Score	Score	Weight	Total Score
Skewed Alignment	73.00	35%	25.55	41.00	25%	10.25	42.50	40%	17.00
Couplet	67.50	35%	23.63	87.50	25%	21.88	95.00	40%	38
A-B With Split Ramps	93.00	35%	32.55	74.00	25%	18.5	88.75	40%	35.5
Wilmington Flyover	53.00	35%	18.55	41.00	25%	10.25	19.50	40%	7.8
A-B Split Ramps with New ACP	84.25	35%	29.49	20.00	25%	5	32.50	40%	13
Local Crossing with At Grade Rail	60.50	35%	21.18	83.00	25%	20.75	57.25	40%	22.9

Final Score	
Alternative	**Score**
Skewed Alignment	**52.80**
Couplet	**83.51**
A-B With Split Ramps	**86.55**
Wilmington Flyover	**36.60**
A-B Split Ramps with New ACP	**47.49**
Local Crossing with At Grade Rail	**64.83**

I-5, Mounts Rd to Thorne Lane Corridor Improvements
Exit 119 Interchange Alternative Scoring

Interchange Option: Skewed Alignment

Date Scored: 7-11-2017

Mobility & Connectivity (35% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
I-5 Performance	**30%**	-	-	-
• I-5 Performance	-	30.0%	100	30.00
Subtotal	-	*30.0%*	-	*30.00*
Access to Local Systems and Communities	**35%**	-	-	-
• DuPont/Steilacoom/Lewis North	-	17.5%	50	8.75
• JBLM (Lewis Main)	-	17.5%	10	1.75
Subtotal	-	*35.0%*	-	*10.50*
Interchange Accommodations	**35%**	-	-	-
• Freight/Truck	-	10.0%	100	10.00
• Driver expectations	-	5.0%	100	5.00
• Non-motorized connectivity/ease	-	5.0%	50	2.50
• Traffic operations/queue capacity	-	15.0%	100	15.00
Subtotal	-	*35.0%*	-	*32.50*
Total	100%	100%	-	73.00

Environmental Impact (25% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
Environmental Impacts	**100%**	-	-	-
• Wetlands/Wildlife	-	25.0%	50	12.50
• Cultural Resources (Section 106) / Section 4f	-	45.0%	30	13.50
• Land Use (planned future improvements)	-	15.0%	30	4.50
• Noise/Visual	-	15.0%	70	10.50
Subtotal	-	*100.0%*	-	*41.00*
Total	100%	100%		41.00

Implementation Characteristics (40% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
Schedule	**30%**	-	-	-
• Right-of-way - Private Acquisition - DOD - Leased Military Housing	-	12.5%	50	6.25
• NEPA - DCE (12 months) - Supplemental EA (18-24 months)	-	12.5%	50	6.25
• Project Development - Design/IJR	-	5.0%	50	2.50
Subtotal		*30.0%*	-	*15.00*
Cost	**35%**	-	-	-
• Cost - relative to each other	-	35.0%	50	17.50
Subtotal		*35.0%*	-	*17.50*
Project Acceptability	**25%**	-	-	-
• Project Acceptability (WSDOT, JBLM, DuPont)	-	25.0%	0	0.00
Subtotal	-	*25.0%*	-	*0.00*
Constructability/MOT	**10%**	-	-	-
• Constructability/MOT	-	10.0%	100	10.00
Subtotal	-	*10.0%*	-	*10.00*
Total	100%	100%	-	42.50

I-5, Mounts Rd to Thorne Lane Corridor Improvements
Exit 119 Interchange Alternative Scoring

Interchange Option: Exit 119 Couplet

Date Scored: 7-11-2017

Mobility & Connectivity (35% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
I-5 Performance	**30%**	-	-	-
• I-5 Performance	-	30.0%	100	30.00
Subtotal	-	*30.0%*	-	*30.00*
Access to Local Systems and Communities	**35%**	-	-	-
• DuPont/Steilacoom/Lewis North	-	17.5%	50	8.75
• JBLM (Lewis Main)	-	17.5%	50	8.75
Subtotal	-	*35.0%*	-	*17.50*
Interchange Accommodations	**35%**	-	-	-
• Freight/Truck	-	10.0%	50	5.00
• Driver expectations	-	5.0%	100	5.00
• Non-motorized connectivity/ease	-	5.0%	50	2.50
• Traffic operations/queue capacity	-	15.0%	50	7.50
Subtotal	-	*35.0%*	-	*20.00*
Total	100%	100%	-	67.50

Environmental Impact (25% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
Environmental Impacts	**100%**	-	-	-
• Wetlands/Wildlife	-	25.0%	50	12.50
• Cultural Resources (Section 106) / Section 4f	-	45.0%	100	45.00
• Land Use (planned future improvements)	-	15.0%	100	15.00
• Noise/Visual	-	15.0%	100	15.00
Subtotal	-	*100.0%*	-	*87.50*
Total	100%	100%		87.50

Implementation Characteristics (40% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
Schedule	**30%**	-	-	-
• Right-of-way - Private Acquisition - DOD - Leased Military Housing	-	12.5%	100	12.50
• NEPA - DCE (12 months) - Supplemental EA (18-24 months)	-	12.5%	100	12.50
• Project Development - Design/IJR	-	5.0%	100	5.00
Subtotal		*30.0%*	-	*30.00*
Cost	**35%**	-	-	-
• Cost - relative to each other	-	35.0%	100	35.00
Subtotal		*35.0%*	-	*35.00*
Project Acceptability	**25%**	-	-	-
• Project Acceptability (WSDOT, JBLM, DuPont)	-	25.0%	100	25.00
Subtotal	-	*25.0%*	-	*25.00*
Constructability/MOT	**10%**	-	-	-
• Constructability/MOT	-	10.0%	50	5.00
Subtotal	-	*10.0%*	-	*5.00*
Total	100%	100%	-	95.00

I-5, Mounts Rd to Thorne Lane Corridor Improvements
Exit 119 Interchange Alternative Scoring

Interchange Option: Exit 119 A-B Split Ramps

Date Scored: 7-11-2017

Mobility & Connectivity (35% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
I-5 Performance	**30%**	-	-	-
• I-5 Performance	-	30.0%	100	30.00
Subtotal	-	*30.0%*	-	*30.00*
Access to Local Systems and Communities	**35%**	-	-	-
• DuPont/Steilacoom/Lewis North	-	17.5%	100	17.50
• JBLM (Lewis Main)	-	17.5%	100	17.50
Subtotal	-	*35.0%*	-	*35.00*
Interchange Accommodations	**35%**	-	-	-
• Freight/Truck	-	10.0%	100	10.00
• Driver expectations	-	5.0%	50	2.50
• Non-motorized connectivity/ease	-	5.0%	10	0.50
• Traffic operations/queue capacity	-	15.0%	100	15.00
Subtotal	-	*35.0%*	-	*28.00*
Total	100%	100%	-	93.00

Environmental Impact (25% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
Environmental Impacts	**100%**	-	-	-
• Wetlands/Wildlife	-	25.0%	50	12.50
• Cultural Resources (Section 106) / Section 4f	-	45.0%	70	31.50
• Land Use (planned future improvements)	-	15.0%	100	15.00
• Noise/Visual	-	15.0%	100	15.00
Subtotal	-	*100.0%*	-	*74.00*
Total	100%	100%		74.00

Implementation Characteristics (40% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
Schedule	**30%**	-	-	-
• Right-of-way - Private Acquisition - DOD - Leased Military Housing	-	12.5%	100	12.50
• NEPA - DCE (12 months) - Supplemental EA (18-24 months)	-	12.5%	50	6.25
• Project Development - Design/IJR	-	5.0%	100	5.00
Subtotal		*30.0%*	-	*23.75*
Cost	**35%**	-	-	-
• Cost - relative to each other	-	35.0%	100	35.00
Subtotal		*35.0%*	-	*35.00*
Project Acceptability	**25%**	-	-	-
• Project Acceptability (WSDOT, JBLM, DuPont)	-	25.0%	100	25.00
Subtotal	-	*25.0%*	-	*25.00*
Constructability/MOT	**10%**	-	-	-
• Constructability/MOT	-	10.0%	50	5.00
Subtotal	-	*10.0%*	-	*5.00*
Total	100%	100%	-	88.75

I-5, Mounts Rd to Thorne Lane Corridor Improvements
Exit 119 Interchange Alternative Scoring

Interchange Option: Wilmington Flyover

Date Scored: 7-06-2017

Mobility & Connectivity (35% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
I-5 Performance	**30%**	-	-	-
• I-5 Performance	-	30.0%	50	15.00
Subtotal	-	*30.0%*	-	*15.00*
Access to Local Systems and Communities	**35%**	-	-	-
• DuPont/Steilacoom/Lewis North	-	17.5%	10	1.75
• JBLM (Lewis Main)	-	17.5%	50	8.75
Subtotal	-	*35.0%*	-	*10.50*
Interchange Accommodations	**35%**	-	-	-
• Freight/Truck	-	10.0%	50	5.00
• Driver expectations	-	5.0%	100	5.00
• Non-motorized connectivity/ease	-	5.0%	50	2.50
• Traffic operations/queue capacity	-	15.0%	100	15.00
Subtotal	-	*35.0%*	-	*27.50*
Total	100%	100%	-	53.00

Environmental Impact (25% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
Environmental Impacts	**100%**	-	-	-
• Wetlands/Wildlife	-	25.0%	50	12.50
• Cultural Resources (Section 106) / Section 4f	-	45.0%	50	22.50
• Land Use (planned future improvements)	-	15.0%	30	4.50
• Noise/Visual	-	15.0%	10	1.50
Subtotal	-	*100.0%*	-	*41.00*
Total	100%	100%		41.00

Implementation Characteristics (40% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
Schedule	**30%**	-	-	-
• Right-of-way - Private Acquisition - DOD - Leased Military Housing	-	12.5%	50	6.25
• NEPA - DCE (12 months) - Supplemental EA (18-24 months)	-	12.5%	50	6.25
• Project Development - Design/IJR	-	5.0%	50	2.50
Subtotal		*30.0%*	-	*15.00*
Cost	**35%**	-	-	-
• Cost - relative to each other	-	35.0%	10	3.50
Subtotal		*35.0%*	-	*3.50*
Project Acceptability	**25%**	-	-	-
• Project Acceptability (WSDOT, JBLM, DuPont)	-	25.0%	0	0.00
Subtotal	-	*25.0%*	-	*0.00*
Constructability/MOT	**10%**	-	-	-
• Constructability/MOT	-	10.0%	10	1.00
Subtotal	-	*10.0%*	-	*1.00*
Total	100%	100%	-	19.50

I-5, Mounts Rd to Thorne Lane Corridor Improvements
Exit 119 Interchange Alternative Scoring

Interchange Option: Exit 119 A-B Split Ramps with New ACP

Date Scored: 7-11-2017

Mobility & Connectivity (35% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
I-5 Performance	**30%**	-	-	-
• I-5 Performance	-	30.0%	100	30.00
Subtotal	-	*30.0%*	-	*30.00*
Access to Local Systems and Communities	**35%**	-	-	-
• DuPont/Steilacoom/Lewis North	-	17.5%	100	17.50
• JBLM (Lewis Main)	-	17.5%	50	8.75
Subtotal	-	*35.0%*	-	*26.25*
Interchange Accommodations	**35%**	-	-	-
• Freight/Truck	-	10.0%	100	10.00
• Driver expectations	-	5.0%	50	2.50
• Non-motorized connectivity/ease	-	5.0%	10	0.50
• Traffic operations/queue capacity	-	15.0%	100	15.00
Subtotal	-	*35.0%*	-	*28.00*
Total	100%	100%	-	84.25

Environmental Impact (25% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
Environmental Impacts	**100%**	-	-	-
• Wetlands/Wildlife	-	25.0%	50	12.50
• Cultural Resources (Section 106) / Section 4f	-	45.0%	10	4.50
• Land Use (planned future improvements)	-	15.0%	10	1.50
• Noise/Visual	-	15.0%	10	1.50
Subtotal	-	*100.0%*	-	*20.00*
Total	100%	100%		20.00

Implementation Characteristics (40% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
Schedule	**30%**	-	-	-
• Right-of-way - Private Acquisition - DOD - Leased Military Housing	-	12.5%	10	1.25
• NEPA - DCE (12 months) - Supplemental EA (18-24 months)	-	12.5%	10	1.25
• Project Development - Design/IJR	-	5.0%	50	2.50
Subtotal		*30.0%*	-	*5.00*
Cost	**35%**	-	-	-
• Cost - relative to each other	-	35.0%	50	17.50
Subtotal		*35.0%*	-	*17.50*
Project Acceptability	**25%**	-	-	-
• Project Acceptability (WSDOT, JBLM, DuPont)	-	25.0%	0	0.00
Subtotal	-	*25.0%*	-	*0.00*
Constructability/MOT	**10%**	-	-	-
• Constructability/MOT	-	10.0%	100	10.00
Subtotal	-	*10.0%*	-	*10.00*
Total	100%	100%	-	32.50

I-5, Mounts Rd to Thorne Lane Corridor Improvements
Exit 119 Interchange Alternative Scoring

Interchange Option: Local Crossingwith At Grade Rail

Date Scored: 8-2-2017

Mobility & Connectivity (35% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
I-5 Performance	**30%**	-	-	-
• I-5 Performance	-	30.0%	100	30.00
Subtotal	-	*30.0%*	-	*30.00*
Access to Local Systems and Communities	**35%**	-	-	-
• DuPont/Steilacoom/Lewis North	-	17.5%	50	8.75
• JBLM (Lewis Main)	-	17.5%	10	1.75
Subtotal	-	*35.0%*	-	*10.50*
Interchange Accommodations	**35%**	-	-	-
• Freight/Truck	-	10.0%	50	5.00
• Driver expectations	-	5.0%	50	2.50
• Non-motorized connectivity/ease	-	5.0%	100	5.00
• Traffic operations/queue capacity	-	15.0%	50	7.50
Subtotal	-	*35.0%*	-	*20.00*
Total	100%	100%	-	60.50

Environmental Impact (25% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
Environmental Impacts	**100%**	-	-	-
• Wetlands/Wildlife	-	25.0%	50	12.50
• Cultural Resources (Section 106) / Section 4f	-	45.0%	100	45.00
• Land Use (planned future improvements)	-	15.0%	100	15.00
• Noise/Visual	-	15.0%	70	10.50
Subtotal	-	*100.0%*	-	*83.00*
Total	100%	100%		83.00

Implementation Characteristics (40% Weight)

Criteria	Total (100%)	Allocation of Total	Points	Score
Schedule	**30%**	-	-	-
• Right-of-way - Private Acquisition - DOD - Leased Military Housing	-	12.5%	50	6.25
• NEPA - DCE (12 months) - Supplemental EA (18-24 months)	-	12.5%	100	12.50
• Project Development - Design/IJR	-	5.0%	50	2.50
Subtotal		*30.0%*	-	*21.25*
Cost	**35%**	-	-	-
• Cost - relative to each other	-	35.0%	100	35.00
Subtotal		*35.0%*	-	*35.00*
Project Acceptability	**25%**	-	-	-
• Project Acceptability (WSDOT, JBLM, DuPont)	-	25.0%	0	0.00
Subtotal	-	*25.0%*	-	*0.00*
Constructability/MOT	**10%**	-	-	-
• Constructability/MOT	-	10.0%	10	1.00
Subtotal	-	*10.0%*	-	*1.00*
Total	100%	100%	-	57.25