MILLENNIUM **Bulk Terminals—Longview**

EIS Environmental Impact Statement

State Environmental Policy Act Draft Environmental Impact Statement

Volume III.c: Operations Technical Reports Part 1

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DEPARTMENT OF ECOLOGY State of Washington

Volume IIIc
Operations Technical Reports

Part 1

SEPA Alternatives Technical Report

SEPA Rail Transportation Technical Report

SEPA Rail Safety Technical Report

SEPA Vehicle Transportation Technical Report

SEPA Vessel Transportation Technical Report

Part 2

SEPA Noise and Vibration Technical Report

SEPA Air Quality Technical Report

SEPA Coal Technical Report

SEPA Greenhouse Gas Emissions Technical Report

SEPA Climate Change Technical Report

SEPA Coal Market Assessment Technical Report

MILLENNIUM BULK TERMINALS–LONGVIEW SEPA ENVIRONMENTAL IMPACT STATEMENT

SEPA ALTERNATIVES TECHNICAL REPORT

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Acronyms and Abbreviations

Applicant	Millennium Bulk Terminals—Longview, LLC
BMP	Black Mud Pond
BPA	Bonneville Power Administration
BNSF	BNSF Railway Company
CCC	Cowlitz County Code
Corps	U.S. Army Corps of Engineers
Ecology	Washington State Department of Ecology
gpm	gallons per minute
LVSW	Longview Switching Company
OHWM	ordinary high water mark
Proposed Action	Millennium Bulk Terminals—Longview Project
Reynolds facility	Reynolds Metals Company facility
SEPA	State Environmental Policy Act
SR	State Route
UP	Union Pacific Railroad
WDNR	Washington Department of Natural Resources

Chapter 1
Introduction

Millennium Bulk Terminals—Longview, LLC (Applicant) is proposing to construct and operate a coal export terminal (Proposed Action) on a 190-acre site (project area) in Cowlitz County, Washington, along the Columbia River (Figure 1). The project area is primarily located within a 540-acre site currently leased by the Applicant (referred to as the Applicant's leased area). The proposed coal export terminal would receive coal from the Powder River Basin in Montana and Wyoming and the Uinta Basin in Utah and Colorado via rail shipment, then load and transport the coal by ocean-going vessels via the Columbia River and Pacific Ocean to overseas markets in Asia. The coal export terminal would receive, stockpile, blend, and load coal by conveyor onto vessels in the Columbia River for export.

The Proposed Action would be constructed in two stages with a maximum throughput of 44 million metric tons of coal per year. The coal export terminal would consist of one operating rail track, eight rail tracks for storing rail cars, rail car unloading facilities, a stockyard for coal storage, conveyor and reclaiming facilities, two new docks (Docks 2 and 3) in the Columbia River, and shiploading facilities on the two docks. Dredging would be required to provide access to and from the Columbia River navigation channel and for berthing at the two new docks. A detailed description of these proposed facilities, existing facilities, and operations at the project area is provided in Chapter 3, *Proposed Action*.

This technical report is organized as follows.

Chapter 1, *Introduction.* This chapter provides an introduction to this technical report.

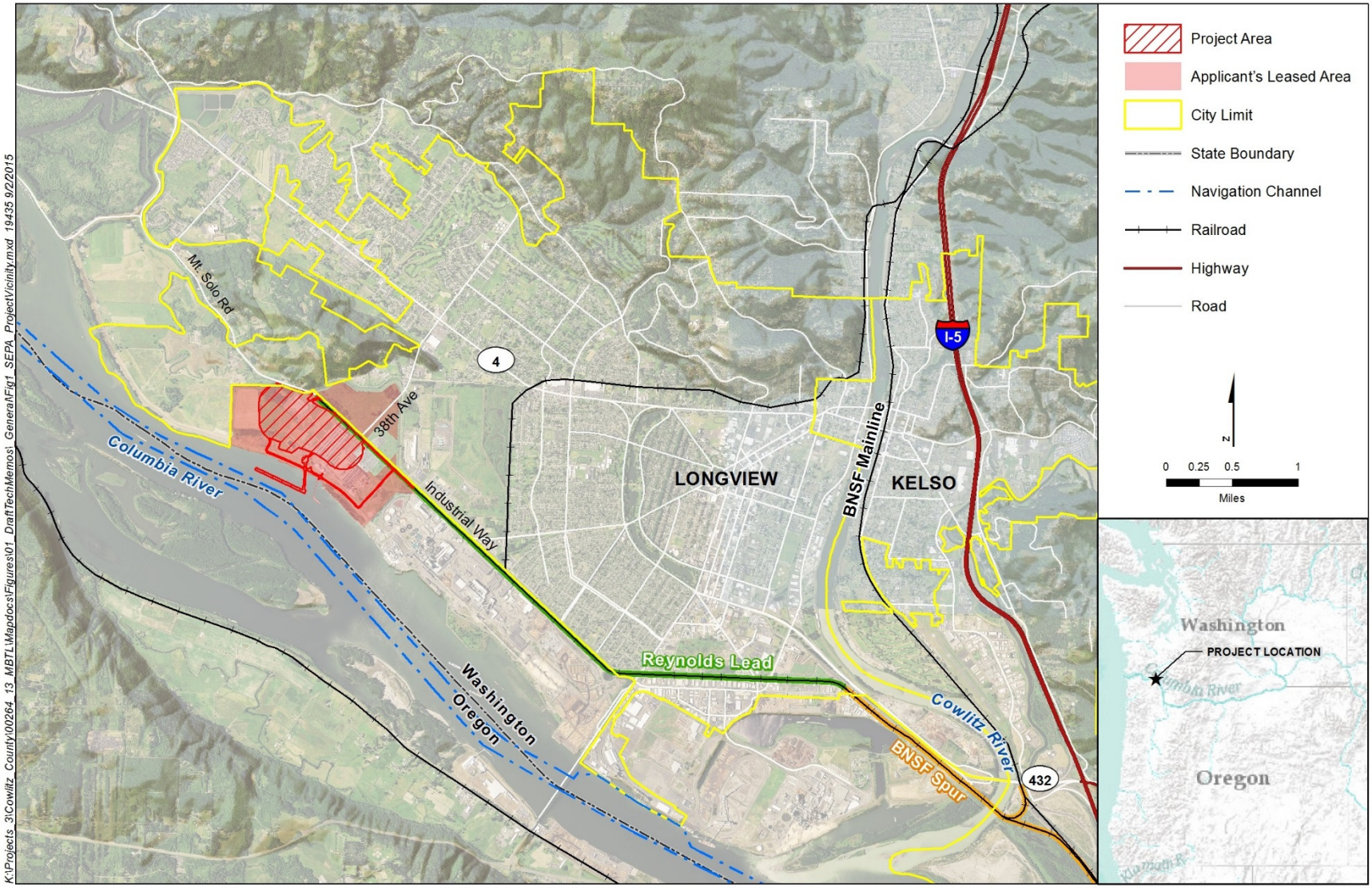
Chapter 2, *Project Objectives*. This chapter describes the Applicant's project objectives for the Proposed Action.

Chapter 3, *Proposed Action*. This chapter describes the Proposed Action, including the project location, existing facilities and operations, and proposed facilities and operations.

Chapter 4, *No-Action Alternative.* This chapter describes the No-Action Alternative, including planned operations and transport, as well as potential future operations and transport.

Chapter 5, *References*. This chapter presents the references cited in this technical report.

Figure 1. Project Vicinity



Chapter 2
Project Objectives

As part of the Washington State Environmental Policy Act (SEPA) process, the Applicant provided the SEPA co-lead agencies[1] with a description of the project objectives. This chapter presents the Applicant's objectives for the Proposed Action, which are listed below and described in the following sections.

- Enable western U.S. coal to compete in the Pacific international coal supply market.
- Diversify Washington State's trade-based economy.
- Reduce local unemployment.

2.1 Enable Western U.S. Coal to Compete in the Pacific International Coal Supply Market

The Applicant states the Proposed Action would enable western U.S. coal to compete in the Pacific international coal supply market by providing a terminal designed to efficiently transport western U.S. coal from rail to ocean-going vessels. Further development of western U.S. coalfields and the growth of Asian market demand for U.S. coal is expected to continue, and existing West Coast terminals are unavailable to support this need. To derive benefit from economies of scale, implementation of the Proposed Action would provide a coal export terminal sufficient in throughput to give U.S. coal producers the opportunity to expand their share of the international coal market.

Further, the Proposed Action would reuse an existing industrial terminal and use existing rail infrastructure and a direct shipping route to Asia, which would promote efficiency and minimize costs for handling and transferring U.S. coal for shipment to Asian markets. These factors would enable U.S. coal to compete in Asian energy markets.

2.2 Diversify Washington State's Trade-Based Economy

The Applicant states the Proposed Action would support the diversification of Washington State's trade-based economy by providing a new coal export terminal to accommodate the anticipated growth in demand for the export of U.S. coal. Approximately 40% of all jobs in Washington State relate to trade, making international trade a key driver of the state's economy (Washington Council on International Trade 2014). Economic diversification of the trade-based economy is vital to Washington State's long-term economic growth. In times of market volatility, an economy that

[1] The two co-lead agencies responsible for the Washington State Environmental Policy Act (SEPA) environmental review are Cowlitz County and the Washington State Department of Ecology (Ecology). Cowlitz County is the designated nominal lead agency for SEPA environmental review since the Proposed Action would occur within unincorporated Cowlitz County.

branches out to other sectors—such as exporting services—can help protect existing, and create new, jobs. Implementation of the Proposed Action would help support the state's diverse economy, which is essential for maintaining economic sustainability.

2.3 Reduce Local Unemployment

The Applicant states the Proposed Action would help reduce unemployment in Cowlitz County by creating employment opportunities in the Longview area. As of February 2016, Cowlitz County's unemployment rate was 8.0%, which was higher than both the national and state averages (Washington State Employment Security Department 2016). The Applicant states the Proposed Action would create approximately 1,350 construction employment opportunities and add approximately 135 new family-wage[2] jobs to operate the coal export terminal. This would also generate needed tax revenues for local economies.

[2] Income that is sufficient to support a family.

Chapter 3
Proposed Action

This chapter describes the Proposed Action, including project location, existing facilities and operations, and proposed facilities, construction, and operations.

Lighthouse Resources, Inc.[3] and Arch Coal, Inc. own Millennium Bulk Terminals—Longview, LLC. In 2010, Millennium Bulk Terminals—Longview, LLC applied for and received a Shoreline Permit from Cowlitz County to build a coal export terminal. In March 2011, the permit was withdrawn. The Proposed Action addresses a separate, second application. In January 2011, Lighthouse Resources, Inc. began looking for a suitable location between northwest Washington and southern California to construct a coal export terminal and determined a 540-acre site in Cowlitz County, Washington, on the Columbia River as the most suitable location.

The Proposed Action would construct and operate a coal export terminal for the shipment of coal in Cowlitz County, Washington, along the Columbia River. The coal export terminal would receive coal from the Powder River Basin in Montana and Wyoming and Uinta Basin in Utah and Colorado via rail shipment. The coal would be stored on site then loaded and transported by ocean-going vessels via the Columbia River and Pacific Ocean to overseas markets in Asia. The coal export terminal would be capable of receiving, stockpiling, blending, and loading coal by conveyor onto vessels in the Columbia River for export.

The Applicant determined there is sufficient Asian market demand for U.S. low-sulfur coal to warrant the development of a coal export terminal in the western United States for shipping Powder River Basin and Uinta Basin coal to Asian markets. Japan, South Korea, and Taiwan lack substantial coal resources and depend almost exclusively on foreign imports. According to the Applicant, Pacific Northwest ports are well positioned to provide western U.S. coal to trade partners in Japan, South Korea, and Taiwan at rates that are competitive in the international marketplace, and to provide a diversification of coal supply to those importing countries.

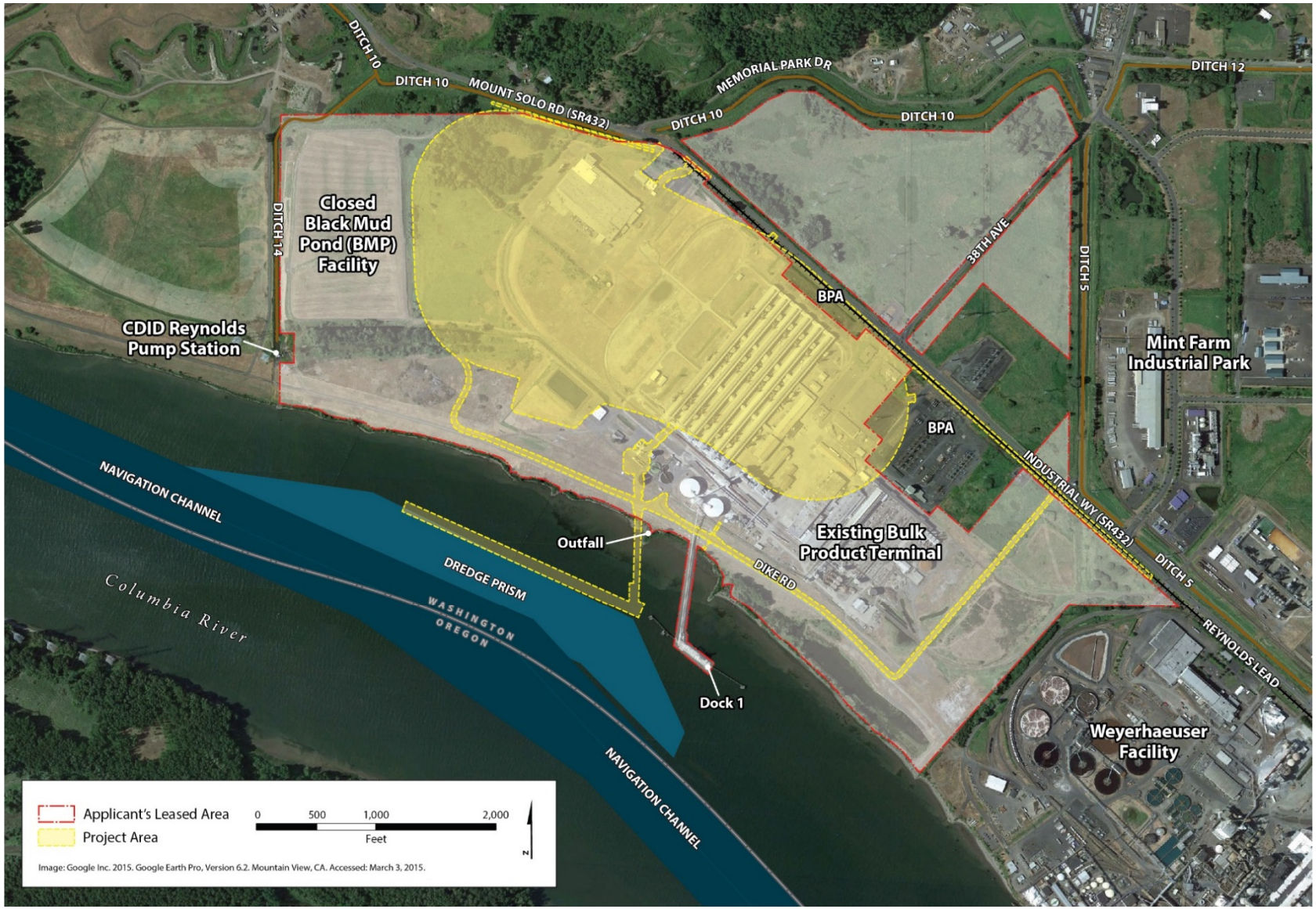
3.1 Project Location

The location for the Proposed Action is adjacent to the Columbia River in unincorporated Cowlitz County, Washington near Longview, Washington. Under the Proposed Action, the Applicant would develop a coal export terminal on 190 acres, primarily within an existing 540-acre site that is currently leased by the Applicant.[4] The 190-acre upland site is referred to as the *project area*, and the 540-acre site is referred to as the *Applicant's leased area*. Figure 2 illustrates the project area and vicinity for the Proposed Action and the Applicant's leased area.

[3] In April 2015, Ambre Energy North America, Inc. announced that it had changed its name to Lighthouse Resources, Inc. In 2014, Ambre Energy North America, Inc. separated from its Australian parent company, Ambre Energy Limited, when Resource Capital Funds became the majority owner of Ambre Energy North America, Inc. (Lighthouse Resources, Inc. 2015).

[4] The project area is also located on two parcels currently owned by Bonneville Power Administration and a portion of the Reynolds Lead.

Figure 2. Project Area



Cowlitz County Land Use and Development Code (CCC) Title 18 designates the project area for heavy industrial use. As illustrated in Figure 2, the project area is bounded by existing industrial uses within the Applicant's leased area to the south and east, the closed Black Mud Pond facility[5] within the Applicant's leased area to the west, and Industrial Way (State Route [SR] 432) and the Reynolds Lead to the north. Existing industrial uses within and adjacent to the project area are described in Section 3.2, *Existing Facilities and Operations*.

Vehicular access to the project area is provided via Industrial Way. The Reynolds Lead and BNSF Spur—both jointly owned by BNSF Railway Company (BNSF) and Union Pacific Railroad (UP), and operated by Longview Switching Company (LVSW)[6]—provide rail access to the project area from a point on the BNSF main line (Longview Junction, Washington) located to the east in Kelso, Washington. The distance from the BNSF main line along the BNSF Spur and the Reynolds Lead to the project area is approximately 7 miles. Vessels access the project area via the Columbia River and berth at an existing dock (Dock 1) in the Columbia River.

3.2 Existing Facilities and Operations

This subsection describes the existing facilities and operations within the Applicant's 540-acre leased area (Figure 2).

3.2.1 Background and History of the Applicant's Leased Area

The Applicant's leased area is the location of the former Reynolds Metals Company facility (Reynolds facility). The facility was constructed in 1941 to support World War II efforts. Reynolds Metals Company expanded in 1968, and operated as an aluminum smelter until 2001 when smelter operations ceased. The former Reynolds facility was an intensive industrial use and, at the time of its closure in 2001, employed approximately 800 workers, and operated 24 hours per day, 7 days per week. In 2000, Reynolds Metals Company was acquired by Alcoa as a wholly owned subsidiary. In 2001, the Longview facility site assets were sold to Longview Aluminum, but ownership of the land was retained by the Reynolds Metals Company. Longview Aluminum declared bankruptcy in 2003. In 2004, Chinook Ventures purchased Longview Aluminum's assets, including the buildings, structures and equipment, and entered into a long-term land lease with the Reynolds Metals Company, who owns the 540 acres. In 2005, Alcoa transferred ownership of the land from the Reynolds Metals Company to Northwest Alloys, a wholly owned subsidiary of Alcoa, Inc. Northwest Alloys also has an existing Aquatic Lands Lease No. 20-B09222 from the Washington Department of Natural Resources (WDNR) through January 2038.

In 2011, Chinook Ventures sold the plant assets to the Applicant, at which time, the Applicant entered into a long-term land lease with Northwest Alloys, a subsidiary of Alcoa. Work has been done to:

- Remove equipment and storage sheds left behind by Chinook Ventures.

[5] More information about the closed Black Mud Pond facility can be found in the SEPA Hazardous Materials Technical Report (ICF International 2016a).

[6] The Longview Switching Company (LVSW) is jointly owned by BNSF Railway Company (BNSF) and Union Pacific Railroad (UP).

- Dispose of wastes generated during the removal process.
- Clean other equipment and buildings.

The 190-acre project area was separated from the Applicant's leased area through a lot boundary adjustment to develop a coal export terminal. The remaining land within the Applicant's leased area is intended to be used for other purposes including the existing bulk product terminal.

Portions of the Applicant's leased area are also subject to ongoing hazardous materials cleanup activities resulting from contamination by the former aluminum smelting and casting uses. Northwest Alloys and the Applicant are actively engaged in site cleanup in the Applicant's leased area, and continue to work with local, state, and federal regulatory agencies to clean up the site. The Applicant's leased area continues to support industrial operations and is currently used as a bulk product terminal that includes both marine and upland facilities.

3.2.2 Existing Bulk Product Terminal

The existing bulk product terminal is within the Applicant's 540-acre leased area (Figure 2). The terminal includes buildings and equipment used for various activities. The terminal is served by Industrial Way and the Reynolds Lead. Vessels access the terminal from an existing dock (Dock 1), which is located on the Columbia River.

The existing bulk product terminal includes rail facilities, storage, conveyors and transfer stations, vessel facilities, and other buildings and employee-support facilities.

3.2.2.1 Rail Facilities

The existing bulk product terminal is located on the Reynolds Lead, an existing rail line serving several industries and connects via the BNSF Spur to the BNSF main line rail network approximately 7 miles away at Longview Junction. The BNSF Spur consists of a track through Longview Junction yard, across the Cowlitz River Bridge, and through the LVSW yard. The Reynolds Lead consists of a track from the LVSW yard to the project area. The Reynolds Lead covers the majority of the distance between the project area and the BNSF main line.

The Applicant has operating permits to load alumina and unload coal by rail. Bulk materials are received and shipped by railcars at an unloading area of the existing bulk product terminal called the Central Transfer Tower. The Central Transfer Tower is an enclosed building receiving bulk material from railcars using a gravity fed bin under the rail line.

3.2.2.2 Storage

Storage of alumina and coal at the existing bulk product terminal occurs in storage tanks (silos). Six vertical storage tanks, originally constructed by Reynolds Metals Company for alumina facility operations, store bulk material near the southern portion of the facility. Three of these tanks receive material from the Central Transfer Tower for storage prior to shipping the material by truck. Two of the remaining tanks are for the storage of bulk materials that then feed to the last of the six tanks for transfer and shipment by train. Maximum capacity for handling materials varies by tank from 30 to 100 tons per hour (Southwest Clean Air Agency 2014).

The existing bulk product terminal includes four additional storage tanks used during previous smelter operations. Currently, one tank is empty and the other three tanks contain material from

previous operations, but are in the process of being emptied by the Applicant. In addition, there are miscellaneous storage tanks on site, including fuel tanks.

The bulk product terminal includes an area in the central portion of the site called the North Plant Potrooms, which contains six potline[7] buildings (approximately 600,000 total square feet). Various bulk products from previous operations were stored in these buildings. However, these products have been removed and the potrooms have been cleared by the Applicant.

3.2.2.3 Conveyors and Transfer Stations

The existing bulk product terminal includes a conveyor system extending from the bulk material unloading facilities to the storage silos or truck loading areas. Existing conveyors are enclosed and use either a wet suppression system or dust-collection equipment to minimize fugitive emissions during the transfer of bulk materials.

3.2.2.4 Vessel Facilities

The existing bulk product terminal includes Dock 1, which is currently used to unload alumina from vessels and to berth other ships. Dock 1 is directly south of the existing terminal's upland facilities and provides vessels access to the terminal via the Columbia River at the existing berthing area. The dock includes an overwater approach trestle and equipment to unload bulk materials from the vessels. Current vessel traffic at the dock is relatively low, at approximately six to seven ships accessing the dock per year.

The Applicant has operating permits to unload alumina from vessels. Unloading facilities include a vacuum ship unloader used for alumina shipments. The existing ship berth has been periodically dredged to support alumina shipments.

3.2.2.5 Buildings and Employee-Support Facilities

The existing bulk product terminal includes a former cable plant building, an approximately 270,000-square-foot facility with associated ancillary structures occupying the northwestern corner of the area. The plant was constructed in the late 1960s, and until 1992, produced electrical cable products, including aluminum wire, rods, and insulated low and medium voltage cable.

The terminal also includes various buildings and employee-support facilities including four office buildings, two cast house buildings, a carbon plant, and several maintenance sheds.

3.2.3 Current Operations and Transport

Current operations of the bulk product terminal, allowed under current permits and zoning, include storing and transporting alumina and up to 150,000 metric tons per year of coal. On-site operations and off-site transport activities are described below. The transport of alumina has been put on hold because Alcoa announced in November 2015 that it will curtail the Wenatchee smelter, temporarily ceasing production while maintaining the facility for restart. The on-site and off-site operations related to alumina are discussed to describe alumina transport when the Wenatchee facility restarts.

[7] Potlines are defined as a row of electrolytic cells connected electrically in series, used in the production of aluminum.

3.2.3.1 On-Site Operations

On-site operations of the existing bulk product terminal involve receiving, storing, and loading (for transport) coal and alumina. Coal is delivered to the site by train, stored in the existing silos, and transferred by truck to the neighboring Weyerhaeuser facility. Alumina is delivered to Dock 1 by vessel, stored on site, and transported by train.

Portions of the project area are also undergoing hazardous waste cleanup activities resulting from contamination by former aluminum smelting operations (Washington State Department of Ecology 2014). Washington State Department of Ecology (Ecology) is overseeing work being done by Northwest Alloys, Alcoa, and the Applicant to investigate and cleanup the site under Washington's Model Toxics Control Act. A Remedial Investigation and Feasibility Study was finalized in January 2015. The study investigated contamination, identified soil and groundwater contaminants and identified cleanup options. The draft Cleanup Action Plan and Consent Decree were issued in January 2016, which describe cleanup methods and standards. Additional hazardous materials are described in the SEPA Hazardous Materials Technical Report and its corresponding appendix (ICF International 2016a).

3.2.3.2 Off-Site Transport

Trains currently deliver coal to the bulk product terminal where it is transferred by truck to Weyerhaeuser, located 1 mile to the east of the bulk product terminal. Vessels would deliver alumina to Dock 1 on the Columbia River. Alumina would be stored and then shipped to Chelan County, Washington, by train. Table 1 identifies current activities and the means for transporting the commodities to and from the existing bulk product terminal.

Table 1. Current Activities and Transport Operations at the Existing Bulk Product Terminal

		Transport Operations		
Commodity	**Activity**	**Truck**	**Train**	**Vessel**
Coal	Trains deliver coal where it is transferred by truck to Weyerhaeuser, located approximately 1 mile southeast of the existing bulk product terminal	Operate on a continual basis (24 hours a day; 7 days a week)	1 train (25 to 30 rail cars) 1 to 2 times per week	N/A (trains deliver coal; trucks transport)
Alumina	Vessels deliver alumina to Dock 1; Alumina is stored and then shipped to Chelan County, Washington by train	Not applicable (vessels deliver alumina; trains transport)	60 rail cars per week shipped at a rate of 12 rail cars per day, 5 days per week	6 vessels per year

Notes:
N/A = not applicable

3.3 Proposed Facilities, Construction, and Operations

As described in the Section 3.2, *Existing Facilities and Operations*, the Applicant currently operates and would continue to operate the bulk product terminal on land leased by the Applicant, separate from and independent of the Proposed Action. Under the Proposed Action, the coal export terminal would be developed on 190 acres (project area), primarily within the Applicant's leased area and adjacent to the existing bulk product terminal (Figure 2). The proposed coal export terminal facilities and operations described in this section would occur within the 190-acre project area.

BNSF or UP trains would transport coal in unit trains (meaning all the rail cars carry the same commodity) from the BNSF main line at Longview Junction to the project area via the BNSF Spur and Reynolds Lead (Figure 3). Coal would be unloaded from rail cars, stockpiled and blended, and loaded by conveyor onto ocean-going vessels at two new docks (Docks 2 and 3) to be located in the Columbia River for export. Figure 4 illustrates the Proposed Action.

Construction of the Proposed Action would involve clearing and grading, construction of rail and coal handling facilities including eight storage track loops to provide staging for arriving and departing trains, as well as a tandem rotary dumper, conveyors, stackers, and reclaimers. The stockpile area would be located within the rail loop and consist of four discrete stockpile pads. The stockpile area would require ground improvements, which would entail preloading[8] of the stockpile area. Approximately 2.1 million cubic yards of preloading material (i.e., rock, dirt, concrete or other appropriate debris) would be placed on the stockpile area to a height of approximately 35 feet.

Wick drains[9] would be placed within the stockpile area to reduce the time required for preloading, from an estimated 18 months to 9 months. The wick drains would allow groundwater to be expelled from beneath the stockpile area and allow the necessary ground settlement to occur.

The Proposed Action would also require constructing a trestle and two docks, with one shiploader on each dock. The trestle and docks would require 630 36-inch pilings, 610 of which would be installed below the ordinary high water mark (OHWM)[10] of the Columbia River. Most pilings would be installed approximately 140 to 165 feet below the mudline, using vibratory pile drivers and an impact pile driver for proofing. Shiploaders located on the docks would consist of a traveling structural steel portal, shuttle, and boom and would be fed coal by a dedicated conveyor. Shiploaders would be rail mounted to allow movement along the dock.

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[8] Preloading is the consolidation or compression of soils to support coal stockpiles and associated infrastructure to prevent excessive future settlement.

[9] Wick drains, also known as prefabricated vertical drains and vertical strip drains, are a ground-improvement technique that provides drainage paths for pore water in soft compressible soil, using prefabricated geotextile filter-wrapped plastic strips with molded channels.

[10] Per Washington State's Shoreline Management Plan, "that mark that will be found by examining the bed and banks and ascertaining where the presence and action of waters are so common and usual, and so long continued in all ordinary years, as to mark upon the soil a character distinct from that of the abutting upland, in respect to vegetation as that condition exists on June 1, 1971, as it may naturally change thereafter, or at it may change thereafter in accordance with permits issued by a local government or the Department of Ecology, provided, that in any area where the ordinary high water mark cannot be found, the ordinary high water mark adjoining salt water shall be the line of mean higher high tide and the ordinary high water mark adjoining fresh water shall be the line of mean high water."

Figure 3. BNSF Spur and Reynolds Lead

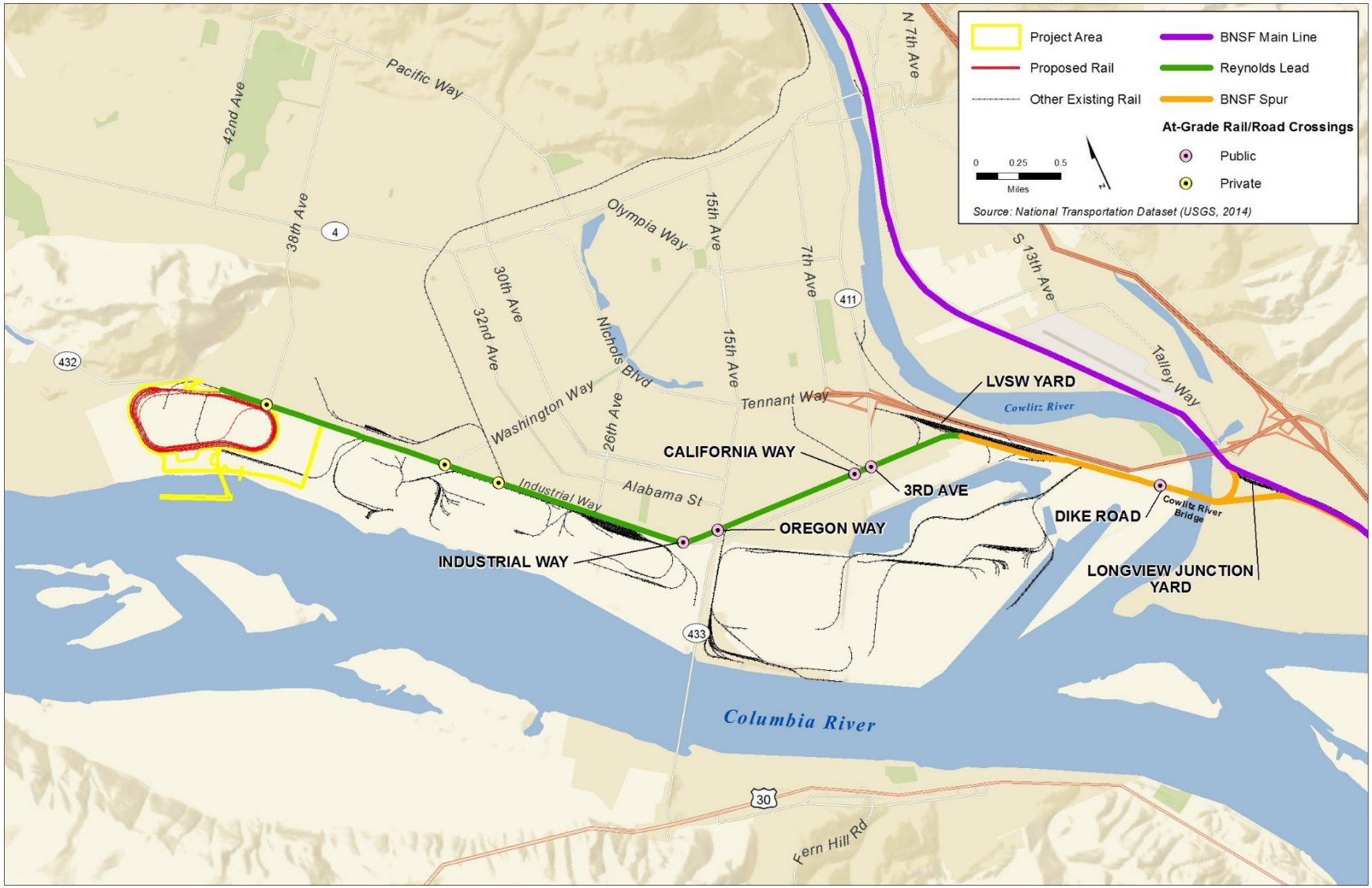
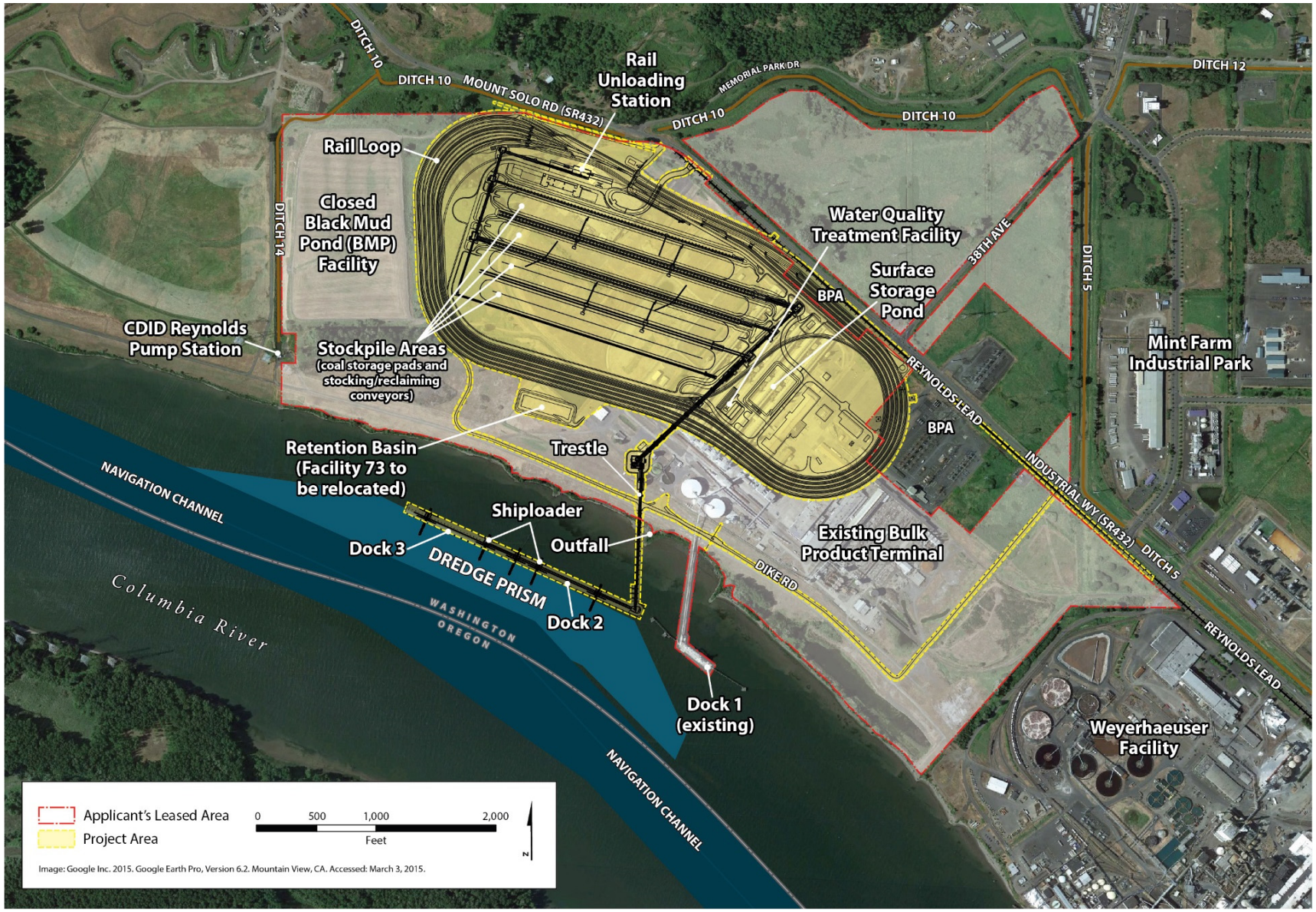


Figure 4. Proposed Action



The Proposed Action could have a maximum annual throughput capacity of up to 44 million metric tons per year.[11,12] As illustrated in Figure 5, the Proposed Action would consist of one operating rail track, eight rail tracks for storing up to 8 unit trains, rail car unloading facilities, a stockpile area for coal storage, conveyor and reclaiming facilities, two new docks in the Columbia River (Docks 2 and 3), and shiploading facilities on the two docks. Dredging of the Columbia River would be required to provide access to the Columbia River navigation channel and for berthing at Docks 2 and 3. Figure 5 illustrates coal export terminal operations for unloading, stockpiling, transferring, and shipping coal.

Vehicles would access the project area from Industrial Way, and vessels would access the project area via the Columbia River and berth at Dock 2 or 3. Coal export terminal operations would occur 24 hours per day, 7 days per week. The Proposed Action would be designed for a minimum 30-year period of operation.

The Applicant anticipates construction would begin in 2018 and would be completed by 2024. Construction and operations would consist of two stages. Stage 1 would include two sub-stages: Stage 1a for start-up operations and Stage 1b for increased operations. Stage 2 would involve construction and operations for full build-out. For the purpose of the analysis in this document, it is assumed that the Proposed Action would be fully operational at maximum capacity by 2028.

3.3.1 Proposed Facilities

The proposed facilities of the Proposed Action would include the following.

- Rail facilities
- Coal stockpile area
- Conveyors, transfer stations, and buffer bins
- Vessel facilities
- Supporting facilities

The following provides a summary of these proposed facilities, based on the project design and project description provided by the Applicant.

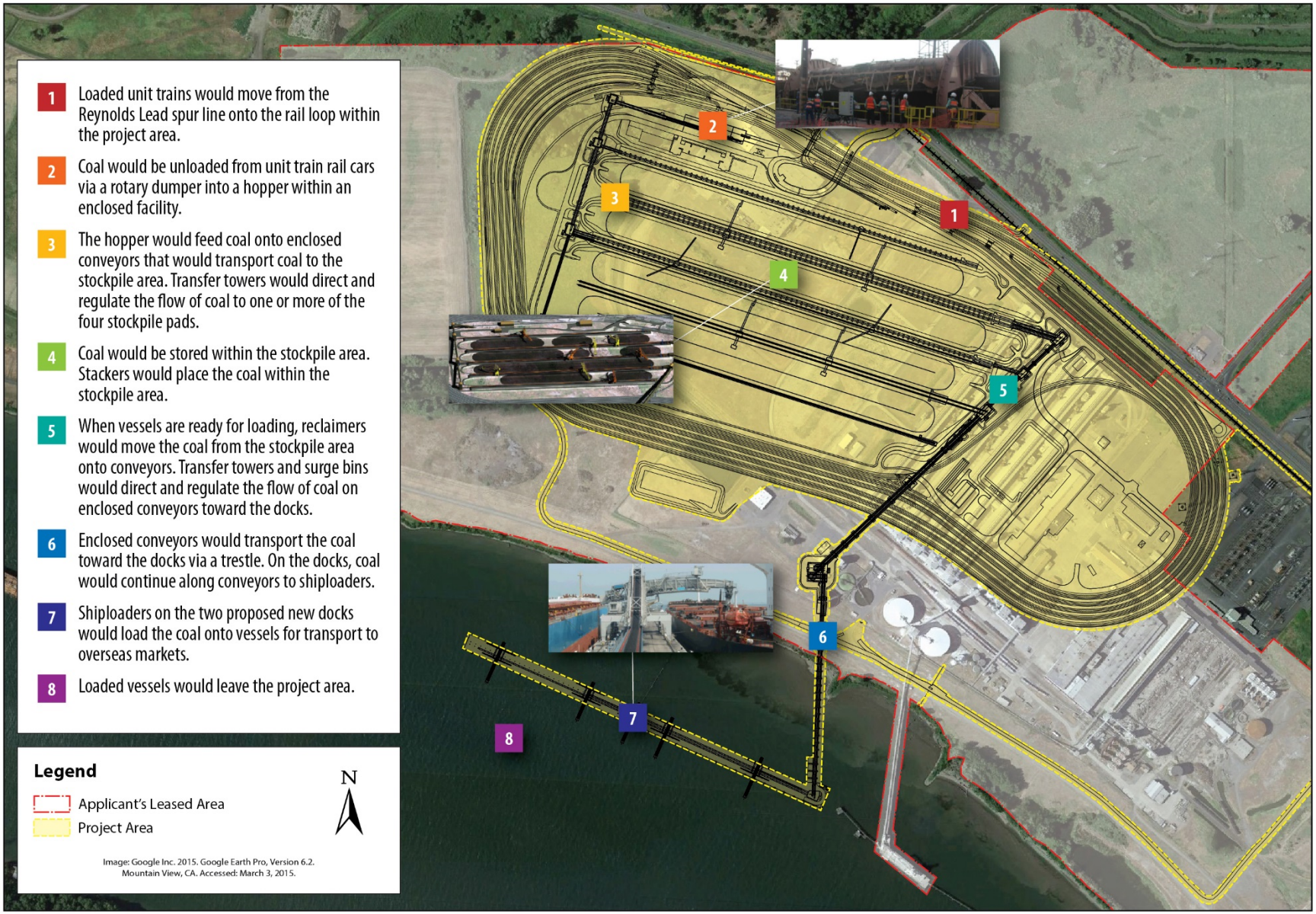
3.3.1.1 Rail Facilities

The Reynolds Lead would be modified within the project area to accommodate unit train access to and from the coal export terminal. Unit trains would move from the Reynolds Lead into a rail loop system where the trains would be directed to an unloading station to unload coal (Figure 5). The rail loop would have one operating track and eight loop tracks to provide storage for arriving and departing trains, and to allow unit trains to travel to and from the Reynolds Lead. Grade-separated roadways above the rail tracks would be provided to allow access to and within the project area.

[11] According to the Applicant, proposed rail operations and coal export terminal design would support terminal throughput of 40 million metric tons per year. The Proposed Action is based on a throughput of up to 44 million metric tons per year. The Applicant assumes a 10% increase in throughput (4 million metric tons per year) from rail car capacity and operational efficiencies that could be achieved through industry process and technological improvements by 2028, the first year of assumed full operations.

[12] A metric ton is the U.S. equivalent to a tonne per the International System of Units, or 1,000 kilograms or approximately 2,204.6 pounds.

Figure 5. Proposed Action Operations

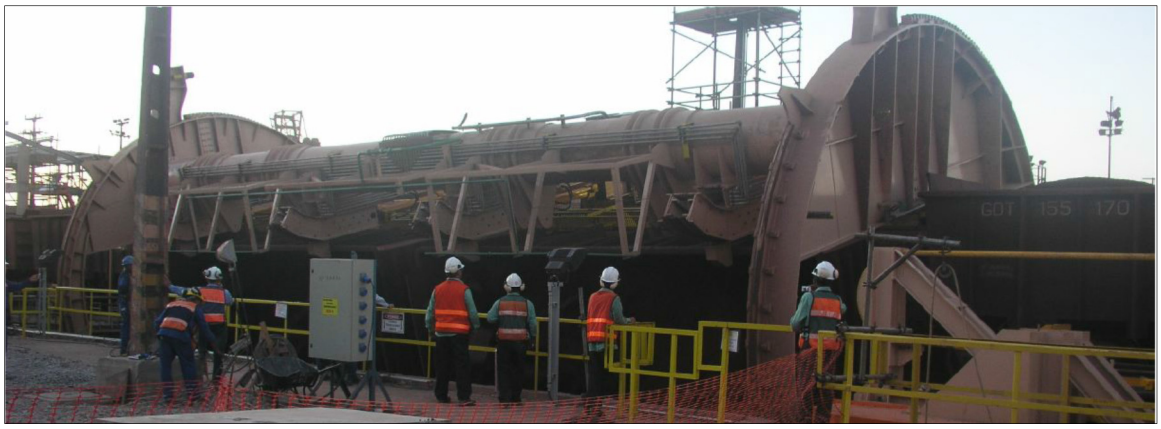


A small portion of the rail loop would be constructed on two parcels currently owned by Bonneville Power Administration (BPA) (Figure 4). One parcel contains an access road and substation. To maintain or provide for pedestrian and vehicular access to BPA facilities, the Applicant would construct an access road between the Proposed Action access road and the BPA yard, and install a gate to the BPA yard at a location to be determined by BPA. According to the Applicant, BPA will not make a determination whether to sell or grant an easement to the Applicant until after the U.S. Army Corps of Engineers (Corps) publishes the National Environmental Policy Act Final EIS for the coal export terminal.

Unit trains would enter the coal export terminal from the east and move through the rail loop in a counter-clockwise direction until the train was contained within the terminal rail loop. The rail loop would be able to accommodate up to 8 unit trains. Once unloaded, trains would be redirected in a clockwise direction on the inner-most rail loop and would then be able to exit the coal export terminal.

Unloading facilities would be constructed to unload coal from rail cars within an enclosed structure. Two rail cars would be simultaneously positioned inside a fully enclosed, metal-clad building. The unloading facilities would contain equipment to rotate rail cars and discharge the coal from the rail cars into a large hopper (Figure 6).

Figure 6. Typical Tandem Rotary Unloader



Source: Millennium Bulk Terminals—Longview 2013

As the tandem rotary dumper rotates the rail cars and begins to unload the coal into hoppers beneath the dumper, sprayers would spray water to avoid and minimize dust dispersion within the enclosed structure. The hopper beneath the rotary dumper would feed coal onto a conveyor at a nominal rate of 7,500 metric tons per hour. The conveyor would move the coal to the stockpile area.

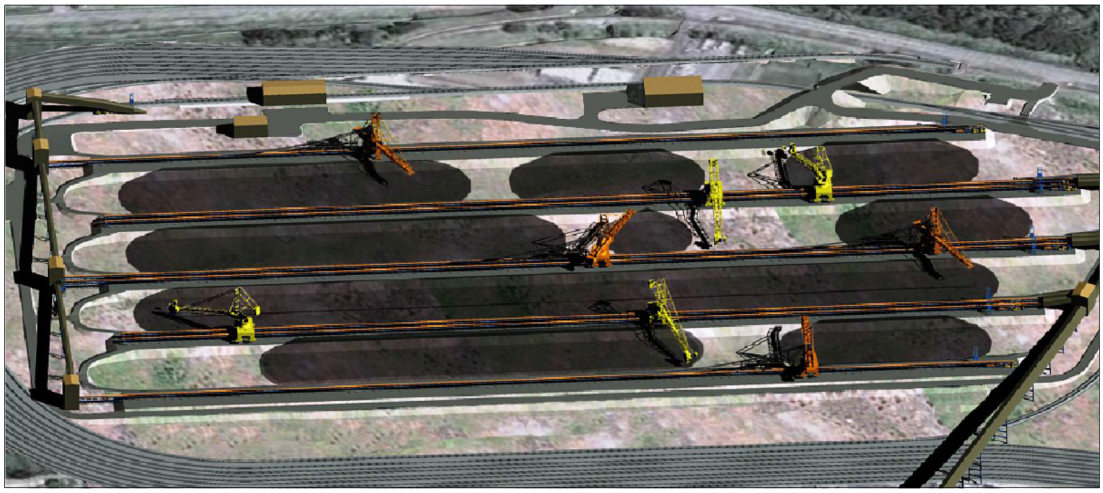
During start-up operations of the Proposed Action, a rapid discharge (i.e., bottom) unloader, located within an enclosed building, would be used to unload rail cars. The rapid discharge unloader would be retained after start-up operations and might be used during maintenance periods of the rotary unloader. Both unloaders would not be able to operate simultaneously.

3.3.1.2 Coal Stockpile Area

The inner portion of the rail loop would include coal stockpile storage pads and associated stacking and reclaiming equipment to place and move coal (Figure 7). The open-air stockpile area would

consist of four parallel stockpile pads and five berms. The stockpile area would cover approximately 75 acres and would be served by four rail mounted stackers and four bucket-wheel reclaimers that would be associated with conveyors.

Figure 7. Representation of the Stockpile Area with Stackers and Reclaimers



Source: Millennium Bulk Terminals—Longview 2013

The stockpile pads together would be able to hold approximately 1,500,000 metric tons of coal. The pads would vary in length from 2,200 to 2,500 feet and could hold from 360,000 to 400,000 metric tons each. Coal would be stacked to approximately 85 feet above the pads. The pads and berms would be made of low-permeability engineered material. The stockpiles and berms would be graded to allow the water to drain and be collected for treatment and reuse or discharge. The use of low-permeability engineered materials for formation of the pads and berms would control water from entering subsurface soil or groundwater.

3.3.1.3 Water Systems

Industrial water supply needed for operations of the coal export terminal and fire protection would be supplied from treated water stored on site from the terminal's water-treatment facility. During dry weather, water would be supplemented from on-site wells as needed. An on-site storage reservoir would provide water required for normal operations (i.e., dust control, stockpile spray, equipment wash-down) and emergency fire demand. A separate pumping system would be designated for the emergency fire system, where appropriate, to provide redundancy and to supply additional pressure where needed. Peak process water demand would be approximately 5,000 gallons/minute (gpm). Peak emergency fire water demand would be approximately 1,500 gpm. Peak potable water demand would be approximately 185 gpm based on anticipated labor force at full build-out. The bulk product terminal's stormwater detention pond would be relocated and would store treated stormwater, collected from the bulk product terminal area and treated in the stormwater-treatment facilities. All water (stormwater and process water) within the limits of the proposed rail loop, trestle and docks would be collected and conveyed to new water-treatment facilities (including a new detention pond). Treated water would be used to maintain process water within the new water pond.

Excess treated water would be discharged to the Columbia River at the existing outfall (Outfall 002A, refer to the SEPA Surface Water and Floodplains Technical Report (ICF International 2016b) for

more information). Process water would be used for operations, such as for dust control and sprayers at the tandem rotary dumper, along all conveyers, the stockpile areas and transfer towers and surge bins. Process water would also be used for wash-down and cleanup of equipment such as conveyors, under-belt plating, bins, hoppers and walkways. All process water—as well as stormwater from the rail loop and those areas within the rail loop, trestle, and docks—would be collected, conveyed, treated, and stored on site. The proposed trestle and docks would have capture and containment measures beneath them and all water captured would be conveyed to water-treatment facilities. Excess treated water would be discharged to the Columbia River.

3.3.1.4 Conveyors, Transfer Stations, and Buffer Bins

A network of belt conveyors would transport coal from the rail car-unloading facilities to the stockpile area, and from the stockpile area to the vessel-loading facilities, or from rail cars directly to the vessel-loading facilities. Multiple conveyors would connect at transfer stations that would redirect the flow of coal. Buffer bins would provide storage capacity in the conveyor system to allow continuous coal reclaiming and transfer. All belt conveyors and transfer stations would be fully enclosed, except for the stockpile area and vessel-loading conveyors, which would be open due to their operational requirements.

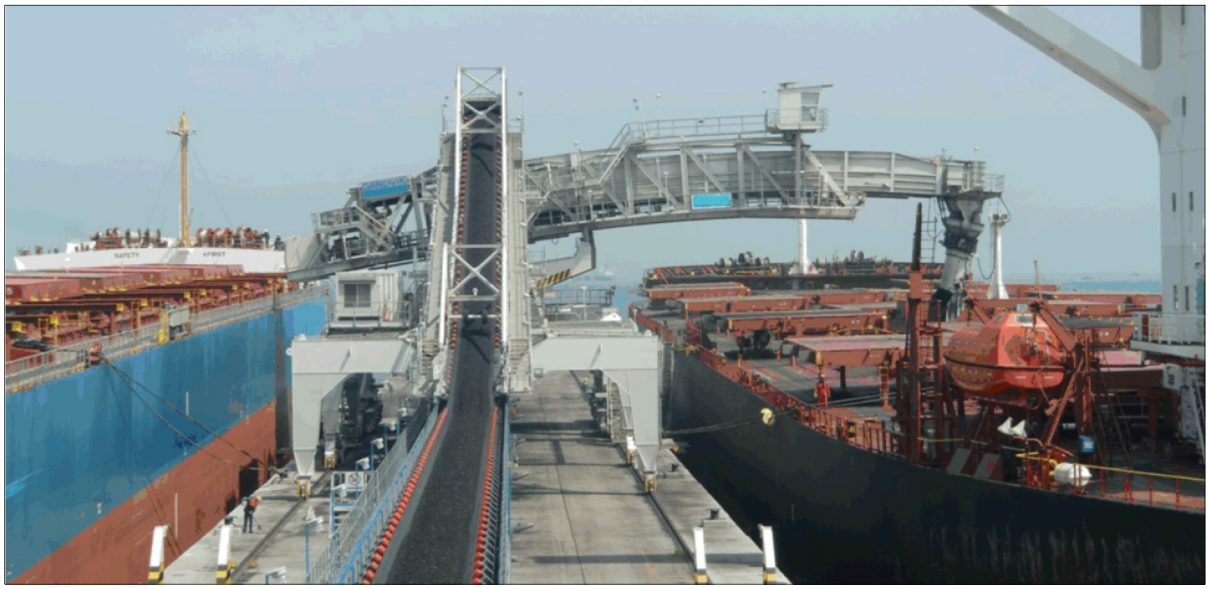
3.3.1.5 Vessel Facilities

The proposed Docks 2 and 3 would be constructed west (downstream) of Dock 1 (Figure 4). Dock 2 would be up to 1,400 feet long and would vary in width from approximately 100 to 130 feet. Dock 3 would be up to 900 feet long and approximately 100 feet wide. Vehicle and pedestrian access and coal transfer to the docks would be provided by a single trestle approximately 800 feet long, varying in width from approximately 35 feet on the northern, landward end, up to 60 feet on the southern end. Each dock would include a shiploader and associated loading equipment (Figure 8). The main shipping channel in the Columbia River is 43 feet deep at low tide (-43 feet Columbia River Datum). The docks and shiploaders would be able to accommodate Panamax-class vessels[13] and Handymax-class vessels.[14] The fleet mix would be approximately 80% Panamax-class vessels and 20% Handymax-class vessels. The Applicant has stated there would be no vessel bunkering at Docks 2 and 3.

[13] Panamax vessels would have a dead weight tonnage (dwt) between 60,000 and 100,000 tons with a draft of between 42 and 49 feet. For more information, see the SEPA Vessel Transportation Technical Report (ICF International 2016c).

[14] Handymax vessels have a dwt of up to 60,000 tons with a draft of between 36 and 39 feet (SEPA Vessel Transportation Technical Report [ICF International 2016c).

Figure 8. Typical Shiploader



Source: Millennium Bulk Terminals—Longview 2013

Vessels would be loaded using shiploaders that would each include an enclosed boom and loading spout. The loading spout would also be telescopic and would be inserted below the deck of the vessel during vessel loading to avoid and minimize dust dispersion. Shiploader cleanup and washdown would be done with pressurized water and all water would be captured and contained, and then conveyed to upland water-treatment facilities.

3.3.1.6 Dredging

Dredging of approximately 500,000 cubic yards of substrate from an approximate 48-acre berthing area along the riverward side of Docks 2 and 3 would be required to provide berthing access from the Columbia River navigation channel to the docks. Sediment transport, current, and river flow studies would be performed to determine the optimum dredge prism. Dredged material is expected to be suitable for flow-lane disposal or beneficial use in the Columbia River based on recent sediment sampling. A dredging and disposal quality control plan would be implemented in compliance with the dredged material management program as required by state agencies (Ecology and WDNR) and federal agencies (Corps and U.S. Environmental Protection Agency). Periodic future maintenance dredging of the berthing area would be required.

3.3.1.7 Water Drainage and Treatment

Drainage systems would be designed such that runoff within the coal export terminal would be collected for treatment before reuse or discharge. The terminal's water-treatment facility would be designed to treat all surface runoff and process water with capacity to store the water for reuse. Treatment would be as required to meet reuse quality or Ecology's requirements for off-site discharge. Additional water storage would be provided in the coal storage area during large storm events. Water volumes exceeding the demands for reuse would be discharged off site via an existing outfall into the Columbia River. Water released off site would be treated and would meet Ecology's requirements and required permits.

3.3.1.8 Supporting Facilities

The Proposed Action would also include the following support facilities.

- Roadways and bridges to provide vehicular access throughout the coal export terminal
- Service and administration buildings
- Stormwater-management facilities
- Utility infrastructure
- Electrical transformers
- Switchgear and equipment buildings
- Process-control systems

3.3.2 Construction

Construction of the Proposed Action is divided into three sections: construction elements; construction staging; and construction environmental controls.

3.3.2.1 Construction Elements

This section summarizes the following primary construction elements.

- Demolition and site preparation
- Preloading
- Rail loop construction
- Trestle and dock construction

Demolition and Site Preparation

An existing cable plant building (approximately 270,000 square feet), existing potline buildings (approximately 600,000 total square feet), and smaller ancillary structures in the project area would be demolished under the Proposed Action. The structures are primarily steel, aluminum, concrete, and wood. The demolition phase would take approximately 6 months. Site preparation would include operating heavy machinery to prepare the site, including clearing of vegetation, grading, earthmoving, earthworks, and constructing erosion-control facilities (including settlement ponds). Heavy machinery could include cranes, wheeled loaders, dozers, dump trucks, excavators, graders, rollers, compactors, drill rigs, vibratory and impact pile-driving equipment, portable ready-mix batch plant, ready-mix trucks, concrete pumps, elevated work platforms, forklifts, rail track laying equipment, welders, water pumps, and other similar machinery. Site preparation would last approximately 3 months.

Preloading

Preloading of the site would be required to strengthen the existing soil conditions and improve the load-bearing capacity of the coal stockpile areas. Import of preloading material and installation of wick drains would be required for ground improvement for the stockpile areas. Approximately 2.1 million cubic yards of material would be imported to be used as preloading material. Material imported for preloading would be clean and obtained from an approved facility. Approximately

2.5 million cubic yards of material would be moved around the project area during preloading activities.

Ground improvement would occur progressively and would take up to 7 years to complete. Preloading material would be imported by truck, rail or barge[15] and could include dredge spoils if the material was suitable.

A rolling preload of material would be used to improve the load-bearing capacity of the soils (i.e., one stockpile pad at a time would be preloaded). Preloading material would be placed in a pile approximately 35 feet high covering the area of the berm and adjacent stockpile pads and would be left in place until soil consolidation is achieved. Following consolidation, preloading material would be moved to another berm and stockpile pad location, with supplementary import material added to achieve a pile approximately 35 feet high. The process would be repeated at each berm and stockpile location until soil consolidation is achieved across the entire stockpile area. After completion of soil consolidation, the excess preloading material would be used on site, stockpiled, or removed from the area and disposed of at an approved facility.

Rail Loop Construction

Rail loop construction would include the following activities. This work would involve the operation of heavy machinery, cranes, and specialized rail laying equipment.

- Importing ballast rock
- Constructing railroad foundations
- Placing railroad ties
- Laying steel rail
- Installing signaling
- Installing switching equipment
- Installing track lighting

The rail loop would include one operating track (i.e., turn-around track) and eight rail storage tracks. Construction of the rail loops would require 130,000 cubic yards of ballast rock for rail foundations. All construction activities work would involve operating heavy machinery, cranes, and specialized rail laying equipment. Once completed, trains would enter the coal export terminal from the east and move through the rail loop in a counter-clockwise direction until the train was contained within the terminal rail loop. The rail loop would be able to accommodate up to 8 unit trains. Once unloaded, trains would be redirected in a clockwise direction on the inner-most rail track and would then be positioned to exit the terminal.

Trestle and Dock Construction

Dredging would occur as part of the construction of Docks 2 and 3, which would include removing approximately 500,000 cubic yards of material. Dock and trestle construction would include pile driving of approximately 630 36-inch-diameter steel pipe piles, 610 of which would be installed in aquatic areas below the OHWM. Most piles would be driven to a depth of 140 to 165 feet below the

[15] Most of the deliveries of preload material would occur early in the construction period with up to 753 barges making deliveries in the first year.

mudline. Each would be installed using a vibratory driver until the pile meets resistance and vibratory driving is no longer effective, at which point an impact driver would be used to complete pile installation. Docks 2 and 3 would consist of 36-inch-diameter piles driven into the riverbed to support the shiploader runway beams, shiploader conveyors, and reinforced concrete decking. The dock structures would be equipped with fenders, mooring bollards, and capstans to facilitate the docking of vessels.

Upon completion of Stage 2 construction, Docks 2 and 3 would be served by two rail-mounted shiploaders. Each shiploader would be fed coal by a dedicated conveyor that would move coal from the stockpile area to the shiploader.

3.3.2.2 Construction Scenarios and Staging

The Applicant has identified three construction-material-delivery scenarios: delivery by truck, rail, or barge.

- **Truck.** If material is delivered by truck, it is assumed that approximately 88,000 truck trips would be required over the construction period. Approximately 56,000 loaded trucks would be needed during the peak construction year.
- **Rail.** If material is delivered by rail, it is assumed that approximately 35,000 loaded rail cars would be required over the construction period. Approximately two-thirds of the rail trips would occur during the peak construction year.
- **Barge.** If material is delivered by barge, it is assumed that approximately 1,130 barge trips would be required over the construction period. Approximately two-thirds of the barge trips would occur during the peak construction year. Because the project area does not have an existing barge dock, the material would be off-loaded at an existing dock elsewhere on the Columbia River and transported to the project area by truck.

The Applicant would construct the Proposed Action in two stages and anticipates that construction activities would primarily occur during daylight hours.

Stage 1

Stage 1 of construction would consist of two sub-stages: Stage 1a Construction and Start-Up Operations, and Stage 1b Construction and Increased Operations. Stage 1 would include the following tasks.

- Perform project-area ground improvements.
- Construct one operating rail track and up to eight rail storage tracks.
- Construct the stockpile area including two stockpile pads.
- Construct rail car unloading facilities and associated facilities and infrastructure.
- Construct Docks 2 and 3, including the shiploader and related conveyors on Dock 2 and the berthing facilities on Dock 3.
- Perform the necessary dredging within the Columbia River for Docks 2 and 3.

After Stage 1 construction, nominal coal export terminal throughput capacity would be up to 25 million metric tons per year. To allow for a start-up of export activities during the project-area preloading activities and construction, Stage 1 would include a start-up facility that would directly

unload coal from rail cars to an enclosed hopper and onto vessels via conveyors and would have a nominal throughput capacity of approximately 5 to 10 million metric tons per year (Table 2).

Table 2. Construction Staging

Element	Stage 1a Construction and Start-Up Operations	Stage 1b Construction and Increased Operations	Stage 2 Construction and Full Build-Out Operations
Description	Start of Stage 1 construction for start-up operations	Continuation of Stage 1 construction through completion of Stage 1 construction	Start of Stage 2 construction through completion of Stage 2 construction and start of full operations
Approximate Timing and Duration	0–1.5 years (18 months) from the start of construction	0–3 years from the start of construction	4–6 years from the start of construction
Approximate Year	2018–2020	2020–2021	2022–2024
Year Used for the Analyses in this Document	2018	2018	2028[a]
Terminal Throughput Capacity During Stage of Construction	None	5 to 10 MMPTY	Up to 25 MMTPY
Terminal Throughput Capacity After Stage of Construction	5 to 10 MMTPY	Up to 25 MMTPY	Up to 44 MMTPY

Notes:

[a] The Applicant anticipates construction would begin in 2018 and would be completed by 2024. For the purpose of the analysis, it is assumed that the Proposed Action would be fully operational by 2028.

MMTPY = million metric tons per year

Stage 2

Stage 2 Construction and Full Build-Out Operations would involve the following tasks.

- Construct a shiploader on Dock 3.
- Construct additional stockpile pads.
- Construct additional conveyors and associated infrastructure to support additional throughput.

After Stage 2 construction, nominal coal export terminal throughput capacity would increase to up to 44 million metric tons of coal per year. Table 2 summarizes the three construction stages. Table 3 identifies the primary elements of the Proposed Action that would be constructed for the Stage 1a Construction and Start-Up Operations, Stage 1b, Construction and Increased Operations, and Stage 2 Construction and Full Build-Out Operations.

Table 3. Primary Construction Elements by Stage

Construction Stage	Description	Primary Construction Elements
Stage 1a Construction and Start-Up Operations	Start of Stage 1 Construction and Start-Up Operations (construction activities for 5 to 10 MMTPY)	• One operating track and up to eight rail storage tracks. • One rapid discharge tandem rail car unloader (bottom dumper). • Conveyors, buffer bins, and transfer towers (approximately 4,300 lineal feet of conveyors, of which approximately 1,000 lineal feet would be open conveyors and approximately 3,300 lineal feet would be enclosed). • Construct Docks 2 and 3. • One shiploader on Dock 2. • Support structures, electrical transformers, switchgear and equipment, process-control systems, and buildings.
Stage 1b Construction and Increased Operations	Continuation of Stage 1 Construction and Increased Operations (construction activities for up to 25 MMTPY)	• Tandem rotary unloading facility (rotary dumper, capable of unloading two rail cars simultaneously). • Three berms for stackers and reclaimers. • Two stackers. • Two reclaimers. • Conveyors, buffer bin, and transfer towers (approximately 16,100 lineal feet of conveyors, of which approximately 4,900 lineal feet would be enclosed). • Support structures, electrical transformers, switchgear and equipment, process control systems, and buildings.
Stage 2 Construction and Full Operations	Construction and Full Operations (construction activities for up to 44 MMTPY)	• The remaining rail storage tracks (for a total of eight rail storage tracks). • The remaining two berms (for stackers and reclaimers) (for a total of five berms). • Two additional stackers (total of four). • Two additional reclaimers (total of four). • Conveyors, buffer bin and transfer towers (approximately 26,200 lineal feet of conveyors, of which 8,300 lineal feet would be enclosed). • One shiploader on Dock 3. • Support structures, electrical transformers, switchgear and equipment, buildings, process-control equipment, etc.

Notes:
MMTPY = million metric tons per year

Appendix A, *Coal Export Terminal Stages of Construction and Operations*, provides detailed information on the construction and operational elements associated with the start of Stage 1 Construction and Start-Up Operations (Stage 1a), continuation of Stage 1 Construction and Increased Operations (Stage 1b), and Stage 2 Construction and Full Operations.

3.3.3 Operations

This section describes on-site operations and off-site transport for the Proposed Action.

3.3.3.1 On-Site Operations

Similar to construction, operations of the Proposed Action would include two stages: Stage 1 and Stage 2.

- **Stage 1.** Stage 1 includes Stage 1a Start-up Operations and Stage 1b Increased Operations.
- **Stage 2.** Stage 2 includes Full Build-Out Operations.

All operations stages would follow the completion of the appropriate construction stages (Stages 1a, 1b, and 2). Table 4 summarizes operations by stage and component. Appendix A, *Coal Export Terminal Stages of Construction and Operations*, provides detailed information on the operational elements associated with Stage 1 and Stage 2. Appendix B, *Coal Export Terminal Design Features*, provides design elements of the coal export terminal provided by the Applicant.

3.3.3.2 Off-Site Transport

Coal would be transported to the project area by rail and transported from the project area by vessel.

Rail

The coal export terminal would receive coal from the Powder River Basin in Montana and Wyoming and possibly the Uinta Basin in Utah and Colorado via rail shipment. BNSF trains would most likely ship Powder River Basin coal and UP trains would ship Powder River Basin and Uinta Basin coal.[16]

[16] UP has the capability to ship Powder River Basin coal. However, the route to the project area would be longer than the BNSF route from the Powder River Basin.

Table 4. Coal Export Terminal Operations by Stage and Component

Component	Stage 1a Start-Up Operations	Stage 1b Increased Operations	Stage 2 Full Build-Out Operations
All Coal Export Terminal Operations			
Appx. Timing	1.5 years from the start of construction	3 years from the start of construction	6 years from the start of construction
Appx. Years of Operation	2020–2021 Follows Construction Stage 1a (2018–2020)	2021–2024 Follows Construction Stage 1b (2018–2021)	2024 and beyond Follows Construction Stage 2 (2022–2024)
Year Used for the Analyses in this Document	N/A	N/A	2028[a]
Terminal Throughput Capacity	5 to 10 MMTPY	Up to 25 MMTPY	Up to 44 MMTPY[b]
Number of Employees	Approximately 60 employees for operations.	Approximately 115 employees for operations.	Approximately 135 employees for operations.
Operations Equipment	Same type of equipment for each stage: Wheel loaders, cranes, forklifts, trucks, welders, pumps, track dozers, and other similar equipment. The equipment would be powered by diesel, liquid petroleum gas, or gasoline engines.		
Land Operations			
Rail	• All coal would arrive by unit train. • Unit trains would consist of 3 locomotives and 125 coal cars, with a total length of 6,844 feet. • Up to 60 loaded unit trains would arrive and 60 empty unit trains would depart monthly (average of 120 unit train trips monthly). This equals approximately 4 trains a day (2 trains arriving and 2 trains departing). • Inbound/outbound trains would be stored on site, on a maximum of eight available storage tracks.	• All coal would arrive by unit train. • Unit trains would consist of 3 locomotives and 125 coal cars, with a total length of 6,844 feet. • An average of 150 loaded unit trains would arrive and 150 empty unit trains would depart monthly (average of 300 unit train trips monthly). This equals approximately 10 trains a day (5 trains arriving and 5 trains departing). • Inbound and outbound trains would be stored on site, on a maximum of eight available storage tracks.	• All coal would arrive by unit train. • Unit trains would consist of 3 locomotives and 125 coal cars, with a total length of 6,844 feet. • An average of 240 loaded unit trains would arrive and 240 empty unit trains would depart monthly (average of 480 unit train trips monthly). This equals approximately 16 trains a day (8 trains arriving and 8 trains departing). • Inbound and outbound trains would be stored on site on up to a maximum of eight available storage tracks.

Component	Stage 1a Start-Up Operations	Stage 1b Increased Operations	Stage 2 Full Build-Out Operations
Rail Car Unloading	• Delivered directly from the rail cars to the shiploader by way of a rapid discharge unloading facility and interconnecting conveyors. • No stockpiling of coal.	• Rail cars would be unloaded by an electrical-powered tandem rotary unloader. • A mechanical positioner would index unit trains, position two rail cars at a time, and dump the coal into a hopper and onto the stacking conveying system.	• The Stage 1 tandem rotary unloader would service Stage 2 Operations; no additional unloading equipment would be required. • The rapid discharger tandem rail car unloader installed for Stage 1 would remain operable and may be used during maintenance of tandem rotary unloader.
Conveyor Systems	• Conveyors would transport coal directly from the rail cars to the shiploader by way of a rapid discharge unloading facility and interconnecting conveyors.	• Conveyors would transport coal from rail car unloading to the stockpile area and from the stockpile area to the shiploader. • Conveyors would be enclosed except where required to feed onto or reclaim from stockpiles or onto the shiploaders. • When unloading rail cars, the conveyors from rail car unloading to the stockpile area would operate, and when loading ships, the conveyors from the stockpile area to the shiploader would operate. • Rail car unloading and shiploading would at times occur both independently and simultaneously. • Conveyors would operate for approximately 45% of the available time.	• Conveyors would transport coal from rail car unloading to the stockpile area and from the stockpile area to the shiploader. • Conveyors would be enclosed except where required to feed onto or reclaim from stockpiles or onto the shiploaders. • When unloading rail cars, the conveyors from rail car unloading to the stockpile area would operate, and when loading ships, the conveyors from the stockpile area to the shiploaders would operate. • Rail car unloading and shiploading could occur independently or simultaneously. • Conveyors would operate for approximately 80% of the available time.
Stockpiling	None.	Two electrical-powered traveling stackers would stockpile coal at an average rate of 7,500 metric tons per hour onto two longitudinal stockpiles with an estimated total storage capacity of 750,000 metric tons.	Four traveling stackers would stockpile coal at an average rate of 7,500 metric tons per hour onto two additional longitudinal stockpiles with a total storage capacity of up to 1.5 million metric tons.

Component	Stage 1a Start-Up Operations	Stage 1b Increased Operations	Stage 2 Full Build-Out Operations
Reclaimers	None.	Two electrical-powered traveling bucket wheel reclaimers would transfer coal from the stockpile to the shiploading system (each with an average rate of 6,500 metric tons per hour).	Two additional traveling bucket wheel reclaimers (total of four at Stage 2) would transfer coal from the stockpile to the shiploading system (each with an average capacity of 6,500 metric tons per hour).
Dock Operations			
Shiploading	Performed using an electrical-powered single traveling shiploader installed on Dock 2 with average capacity of 6,500 metric tons per hour.	Would use the shiploader installed for Stage 1 Start-Up Operations (Dock 2 only).	One additional traveling shiploader would be installed on Dock 3 with an average rated capacity of 6,500 metric tons per hour.
Vessels	Up to 15 vessels per month (80% Panamax, 20% Handymax) would be loaded.	Up to 40 vessels per month (80% Panamax, 20% Handymax) would be loaded.	Up to 70 vessels per month (80% Panamax, 20% Handymax) would be loaded.

Notes:

[a] The Applicant anticipates construction would begin in 2018 and would be completed by 2024. For the purpose of the analysis, it is assumed that the Proposed Action would be fully operational by 2028.

[b] According to the Applicant, proposed rail operations and coal export terminal design would support terminal throughput of 40 million metric tons per year. The Proposed Action is based on a throughput of up to 44 million metric tons per year. The Applicant assumes a 10% increase in throughput (4 million metric tons per year) from rail car capacity and on-site operational efficiencies that can be achieved through industry process and technological improvements by 2028, the first year of assumed full operations.

MMTPY = million metric tons per year; N/A = not applicable

Proposed Action-related train routes from mines in the Powder River Basin and Uinta Basin to the project area, and the return of empty trains from the project area, was assumed to be the same as current BNSF and UP train operational protocols in Washington State, as documented in adopted publications, including the *Washington State Rail Plan* (Washington State Department of Transportation 2014a) and *Washington State Freight Mobility Plan* (Washington State Department of Transportation 2014b). In 2012, BNSF changed its train operations protocol in Washington State using directional running to enhance use of existing capacity. This strategy routes all westbound-loaded unit trains (including coal) from Pasco via the Columbia River Gorge to Vancouver, where they continue on the BNSF north-south main line to their final destination. Empty unit bulk trains north of Vancouver, including Cowlitz County, return to Pasco and to points east via Auburn and Stampede Pass.

Loaded and empty Proposed Action-related BNSF trains would travel on the same route between the Powder River Basin and Pasco, Washington. West of Pasco, westbound loaded trains are expected to travel to the project area via the Columbia River Gorge route through Vancouver to Longview Junction. Empty trains are expected to travel from Longview Junction on the Stampede Pass route through Centralia, Auburn, and Yakima to Pasco, Washington (Figure 9).

However, as volume increases on any one-line segment, BNSF may revise its operations within Washington State to distribute the traffic over existing infrastructure. Railroad companies may also expand their infrastructure, which occurs on an ongoing basis based on demand. For these reasons, empty and loaded BNSF trains could travel through the Columbia River Gorge or across Stampede Pass, depending on BNSF system operations for maintenance or traffic flow.

Loaded and empty Proposed Action-related UP trains would travel on the same route between the Uinta Basin and Powder River Basin and Longview Junction. Within Washington State, UP operates over the same track that carries BNSF trains between Vancouver and Longview Junction (Figure 9).

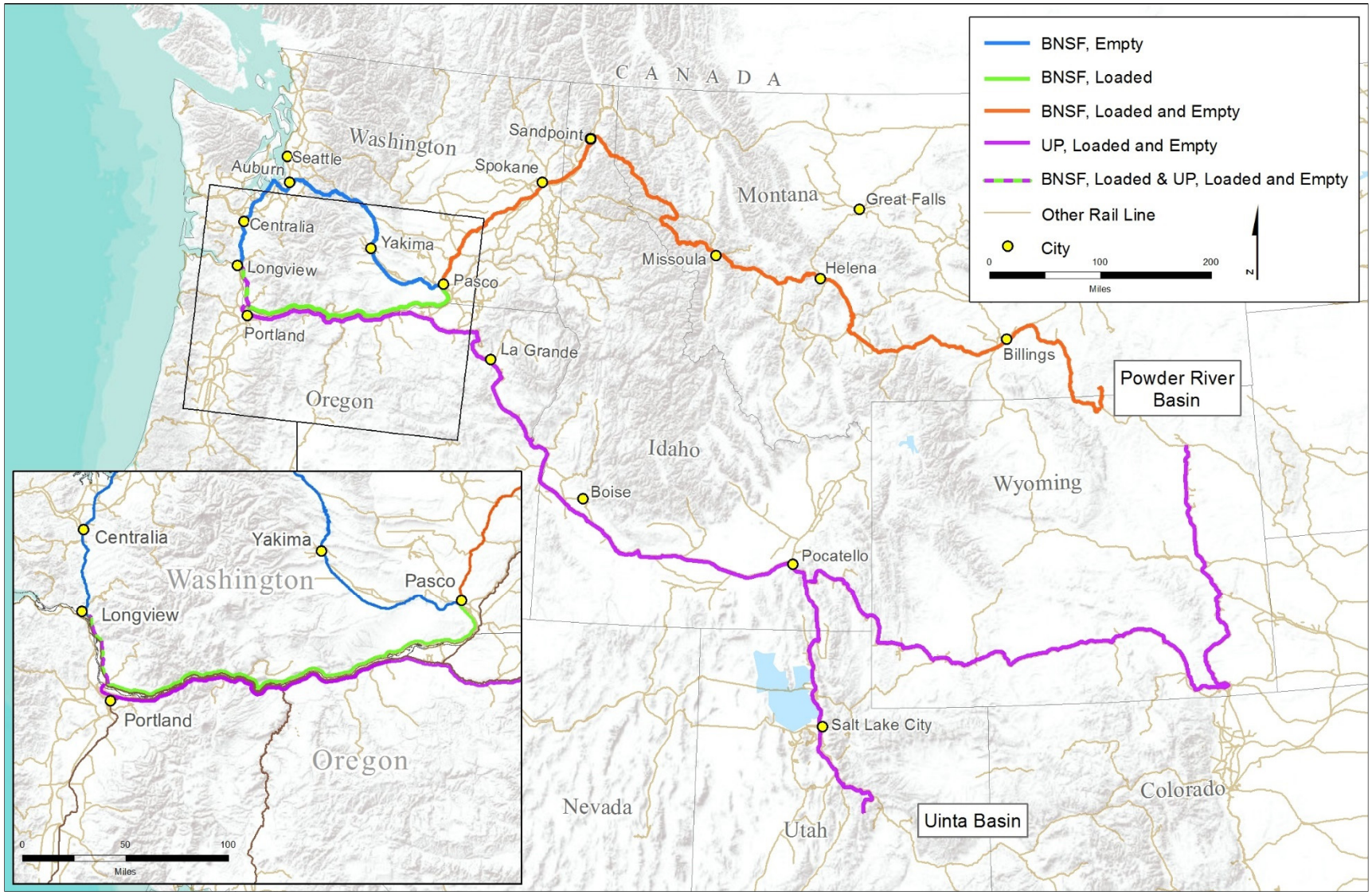
Between Longview Junction and the project area, BNSF and UP trains would travel over the BNSF Spur and Reynolds Lead rail line. Rail transportation is discussed in detail in the SEPA Rail Transportation Technical Report (ICF International and Hellerworx 2016).

Increased train traffic would consist of unit trains 125 cars long (approximately 1.3 miles long). Unit trains would be typically hauled by three locomotives. At full capacity, an average of 8 loaded trains and 8 empty coal trains per day (average of 16 trains daily; 480 trains monthly) would operate on BNSF and UP rail lines inside and outside of Washington State as they travel to and from the project area.

Vessel

Coal would be transported from the project area by vessel to Asian markets. The Applicant anticipates these markets would be Japan, South Korea, and Taiwan. Vessels would travel from the project area via the Columbia River and across the Pacific Ocean. Vessel transportation is discussed in the SEPA Vessel Transportation Technical Report (ICF International 2016c). Vessel trips would use Panamax-class (including new Panamax-class) and Handymax-class vessels. The fleet mix is estimated to be 80% Panamax and 20% Handymax vessels. The Proposed Action would result in an average of 840 vessel trips per year (an average of 2.3 vessel trips per day).

Figure 9. Route of Loaded and Empty Trains



Chapter 4
No-Action Alternative

This chapter describes the No-Action Alternative, including planned operation and transport, as well as potential future operations and transport.

Under the No-Action Alternative, the Applicant would not construct the Proposed Action. Current operations of the adjacent existing bulk product terminal under existing permits would continue, which include storing and transporting alumina and up to 150,000 metric tons per year of coal. Importing of alumina would continue using Dock 1. Upland areas of the project area are zoned Heavy Industrial and it is assumed that future proposed industrial uses in these upland areas could be permitted. Cleanup activities caused by past industrial uses would also continue.

The Applicant could expand the existing bulk product terminal onto the project area, developing storage and shipment facilities to increase bulk product terminal operations. Coal and alumina would continue to be stored, transferred, and shipped. Additional bulk product transfer activities involving products such as calcine pet coke, coal tar pitch, cement, fly ash, and sand or gravel could also be pursued, and new or revised permits could be required based on the operations. These operations could involve storage and upland transfer of bulk products, which would use existing or new buildings. Construction of new buildings could involve demolition and replacement of existing buildings and new or modified permits. The No-Action Alternative does not include activities that could require a Corps permit or shoreline permit. Any new construction would be limited to uses allowed under existing Cowlitz County development regulations (CCC Title 18, Land Use and Development).

Under the No-Action Alternative, new construction, demolition, or related activities to develop the project area into an expanded bulk product terminal would occur on previously developed upland portions of the project area. The quantity of impervious surface area would not change and new construction, demolition, or different activities would not require new docks or new unloading structures on Dock 1. The No-Action Alternative includes current roadway and rail infrastructure near the project area that will be implemented by 2018. It is assumed that continued operation of the bulk terminal within the 20-year analysis period (2018 to 2038) would continue to be economically viable. The following describes planned operations and transport and potential future operations and transport under the No-Action Alternative.

4.1 Planned Operations and Transport

The Applicant plans to continue current activities at the bulk product terminal and increase commodities storage regardless of whether the Proposed Action in the 190-acre project area is built. Maintenance of the bulk product terminal would continue, including maintenance dredging for the existing dock which would occur every 2 to 3 years (Table 5).

Table 5. Planned Activities and Transport Operations at the Existing Bulk Product Terminal

		Transport Operations[a]		
Commodity	**Activity**	**Truck**	**Train**	**Vessel**
Coal	Trains would continue to deliver coal where it would be stored on site and transferred as needed by truck to Weyerhaeuser, located approximately 1 mile southeast of the existing bulk product terminal. An increase in the receipt and transfer of Weyerhaeuser coal by 50% began in late 2014, and is separate from the coal export terminal.	Operate on a continual basis (24 hours a day; 7 days a week)	1 train (38 to 45 rail cars); 3 times per week	N/A (trains deliver coal; trucks transport)
Alumina	Vessels deliver alumina to Dock 1. Alumina is stored on site and then shipped to Chelan County by train.	N/A (vessels deliver alumina; trains transport)	80 rail cars per week at a rate of 16 rail cars per day, 5 days per week	8 vessels per year
Other Commodities	Other commodities that are assumed to be delivered by vessel, stored, and shipped via truck and train to various locations	Transported by truck for local distribution at the rate of 16 trucks per day (4,160 trucks per year)	4 rail cars per day (1,040 rail cars per year) for non-local distribution	6 vessels per year

Notes:
[a] Includes existing transport operations as identified in Table 1.
N/A = not applicable

4.1.1 On-Site Operations

On-site operations under the Applicant's planned operations would be similar to those associated with the current operations of the existing bulk product terminal. Planned activities would include increasing the amount of the existing commodities stored and shipped. Thus, planned operations for handling the increase in existing commodities would be similar, but would be more frequent.

4.1.2 Off-Site Transport

The Applicant plans to increase commodities shipment regardless of whether the Proposed Action is built. Table 5 provides information about the planned activities and the means for transporting commodities to and from the existing bulk product terminal.

4.2 Potential Future Operations and Transport

In addition to current and planned activities described in Tables 3-1 and 4-1, the Applicant is also considering receiving and shipping any products permitted by the terms of an existing WDNR aquatic lands lease[17] including pet coke, coal tar pitch, cement, fly ash, and sand/gravel.

4.2.1 On-Site Operations

The following are estimates of the amount and method for transporting each of the commodities permitted per the terms of the existing aquatic lands lease. These operations would be separate from, and independent of, the Proposed Action.

- Calcine pet coke would be imported by vessel from Asia, unloaded from vessels on Dock 1 using a vacuum unloader, and stored in an existing on-site building. Approximately 600,000 tons of calcine pet coke per year could be imported.
- Coal tar pitch would arrive by vessel via super-sacks, and unloaded from either vessel mounted unloading gear or new equipment. Approximately 200,000 tons of coal tar pitch per year could be imported.
- Cement would arrive by vessel and distributed either by rail or truck.
- Fly ash would arrive by rail and depart by truck, or come in by truck and depart by rail.
- Sand or gravel would likely come in by rail and depart by truck, or come in by truck and depart by rail.

4.2.2 Off-Site Transport

The following are estimates of the anticipated transport operations of the potential future commodities by the year 2028 (Table 6) and estimates of the anticipated transport operations of the potential future commodities combined with the existing and planned activities and transport operations at the bulk product terminal (Table 7). These operations would be separate from, and independent of, the Proposed Action.

Table 6. Potential Future Commodities and Transport Operations at the Bulk Product Terminal by Year 2028

	Anticipated Transport Operations		
Future Commodity	**Truck**	**Train**	**Vessel**
Calcine pet coke, coal tar pitch, cement, fly ash, sand, or gravel	24 hours per day, 7 days per week	6 to 7 trains per week (30 rail cars per train)	10 to 12 additional vessels per year

[17] Northwest Alloys holds a 30-year aquatic lease (20-B09222) with the Washington State Department of Natural Resources (WDNR) allowing the use of WDNR property for three docks. The lease expires January 2, 2038. Per the existing lease:

- The existing dock can be used for off-loading alumina ore from vessels for transfer to rail car or trucks, off-loading cement for transfer to rail cars and trucks, and off-loading any product that can be moved by vacuum including any type of powder or granulated product.
- Two new fixed docks can be used for products not compatible with the existing system on Dock 1. The products include coal, silica sand, dry fertilizer, potash, coke, cement clinker and other general bulk cargo.

Table 7. Total Transportation Operations for Existing, Planned, and Potential Future Activities at the Bulk Product Terminal

	Total Transport Operations		
Activities	**Truck**	**Train**	**Vessel**
Existing (Table 1), Planned (Table 5), and Potential Future (Table 6)	24 hours per day, 7 days per week	2 trains per day; 12 to 14 trains per week: • 2 to 4 incoming trains (between 38 and 45 rail cars) • 10 outgoing trains (between 12 and 16 rail cars)	26 vessels per year

Chapter 5
References

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Appendix A

Coal Export Terminal Stages of Construction and Operations

Millennium Bulk Terminals—Longview
Coal Export Terminal Stages of Construction and Operations

TABLE 1

Stage of Construction/Operations: Stage 1a Construction

Description: Start of Stage 1 Construction

Timing: 0–1.5 years (18 months) from the start of construction

Approximate Years:[1] 2018–2020

Throughput Capacity: 0 MMTPY[2]

Stage 1a Construction	
Project Component	**Activity**
Number of Construction Workers	• 1,350 construction workers (combined number of workers for all construction activities associated with Stage 1 and Stage 2)
Construction Trips	• Total construction trips are dependent on how material is imported during preloading activities (numbers below are combined for preloading activities during Stage 1 and Stage 2): ○ If all material is imported by truck: approximately 88,000 loaded truck trips over an approximate 5-year period with the majority of the truck trips occurring during the first 1 to 2 years (Stage 1). ○ If all material is imported by rail: approximately 35,000 loaded railcars over an approximate 5-year period with the majority of the railcars received during the first 1 to 2 years (Stage 1). ○ If all material is imported by barge: approximately 1,130 barge trips over an approximate 5-year period with the majority of the barge trips occurring during the first 1 to 2 years (Stage 1)
Construction Staging	• Demolish existing structures • Prepare site area and make ground improvements/grading • Stockpile area, including preloading for stockpile pads (2 out of 4 stockpile pads would be preloaded during Stage 1 construction). • Coal export terminal start-up facilities ○ One shiploader and related conveyors on Dock 2 ○ Rail car unloading facilities (rapid unloader, bottom dumper) ○ Associated facilities and infrastructure (i.e., conveyors, etc.) • Construct rail loop ○ Complete berm for rail tracks ○ Install up to 8 rail storage tracks for train parking ○ Install 1 operating track • Conduct dredging in the Columbia River • Construct 2 docks (Docks 2 and 3) and trestle
Demolition of Existing Structures	• Demolish existing cable plant building (approximately 270,000 ft^2) • Demolish existing potline buildings (approximately 600,000 ft^2) and some smaller ancillary structures • Duration of approximately 6 months
Site Preparation	• Clearing of vegetation

[1] Assumes that construction begins 2018

[2] MMTPY = million metric tons per year

Millennium Bulk Terminals—Longview
Coal Export Terminal Stages of Construction and Operations

TABLE 1

Stage of Construction/Operations: Stage 1a Construction

Description: Start of Stage 1 Construction

Timing: 0–1.5 years (18 months) from the start of construction

Approximate Years:[1] 2018–2020

Throughput Capacity: 0 MMTPY[2]

Stage 1a Construction	
Project Component	**Activity**
	• Grading • Earthmoving • Earthworks • Construction of erosion control facilities (including settlement ponds) • Duration of approximately 3 months
Preloading	• Initiation of rolling preload: up to 7 years total for entire stockpile areas (continues through construction of both Stage 1 and Stage 2) • Preloading would commence on 2 of the 4 stockpiling areas • Existing soil conditions would be strengthened to improve load-bearing capacity • Preload material would be imported and wick drains would be installed for ground improvement for the stockyard area • Preload material would be placed in a pile approximately 35 feet high covering the area of the berm and adjacent stockpile pad(s) • Process would be repeated at each berm and stockpile location until soil consolidation is achieved across the complete stockyard • Groundwater expelled through the wick drains would be collected, treated, and discharged to the Columbia River • Excess preload material would be used on site, stockpiled, or removed from the area • Approximately 2.1 million cubic yards of preload material would be imported (Stage 1 and Stage 2) • Approximately 2.5 million cubic yards of material would be moved around the project area (Stage 1 and Stage 2)

Construction/Installation of Coal Export Terminal Equipment	• Coal would not be stockpiled during any stage of construction
	• Installation of plant and equipment for start-up operations would include:
	  ○ One operating track
	  ○ Up to 8 rail storage tracks for train parking/staging
	  ○ One rapid discharge (bottom) tandem railcar unloader to unload coal for transfer by conveyor to the dock for shiploading; the rail car unloader would be capable of unloading 2 railcars at once.
	  ○ Conveyors, buffer bin, and transfer towers, including approximately 4,300 lineal feet of conveyors, of which approximately 1,000 lineal feet would be open conveyors and approximately 3,300 lineal feet would be enclosed
	  ○ Dock 2 and Dock 3
	  ○ One shiploader on Dock 2
	  ○ Support structures, electrical transformers, switchgear and equipment, process control systems, buildings, etc.

Rail Loop Construction	• Importing and placing of approximately 130,000 cubic yards of ballast rock for the rail foundations • Placement of railroad ties • Laying of steel rail lines

Millennium Bulk Terminals—Longview
Coal Export Terminal Stages of Construction and Operations

TABLE 1

Stage of Construction/Operations: Stage 1a Construction

Description: Start of Stage 1 Construction

Timing: 0–1.5 years (18 months) from the start of construction

Approximate Years:[1] 2018–2020

Throughput Capacity: 0 MMTPY[2]

Stage 1a Construction	
Project Component	**Activity**
	• Installation of signaling • Installation of switching equipment • Installation of track lighting • Installation of 1 rapid discharge (bottom) tandem railcar unloader
Dredging, Trestle, and Dock Construction	• Dredging would occur as part of the construction of Docks 2 and 3 (simultaneous with site prep and preload; may require 2 fish windows to complete) • Dredging would remove approximately 500,000 cubic yards of material over a 48-acre area and to a depth of -43 feet Columbia River Datum • Dredging would be required from the river side face of the dock out to the Columbia River navigation channel; the riverbed would be sloped from the dock to the riverbank with a 3H:1V slope • Dock and trestle construction would include pile driving of approximately 630 36-inch-diameter steel pipe piles, 610 of which would be installed in aquatic areas below ordinary high water • Piling would be installed from approximately 140 to 165 feet below the mudline • Dredge spoils will be disposed of adjacent to the navigation channel between approximately river mile 60 and 66 • Approximately 225 linear feet (125 feet and 100 feet, respectively) of the existing west and east pile dikes would be removed

Millennium Bulk Terminals—Longview
Coal Export Terminal Stages of Construction and Operations

TABLE 2

Stage of Construction/Operations: Stage 1b Construction and Start-Up Operations

Description: Continuation of Stage 1 construction through completion of Stage 1 construction and start-up operations

Timing: 0–3 years from the start of construction

Approximate Years[1]: 2018–2021

Throughput Capacity: 5 to 10 MMTPY[2]

Stage 1b Construction		Start-Up Operations	
Project Component	Activity	Project Component	Activity
N/A	N/A	Number of Trains	Arrival of coal by rail: • Up to 10 MMTPY throughput capacity • Up to 60 unit trains arriving and departing monthly
N/A	N/A	Number of Vessels	Transfer of coal to ship: • Up to 10 MMTPY throughout capacity • Up to 15 ships loaded monthly (80% Panamax, 20% Handymax)
Number of Construction Workers	• 1,350 construction workers (combined number of workers for all construction activities associated with Stage 1 and Stage 2)	Number of Employees	• 60 employees required
Construction Trips	• Construction trips are dependent on how material is imported during preloading activities (numbers below are combined for preloading activities during Stage 1 and Stage 2): ○ If all material is imported by truck: approximately 88,000 loaded truck trips over an approximate 5-year period with the majority of the truck trips occurring during the first 1 to 2 years (Stage 1) ○ If all material is imported by rail: approximately 35,000 loaded railcars over an approximate 5-year period with the majority of the railcars received during the first 1 to 2 years (Stage 1) ○ If all material is imported by barge: approximately 1,130 barge trips over an approximate 5-year period with the majority of the barge trips occurring during the first 1 to 2 years (Stage 1)	N/A	—
Construction/Installation of Coal Export Terminal	Coal would not be stockpiled during any stage of construction. Would include the installation of additional facilities and	Rail Cars/Trains	• Inbound and outbound trains would be staged on site on up to eight available storage tracks

[1] Assumes that construction begins 2018

[2] MMTPY = million metric tons per year

Millennium Bulk Terminals—Longview
Coal Export Terminal Stages of Construction and Operations

TABLE 2

Stage of Construction/Operations: Stage 1b Construction and Start-Up Operations

Description: Continuation of Stage 1 construction through completion of Stage 1 construction and start-up operations

Timing: 0–3 years from the start of construction

Approximate Years[1]: 2018–2021

Throughput Capacity: 5 to 10 MMTPY[2]

Stage 1b Construction		Start-Up Operations	
Project Component	Activity	Project Component	Activity
Equipment	equipment not installed during the start of Stage 1a construction: • Tandem rotary unloading facility (capable of unloading 2 rail cars) • Three berms (for stackers and reclaimers) • Water management facilities • Two stackers • Two reclaimers • Conveyors, buffer bin, and transfer towers, including approximately 16,100 lineal feet of conveyors, of which approximately 11,200 lineal feet would be open conveyors and approximately 4,900 lineal feet would be enclosed. • Support structures, electrical transformers, switchgear and equipment, process control systems, buildings, etc. Completion of Stage 1 construction would result in a nominal throughput capacity of up to 25 MMTPY		• Rail car unloading operations would use the operating track and the rapid discharge (bottom) unloaders • Up to 60 unit trains would arrive and depart monthly
		Rail Car Unloading	• No stockpiling of coal; coal would be delivered directly from the rail cars to the shiploader by way of a rapid discharge unloading facility and interconnecting conveyors
		Water Management Facilities	• Water collection, conveyance, treatment, reuse, or discharge
—	—	Shiploading	• Ship loading would be performed using a single electrical-powered traveling shiploader installed on Dock 2 • The shiploader would have an average capacity of 6,500 metric tons per hour
		Shipping	• Up to 15 ships per month (80% Panamax, 20% Handymax) would be loaded
		Ship Bunkering Crew Supplies	• These activities would not be allowed or provided for at the dock

Millennium Bulk Terminals—Longview
Coal Export Terminal Stages of Construction and Operations

TABLE 2

Stage of Construction/Operations: Stage 1b Construction and Start-Up Operations

Description: Continuation of Stage 1 construction through completion of Stage 1 construction and start-up operations

Timing: 0–3 years from the start of construction

Approximate Years[1]: 2018–2021

Throughput Capacity: 5 to 10 MMTPY[2]

Stage 1b Construction		Start-Up Operations	
Project Component	Activity	Project Component	Activity
		Equipment	• Equipment needed to maintain the terminal would include ○ wheel loaders ○ cranes ○ forklifts ○ trucks ○ welders ○ pumps and other similar equipment

Millennium Bulk Terminals—Longview
Coal Export Terminal Stages of Construction and Operations

TABLE 3
Stage of Construction/Operations: Stage 2 Construction/Increased Operations
Description: Stage 2 Construction and increased operations through completion of Stage 2 construction
Timing: 4–6 years from the start of construction
Approximate Years[1]: 2022–2024
Throughput Capacity: Up to 25 MMTPY[2]

Stage 2 Construction		Increased Operations	
Project Component	Activity	Project Component	Activity
N/A	N/A	Number of Trains	Arrival of coal by rail: • Up to 25 MMTPY throughput capacity • An average of 150 unit trains arriving and departing monthly
N/A	N/A	Number of Vessels	Transfer of coal to ship: • Up to 25 MMTPY throughput capacity • Total average of 40 ships loaded monthly (80% Panamax, 20% Handymax)
Number of Construction Workers	• 1,350 construction workers (combined number of workers for all construction activities associated with Stage 1 and Stage 2)	Number of Employees	• 115 employees required
Construction Trips	• Construction trips are dependent on how material is imported during preloading activities (numbers below are combined for preloading activities during Stage 1 and Stage 2 Construction): ○ If all material is imported by truck: approximately 88,000 loaded truck trips over an approximate 5-year period with the majority of the truck trips occurring during the first 1 to 2 years (Stage 1. ○ If all material is imported by rail: approximately 35,000 loaded railcars over an approximate 5-year period with the majority of the railcars received during the first 1 to 2 years (Stage 1) ○ If all material is imported by barge: approximately 1,130 barge trips over an approximate 5-year period with the majority of the barge trips occurring during the first 1 to 2 years (Stage 1)	N/A	—
Construction Staging	• Associated stockpile pads (preloading for remaining 2 of 4 berms/stockpile pads) • Any of the remaining eight rail storage tracks for train parking that were not constructed as part of Stage 1 • Two additional stackers • Two additional reclaimers • Conveyors	Rail Cars/Trains	• Inbound and outbound trains would be stored on site on up to eight available storage tracks • Rail car unloading operations would use the operating track and rail cars would be unloaded using the tandem rotary unloader • An average of 150 unit trains would arrive and depart monthly

[1] Assumes that construction begins 2018
[2] MMTPY = million metric tons per year

Millennium Bulk Terminals—Longview
Coal Export Terminal Stages of Construction and Operations

TABLE 3
Stage of Construction/Operations: Stage 2 Construction/Increased Operations
Description: Stage 2 Construction and increased operations through completion of Stage 2 construction
Timing: 4–6 years from the start of construction
Approximate Years[1]: 2022–2024
Throughput Capacity: Up to 25 MMTPY[2]

Stage 2 Construction		Increased Operations	
Project Component	Activity	Project Component	Activity
	• One additional shiploader on Dock 3 • Equipment necessary to add 19 MMTPY and bring the nominal total throughput up to 44 MMTPY		
Preloading	• Remaining 2 of 4 berms/stockpile areas would be preloaded during Stage 2 construction • Existing soil conditions would be strengthened to improve load bearing capacity • Preload material would be imported and wick drains would be installed for ground improvement for the stockyard area • Preload material would be placed in a pile approximately 35 feet high covering the area of the berm and adjacent stockpile pad(s) • The preload process would be repeated at each berm and stockpile location until soil consolidation is achieved across the complete stockyard • Excess preload material would be used on site, stockpiled, or removed from the site • Approximately 2.1 million cubic yards of preload material would be imported (Stage 1 and 2) • Approximately 2.5 million cubic yards of material would be moved around the project area (Stage 1 and 2)	Rail Car Unloading	• Rail cars would be unloaded by an electrical-powered tandem rotary unloader • The terminal would include a mechanical positioner to index the unit into the rotary unloader • Coal would be transferred to the stackers via conveyors

Millennium Bulk Terminals—Longview
Coal Export Terminal Stages of Construction and Operations

TABLE 3
Stage of Construction/Operations: Stage 2 Construction/Increased Operations
Description: Stage 2 Construction and increased operations through completion of Stage 2 construction
Timing: 4–6 years from the start of construction
Approximate Years[1]: 2022–2024
Throughput Capacity: Up to 25 MMTPY[2]

Stage 2 Construction		Increased Operations	
Project Component	Activity	Project Component	Activity
Construction/ Installation of Coal Export Terminal Equipment	Coal would not be stockpiled during any stage of construction. Would include the installation of additional facilities and equipment not installed during Stage 1 construction: • The remaining rail storage tracks (total of eight rail storage tracks) • The remaining 2 berms for stackers and reclaimers (total of 5 berms after Stages 1 and 2 construction is complete) • Two stackers (total of up to 4 stackers after Stages 1 and 2 of construction are complete) • Two reclaimers (total of up to 4 reclaimers after Stages 1 and 2 construction is complete) • Conveyors, buffer bin, and transfer towers, including approximately 26,200 lineal feet of conveyors, of which approximately 17,900 lineal feet would be open conveyors and approximately 8,300 lineal feet would be enclosed • One shiploader on Dock 3 • Support structures, electrical transformers, switchgear and equipment, buildings, process control equipment, etc.	Conveyor Systems	• Conveyors would transport coal from rail unloading to the stockyard and from the stockyard to the shiploader • Conveyors would be enclosed except where required to feed onto or reclaim from stockpiles or onto the shiploaders • Rail car unloading and shiploading would at times occur both independently and simultaneously • Conveyors would operate for approximately 45% of the available time • Conveyor drives are electrically powered
		Stockpiling	• Two electrical-powered traveling stackers would stockpile coal at an average rate of 7,500 metric tons per hour onto 2 longitudinal stockpiles with an estimated total storage capacity of 750,000 metric tons
		Reclaiming	• Two electrical-powered traveling bucket wheel reclaimers, each with an average rate of 6,500 metric tons per hour, would transfer coal from the stockpile to the shiploading system
		Shiploading	• Would use the shiploader installed for startup operations on Dock 2 only
		Shipping	• Total average of 40 ships per month (80% Panamax, 20% Handymax) would be loaded
		Mobile Equipment	• Equipment needed to maintain the terminal would include: ○ wheel loaders

Millennium Bulk Terminals—Longview
Coal Export Terminal Stages of Construction and Operations

TABLE 3
Stage of Construction/Operations: Stage 2 Construction/Increased Operations
Description: Stage 2 Construction and increased operations through completion of Stage 2 construction
Timing: 4–6 years from the start of construction
Approximate Years[1]: 2022–2024
Throughput Capacity: Up to 25 MMTPY[2]

Stage 2 Construction		Increased Operations	
Project Component	Activity	Project Component	Activity
			○ dozers ○ cranes ○ forklifts ○ trucks ○ welders ○ pumps and other similar equipment

Millennium Bulk Terminals—Longview
Coal Export Terminal Stages of Construction and Operations

TABLE 4
Stage of Construction/Operations: Full Build-Out Operations
Description: Construction complete and full build-out operations
Timing: 6+ years from the start of construction
Approximate Years[1]: 2024+
Throughput Capacity: Up to 44 MMTPY[2]

		Full Build-Out Operations	
		Project Component	Activity
—	—	Number of Trains	Arrival of coal by rail: • Up to 44 MMTPY throughput capacity • Average of 240 unit trains arriving and departing monthly
—	—	Number of Vessels	Transfer of coal to ship: • Up to 44 MMTPY throughput capacity • Total average of 70 ships loaded monthly (80% Panamax, 20% Handymax)
—	—	Number of Employees	• 135 employees
—	—	Rail Loop	• Arrival and departure tracks, with 1 operating turnaround track • Eight storage tracks would allow trains to travel directly onto the site from the Reynolds Lead • Two rail cars at unloading station inside an enclosed facility; both would be rotated at the same time for discharge of material • Hopper to feed coal onto conveyor 2 at a nominal rate of 7,500 metric tons per hour
—	—	Stockyard	• Four parallel stockpile pads (hold approximately 1,500,000 metric tons of coal) and 5 berms, located inside the rail loop • Stockyard would cover an area of approximately 75 acres • Served by up to 4 rail-mounted stackers and up to 4 bucket wheel reclaimers, each with associated conveyors • Pads would vary in length from 2,200 feet to 2,500 feet and hold from 360,000 metric tons to 400,000 metric tons each • Coal would be stacked up to a height of approximately 85 feet above the pads

[1] Assumes that construction begins 2018
[2] MMTPY = million metric tons per year

Millennium Bulk Terminals—Longview
Coal Export Terminal Stages of Construction and Operations

TABLE 4
Stage of Construction/Operations: Full Build-Out Operations
Description: Construction complete and full build-out operations
Timing: 6+ years from the start of construction
Approximate Years[1]: 2024+
Throughput Capacity: Up to 44 MMTPY[2]

		Full Build-Out Operations	
		Project Component	Activity
			• Stockyard would be graded to allow water to drain and be collected for treatment and reuse
—	—	Conveyors, Transfer Towers, and Buffer Bins	• Conveyors would transport coal from railcar unloading to the stockpile and stockpile to the shiploader • Conveyors would be enclosed except where required to feed to or receive from stacking, reclaiming, or shiploading equipment • Stockyard and ship loading conveyors would be open • Buffer bins would provide storage capacity during the shiploading process • Once unloaded, coal would be stockpiled or loaded directly onto ships • Stockpiled coal would be reclaimed for shiploading
—	—	Dock 2	• 1,400 feet long and varying in width from approximately 100 feet up to 130 feet • Dredging required to provide berthing access
—	—	Dock 3	• 900 feet long, with a width of approximately 100 feet • Dredging would be required to provide berthing access
—	—	Trestle	• Access to Docks 2 and 3 would be provided by a single trestle approximately 800 feet long and varying in width from approximately 35 feet on the northern end and up to 60 feet on the southern end

Millennium Bulk Terminals—Longview
Coal Export Terminal Stages of Construction and Operations

TABLE 4
Stage of Construction/Operations: Full Build-Out Operations
Description: Construction complete and full build-out operations
Timing: 6+ years from the start of construction
Approximate Years[1]: 2024+
Throughput Capacity: Up to 44 MMTPY[2]

		Full Build-Out Operations	
		Project Component	Activity
—	—	Shiploaders	• Each dock would be served by its own shiploader to load ships at the 2 docks
—	—	Rail Cars/Trains	• Total of 8 storage tracks and 1 operating track • The 1 operating track installed as part of start-up operations would service full build-out operations • 90 additional unit trains per month, increasing the overall number of trains to an average of 240 unit trains arriving and departing monthly
—	—	Rail Car Unloading	• The Stage 1 tandem rotary unloader would service full build-out operations • No additional unloading equipment would be required • The rapid discharge (bottom) tandem railcar unloader installed for Stage 1 Start-Up Operations would remain operable and be used during maintenance of the tandem rotary unloader

Millennium Bulk Terminals—Longview
Coal Export Terminal Stages of Construction and Operations

TABLE 4
Stage of Construction/Operations: Full Build-Out Operations
Description: Construction complete and full build-out operations
Timing: 6+ years from the start of construction
Approximate Years[1]: 2024+
Throughput Capacity: Up to 44 MMTPY[2]

		Full Build-Out Operations	
		Project Component	Activity
—	—	Conveyor Systems	• Conveyors would transport coal from railcar unloading area to the stockyard, and from the stockyard to the shiploader • Conveyors would be enclosed except where required to feed onto or reclaim from stockpiles or onto the shiploaders • When unloading rail cars, the conveyors from rail car unloading to the stockyard would operate • When loading ships, the conveyors from the stockyard to the shiploaders would operate • Rail car unloading and ship loading would at times occur both independently and simultaneously • Conveyors would operate approximately 80% of the time
—	—	Stockpiling	• Total of up to 4 stackers • Each stacker would stockpile coal at an average rate of 7,500 metric tons per hour onto 2 additional longitudinal stockpiles with a total storage capacity of up to 1.5 million metric tons
—	—	Reclaiming	• Total of up to 4 reclaimers • Each would reclaim coal from the stockpile to the shiploading system, with an average capacity of 6,500 metric tons per hour
—	—	Shiploading (Docks 2 and 3)	• Total of 2 traveling shiploaders, 1 on each dock • Each shiploader would have an average rated capacity of 6,500 metric tons per hour

Millennium Bulk Terminals—Longview
Coal Export Terminal Stages of Construction and Operations

TABLE 4
Stage of Construction/Operations: Full Build-Out Operations
Description: Construction complete and full build-out operations
Timing: 6+ years from the start of construction
Approximate Years[1]: 2024+
Throughput Capacity: Up to 44 MMTPY[2]

		Full Build-Out Operations	
		Project Component	Activity
—	—	Shipping	• Up to 30 additional ships, for a total average of 70 ships per month (80% Panamax, 20% Handymax) would be loaded
—	—	Ship Bunkering and Crew Supplies	• These activities would not be allowed or provided for at the dock
—	—	Mobile Equipment	• Equipment needed to maintain the terminal would include: ○ wheel loaders ○ dozers ○ cranes ○ forklifts ○ trucks ○ welders ○ pumps and other similar equipment

Appendix B

Coal Export Terminal Design Features

Appendix B
Coal Export Terminal Design Features

Table B-1 provides a summary of detailed design features for the coal export terminal provided by the Applicant.

Table B-1. Applicant-Provided Coal Export Terminal Design Features

Topic or Environmental Element	Description	Project Design Features
Design Life of Coal Export Terminal	Reduce the need to replace major equipment, reducing additional construction impacts	Design life for the various components is: • Major Equipment Structures (shiploader, stacker, reclaimer, rail car rotary dumper): 30 years • Mechanical Components (reducers, bearings, pumps. etc.): 80,000 hours • Structural (storage building, conveyors, marine): 50 years • Marine Fender Systems: 25 years
		Achieving the design service life for the above components requires regular maintenance and inspection to identify any deterioration, wear and tear, or damage, and the undertaking of repairs of identified items. In addition to regular inspection and maintenance, it is anticipated that all plant and equipment will require periodic major refurbishment to reinstate protective coating systems and upgrade control/electrical systems.
Applicable Codes, Standards, and Agencies	Applicable codes, standards, and agency oversight are anticipated to reduce or eliminate many potential impacts that could otherwise occur	**Agencies** Equipment shall comply with the present environmental requirements as specified by the following agencies: • Cowlitz County • City of Longview • Washington State Department of Ecology (Ecology) • U.S. Environmental Protection Agency, Region 10 (EPA) • Southwest Clean Air Agency • U.S. Army Corps of Engineers (Corps) • U.S. Fish and Wildlife Service (USFWS)

Topic or Environmental Element	Description	Project Design Features
		• National Oceanic and Atmospheric Administration (NOAA Fisheries) • Washington Department of Fish and Wildlife (WDFW) • Washington State Department of Transportation (WSDOT)
		• **Codes and Standards** • ASTM: American Society for Testing and Materials • ASME: American Society of Mechanical Engineers • ANSI: American National Standards Institute • AGMA: American Gear Manufacturer's Association • NFPA: National Fluid Power Association and National Fire Protection Association • JIC: Joint Industry Conference • SAE: Society of Automotive Engineers • AREMA: The American Railway Engineering and Maintenance-of-Way Association • AASHTO: American Association of State Highway and Transportation Officials • FUS: Fire Underwriters Survey, 1999 Edition • AISC: Steel Construction Manual, 13th Edition • AWS: American Welding Society • AWS A5.X: Arc Welding Electrodes and Fluxes (Various Standards) • ANSI / AISC 360-05: Specification for Structural Steel Buildings (Allowable Stress Design) • 80552-design criteria-rep-0901 (2).docx Page 4 80528 : Rev B : October 27, 2010 • A6 / A6M-09: General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling • ASTM A529 / A529M: High-Strength Carbon-Manganese Steel of Structural Quality • ASTM A123 / A123M: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products • AASHTO HB-17: Standard Specifications for Highway Bridges, 17th Edition

Topic or Environmental Element	Description	Project Design Features
		• ASCE 7-05: Minimum Design Loads for Buildings and Other Structures • AISC 360-05: Steel Construction Manual • ACI 318-08: Building Code Requirements for Structural Concrete • ASCE 8-02: Design of Cold-Formed Stainless Steel Members • ASTM A615 / A615M-09b: Deformed and Plain Billet-Steel Bars for Concrete Reinforcement • ASTM A1023 / A1023M: Stranded Carbon Steel Wire Ropes for General Purpose • ASME B20.1: Safety Standard for Conveyors and Related Equipment • CEMA: Conveyor Equipment Manufacturers Association; Belt Conveyors for Bulk Materials • ISO R773/4: International Standards Organization, Recommendations for Keys and Key Seats • MSHA: US Department of Labor, Mine Safety and Health Administration, C.F.R. 30, Part 18.65; Fire Resistance of Conveyor Belting • SSPC Standards: Steel Structures Painting Council – Painting Manual Volumes I and II • ASTM A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless • ASTM A325: Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength • ASTM A307: Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength • ASTM A504: Standard Specification for Wrought Carbon Steel Wheels • IBC: International Building Code and Washington State Amendments • MOTEMS: Marine Oil Terminal Engineering and Maintenance Standards • OSHA: Occupational Safety and Health Act • WISHA: Washington Industrial Safety and Health Act

Topic or Environmental Element	Description	Project Design Features
		• API 650: Welded Steel Tanks for Oil Storage • NEMA: National Electrical Manufacturers Association • MPTA: Mechanical Power Transmission Association • NFPA 70: National Electrical Code • NFPA 70E: Standard for Electrical Safety in the Workplace • ICEA: Insulated Cable Engineers Association • IES: Illumination Engineering Society • ISA: International Society of Automation • ISO: International Organization for Standardization • NEC: National Electrical Code • NESC: National Electrical Safety Code • UL: Underwriters Laboratories • CoV's (USA) Electrical Code • IEEE: Institute of Electrical and Electronic Engineers • FEM: Fédération Européenne de la Manutention, Section II, Document 2 131/2 132, Rules for the Design of Mobile Equipment for Continuous Handling of Bulk Materials • ISO / 5049-1: Mobile Equipment for Continuous Handling of Bulk Materials, Part 1 – Rules for the Design of Steel Structures
Aesthetics, Light, and Glare	**Operation –** Prevent potential spillage of light off of project site	• Typical industrial lighting would be provided and installed in a manner so as to prevent light and glare from spilling off of the area • Night lighting would be restricted to the minimum required for operational and safety requirements and would be directed away from roads and sensitive viewpoints, where practicable • Light shields would be used to limit the spill of lighting where practicable • Project lighting would be directed downward to minimize off-site light spill
Air Quality	**Construction –** Prevent creation of dust and wind-borne soil erosion	• Demolition activities would be carried out in accordance with the best management practices listed in the Stormwater Manual for Western Washington. These practices include, but are not limited to:

Topic or Environmental Element	Description	Project Design Features
		• **BMP C105:** Stabilized Construction Entrance / Exit – stabilized entrance and exit would be installed and maintained through the duration of demolition, site preparation, preloading and construction
	Construction – Reduce or eliminate the potential tracking of soils off site	• **BMP C106**: Wheel Wash – would be used if the stabilized construction entrance/exit is not preventing sediment from being tracked off site
	Operation – Reduce or eliminate the potential for dust and soil erosion from internal roadways	• All regularly used roads accessing the buildings and facilities within the site will be sealed with asphalt pavement, other roads will be gravel
		• All sealed roads would be frequently and routinely swept to collect airborne dust
		• Vehicle access to unsealed areas would be controlled to limit airborne dust
	Operation – Reduce or eliminate potential for coal dust during unloading and loading	• The equipment design would incorporate features to minimize dust emissions to the air that could otherwise occur from the use of loaded rail cars, the use of transfer equipment to unload rail cars, the use of conveyors to transfer product, stockpiling of product and the use of equipment to load ships. The design of the terminal incorporates best available practices for control of dynamic and fugitive dust. The design of the terminal would allow for the safe operation and safe maintenance of the plant and equipment using current best available control technologies, and in compliance with the latest OSHA and NFPA requirements.
		• Industrial water would be used for process water and fire protection; process water uses include dust control, stockpile sprays, washdown and cleanup
	Operation – Dust control measures included in design for rail car unloaders	• At the unloading station, two rail cars at a time would be positioned inside the fully enclosed metal clad unloading building where they would be rotated to discharge the material from the cars into a large hopper • A water spray system and/or dry fog system would be used at the tandem rotary unloader to control dust • Unloaders within an enclosed building

Topic or Environmental Element	Description	Project Design Features
		• Dry fog system • Water spray system
	Operation – Dust control measures included in design for conveyors	• All belt conveyors would be fully enclosed, except for the stockyard and shiploading conveyors, which would be open due to their operational requirements • Water spray system would be used at the conveyor transfer points • Enclosed conveyors and transfer points (except for stockyard and shiploader conveyors) • Regular washdown and under-belt plating • Monitoring status of conveyors • Washdown collection and containment • Cleanup using high pressure water • Belt cleaners to control and collect any dust
	Operation – Dust control measures included in design for transfer points	• All transfer points would be fully enclosed, except for the stockyard and shiploader conveyors which would be open due to their operational requirements • Water spray system would be used at the conveyor transfer points • Skirting would be installed at transfer points to control coal flow and spillage • Transfer chutes enclosed in transfer towers • Soft flow transfer chutes • Inlet and outlet curtains and side skirts • Water spray systems • Regular washdown and under-belt plating • Washdown water collection and containment • Cleanup using high pressure water • Enclosed transfer towers
	Operation – Dust-control measures included in design for stockpiles	• A stockpile spray system would be installed to wet the coal surface to control fugitive dust • The stockpile spray system would be controlled by an on-site and remote weather monitoring system to ensure system is operating before wind may arrive at the site

Topic or Environmental Element	Description	Project Design Features
		• Control of drop height from stackers • Cleanup along conveyor berms and sealed roadways • Vehicle access would be limited in the stockpile areas
	Operation – Dust control measures included in design for shiploading	• Vertically adjustable loading boom to decrease drop height • Enclosed shiploader boom • Enclosed loading spout • Discharge below deck of vessel • Cleanup and washdown by high pressure water • Capture and containment of washdown water
	Operation – Diesel particulate matter from trains. Based on information contained in our Air Quality Resource Report, the emission of diesel particulate matter from trains at the site and on the short line were included in the air quality modeling. The estimate impact would be minimal (less than a 1% increase) over countywide 2011 concentrations, and countywide emissions would be expected to remain below the federal and state standards. Because there would be minor or minimal impacts which would not create an exceedance of any standards, no mitigation is required.	• Emissions from rail are mobile and would be spread along the short line, making it unlikely that a localized concentration would exceed 1-hour standards. There are no local or state regulations for diesel particulate emissions from mobile sources.
Aquatic Habitat, general	Shading design considerations for Docks 2 and 3 and the associated trestle	• Trestle has been designed to be long and narrow, and at a height above ordinary high water to minimize shading in shallow water areas. From shore, the trestle would measure 24 feet in width for 700 feet, and 51 feet in width for the final 150 feet. The top of the deck would be at +22 feet Columbia River Datum (CRD) and the bottom of the deck at +19.5 feet CRD. Therefore, the bottom of the deck would be more than 8 feet above ordinary high water.
	Structural design considerations for Docks 2 and 3 and the associated trestle	• Trestle has been designed to minimize overall impact in shallow water areas, including impacts on habitat connectivity along the shoreline • Docks 2 and 3 will be located entirely in deep water habitat to locate structure and terminal activities away from shallow water areas

Topic or Environmental Element	Description	Project Design Features
	Dredging design considerations for Docks 2 and 3 and the associated trestle	• The berthing area will be located at depths that are currently at least -20 feet CRD to avoid habitat conversion from shallow to deep during dredging • Location of the berthing area in deep water closer to the navigation channel will minimize the scope of future maintenance dredging
	General habitat-related design considerations for Docks 2 and 3 and the associated trestle	• Flow lane disposal (initial and maintenance dredging) will be used to keep dredged materials in aquatic areas, maintaining sediment transport processes and aquatic habitats in the lower Columbia River
		• Project lighting will be directed downward or at structures, and will incorporate shielding to avoid spillage of light into aquatic areas
		• The end of the shiploading boom will include a pinpoint light source that will be aimed straight down into the ship hold area, avoiding a broader beam that could cause light spillage
		• Pile caps will be used to minimize opportunities for piscivorous birds to perch
Aquatic Species	**Construction –** General	• The Applicant has developed a series of activity-specific work windows that are designed to minimize specific impact mechanisms as they affect individual species (or populations within those species) of concern • These proposed work windows are protective of the species of concern while providing feasible construction periods for the in-water portion of the Proposed Action over a 2-year schedule
Aquatic Species (includes federally-listed species)	**Construction -** General (regulatory consideration)	• Timing restrictions specifying that in-water construction must occur when species of concern (i.e., salmonids, eulachon, green sturgeon) are absent or present in very low numbers in the adjacent waterbody would be strictly observed. All timing restrictions that may be established by WDFW, the Corps, NOAA Fisheries, or USFWS would be strictly observed (Corps permit and Hydraulic Project Approval
Earth	**Construction –** Reduce the potential for soil erosion	• **BMP C107:** Construction Road/Parking Area Stabilization - roads, parking areas, and other onsite vehicle transportation

Topic or Environmental Element	Description	Project Design Features
		routes would be stabilized to reduce erosion caused by construction traffic or runoff
	Construction – Minimize impacts of disposal of dredge materials	• Dredging would use in-river flow lane disposal;
		• Dredged material that meets environmental standards may be used to construct habitat mitigation sites
		• Should relevant conditions allow, dredge materials may be disposed of upland for preloading the stockpile area
	Operation – Reduce or eliminate the potential for dust and soil erosion from internal roadways	• All regularly used roads accessing the buildings and facilities within the site will be sealed with asphalt pavement, other roads will be gravel
Noise	**Operation –** General	• Operational noise levels at all noise receivers are anticipated to be below both Class A EDNA and Class C EDNA receiver limits, with the exception of the ST5 location. Day and nighttime noise levels at ST5 are compliant with the Class C EDNA receiver limits.
	Operation – Noise control measures to limit sound of rail car unloading	• Rail car unloading would be within an enclosed building • Track lubricators would be installed to control rail and wheel noise
	Operation – Noise control measures to limit sound from conveyors	• Incorporation of "quiet conveyor technologies" (i.e., quiet drives, quiet idlers, and controlled idler harmonics) • Engineered startup and travel alarms • Cladding is proposed to enclose the transfer tower structures and several conveyors to reduce operational noise levels
	Operation – Noise control measures to limit sound from stackers and reclaimers in stockyard	• Incorporation of "quiet technology" • Engineered travel and startup alarms
	Operation – Noise control measures to limit sound from shiploading	• Incorporation of "quiet technology" • Engineered travel and startup alarms
Pubic Services and Utilities	**Construction and Operation –** Maintain or provide for pedestrian, vehicular, and rail access to Bonneville Power Administration (BPA)-owned property	• BPA will be granted access to the Proposed Action's access road, which will be located around the outside of the rail loop. In addition, the Applicant will construct an access road between the access road for the Proposed Action and the BPA yard, and install a gate to the BPA yard at a location to be determined by BPA.

Topic or Environmental Element	Description	Project Design Features
	Operation – Fire Protection – Provide adequate access for fire vehicles in the case of an emergency	• Longitudinal grades of roads will not exceed 10% where fire access is anticipated
	Operation – Fire Protection – Provide for adequate fire flow in case of an emergency	• The firewater system will be fed from on-site wells, filling a 4-hour storage tank as recommended by the National Fire Protection Association 307 "Standard for the Construction of Fire Protection of Marine Terminals, Piers, and Wharves" Chapter 7
Sustainability, Public Utilities, Hazardous Materials	**Construction –** Disposal of demolished structures in a manner to reduce or eliminate impacts	• The materials from the demolition would be recycled (on site or off site) or disposed of at an appropriate waste facility
Traffic and Transportation	**Construction –** Reduce or eliminate potential land use and transportation impacts from off-site construction parking	• Parking would be provided for construction workers
	Operation – Reduce impacts from on- and off-site transportation	• Access to the site is from an existing arterial (Industrial Way). The main access includes an elevated bridge crossing the rail corridor. An additional elevated bridge would be provided to cross the railway and access the easterly yard area.
		• Access to the site would be from Industrial Way (SR 432) either using the existing entrance at the intersection with 38th Avenue or via a new entrance located west of the existing entrance
		• Access to the site would be from a single entry point, with authorized vehicles being able to enter the train unloading and storage facilities, or the marine facilities
	Operation – On-Site Roadways – Provide for safe vehicular movements on site	• The on-site roadways would cross above the rail tracks (grade-separated) to allow for safe and efficient access to the site
		• Overpasses shall be constructed to WSDOT standards for roads and bridges and allow for maximum emergency vehicle loadings
		• Access roads would be designed to allow two-way traffic for standard vehicles
		• All regularly used roads accessing the buildings and facilities within the site would be sealed with asphalt pavement; other roads would be gravel
		• Paved road cross sections will be sloped at 2% minimum

Topic or Environmental Element	Description	Project Design Features
		• Longitudinal grades of roads will not exceed 10% where fire access is anticipated
		• All roadways, parking areas, and paving shall be designed and constructed to WSDOT standards
		• Paving shall be designed to accommodate the appropriate mobile equipment loadings for the particular use of that portion of the site, and asphalt or concrete pavement shall have a design life of 20 years
		• Surfacing of unpaved areas shall be used in order to control soil erosion by wind and water, be able to support pedestrians and light vehicles, including 4-wheel drive vehicles and repress undesirable vegetation
	Operation – Rail – Provide adequate space on site to allow rail to move off the main line and Reynolds Spur to eliminate potential conflicts with other rail users	• Design includes a rail loop with arrival and departure tracks to include one operating track (turn around track) and eight rail storage tracks
Water Quality, Aquatic Habitat, Aquatic Species	**Construction –** Pile Removal and Installation	• A decision was made to use 36-inch rather than 48-inch piles to reduce impacts on aquatic habitat • Vibratory pile-driving/removal will be used to the extent possible to minimize potential injurious or disturbing noise levels on fish species
Water Quality, Aquatic Habitat, Aquatic Species	**Construction –** Dredging and Flow Lane Disposal	• Flow lane (i.e., in-water) disposal of dredged material is proposed as an avoidance/minimization measure. Flow lane disposal keeps the dredged material in aquatic areas and maintains sediment transport processes that build and maintain dynamic aquatic habitats. This is consistent with the Corps' requirements and practices in the Columbia River.

Topic or Environmental Element	Description	Project Design Features
Water Quality	**Construction and Operation –** Reduce or eliminate potential impacts on water quality	• Stormwater, sediment, and erosion control best management practices would be installed in accordance with the Stormwater Management Manual for Western Washington and Cowlitz County. Water quality management would be performed in accordance with the requirements of the NPDES Industrial Stormwater General Permit. The site's NPDES Stormwater Pollution Prevention Plan will provide details of the site best management practices.
	Construction – Reduce or eliminate the potential for sediment to enter surface or	• Stormwater, sediment, and erosion control best management practices would be installed in accordance with the Stormwater Management Manual for Western Washington and Cowlitz County
		• Construction would be performed in accordance with the requirements of the NPDES Construction Stormwater General Permit
		• Drainage systems would be designed such that runoff within the construction site would be collected and treated as necessary before reuse or discharge
		• The treatment facility could treat surface runoff and process/construction waters with capacity to store the water for reuse
		• Treatment could be as required to meet reuse quality or Ecology requirements for off-site discharge
		• **BMP C200:** Interceptor Dike and Swale – A ridge of compacted soil, or a ridge with an upslope swale, would be provided at the top or base of a disturbed slope or along the perimeter of a disturbed construction area to convey stormwater. The dike and/or swale would be used to intercept the runoff from unprotected areas and direct it to areas where erosion can be controlled. This would be used to prevent storm runoff from

Topic or Environmental Element	Description	Project Design Features
		entering the work area or sediment-laden runoff from leaving the construction site.
	Construction – Reduce or eliminate the potential for pollutants to reach surface or	• **BMP C153:** Material Delivery, Storage and Containment – Would be used to prevent, reduce, or eliminate the discharge of pollutants to the stormwater system or watercourses from material delivery and storage • Storage of hazardous materials on site would be minimized to the extent feasible • Materials would be stored in a designated area, and secondary containment would be installed where needed • Refueling would occur in designated areas with appropriate spill control measures • Typical construction best management practices for working over, in, and near water will be applied, including checking equipment for leaks and other problems that could result in discharge of petroleum-based products, hydraulic fluid, or other material to the Columbia River.
		• **BMP C154:** Concrete Washout Area – Concrete waste and washout waters would be either carried out off site or disposed of in a designated facility on site designed to contain the waste and washout water
	Operation – Control of surface drainage to prevent erosion and release of pollutants	• Based on site grading and drainage areas, five water quality ponds (wetponds) will treat runoff based on Ecology requirements. In general, the ponds are sized for treatment of the volume and flow from the water quality design storm event (72% of the 2-year storm). Additional storage will be provided within the coal storage area so that the runoff is always treated within the stockyard area, even for larger storm events. The ponds are designed to provide settlement as the water passes through. Subsequently, water released from these ponds will be conveyed downstream to the existing pump station outfall 002A, which discharges into the Columbia River via an existing 30-inch steel pressure line. The ponds that treat runoff from the coal stockyard would harvest water for circulation around the site for multiple uses, including dust control measures.

Topic or Environmental Element	Description	Project Design Features
		• The Ecology criteria will be used as the basis of design, which uses the Western Washington Hydrology Model (WWHM) computer simulation for sizing. Because of the flat nature of the site, some surface ponding will occur in both the yard areas and open conveyance systems. The piped conveyance systems will be sloped at 0.50% minimum.
		• The surface drainage system and features will be designed and constructed in accordance with the Ecology Stormwater Management Manual for Western Washington
		• Based on site grading and drainage areas, water quality ponds (wetponds) will treat runoff based on Ecology requirements
		• The Ecology criteria will be used as the basis of the design, which uses the WWHM computer simulation for sizing
		• The pads and berms would be made of low permeability engineered material. The use of low permeability engineered materials for formation of the pads and berms would control water from entering subsurface soil or groundwater
		• The stockyard and berms would be graded to allow the water to drain and be collected for treatment and reuse
	Operation – Drainage and treatment of water to prevent on- and off-site impacts on water quality	Drainage systems would be designed such that runoff within the terminal site would be collected for treatment before reuse or discharge. Best management practices that would be part of the terminal design to maximize the availability of water for reuse include: • Enclosed conveyor galleries • Enclosed rotary unloader building and transfer towers • Washdown collection sumps for settlement of sediment • Regular cleanout and maintenance of washdown collection sumps • Containment around refueling, fuel storage, chemicals and hazardous materials • Oil/water separators on drainage systems and vehicle washdown pad

Topic or Environmental Element	Description	Project Design Features
		• Requirement that all employees and contractors receive training, appropriate to their work activities, in the site best management practices • Design of docks to contain spillage, with rainfall runoff and washdown water contained and pumped to the upland water treatment facilities • Design of system to collect and treat all runoff and washdown water either to be reused on site (dust suppression, washdown water or fire system needs) or to be discharged off site
		• The wharf area would be sealed to capture the washdown water and stormwater runoff, preventing it from flowing to the Columbia River without treatment
		• The water treatment facility would be designed to treat all surface runoff and process water with capacity to store the water for reuse. Treatment would be as required to meet reuse quality or Ecology requirements for off-site discharge
		• Additional water storage would be provided within the coal storage area in the event of a larger storm event. Water volumes exceeding the demands for reuse would be discharged off site via the existing outfall 002A into the Columbia River. Water released off site would be treated and would meet the requirements of Ecology and required discharge permits
	Operation – Design of water system to provide fire and health protection	The water system shall be designed and constructed in accordance with or consideration of the latest edition of the following standards, where applicable: • International Building Code • National Fire Protection Association • Washington State Department of Ecology Stormwater Design Manual • United States Department of Health – Occupational Safety and Health Standards • Washington State Department of Health • In the event of conflict between codes and technical specification, the requirements will be reviewed and a decision made on the action to be implemented with the agency of jurisdiction

Topic or Environmental Element	Description	Project Design Features
Water Supply	Use of industrial water to limit impacts on public water supply	• Industrial water supply needed for process and fire protection would be supplied from treated water from the water treatment facility. During times of dry weather, water would be supplemented from on-site wells.
		• A storage reservoir would be included to provide water required for normal operations and water required to be on reserve for fire demand, should the need arise.
		• A separate pumping system would be provided for the fire system, where appropriate, to provide redundancy and to supply additional pressure where needed

MILLENNIUM BULK TERMINALS—LONGVIEW SEPA ENVIRONMENTAL IMPACT STATEMENT

SEPA RAIL TRANSPORTATION TECHNICAL REPORT

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Acronyms and Abbreviations

ABS	Automatic Block Signals
Applicant	Millennium Bulk Terminals—Longview, LLC
BNSF	BNSF Railway Company
Btu	British thermal unit
CFR	Code of Federal Regulations
CLC	Columbia and Cowlitz Railway
CTC	Centralized Traffic Control
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
LVSW	Longview Switching Company
mph	miles per hour
NEPA	National Environmental Policy Act
PTC	Positive Train Control
RCW	Revised Code of Washington
SEPA	Washington State Environmental Policy Act
TCS	Traffic Control Systems
TWC	Traffic Warrant Control
UP	Union Pacific Railroad
USC	United States Code
USDOT	U.S. Department of Transportation
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation
WUTC	Washington Utilities and Transportation Commission

Chapter 1
Introduction

This technical report assesses the potential rail transportation impacts of the proposed Millennium Bulk Terminals—Longview project (Proposed Action) and No-Action Alternative. For the purposes of this assessment, rail transportation refers to the Proposed Action-related trains that would service the project area as well as the type and volume of other rail traffic using the same rail lines. This report describes the regulatory setting, establishes the method for assessing potential rail transportation impacts, presents the historical and current rail transportation conditions in the study area, and assesses potential impacts. Appendix A, *Coal Train Operating Plans,* provides a detailed analysis of the rail operations necessary to support the Proposed Action.

1.1 Project Description

Millennium Bulk Terminals—Longview, LLC (Applicant) proposes to construct and operate a coal export terminal in Cowlitz County, Washington, along the Columbia River (Figure 1). The coal export terminal would receive coal from the Powder River Basin in Montana and Wyoming and the Uinta Basin in Utah and Colorado via rail, then load and transport the coal by ocean-going ships via the Columbia River and Pacific Ocean to overseas markets in Asia. The coal export terminal would be capable of receiving, stockpiling, blending, and loading coal by conveyor onto ships for export. Construction of the coal export terminal would begin in 2018. For the purpose of this analysis, it is assumed the coal export terminal would operate at full capacity in 2028.

The following subsections present a summary of the Proposed Action and No-Action Alternative. For detailed information on these alternatives, see the Washington State Environmental Policy Act (SEPA) Alternatives Technical Report (ICF International 2016).

1.1.1 Proposed Action

The Proposed Action would develop a coal export terminal on 190 acres (project area). The project area is located within an existing 540-acre area currently leased by the Applicant at the former Reynolds Metals Company facility, and land currently owned by Bonneville Power Administration. The project area is adjacent to the Columbia River in unincorporated Cowlitz County, Washington near Longview city limits (Figure 2).

The Applicant currently and separately operates, and would continue to separately operate, a bulk product terminal on land leased by the Applicant. Industrial Way (State Route 432) provides vehicular access to the Applicant's leased land. The Reynolds Lead and the BNSF Spur, both operated by Longview Switching Company (LVSW),[1] provide rail access to the Applicant's leased area from a point on the BNSF Railway Company (BNSF) main line (Longview Junction, Washington) located to the east in Kelso, Washington. Ships access the Applicant's leased area via the Columbia River and berth at an existing dock (Dock 1) operated by the Applicant in the Columbia River.

[1] LVSW is jointly owned by BNSF Railway Company (BNSF) and Union Pacific Railroad (UP).

Figure 1. Project Vicinity

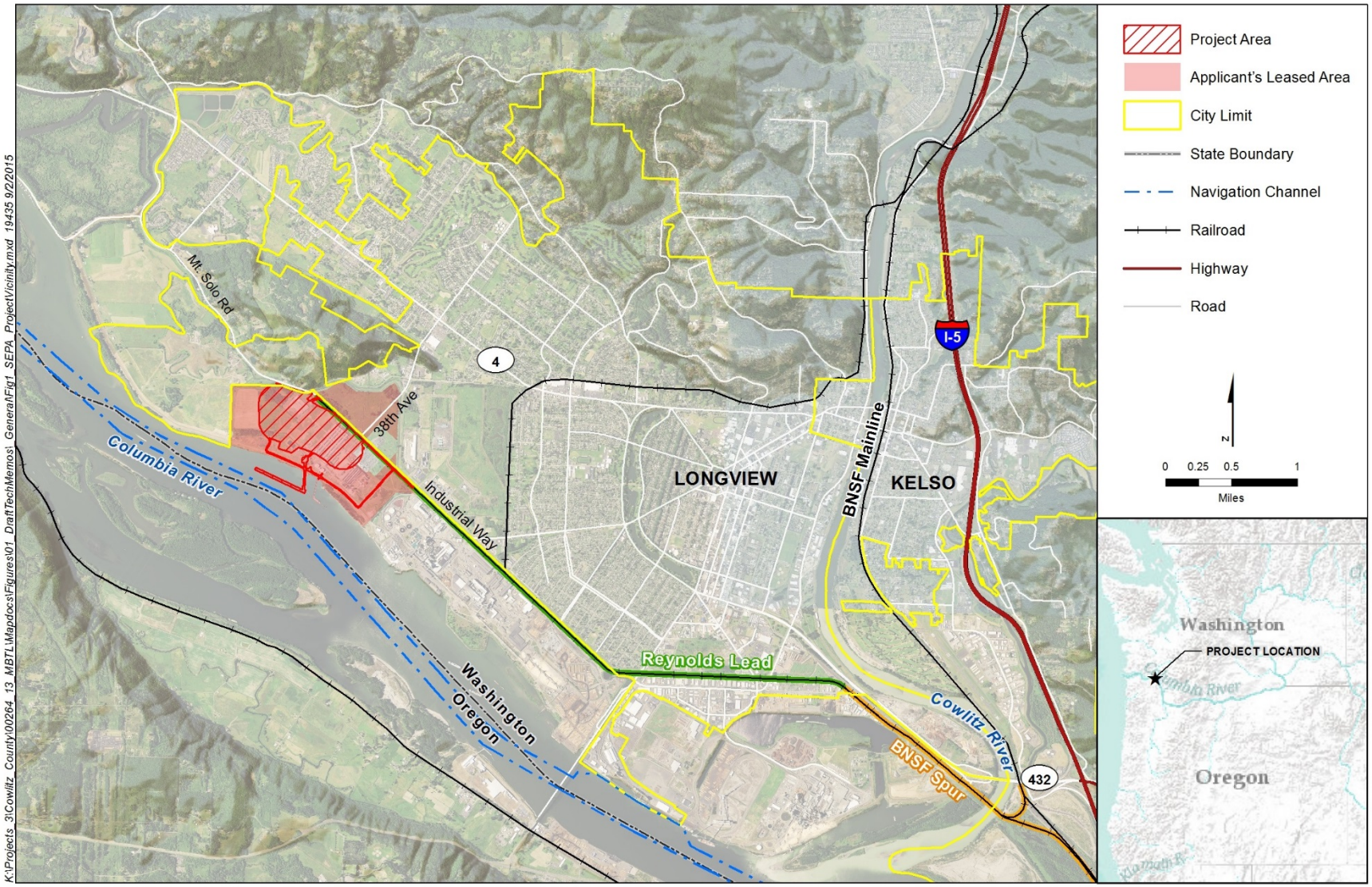
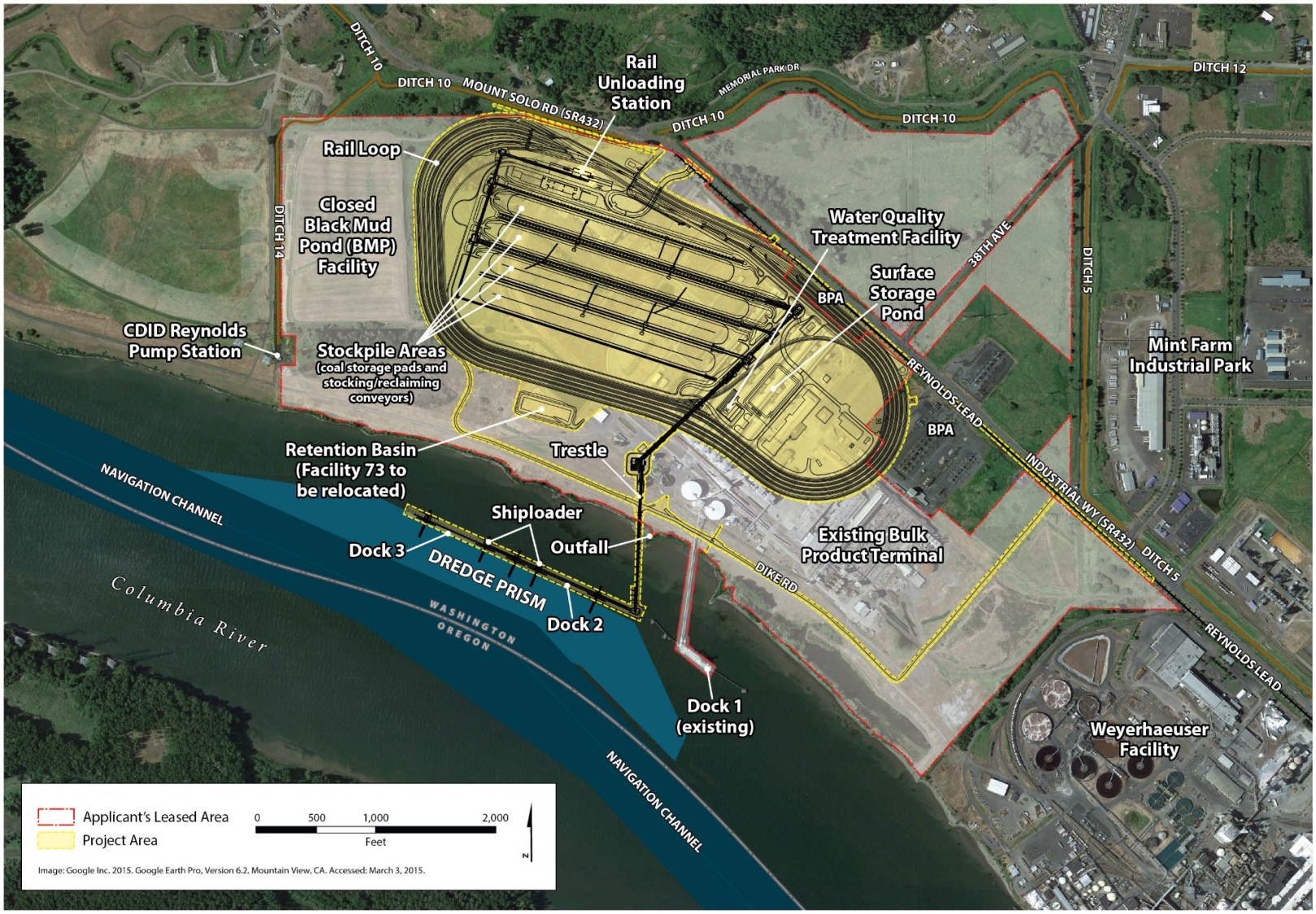


Figure 2. Proposed Action



Under the Proposed Action, BNSF or Union Pacific Railroad (UP) trains would transport coal in rail cars from the BNSF main line at Longview Junction, Washington, to the project area via the BNSF Spur and Reynolds Lead. Coal would be unloaded from rail cars, stockpiled and blended, and loaded by conveyor onto ocean-going ships at two new docks (Docks 2 and 3) on the Columbia River for export.

Once construction is complete, the Proposed Action would have an annual throughput capacity of up to 44 million metric tons.[2] The coal export terminal would consist of one operating rail track, eight rail tracks for the storage of rail cars, rail car unloading facilities, stockpile areas for coal storage, conveyor and reclaiming facilities, two new docks in the Columbia River (Docks 2 and 3), and ship-loading facilities on the two docks. Dredging of the Columbia River would be required to provide access to and from the Columbia River navigation channel and for berthing at the two new docks.

Vehicles would access the project area from Industrial Way (State Route 432). Ships would access the project area via the Columbia River and berth at one of the two new docks. Terminal operations would occur 24 hours per day, 7 days per week. The coal export terminal would be designed for a minimum 30-year period of operation.

1.1.2 No-Action Alternative

Under the No-Action Alternative, the proposed export terminal would not be constructed. Current operations of the bulk product terminal, which include the storage and transport of alumina and up to 150,000 metric tons per year of coal. Importing of alumina would continue and increase in the project area using Dock 1. The Applicant could expand the existing bulk product terminal onto the 190-acre project area, developing storage and shipment facilities to bulk product terminal operations. Coal and alumina would continue to be stored, transferred, and shipped. Additional bulk product transfers activities involving products such as calcine pet coke, coal tar pitch, cement, fly ash, and sand or gravel could also be pursued, and new or revised permits could be required. These operations would involve storage and upland transfer of bulk products, which would use existing or new buildings. Construction of new buildings could involve demolition and replacement of existing buildings and new or modified permits. Any new construction would be limited to uses allowed under existing Cowlitz County development regulations and federal and state permits.

1.2 Regulatory Setting

The jurisdictional authorities and corresponding regulations, statutes, and guidance for determining potential impacts on rail transportation are summarized in Table 1.

[2] A metric ton is the U.S. equivalent to a tonne per the International System of Units, or 1,000 kilograms or approximately 2,204.6 pounds.

Table 1. Regulations, Statutes, and Guidelines for Rail Transportation

Regulation, Statute, Guideline	Description
Federal	
National Environmental Policy Act (42 USC 4321 *et seq*.)	Requires the consideration of potential environmental effects. NEPA implementation procedures are set forth in the President's Council on Environmental Quality's Regulations for Implementing NEPA (49 CFR 1105).
Federal Railroad Safety Act of 1970	Gives FRA rulemaking authority over all areas of rail line safety. FRA has designated that state and local law enforcement agencies have jurisdiction over most aspects of highway/rail grade crossings, including warning devices and traffic law enforcement.
Highway Safety Act and the Federal Railroad Safety Act	Gives FHWA and FRA regulatory jurisdiction over safety at federal highway/rail grade crossings. USDOT has promulgated rules addressing grade-crossing safety and provides funding for installation and improvement of warning devices. FRA has issued rules that impose minimum maintenance, inspection, and testing standards for at-grade crossing warning devices for highway/rail grade crossings on federal highways and state and local roads (49 CFR Parts 234–236).
Federal Railroad Administration general regulations (49 CFR Parts 200–299)	Regulates safety, including operations, engineers, and crew (e.g., control of alcohol and drug use), track, signaling, and rolling stock (e.g., locomotives and passenger and freight cars) for common carrier rail lines that are part of the general rail line system of transportation.
ICC Termination Act of 1995 (49 USC 101)	Establishes the Surface Transportation Board and upholds the common carrier obligations of railroads; requires railroads to provide service upon reasonable request.
State	
Washington State Environmental Policy Act (197-11 WAC, RCW 43.21C)	Requires state and local agencies in Washington State to identify potential environmental impacts that could result from governmental decisions.
Washington Utilities and Transportation Commission	Inspects and issues violations for hazardous materials, tracks, signal and train control, and rail operations. WUTC regulates the construction, closure, or modification of public railroad crossings. In addition, WUTC inspects and issues defect notices if a crossing does not meet minimum standards. However, WUTC has no jurisdiction over public crossings in first-class cities.[a]
WSDOT Local Agency Guidelines M 36-63.28, June 2015, Chapter 32, Railroad/Highway Crossing Program	Focuses on adding protection that improves safety and efficiency of railroad/highway crossings. Provides a process for investigating alternatives for improving grade-crossing safety, such as closure, consolidation, and installation of warning devices.
WSDOT Design Manual M 22.01.10, November 2015, Chapter 1350, Railroad Grade Crossings	Provides specific guidance for the design of at-grade railroad crossings.

Regulation, Statute, Guideline	Description
Rail Companies—Operation (480-62 WAC)	Establishes operating procedures for railroad companies operating in Washington State. Includes general and procedural rules, safety rules, reporting requirement rules, and the establishment and distribution of a grade-crossing protective fund.
Local	
Cowlitz County SEPA Regulations (CCC 19.11)	Provides for the implementation of SEPA in Cowlitz County.

Notes:

[a] Per RCW 35.01.01, a first-class city is a city with a population of 10,000 or more at the time of organization or reorganization that has adopted a charter.

USC = United States Code; NEPA = National Environmental Policy Act; CFR = Code of Federal Regulations; FRA = Federal Railroad Administration; FHWA = Federal Highway Administration; USDOT = U.S. Department of Transportation; WAC = Washington Administrative Code; RCW = Revised Code of Washington; WUTC = Washington Utilities and Transportation Commission; WSDOT = Washington State Department of Transportation; SEPA = Washington State Environmental Policy Act; CCC = Cowlitz County Code

1.3 Study Area

The study area for direct impacts on rail transportation is the project area for the Proposed Action. The study area for indirect impacts on rail transportation includes the rail routes expected to be used by Proposed Action-related trains between the project area and the Powder River Basin and Uinta Basin.

Indirect impacts focuses on the Reynolds Lead and BNSF Spur and the BNSF main line in Cowlitz County. A qualitative assessment along the BNSF main line in Washington State and to and from the Powder River Basin and Uinta Basin is also presented.

Chapter 2
Existing Conditions

This chapter describes the methods for identifying existing conditions and determining impacts, and the existing conditions in the study area as they pertain to rail transportation.

2.1 Methods

This section describes the sources of information and methods used to characterize the affected environment and assess the potential impacts of the Proposed Action and No-Action Alternative on rail transportation.

2.1.1 Data Sources

The following sources of information were used to define the existing conditions relevant to rail transportation and identify the potential impacts of the Proposed Action and No-Action Alternative on rail transportation in the study areas.

2.1.1.1 Rail Segment Capacity

Estimates of rail segment capacity for the Reynolds Lead and BNSF Spur were based on the methods developed for the Association of American Railroads (Cambridge Systematics 2007). The *Washington State Rail Plan* (Washington State Department of Transportation 2014a) was used to estimate rail segment capacity on BNSF main line routes in Washington State.

2.1.1.2 Existing, Projected, and No-Action Alternative Rail Traffic

Existing and projected rail traffic for the Reynolds Lead and BNSF Spur were based on information from LVSW as operator of the Reynolds Lead and BNSF Spur and field observations. Existing and projected rail traffic for routes within Washington State was based on the *Washington State Rail Plan* (Washington State Department of Transportation 2014a). The Applicant provided estimates of rail traffic under the No-Action Alternative (approximately 2 additional trains per day in 2028).

2.1.1.3 Rail Operations

The following information sources were used for Proposed Action-related rail operations.

- **Volumes.** Proposed Action-related rail traffic to the project area at full operations would include 8 loaded trains per day and 8 empty trains per day.

  The types and number of trains from Longview Junction to the project area for 2015 and 2028 were developed from meetings with LVSW and the Port of Longview. The types and number of baseline train traffic beyond Longview Junction on main line routes were developed from the *Washington State Rail Plan* (Washington State Department of Transportation 2014a) using linear extrapolation of 2010 and 2035 projected train traffic to 2015 and 2028.

- **Routes.** Representative coal mines were selected to identify rail routes outside of Washington State. Routes to and from the project area within Washington State were based on existing BNSF and UP operational practices and Washington State Department of Transportation (WSDOT) documents including the *Washington State Rail Plan* (Washington State Department of Transportation 2014a) and *Washington State Freight Mobility Plan* (Washington State Department of Transportation 2014b).
- **Train parameters.** Train parameters including the number of rail cars per unit train (125 rail cars for each train) and locomotives were based on information provided by the Applicant, input from BNSF, and existing BNSF coal train operations (BNSF Railway Company 2016).
- **Reynolds Lead, BNSF Spur, and project area operations**. Operations of the Reynolds Lead, BNSF Spur, and the project area was based on information provided by LVSW and the Applicant.

2.1.2 Impact Analysis

The following methods and assumptions were used to evaluate the potential impacts of the Proposed Action and No-Action Alternative on rail transportation.

No rail construction outside of the project area is proposed by the Applicant. However, LVSW plans to upgrade the Reynolds Lead and part of the BNSF Spur as a separate action should it be warranted by increased rail traffic resulting from existing and future customers. Upgrades to the track would include adding ballast, replacing ties, and upgrading rail. These improvements would provide for safer operations and increased speed over the BNSF Spur and Reynolds Lead. LVSW would also install signals and upgrade the traffic control system to Centralized Traffic Control (CTC) and add an electric remotely operated switch from the BNSF Spur to the Reynolds Lead. The signaling would add capacity to the line, allowing trains to be spaced closer together and the electronic switch would eliminate the need for loaded and empty trains to stop while a train crew member operates the switch (Wolter pers. comm.). Construction of these improvements would take approximately 6 months. Because these improvements are not certain, the impact analysis analyzes infrastructure with and without these planned improvements.

For the purposes of this analysis, potential operations impacts are based on the Applicant's planned throughput capacity (up to 44 million metric tons per year).

- **Train speed and travel time from Longview Junction to project area.** The operating plan (Appendix A, *Coal Train Operating Plans*) assumes that the maximum speed over the Reynolds Lead could increase from 10 miles per hour (mph) to up to 25 mph if track improvements are made by LVSW, which would reduce the train travel time from Longview Junction to the project area from approximately 49 minutes to approximately 32 minutes. For purposes of this analysis, it is assumed that Proposed Action-related trains would reach a maximum speed of 20 mph if the planned improvements were made, with an average speed of approximately 11 mph.

  However, also included is an analysis of train speeds and transit time over each road crossing assuming the planned improvements are not made. Trains would accelerate or decelerate at various points along the route approaching switches. Estimates of the train speeds at various points on the route were used to estimate the time that trains would transit each road crossing. The analysis assumes that none of the improvements would be made to the road crossings as

proposed in WSDOT's *State Route 432 Rail Realignment and Highway Improvements Project* (Parsons Brinckerhoff 2014).

- **Proposed Action-related train parameters.** The number of cars per train and number of locomotives are based on information provided by the Applicant. The coal car type, tare weight,[3] length, and capacity are based on a typical aluminum rotary coal gondola. The parameters of Proposed Action-related trains that would service the project area are summarized in Table 2. For purposes of this analysis, all Proposed Action-related trains are assumed to have the characteristics shown in Table 2.

  According to the Applicant, rail operations would support coal export terminal throughput of 40 million metric tons per year. The Proposed Action is based on a throughput of up to 44 million metric tons per year. The Applicant assumes a 10% increase in throughput (4 million metric tons per year) from rail car capacity that can be achieved through industry process and technological improvements by 2028.

Table 2. Proposed Action-Related Train Parameters

Rail Cars	
Type	Alum Rotary Gondola
Gross rail load (tons)	143
Tare weight (tons)	20.9
Lading per car (tons)	122.1
Coupled Length (feet)	53
Locomotives	
Type	4400 HP AC
Weight (tons)	216
Length (feet)	73
Number in train[a]	3
Configuration[b]	2-0-1
Total Train	
Cars per train[b]	125
Total lading weight (tons)	15,263
Total tare weight of cars (tons)	2,613
Weight locomotives (tons)	648
Total train weight (tons)	18,524
Total train length (feet)	6,844

[a] Three locomotives and 125 cars are consistent with current BNSF operations (URS Corporation 2014).

[b] Locomotives are distributed through trains (distributed power) in various configurations. Proposed Action-related trains would likely have two locomotives at the head and one at the rear of the train (Wolter pers.comm. verified by field observations December 4, 2014).

- **Rail line capacity.** The capacity of a rail line is generally determined by the number of main tracks, type of traffic control system, and types of trains moving over the segment. The assumptions for the contribution of each of these factors and the basis for assumptions are described in Section 2.1.3, *Rail Segment Capacity.*

[3] Weight of the empty railcar.

- **Longview Junction to project area.** The track segment from Longview Junction to the project area is currently not signaled. Permission to occupy this track is controlled by the LVSW yardmaster. Along with upgrading the track to enable 25 mph speeds, LVSW plans to upgrade the signal system to CTC, which would increase the capacity of this portion of the route from approximately 16 to 30 trains per day.
- **Beyond Longview Junction.** Beyond Longview Junction, the number of main tracks and traffic control systems were developed from the *Washington State Rail Plan* (Washington State Department of Transportation 2014a).

- **Routes.** The BNSF route for loaded Proposed Action-related trains from the Powder River Basin would run through Montana and Sandpoint, Idaho to Spokane and Pasco, Washington, and is expected to travel along the Columbia River Gorge to Vancouver, Washington, then north to Longview. Empty trains are expected to travel north from Longview Junction to Auburn and over Stampede Pass to Pasco. The UP route for Proposed Action-related trains originating in the Uinta Basin or Powder River Basin would run through Oregon to the North Portland Junction. From there, Proposed Action-related UP trains would cross into Washington at Vancouver and run over the BNSF Seattle Subdivision to the project area. This same track would be used by Proposed Action-related BNSF trains going to the project area. Alternative routes and additional information on Proposed Action-related train routes is provided in Section 2.1.4, *Train Routes*.
- **Baseline rail traffic.** The types and number of trains from Longview Junction to the project area for existing year and 2028 were developed from meetings with LVSW and the Port of Longview. The types and number of baseline train traffic beyond Longview Junction were developed from the *Washington State Rail Plan* (Washington State Department of Transportation 2014a) using linear extrapolation of 2010 and 2035 train traffic projected to 2015 and 2028.
- **Rail traffic.** The Applicant estimates that, at full capacity, operation of the Proposed Action would move up to 44 million metric ton of coal per year, requiring the receipt and return of 8 Proposed Action-related trains per day, or 16 daily trains. Train parameters are outlined in Table 2.

2.1.3 Rail Segment Capacity

Capacity estimates for BNSF and UP rail segments were obtained from the *Washington State Rail Plan* (Washington State Department of Transportation 2014a, Technical Note 4a). As described in Technical Note 4a of the *Washington State Rail Plan*, this approach involves estimating maximum practical capacity in number of trains per day, determined by signal type, number of tracks, and geometric limitations. Practical capacity provides a reasonable figure for real-world train capacity rather than operational capacity, which only considers the number of trains per day that could run over a route.

Capacities for each of the LVSW rail segments were estimated using the methods developed for the Association of American Railroads (Cambridge Systematics 2007:4–5). This is the same method used in the *Washington State Rail Plan*. Capacity estimates provided throughout this report are practical capacities as presented in or consistent with the capacity estimates presented in the *Washington State Rail Plan.*

2.1.3.1 Main Tracks and Sidings

Most of the route segments in this analysis have one main track with multiple sidings for trains to meet or pass, but there are several segments with two or three main tracks.

2.1.3.2 Traffic Control Systems

Traffic control systems help maintain a safe distance between trains passing or meeting on the same track. There are three basic types of systems.

- **Automatic Block Signals (ABS).** ABS is an electronic signal system that can control when a train can advance into the next block. A block is a section of track with signals at each end. Only 1 train can occupy a block at one time at normal speed. Trains may enter a block occupied by another train in the same direction, but must be prepared to stop within half the range of vision. The signals provide information to the train crew about some speed restrictions and they provide information about the occupancy of the blocks ahead.
- **Traffic Warrant Control (TWC).** Under this basic control system, train crews obtain authority to occupy and move on a main track from the dispatcher in the form of a completed track warrant form. Usually the track warrant information is transmitted to the train crew by phone, radio, or electronic transmission to the locomotive. It is the least costly system and is generally used on the low-density track where capacity is generally not an issue. Track warrant authority may be used in combination with ABS or on track that has no block signals.
- **Centralized Traffic Control (CTC) and Traffic Control Systems (TCS)**. With CTC, electrical circuits monitor the location of trains, allowing dispatchers to control train movements from a remote location, usually a central dispatching office. The signal system prevents trains from being authorized to enter sections of track occupied by other trains moving in the opposite direction. The dispatcher controls traffic by controlling the signals. If the signal is at stop, the approaching train is not authorized to proceed. If the signal is not at stop, the train is authorized to continue to the next controlled signal.

In 2008, Congress passed the Rail Safety Improvement Act of 2008, which requires all passenger railroads and Class I freight railroads to install Positive Train Control (PTC) on all lines that carry passengers or toxic-by-inhalation commodities.[4] PTC automatically stops a train if the engineer does not respond properly to a signal indication. PTC is designed to reduce the number of train accidents caused by human error. While future generations of PTC may help railroads increase capacity on individual corridors, the PTC technology currently being installed on U.S. railroads is not expected to have a meaningful impact on corridor capacity (Association of American Railroads 2014).

Table 3 summarizes estimated capacity based on the number of main tracks and traffic control systems.

[4] Toxic-by-inhalation commodities are gases or liquids such as chlorine or anhydrous ammonia that are especially hazardous when released into the atmosphere.

Table 3. Average Capacities of Typical Rail Freight Corridors (trains per day)

Number of Tracks	Type of Control	Practical Maximum if Multiple Train Types use Corridor[a]
1	N/S or TWC	16
1	ABS	18
2	N/S or TWC	28
1	CTC or TCS	30
2	ABS	53
2	CTC or TCS	75
3	CTC or TCS	133
4	CTC or TCS	173
5	CTC or TCS	248
6	CTC or TCS	360

Notes:
[a] For example, a mix of merchandise, intermodal, and passenger trains.
Source: Cambridge Systematics 2007: 4–7
N/S = No Signal; TWC = Track Warrant Control; ABS = Automatic Block Signaling; CTC = Centralized Traffic Control; TCS = Traffic Control System

2.1.3.3 Train Types and Operations

Different train types such as passenger, intermodal, automotive, coal unit, and general manifest trains operate at different speeds. Trains operating at different speeds require a larger separation than trains of the same type operating on the same segment. For the purpose of this analysis, multiple train types were assumed. Capacity on a single-track segment can also be increased by running trains in only one direction over that segment. Two single-track routes can be combined to function essentially as double track. This strategy, known is directional running is described in Section 2.1.4, *Train Routes*.

2.1.4 Train Routes

The routes from the selected representative mines to the project area were assumed to be the same as current BNSF and UP routes and as documented in WSDOT publications, including the *Washington State Rail Plan* (Washington State Department of Transportation 2014a) and *Washington State Freight Mobility Plan* (Washington State Department of Transportation 2014b).

In 2012, BNSF changed its train operations protocol to enhance use of existing capacity using directional running. This strategy routes all westbound loaded unit trains[5] (including coal) from Pasco via the Columbia River Gorge to Vancouver, where it continues on the BNSF north-south main line to its final destination. Empty unit bulk trains from north of Vancouver, including Cowlitz County, return to Pasco and to points east via Stampede Pass.

[5] A unit train is a train in which all cars carry the same commodity and are shipped from the same origin to the same destination. Unlike unit trains, manifest trains are composed of rail cars with different commodities originating in different locations and delivered to different locations.

However, each railroad company has alternative routes. As volume increases on any one-line segment, each railroad company may revise its operations to distribute traffic over existing infrastructure. Railroad companies may also expand their infrastructure, which occurs on an ongoing basis based on demand. Figure 3 displays the routes used for this analysis.

Loaded and empty BNSF trains would travel on the same route from the Powder River Basin to Pasco, Washington.[6] West of Pasco, westbound loaded trains would be expected to move to the project area on the Columbia River Gorge route through Vancouver to Longview Junction, Washington. Empty trains would be expected to move from Longview Junction on the BNSF Stampede Pass route through Auburn and Yakima to Pasco, Washington.

The UP route is largely outside of Washington State. Proposed Action-related trains would move from the Uinta Basin and Powder River Basin through Pocatello, Idaho; Boise, Idaho; and Hinkle, Oregon. From Hinkle, the route parallels the Columbia River on the Oregon side to Portland, Oregon. Between Portland, Oregon, and Longview Junction, Washington, UP operates over the same track that carries BNSF trains. Empty UP Proposed Action-related trains would return to the Uinta Basin or Powder River Basin via the same route.

Between Longview Junction and the project area, both BNSF and UP Proposed Action-related trains would move over the LVSW rail line (Reynolds Lead and BNSF Spur).

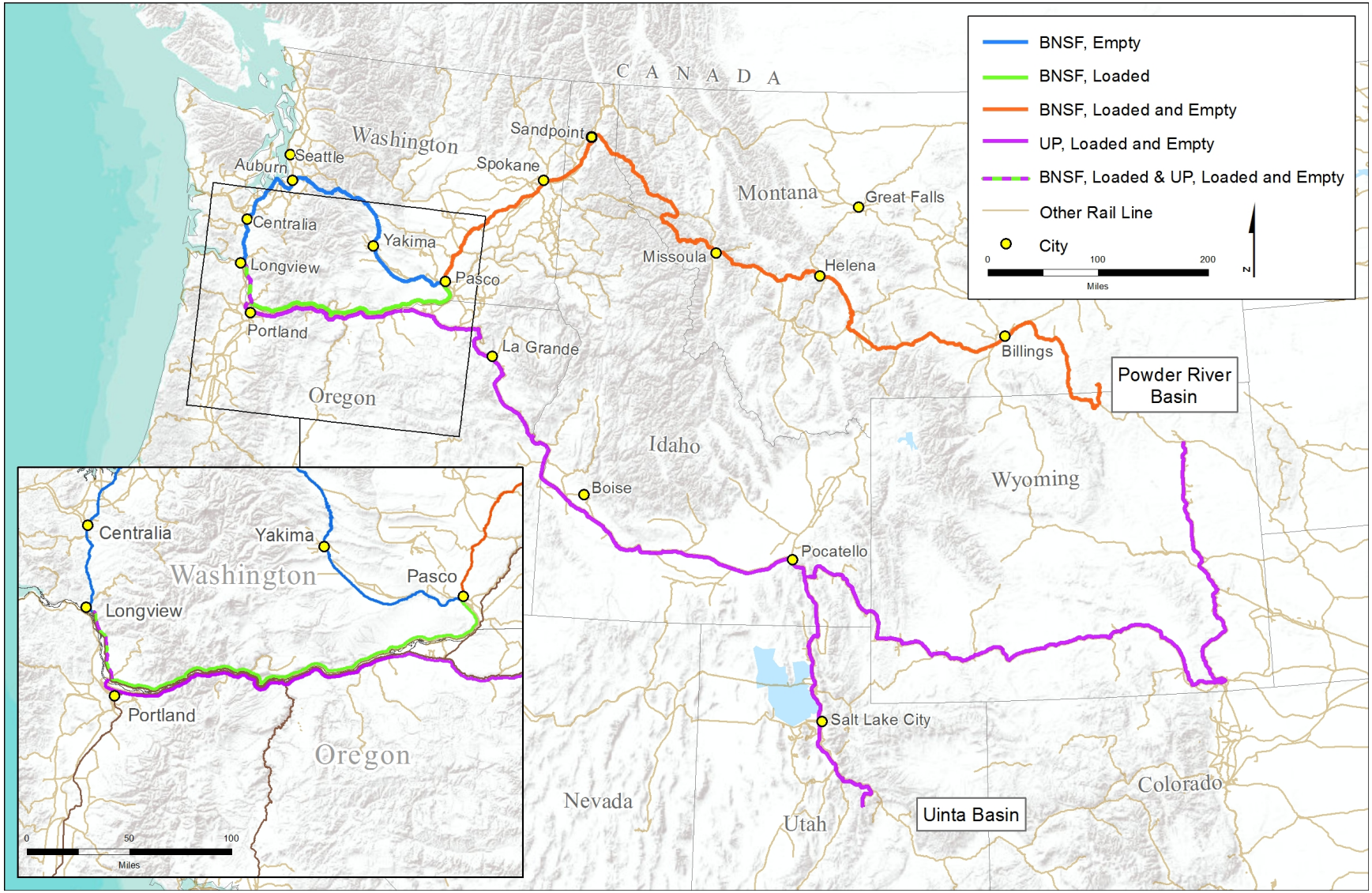
2.1.4.1 Train Origins

Two types of coal could be exported from the coal export terminal.

- Subbituminous coal (approximately 8,800 to 9,200 British thermal units [Btu] per pound), originating in the Powder River Basin in Montana or Wyoming.
- Bituminous coal (approximately 11,700 Btu per pound), originating in the Uinta Basin in Utah or Colorado.

[6] In late 2014, the BNSF constructed and began operation of a respray facility along their main line in Pasco, Washington. Before coal trains continue their route west along the Columbia River Gorge, BNSF resprays the coal rail cars with a surfactant to ensure coal dust release is further mitigated.

Figure 3. BNSF and Union Pacific Routes to and from Longview, Washington



For purposes of this analysis, an example mine was used from each of these origin areas (Table 4) to estimate rail miles and routes. Rail routes would be similar for other mines from these regions to the coal export terminal. Given market economics, most of the coal that would be exported would be expected to come from Powder River Basin mines in Montana and Wyoming and would move via the BNSF routes.

Table 4. Representative Mine Origins Selected for Analysis

Coal Supply Region	Representative Mine	Rail Station	Railroad
Powder River Basin	Spring Creek Mine	Spring Creek Mine, Montana	BNSF
Utah	Skyline Mine	Skyline, Utah	UP

Notes:
BNSF = BNSF Railway Company; UP = Union Pacific Railroad

2.2 Existing Conditions

The existing environmental conditions related to rail transportation in the study area are described below.

As described in Section 1.1.1, *Proposed Action,* the project area is located on 190 acres primarily within a 540-acre existing industrial site near Longview, Washington. The project area is located on the Reynolds Lead, an existing rail line that serves several industries and connects via the BNSF Spur to the rail network approximately 6 miles away in Longview Junction. The track and rail infrastructure leading to the project area are described as follows.

- The BNSF Spur consists of a track through Longview Junction yard, across the Cowlitz River Bridge,[7] and through the LVSW yard. Figure 1 illustrates the BNSF Spur.
- The Reynolds Lead consists of a track from the LVSW yard to the project area. The Reynolds Lead covers the majority of the distance between the project area and the BNSF main line. Figure 1 illustrates the Reynolds Lead.

The route has a single main track with TWC (no signals). Two sidings on the Reynolds Lead are currently used to interchange cars with the Columbia and Cowlitz Railway (CLC).[8] Speed limit on the line is 10 mph. At an average speed of 9 mph (allowing for slowing and accelerating at various locations), train travel time from Longview Junction to the project area under current conditions would be approximately 49 minutes.

[7] The Cowlitz Bridge is a manually operated drawbridge controlled by LVSW. The bridge only opens once every 4 or 5 years to allow passage of river-dredging vessels.
[8] CLC is owned by Patriot Rail. It primarily provides switching service inside the Weyerhaeuser plant and serves a few industries. All cars to or from CLC are handled by LVSW for interchange to BNSF and UP. CLC interchanges with LVSW at two sidings on the Reynolds Lead near the LVSW yard.

2.2.1 BNSF Spur and Reynolds Lead

Table 5 summarizes current baseline traffic data for the BNSF Spur and Reynolds Lead to and from the Port of Longview or other industrial customers. The table also includes the estimated train size and average passing time over a road crossing for those trains. Finally, the table includes a weighted average of baseline trains per day passing each road crossing. The train counts include both loaded and empty trains.[9] For purposes of describing baseline traffic, the LVSW rail line is divided into two parts, the BNSF Spur and the Reynolds Lead, as shown in Figure 4.

Between Longview Junction and the project area there are five public at-grade road crossings (Figure 4). These road crossings experience rail traffic from current train operations to and from the Port of Longview and/or from industrial switching activities at locations along the Reynolds Lead. Each Proposed Action-related train, loaded and empty, would also cross roads at these locations. This section analyzes the train volume and train crossing times at each of these road crossings. The analysis assumes no improvements would be made to the crossings.

BNSF Spur

The BNSF Spur runs from the BNSF Seattle Subdivision mainline switch, across the Cowlitz River Bridge, to the LVSW yard. Baseline traffic on the BNSF Spur is about 7 trains (or switch movements) per day. The Port Industrial Rail Corridor connects with the BNSF Spur just east of the LVSW yard. Trains to or from the EGT, LLC and other Port of Longview facilities leave or enter the BNSF Spur at the Industrial Rail Corridor switch. Other trains originate or terminate in the LVSW yard. Dike Road is the only at-grade road crossing on the BNSF Spur. All 7 trains per day (on average) on the BNSF Spur cross Dike Road.

The switch from the BNSF Spur to the Port Industrial Rail Corridor is a remotely controlled switch operated by the BNSF dispatcher. The speed limit through this area is 10 mph because of speed restrictions on the bridge. There is one main track, and traffic control is TWC. Capacity through this area currently is about 16 trains per day, which supports the current volume.

[9] Train count and train size estimates include both loaded and empty cars based LVSW (pers. comm.) and Port of Longview (pers. comm.). These estimates are similar to those reported in Parsons Brinckerhoff (2014:8-9), which shows 450 loaded cars per day.

Table 5. Baseline Rail Traffic on the BNSF Spur and Reynolds Lead

	Trains/ Day	Days/ Week	Trains/ Year	Cars/ Train	Locomotives/ Train	Train Length (Feet)[d]	Estimated Passing Time (Minutes)[e]	Weighted Average Trains per Day over Road Crossings				
								BNSF Spur crossing of Dike Road	Reynolds Lead crossing of 3rd Avenue (SR 432)	Reynolds Lead crossing of California Way	Reynolds Lead crossing of Oregon Way	Reynolds Lead crossing of Industrial Way
CLC trains interchange to/from LVSW rail line[a,b]	2	5	520	15	2	1,065	1.2				1.42	1.42
LVSW rail line interchange to/from CLC[a,b]	2	5	520	15	2	1,093	1.2		1.42	1.42		
Reynolds Lead Industry local crew[a,c]	2	3	312	30	2	2,068	2.4		0.85	0.85	0.85	0.85
Manifest trains from Longview Junction yard to LVSW yard[a,f]	4	5	1,040	30	2	2,068	2.4	2.85				
Grain unit trains to/from EGT[a,g]	4	7	1,456	110	3	6,819	7.7	3.99				
Clay, soda ash and other Port unit trains[a,h]	2	1	104	110	3	6,819	7.7	0.28				
Weighted Average Trains/day								7.12	2.28	2.28	2.28	2.28
Weighted Average Length (feet)								4,919	1,459	1,459	1,441	1,441
Weighted Average Cars/train								78	21	21	21	21

a Source: Wolter pers. comm.

b CLC switch crew from Weyerhaeuser plant delivers and picks up cars to/from interchange sidings just west of California Way. LVSW switch crew from LVSW yard delivers and picks up cars to/from interchange sidings just west of California Way.

c Crew works afternoon shift 5 days/week but serves Reynolds Lead 3 days/week. Cars per train range from 5 to 30 depending on whether train is delivering coal or alumina or to the Port of Longview.

d Car length is average of car types handled (Wolter pers. comm.) and Hellerworx observations, December 3, 2014. Locomotive type based on Hellerworx observations, December 3, 2014.

e Based on 10 mph average speed.

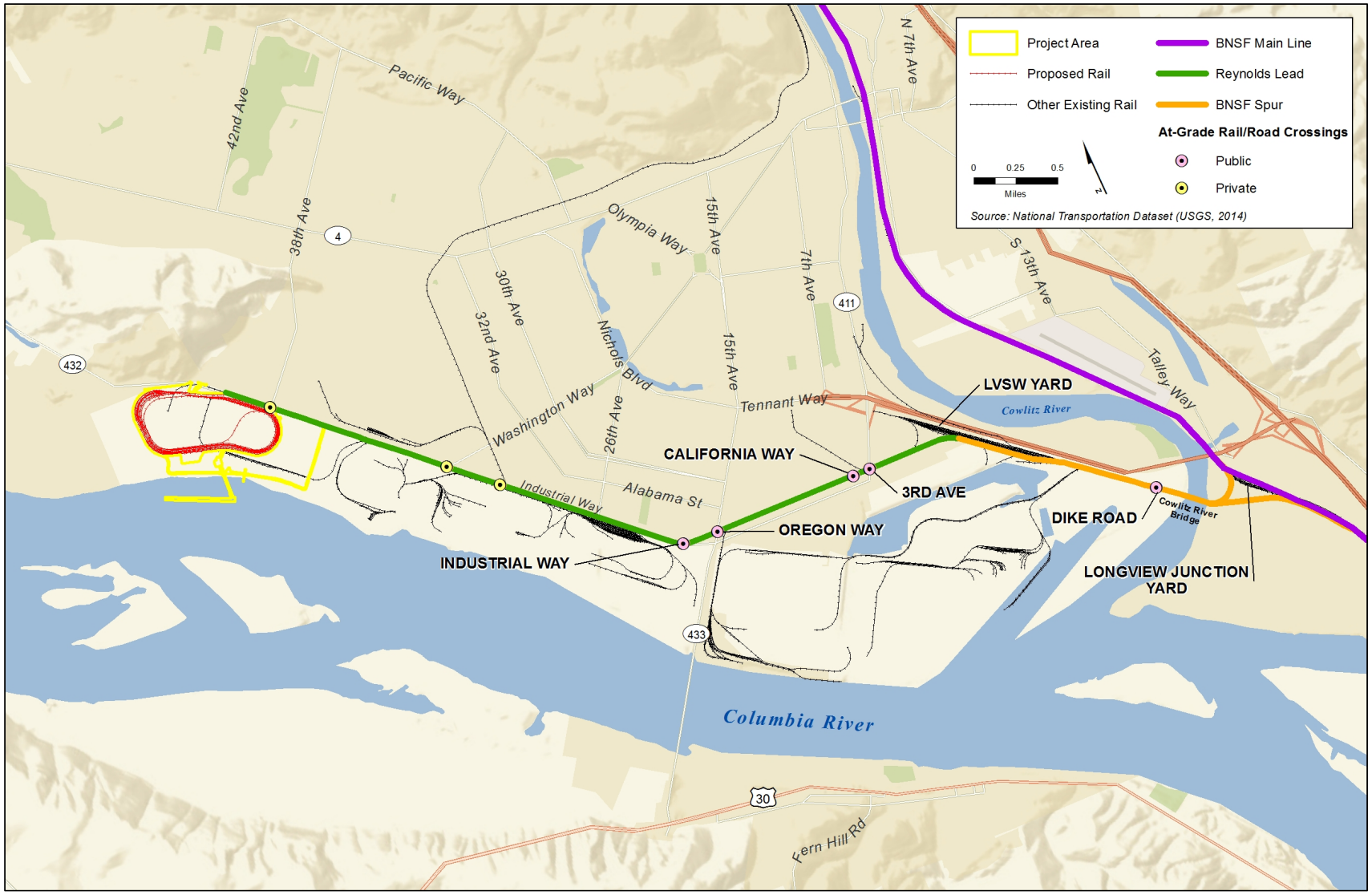
f Manifest movements between Longview Junction yard and LVSW yard across bridge are generally cuts of cars moving as a yard transfer (Wolter pers. comm.). Occasionally LVSW yardmaster will direct BNSF or UP road crew to bring a manifest train off BNSF main line into the LVSW yard instead of switching it in Longview Junction yard because most of the cars on the train are destined to the Port of Longview.

g EGT capacity for 4 trains per day but current volume is 2 (Wolter pers. comm.). Train size is BNSF standard grain unit shuttle train, 110 cars. Number of locomotives on grain unit trains and locomotive configuration (Wolter pers. comm.). Locomotive specs same as projected coal trains 3 GE AC 4400 units; 2 loaded and 2 empty trains per day.

h Miscellaneous Port of Longview unit trains carry the following products: clay,1 train per month; soda ash, 2 or 3 trains per month; a few unit trains per year of potash and urea (Port of Longview pers. comm.) Volume estimates provided by Wolter (pers.comm.), LVSW (pers.comm.), and Port of Longview (pers. comm.). Estimated train length and locomotives provided by Wolter (pers. comm.), LVSW (pers. comm.), and Hellerworx experience. Port of Longview manifest traffic crossing the dike road is included in manifest traffic between the Longview Junction yard and LVSW yard.

CLC = Columbia and Cowlitz Railway; LVSW = Longview Switching Company; mph = miles per hour

Figure 4. BNSF Spur and Reynolds Lead



Reynolds Lead

The Reynolds Lead runs from the west end of the LVSW yard to the project area. There is one main track with TWC traffic control. The current speed limit is 10 mph, and capacity is approximately 16 trains per day. Baseline traffic is just more than 2 trains per day, on average. Trains operating on the Reynolds Lead include an LVSW local crew that places and pulls cars at industrial facilities located along the Reynolds Lead 3 days per week and a local crew that delivers and picks up cars that are interchanged to and from the CLC at two sidings just west of California Way. CLC also operates on the Reynolds Lead between the Weyerhaeuser plant near Industrial Way and these sidings to deliver and pick up interchange cars to or from the LVSW rail line.

The Reynolds Lead ends at the project area. There are four public at-grade road crossings on the Reynolds Lead between the LVSW yard and the project area (Figure 4). Not all of the trains cross each of these roads. The LVSW local crew switching industries on the Reynolds Lead crosses all four roads twice. The LVSW crew that interchanges cars to the CLC on the sidings crosses 3rd Avenue and California Way twice. The CLC crew interchanging cars to the LVSW rail line crosses twice over Oregon Way and Industrial Way on the way to the sidings.

2.2.2 Existing Rail Traffic on the BNSF Infrastructure in Washington State beyond Longview Junction

Within Washington State, Proposed Action-related trains would travel mostly on BNSF track. Table 6 summarizes infrastructure and traffic data for each major segment of the BNSF route in Washington State. These major segments and the rail traffic they support are described below. Figure 5 illustrates 2015 rail traffic and capacity along the major rail segments using the *Washington State Rail Plan* (Washington State Department of Transportation 2014a).[10]

- **Idaho/Washington State Line–Spokane.** This segment covers 18.6 miles and is part of BNSF's Kootenai River Subdivision. It is a double track with CTC. Capacity is approximately 76 trains per day and volume is approximately 70 trains per day. All BNSF trains between the eastern part of BNSF's system and points in Washington State move over this corridor. Train traffic includes intermodal, grain, coal and general manifest trains. Amtrak's Empire Builder passenger service between Chicago, Illinois; Seattle, Washington; and Portland, Oregon also uses this segment.
- **Spokane–Pasco.** This corridor covers 145.5 miles and is part of BNSF's Lakeside Subdivision. This line is mostly single track with CTC. Capacity is approximately 37 trains per day and volume is approximately 39 trains per day. Train traffic on this segment includes intermodal, grain, coal and general manifest trains. The Portland section of Amtrak's Empire Builder passenger service uses this segment. BNSF is currently making upgrades to this segment, including adding a second main line in some areas.

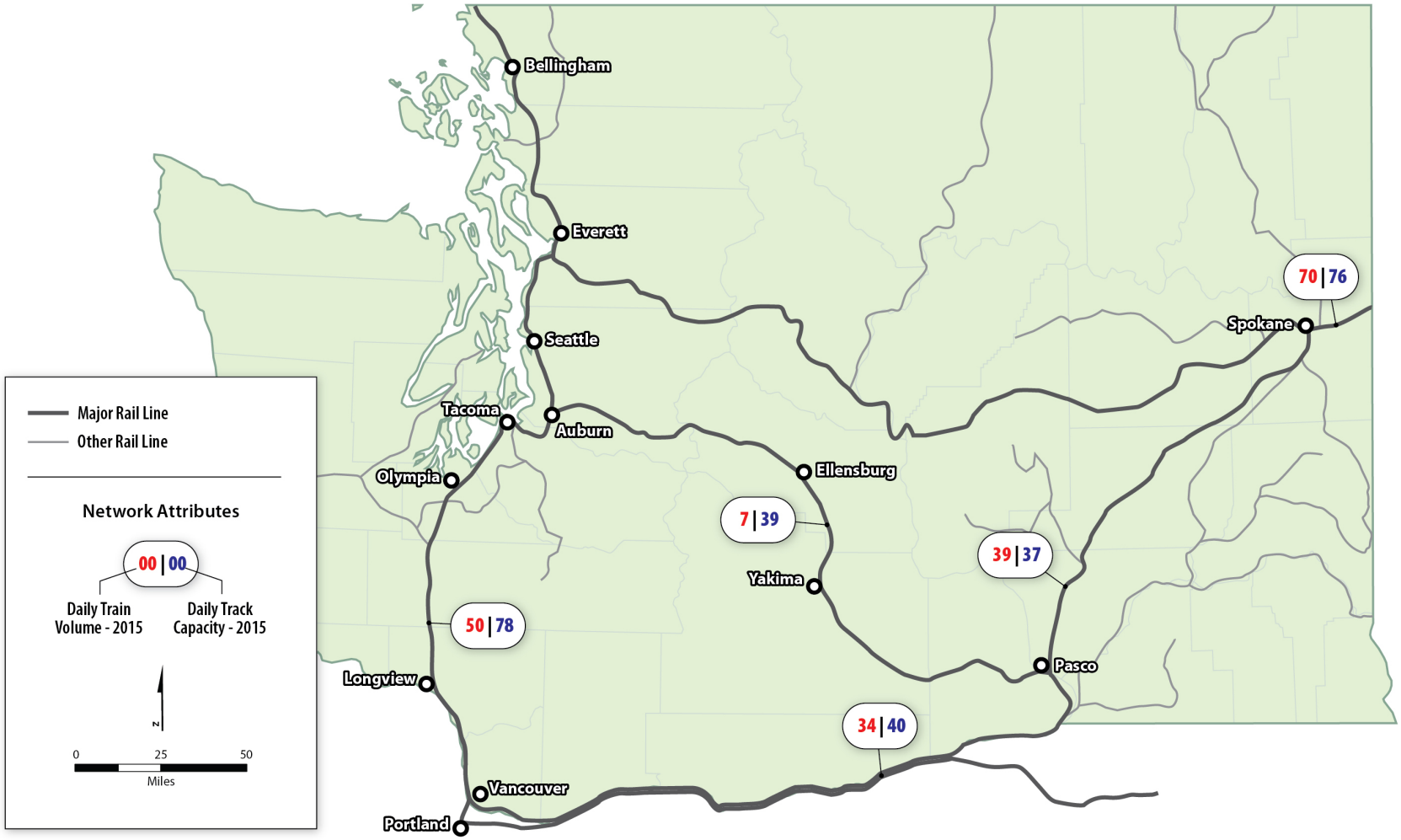
[10] Rail traffic estimates provided in the *Washington State Rail Plan* do not include the rail traffic for proposed coal or crude oil projects in Washington State.

Table 6. Route Infrastructure and Rail Traffic

Route Segment		Railroad	Subdivision	Current Traffic Control System[a]	Current Main Tracks[a]	Current Passenger Train Route	Future Passenger Train Route	Estimated Current Capacity (Trains/day)[b]	Miles[c]	Estimated Baseline (2015) Trains Per Day[d]	Projected 2035 Trains per Day[e]
ID/WA Line	Spokane, WA	BNSF	Spokane	CTC	2	Yes	Yes	76	18.6	70	125
Spokane, WA	Pasco, WA	BNSF	Lakeside	CTC	1	Yes	Yes	37	145.5	39	66
Pasco, WA	Vancouver, WA	BNSF	Fallbridge	CTC	1	Yes	Yes	40	221.4	34	56
Vancouver, WA	Longview Jct., WA	BNSF	Seattle	CTC	2	Yes	Yes	78	34.8	50	85
Longview Jct., WA	LVSW Yard, WA	BNSF	LVSW	TWC	1	No	No	16	2.1	7	N/A
LVSW Yard, WA	Project Area, WA	BNSF	LVSW	TWC	1	No	No	16	5.0	2	N/A
Longview Jct., WA	Auburn, WA	BNSF	Seattle	CTC	2	Yes	Yes	78	118.6	50	85
Auburn, WA	Yakima, WA	BNSF	Stampede	TWC	1	No	No	39	139.6	7	13
Yakima, WA	Pasco, WA	BNSF	Yakima Valley	TWC	1	No	No	39	89.4	7	13

[a] Source: Washington State Department of Transportation 2014b.
[b] Source: Washington State Department of Transportation 2014b. LVSW rai line segments were estimated from Table 5.
[c] Source: Estimated based on GIS measurements.
[d] Source: Washington State Department of Transportation 2014b; Wolter pers. comm.; Port of Longview pers. comm.
[e] Source: Washington State Department of Transportation 2014a.
LVSW = Longview Switching Company; CTC = Centralized Traffic Control; TWC = Traffic Warrant Control; N/A = No projection is available.

Figure 5. Washington Rail Network Daily Track Utilization (2015)



- **Pasco–Vancouver.** This segment covers 221.4 miles and is BNSF's Fallbridge Subdivision, also known as the Columbia River Gorge route. It is mostly single track with CTC. Capacity is approximately 40 trains per day and volume is approximately 34 trains per day. Train traffic on this segment includes intermodal, grain, coal and manifest. The Portland section of Amtrak's Empire Builder passenger service also uses this route. BNSF uses directional operations on this segment, which increases capacity by running westbound loaded unit trains on this segment and eastbound empty unit trains via Stampede Pass.

- **Vancouver–Longview Junction.** This segment covers 34.8 miles of BNSF's Seattle Subdivision. It is double track with CTC. About 21 miles of this segment is in Cowlitz County. Capacity is approximately 78 trains per day and volume is approximately 50 trains per day. This line also carries all UP trains between Portland, Oregon and Tacoma. Traffic includes intermodal, grain, coal and other unit trains along with manifest trains. This section of the BNSF line is also a key route for passenger trains. Amtrak's Coast Starlight trains to and from California and Amtrak Cascades trains between Eugene, Oregon and Seattle use this segment.

  Scheduled to be completed by 2017, WSDOT is constructing 3.7 miles of a third main track on the BNSF Seattle Subdivision main line between Longview Junction and Kelso. The purpose of the third main track is to enable 2 trains to pass while a train is simultaneously moving into or out of the Longview Junction yard (Washington State Department of Transportation 2014c). This would reduce the potential for delays to passenger and freight trains running through the area.

- **Longview Junction–Auburn.** This segment includes 118.6 miles of BNSF's Seattle Subdivision. About 18 miles of this segment are in Cowlitz County. There are two main tracks and traffic control is CTC. Current capacity is approximately 78 trains per day and volume is about 50 trains per day. Traffic on this line includes intermodal, empty coal, and grain trains returning to the east and manifest trains. This segment is also a key section for passenger trains. Amtrak's Coast Starlight trains to/from California and Amtrak Cascades trains use this route as do Sound Transit Sounder commuter trains on the section between Tacoma and Auburn.

- **Auburn–Yakima.** This segment is known as BNSF's Stampede Pass route. The Auburn–Yakima segment covers 139.6 miles and make up BNSF's Stampede Subdivision. The track structure is mostly single track and traffic control is mostly TWC with some segments of CTC. Current capacity is approximately 39 trains per day and volume is approximately 7 trains per day. Traffic volume consists largely of empty coal and grain trains. BNSF uses directional operations on this segment, which increases capacity by running eastbound unit trains on this segment and westbound loaded unit trains via the Columbia River Gorge.

- **Yakima–Pasco.** This segment covers 89.4 miles. It makes up BNSF's Yakima Valley Subdivision. The track structure is mostly single track and traffic control is mostly TWC with some segments of CTC. Current capacity is approximately 39 trains per day and volume is approximately 7 trains per day. Traffic volume consists largely of empty coal and grain trains returning to the east and some manifest trains.

West of Pasco, BNSF uses directional running, which increases capacity by running trains in different directions on different routes. From Pasco, westbound rail traffic moves via BNSF's Fallbridge Subdivision to Vancouver. This route services the Portland, Oregon section of Amtrak's Empire Builder passenger train and unit trains carrying grain, crude oil, and other commodities and general manifest trains. These trains then move north on the Seattle Subdivision. The Seattle

Subdivision handles many Amtrak passenger trains and commuter trains per day in addition to intermodal, grain, and general manifest BNSF and UP trains.

2.2.3 Existing Rail Traffic on the BNSF and UP Infrastructure Outside of Washington State

From Wyoming or Montana Powder River Basin mines, Proposed Action-related trains operating on BNSF rail lines would move west to Huntley, Montana. From Huntley, Montana to Sandpoint, Idaho, BNSF typically operates coal and other trains over Montana Rail Link tracks. This route is mostly single track with CTC traffic control; however, some sections have two main tracks. From Sandpoint, Idaho, trains would move back to BNSF tracks and cross into Washington moving toward Spokane. Capacity is approximately 30 to 75 trains per day, depending upon the specific location and track characteristics, and volume is 25 to 28 trains per day (Federal Railroad Administration 2012).

From Utah and Colorado Uinta Basin mines or Wyoming Powder River Basin mines, Proposed Action-related trains would transit through Pocatello and Boise, Idaho; then along the Oregon side of the Columbia River to the North Portland Junction. There, UP trains would operate on BNSF tracks, crossing the Columbia River to Vancouver and heading north on the BNSF Seattle Subdivision to Longview Junction. This segment has mostly one main track with CTC or ABS. Capacity is approximately 18 to 75 trains per day, depending on the specific location and track characteristics, and volume is 8 to 16 trains per day.

Chapter 3
Impacts and Mitigation

This chapter describes the impacts on rail transportation that would result from construction and operation of Proposed Action and under the No-Action Alternative.

3.1 Impacts

This section describes the impacts on rail transportation that could result from the Proposed Action or No-Action Alternative.

3.1.1 Proposed Action

This section describes the potential impacts that could occur in the study area as a result of construction and operation of the Proposed Action.

At full operation, Proposed Action-related trains would add 8 loaded and 8 empty Proposed Action-related trains per day (16 total trains per day) to the rail lines between the Powder River Basin or the Uinta Basin and the project area.

3.1.1.1 Construction: Direct Impacts

The Reynolds Lead would be modified within the project area to accommodate unit train access to and from the coal export terminal. Because the project area is at the terminus of the Reynolds Lead, this construction would not affect existing rail traffic on the Reynolds Lead. Under the rail scenario, trains transporting construction materials would travel to and from the project area. The unloading and maneuvering of these trains during construction within the project area would not affect the operations of existing rail traffic on the Reynolds Lead.

3.1.1.2 Construction: Indirect Impacts

Construction of the Proposed Action would result in the following indirect impact.

Add Temporary Rail Traffic for Transport of Construction Materials

The Applicant has stated that 2.1 million yards of rock would be needed for construction. This material would be transported to the project area by truck or rail. The Applicant estimates approximately two-thirds of the volume (1.4 million yards) would move during the first year of construction. The Applicant has further stated that moving the rock by rail would require an estimated 350 loaded trains of 100 cars each, equivalent to 700 trains (loaded and empty) over the construction period. During the first year of construction, when two–thirds of the volume would be transported, this would amount to approximately 467 trains or an average of 1.3 trains per day.

The baseline rail traffic from Longview Junction to the LVSW yard is approximately 7 trains per day. Baseline trains consist of approximately 4 grain trains per day (2 loaded and 2 empty) to/from the EGT grain terminal at the Port of Longview, 2 to 3 manifest trains per day from the BNSF main line to the LVSW yard, and an occasional unit train of clay, soda ash, or other trains destined to or from

the Port of Longview. From the LVSW yard to the project area, the baseline volume is approximately 2 trains per day. The current capacity over these segments is approximately 16 trains per day. Transport of rock for construction would not be expected to disrupt current rail traffic.

This construction rail traffic would use BNSF main line routes in Washington State in 2018. Due to the low number of trains per day compared to existing rail traffic volumes and the daily variability of rail traffic volumes, Proposed Action-related construction trains would have a low impact on rail capacity and operations on BNSF main line routes.

3.1.1.3 Operations: Direct Impacts

During operations, 8 loaded trains would travel to the project area daily, and 8 empty trains would travel from the project area daily. These trains would maneuver along the rail loop in the project area. Rail traffic operations within the project area would not affect rail traffic on the Reynolds Lead because rail operations would be limited to the project area.

3.1.1.4 Operations: Indirect Impacts

Operation of the Proposed Action would result in the following indirect impacts. Capital investments by BNSF or UP to increase capacity in Washington State would be made based on the general level of traffic and not specifically related to the projected volume. The timing of any capital investments to increase capacity or operating changes designed to eliminate congestion by rerouting traffic to less-congested routes would depend on the individual railroad priority for capital needs on their systems and the general level of traffic on the lines between their respective origins and the coal export terminal. Capital improvements and/or changes in operations would occur, as warranted by growth in traffic and would likely be implemented over time. This is the typical process used by rail carriers to adjust network capacity to meet changing traffic volumes.

Add Rail Traffic on the BNSF Spur and Reynolds Lead

Operation of the Proposed Action would require moving loaded Proposed Action-related trains from the Longview Junction yard to the project area and the reverse (moving empty trains from the project area to Longview Junction). This movement would add train traffic to existing rail lines. Each Proposed Action-related train is assumed to move empty back to the representative mine, which is typical of unit train coal service. Figure 4 shows the routes. The step-by-step work activities are described in Appendix A, *Coal Train Operating Plans.*

The Applicant has projected shipping tonnage for three phases of operation: Start Up, Stage 1 and Stage 2. Projected average coal volumes per year and per month and the corresponding number of loaded trains per month and per day are shown in Table 7. At full capacity, the coal export terminal would receive an average of 8 loaded trains and return an average of 8 empty Proposed Action-related trains per day (16 trains would operate on the incoming/outgoing rail line).

Table 7. Loaded Train and Volume Forecast

	Start Up	Stage 1	Stage 2
Throughput (metric tons/year)	10,000,000	25,000,000	44,000,000
Average train loaded trains/day	2	5	8

The projected 2028 capacity assumes no railroad investments would be made to increase capacity and no substantial changes in existing operation would occur. Between Longview Junction and the project area there are two route segments: Longview Junction to the LVSW yard (BNSF Spur) and LVSW yard to the project area (Reynolds Lead).

Both of these segments have one main track and TWC. Capacity is approximately 16 trains per day and baseline volume is 7 trains per day on the BNSF Spur and 4 trains per day on the Reynolds Lead. At full terminal operations, Proposed Action-related trains would add 16 trains per day (8 loaded and 8 empty) on each of these segments for a total of 23 on the BNSF Spur and 20 on the Reynolds Lead. Without improvements to increase capacity, neither of these segments would have the capacity to handle all of the projected Proposed Action-related trains and the growth in baseline traffic. Without improvements, LVSW would not be able to accommodate the full growth of the Proposed Action. However, LVSW has indicated it would expand capacity to meet projected volume for the Proposed Action or any other action, and this would be consistent with typical U.S. railroad policy to do so.

As discussed in Sections 2.1.2, *Impact Analysis,* and 2.2, *Existing* Conditions, LVSW has indicated that it would upgrade the traffic control technology on both the BNSF Spur and the Reynolds Lead from TWC to CTC. The upgrade in traffic control technology would increase capacity on both segments from 16 trains per day to approximately 30 trains per day. This improvement would provide sufficient capacity to handle both the Proposed Action-related trains and the projected growth in baseline traffic.

In addition to CTC, LVSW indicated it would upgrade the track on both segments. Upgrades would include, additional ballast, replacing ties, and upgrading rail. These improvements would provide for a safer operation and allow for an increase in maximum speed from 10 mph to 25 mph on the Reynolds Lead. LVSW would also install a remotely operated electric switch from the BNSF Spur to the Reynolds Lead to allow for continuous movement and more consistent operation. The speed limit on the BNSF Spur is largely governed by the speed limit across the Cowlitz River Bridge, which would remain at 10 mph. The electronic switch would eliminate the need for loaded and empty trains to stop while a train crew member operates the switch.

While LVSW has planned for the capital investment, it has not begun work or applied for permits. LVSW would start the permit process and would make these investments once it was reasonably certain that the projected volume would materialize. This approach is consistent with typical railroad capital investment policy. Table 8 provides additional information on anticipated operations over the Reynolds Lead and BNSF Spur, including the expected average time for the Proposed Action-related trains to cross each of the road crossings with the existing track infrastructure and with the planned infrastructure improvements. Table 9 provides information on route capacity for mainline services from Longview Junction to the Powder River Basin.

Table 8. BNSF Spur and Reynolds Lead Operations Detail—Incoming and Outgoing Proposed Action-Related Trains[a]

	West end of Cowlitz River Bridge, crossing of Dike Road	Port of Longview Central Corridor Switch	Reynolds Lead Switch	Reynolds Lead Crossing of 3rd Avenue	Reynolds Lead Crossing of California Way (Loaded/Empty)	CCR Interchange Sidings (Loaded/Empty)	Reynolds Lead Crossing of Oregon Way	Reynolds Lead Crossing of Industrial Way	Project Area Clear of Reynolds Lead
Segment miles	1.50	0.38	0.84	0.56	0.11	0.07	0.80	0.22	2.90
Estimated mph with planned track improvements	10	10	10	15	15/20	18/20	20	20	5
Cumulative miles from BNSF main line switch at Longview Junction	1.50	1.88	2.72	3.28	3.39	3.46	4.26	4.48	7.38
Estimated passing time with planned track improvements (minutes)[a,b]	8	8	8	5	5/4	4	4	4	16
Estimated mph with current track infrastructure[c]	10	10	5	8	8/10	8/10	10	10	5
Estimated passing time with current track infrastructure (minutes)[a,c]	8	8	16	10	10/8	10/8	8	8	16

Notes:

[a] Estimated coal train length, 125 cars, 3 GE AC; 4400 locomotives = 6,844 feet.

[b] Track improvements include upgrading Reynolds Lead to speed limit of 25 mph, new bypass track around LVSW yard, and electronic switches onto Reynolds Lead. Train operation is estimated based on existing operations (Wolter, LVSW pers. comm.) and is consistent with Parsons Brinkerhoff 2014: Appendix B, page 20.

[c] Train operation with current infrastructure is estimate based on existing operations and LVSW pers. comm.

mph = miles per hour; LVSW = Longview Switching Company

Table 9. Infrastructure Capacity and Projected Rail Traffic, Including Proposed Action-Related Trains (trains per day)

Route Segment		Railroad	Subdivision	Current Traffic Control System[a]	Current Main Tracks[a]	Projected 2028 Capacity (trains/day)[b]	Miles[c]	Estimated Baseline 2015 (trains/day)[b,d]	Projected Baseline Trains 2028 (trains/day)[b,d,e]	2028 with Proposed Action (trains/day)	Projected 2028 Capacity Surplus (Deficit)[f]
ID/WA Line	Spokane, WA	BNSF	Spokane	CTC	2	76	18.6	70	106	122	(46)
Spokane, WA	Pasco, WA	BNSF	Lakeside	CTC	1	38	145.5	39	56	72	(34)
Pasco, WA	Vancouver, WA	BNSF	Fallbridge	CTC	1	41	221.4	34	48	56	(15)
Vancouver, WA	Longview Jct., WA	BNSF	Seattle	CTC	2	80	34.8	50	73	81	(1)
Longview Jct., WA	LVSW Yard, WA	BNSF	LVSW	TWC	1	16	2.1	7	7	23	(7)
LVSW Yard, WA	Project Area, WA	BNSF	LVSW	TWC	1	16	5.0	2	4	20	(4)
Longview Jct., WA	Auburn, WA	BNSF	Seattle	CTC	2	80	118.6	50	73	81	(1)
Auburn, WA	Yakima, WA	BNSF	Stampede	TWC	1	39	139.6	7	11	19	20
Yakima, WA	Pasco, WA	BNSF	Yakima Valley	TWC	1	39	89.4	7	11	19	20

Notes:

[a] Source: Washington State Department of Transportation 2014a, Technical Note 2 2-13

[b] Source: Washington State Department of Transportation 2014ba Technical Note 4a: 4-6 except LVSW rail line segments

[c] Source: Estimated based on GIS measurements.

[d] Source: Washington State Department of Transportation 2014ba Wolter pers. comm.; Port of Longview pers. comm.

[e] Source: Washington State Department of Transportation 2014a: 42; Parsons Brinckerhoff 2014: 9

[f] Projected capacity surplus/deficit without infrastructure improvements or changes in operations.

CTC = Centralized Traffic Control; TWC = Traffic Warrant Control

Add Rail Traffic on the BNSF Main Line To and From Longview Junction, Washington within Cowlitz County

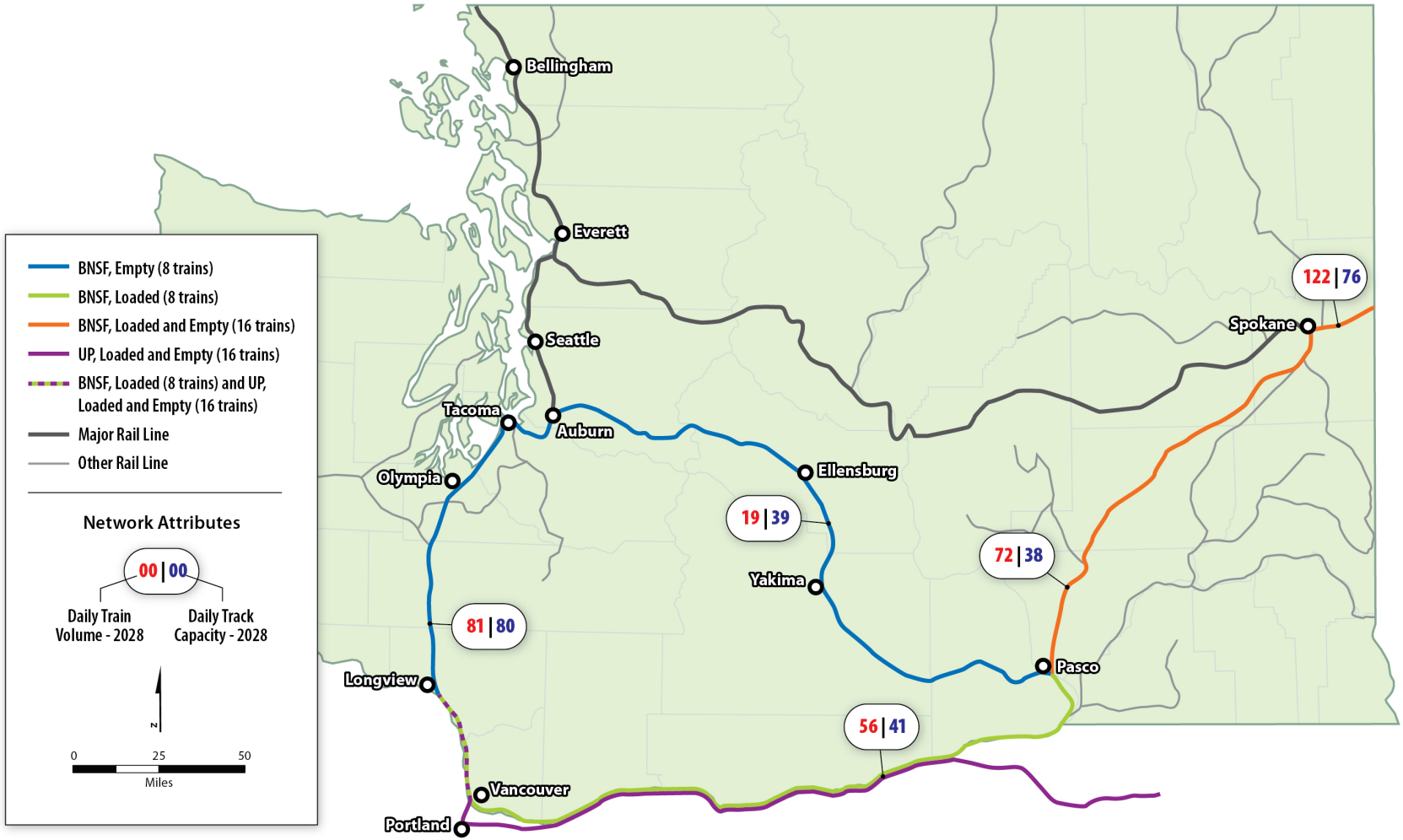
As shown in Table 9, this segment is part of the BNSF Seattle Subdivision and has two main tracks with CTC. As shown in Figure 6, projected 2028 capacity without improvements or operating changes is approximately 80 trains per day. Projected 2028 volume with Proposed Action-related trains is 81 trains per day; therefore, projected volume would about match the capacity. If BNSF handles most of the volume and continues to use its directional running strategy, 8 loaded Proposed Action-related trains per day would use the segment from Vancouver, Washington to Longview Junction, Washington, and 8 empty Proposed Action-related trains per day would use the segment from Longview Junction, Washington to Auburn, Washington. If UP captures most of the volume, then all 16 Proposed Action-related trains (8 loaded and 8 empty) would use the segment from Vancouver, Washington to Longview, Washington, increasing volume beyond current capacity. Impacts of exceeding the capacity would include congestion and delays to both passenger and freight trains. It is unlikely that this volume increase would happen without BNSF making the necessary investments or operating changes to accommodate the growth.

Add Rail Traffic to Existing BNSF Rail Infrastructure in Washington State beyond Cowlitz County

The Proposed Action would add rail traffic to the BNSF main lines in Washington State, affecting capacity on all segments, as summarized in Table 9. The projected rail traffic assumes that directional running continues on the Columbia River Gorge route (primarily westbound trains) and Stampede Pass route (primarily eastbound trains) (Washington State Department of Transportation 2014a). The projected increase in rail traffic relative to capacity are described for segments in Washington State and beyond Cowlitz County below.

- **Idaho/Washington State Line–Spokane**. All Proposed Action-related trains to and from the Powder River Basin on BNSF would move over this segment. This segment has two main tracks with CTC. Projected 2028 capacity without improvements is 76 trains per day. The projected rail traffic in 2028 with Proposed Action-related trains would be 122 trains per day. Without improvements or operating changes, the projected volume on this segment would exceed the existing capacity of 76 trains per day. Proposed Action-related trains would contribute to congestion or delays on this segment, or the inability of BNSF to handle all of the volume. The capacity concerns for this segment extend beyond Washington State to Sandpoint, Idaho. This potential constraint is identified in the *Washington State Rail Plan* (Washington State Department of Transportation 2014ba Technical Note 4:4–8) as a key potential chokepoint.

Figure 6. Projected Washington Rail Network Daily Track Utilization, 2028 Baseline Conditions with Proposed Action-Related Trains



- **Spokane–Pasco**. All Proposed Action-related trains to and from the Powder River Basin on BNSF would move over this segment under current BNSF operations. At Spokane, BNSF's Stevens Pass route to Seattle, Washington via Wenatchee, Washington splits off. All BNSF trains moving from Spokane to the west via the Columbia River Gorge route or Stampede Pass route move over this segment from Spokane to Pasco. This segment has one main track and CTC. Projected 2028 capacity without improvements or operating changes is 38 trains per day. Projected 2028 volume with Proposed Action-related trains is 72 trains per day. Without improvements or operating changes, this segment would also exceed capacity and Proposed Action-related trains would contribute congestion or delays on this segment, or an inability of BNSF to handle all of the volume. This potential constraint is identified in the *Washington State Rail Plan* (Washington State Department of Transportation 2014a, Technical Note 4:4–8) as a key potential chokepoint.
- **Pasco–Vancouver**. Loaded Proposed Action-related trains on BNSF from the Powder River Basin to the coal export terminal would move over this segment. The segment has one main track with CTC. Projected volume with Proposed Action-related trains is 56 trains per day. Without improvements or operating changes, the projected traffic on this segment would exceed the existing capacity of 41 trains per day. Proposed Action-related trains would contribute to congestion or delays on this segment, or the inability to handle all of the volume. This potential constraint is identified in the *Washington State Rail Plan* (Washington State Department of Transportation 2014a, Technical Note 4:4–8) as a significant capacity concern.
- **Vancouver–Longview Junction and Longview Junction–Auburn (outside Cowlitz County)**. This is the same segment described for Cowlitz County. This segment has two main tracks with CTC. Projected 2028 capacity without improvements or operating changes is approximately 80 trains per day. Projected 2028 volume with Proposed Action-related BNSF trains to and from the Powder River Basin is 81 trains per day; therefore, the projected volume on this segment with Proposed Action-related trains would exceed capacity (80 trains per day).

  If all 16 Proposed Action-related trains use the segment between Vancouver and Longview Junction (UP trains), the 2028 volume on this segment would be 89 trains daily and would exceed capacity without improvements (80 trains daily). It is expected that BNSF and UP would make the necessary investments or operating changes to accommodate the growth in rail traffic, but it is unknown when these actions would be taken.
- **Auburn–Yakima and Yakima–Pasco.** Empty trains returning to the Powder River Basin on BNSF would move over these segments. The projected rail traffic in 2028 would be 11 trains per day. Projected 2028 capacity is 39 trains per day, and therefore, these segments would not have capacity issues in 2028.

Add Rail Traffic to Existing BNSF and UP Rail Infrastructure Outside Washington State

Operation of the Proposed Action would add 8 loaded and 8 empty Proposed Action-related trains per day (16 trains) to existing rail traffic beyond Washington State (Figure 3). The rail infrastructure is described in Section 2.2, *Existing Conditions.* The current rail traffic on the BNSF rail lines is approximately 25 to 28 trains per day and the capacity is approximately 30 to 75 trains per day. The addition of 16 Proposed Action-related trains per day could result in rail traffic on some segments exceeding capacity if no capacity expansions were made. The current rail traffic on the UP route is approximately 8 to 16 trains per day and a capacity of 18 to 75 trains per day. Proposed Action-

related trains could also result in rail traffic exceeding capacity on some parts of the UP route if no capacity expansions or operating changes were implemented.

3.1.2 No-Action Alternative

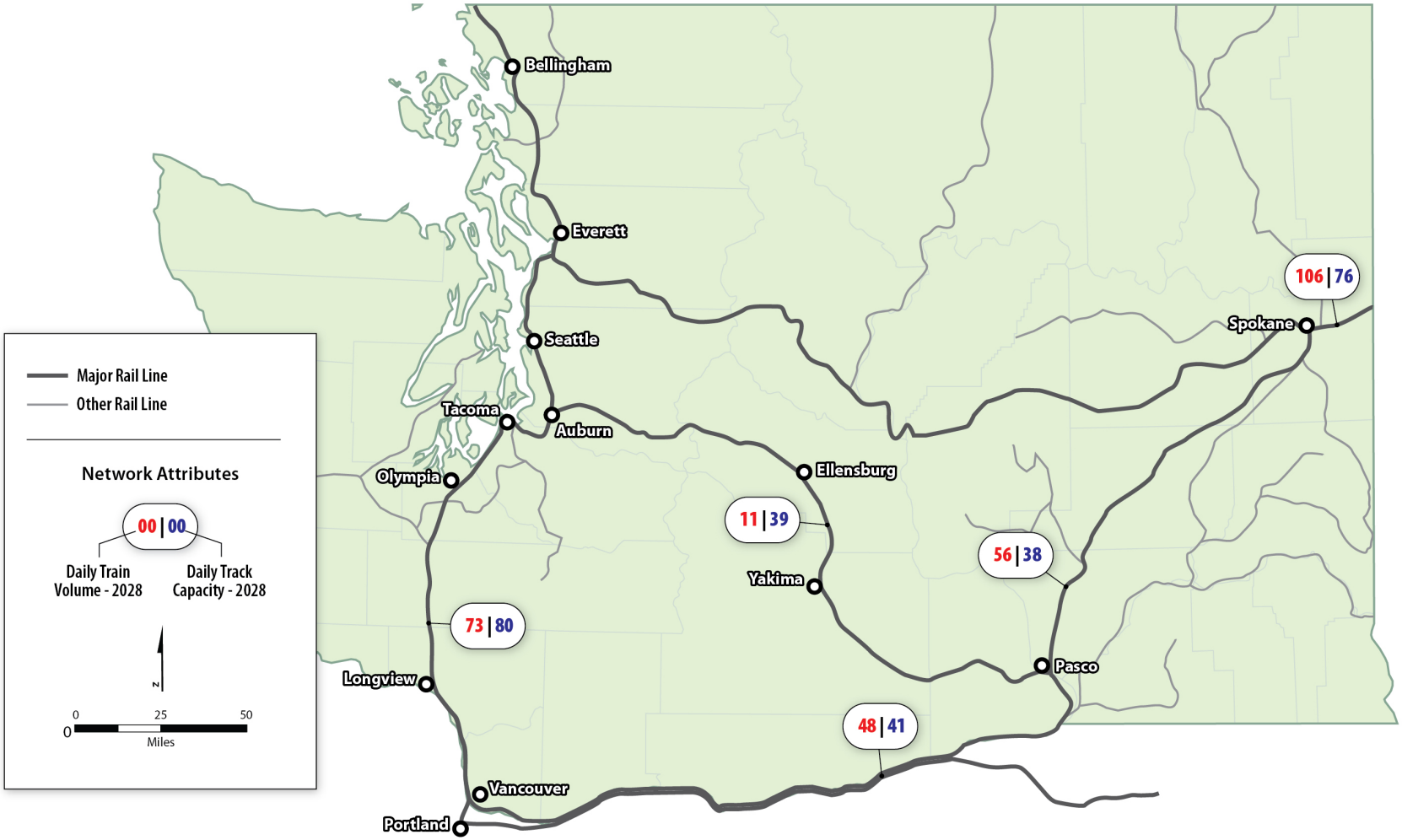
Under the No-Action Alternative, the Applicant would not construct the coal export terminal. The Applicant would continue with current and future increased operations in the project area. The project area could be developed for other industrial uses including an expanded bulk product terminal or other industrial uses. The Applicant has indicated that, over the long term, it would expand the existing bulk product terminal and develop new facilities to handle more products such as calcine petroleum coke, coal tar pitch, and cement.

The Applicant's planned growth under the No-Action Alternative would require approximately two additional trains per day on the Reynolds Lead, BNSF Spur, and BNSF main line in Cowlitz County regardless of whether the coal export terminal is constructed. The existing infrastructure on the Reynolds Lead, BNSF Spur, and BNSF main line would provide sufficient capacity to handle the projected growth in baseline traffic and investments to increase capacity would not be necessary. Some BNSF main line segments would exceed capacity in 2028 if BNSF does not make capital investments or operating changes to expand capacity. Projected 2028 baseline traffic volumes are included in Table 9 and illustrated in Figure 7.

3.2 Mitigation

Based on the findings in this technical report, the co-lead agencies (Cowlitz County and Washington State Department of Ecology) developed potential Applicant mitigation measures. The SEPA Draft Environmental Impact Statement presents these mitigation measures.

Figure 7. Projected Washington Rail Network Daily Track Utilization, 2028 Baseline Conditions (without Proposed Action-Related Trains)



Chapter 4
Required Permits

No permits related to rail transportation would be required for the construction or operation of the Proposed Action.

Chapter 5
References

5.1 Written References

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5.2 Personal Communications

Port of Longview. December 3, 2014—Meeting regarding estimated trains per day.

Wolter, David. Longview Switching Company. December 3, 2014—Meeting regarding coal train configurations on the BNSF, current and projected operations on LVSW.

Appendix A

Coal Train Operating Plans

Table A-1. BNSF Coal Train Operating Plan

Activity	Event	City	State	Miles[a]	Running Time or Dwell Time[b]		MPH[c]	Work Activities[d]	Comments
Loaded trains from WA state line to Longview Jct.	Depart	ID/WA Line	WA						
	Arrive	Spokane	WA	18.3	1:00	1.00	18		
	Arrive	Pasco	WA	142.8	8:00	8.00	18		BNSF current project to double track
	Arrive	Vancouver	WA	226.2	12:00	13.00	18	Crew change	
	Arrive	Longview Jct	WA	35.2	2:00	2.00	18		Possible construction of 3rd main track through Longview/Kalama
Loaded movement within port	Depart	Longview Jct	WA	Dwell	0:00		-	BNSF dispatcher requests permission from LVSW yardmaster to access LVSW track through to MBTL. LVSW yardmaster lines switches and signals through to MBTL then provides authority to BNSF dispatcher. BNSF dispatcher lines switches and signals off BNSF main into Longview Jct yard. Trains proceeds via south leg of Y across Cowlitz River bride. Train does not stop until MBTL switch unless LVSW or MBTL cannot take	BNSF plans to upgrade LVSW route from west side of Cowlitz River bridge to MBTL with CTC and remote control switches which would increase speed to 25 MPH. Speed over Cowlitz River bridge would remain at 10 MPH. Average speed of 12 MPH is Hellerworx estimate.

Activity	Event	City	State	Miles[a]	Running Time or Dwell Time[b]		MPH[c]	Work Activities[d]	Comments
								train. If LVSW or MBTL cannot take train - it will wait on BNSF main at signal until it can proceed to MBTL.	
	Arrive	MBTL Loop	WA	7.4	0:32	0.74	10	Train stops, conductor operates switch into MBTL, BNSF or UP crews handle unit train to MBTL. Proceed into MBTL track designated by MBTL yardmaster	6 miles Longview Jct. to MBTL switch. About 1.4 miles to pull entire train onto MBTL storage track.
	Secure Train	MBTL Loop	WA	Dwell	0:00		-	BNSF or UP crew secures train and either transported by automobile back to Vancouver, WA (BNSF) or Albina (UP) or board outbound train for return to Vancouver, WA or Albina	BNSF or UP crew may remain on duty to unload train or to move an empty train direct to dumper
Unloading	Prep for dumping	MBTL Loop	WA	Dwell	2:30		-	Mechanical inspection, train then waits on storage track until MBTL ready to unload.	Dwell time waiting to unload - Hellerworx estimate
	Begin Dumping	MBTL Loop	WA	0			1	MBTL crew positions train with first 2 cars positioned at dumper, indexer would move train through dumper stopping every 2 cars to dump,	
	Dumping Completed	MBTL Loop	WA	1	1:20		1	MBTL crew takes lead locomotives to end of loading loop, couple to empty train when unloading completed. From dumper, train proceeds into storage track awaiting outbound train crew	Unloading time estimate based on proposed rotary dumper specs of 8,267 ST/ hour and average train of 15,263 ST

Activity	Event	City	State	Miles[a]	Running Time or Dwell Time[b]		MPH[c]	Work Activities[d]	Comments
Empty Movement within Port	Empty train prep	MBTL Loop	WA	Dwell	3:00		-	Mechanical inspection, Bad Order (cars with defects) repaired in place or switched out of train to Bad Order track. Train waits for outbound train slot. BNSF crew taxi from Vancouver, WA or crew from inbound train boards outbound.	Mechanical inspection and switching out Bad Orders about 1 hour, balance of time waiting crew/train slot to depart, all Hellerworx estimates.
	Depart	MBTL Loop	WA	Dwell	0:00		-	Crew obtains authority from BNSF dispatcher to proceed on BNSF main line. BNSF dispatcher lines switches from Longview Jct - North leg of Y from Cowlitz River bridge. LVSW yard master lines switches and signals over LVSW to Longview Jct yard. Train stops at MBTL switch, conductor operates switch to line movement onto Reynolds Lead, transported by road to lead locomotive when switch closed.	
	Arrive	Longview Jct	WA	7.4	0:32	0.74	10	Train moves directly from MBTL over LVSW track and across Cowlitz River bridge over north leg of Y onto BNSF main line at Longview Jct. heading north toward Auburn	BNSF currently improving northbound leg of Y at Longview Jct to increase radius- current tight curve sometimes causes empties to derail. Train does not depart MBTL until authority to proceed on BNSF main line is obtained from BNSF dispatcher. It would not typically stop at any point on LVSW between MBTL and Longview Jct.

Activity	Event	City	State	Miles[a]	Running Time or Dwell Time[b]		MPH[c]	Work Activities[d]	Comments
	Depart	Longview Jct	WA	0	0:00			Train moves directly onto BNSF main line heading north toward Auburn	
Empty trains port to WA state line	Arrive	Auburn	WA	119.9	7:00	6.66	18		Crew change location and dwell times are Hellerworx estimates. Empty return route via Stampede Pass, Hellerworx estimate.
	Arrive	Yakima	WA	139	8:00	7.72	18		
	Arrive	Pasco	WA	89.5	5:00	4.97	18		
	Arrive	Spokane	WA	142.8	8:00	7.93	18		
	Arrive	ID/WA Line	WA	18.3	1:00	1.02	18		

Notes

[a] BNSF and UP Route miles from PC Rail 21 Coal/Bulk Familzed Reynolds Lead miles from meeting with David Wolter 12.03.14 and Hellerworx estimate from Google Earth

[b] Hellerworx estimate

[c] MPH for main line movements - Hellerworx estimate based on BNSF coal unit train performance 53 week average reported to AAR, less Hellerworx estimated dwell time enroute
MPH for port area movements from Noise Report Sept 2014 P20 and Hellerworx estimate
Meeting with LVSW David Wolter 12.03.14

[d] Work activities from BNSF, UP and LVSW work activity from Hellerworx experience and Meeting with LVSW David Wolter 12.03.14

Table A-2. UP Coal Train Operating Plan

Activity	Event	City	ST	Miles [a]	Running Time or Dwell Time [b]	MPH [c]	Work Activities[d]	Comments
Loaded trains from WA state line to Longview Jct	Depart	OR/WA Line	WA				UP trains, crew change Albina Yard (Portland), enter BNSF trackage at Albina Yard, proceed across Columbia River bridge to Vancouver, WA	
	Arrive	Vancouver	WA	0.7	0:30	1		
	Arrive	Longview Jct	WA	35.2	2:00	18	0	Possible construction of 3rd main track through Longview/Kalama
Loaded movement within port	Depart	Longview Jct	WA	Dwell	0:00	-	BNSF dispatcher requests permission from LVSW yardmaster to access LVSW track through to MBTL. LVSW yardmaster lines switches and signals through to MBTL then provides authority to BNSF dispatcher. BNSF dispatcher lines switches and signals off BNSF main into Longview Jct yard. Trains proceeds via south leg of Y across Cowlitz River bride. Train does not stop until MBTL switch unless LVSW or MBTL cannot take train. If LVSW or MBTL cannot take train - it will wait on BNSF main at signal until it can proceed to MBTL.	BNSF plans to upgrade LVSW route from west side of Cowlitz River bridge to MBTL with CTC and remote control switches which would increase speed to 25 MPH. Speed over Cowlitz River bridge would remain at 10 MPH. Average speed of 12 MPH is Hellerworx estimate based on
	Arrive	MBTL Loop	WA	7.4	0:32	10	Train stops, conductor operates switch into MBTL, BNSF or UP crews handle unit train to MBTL. Proceed into MBTL track designated by MBTL yardmaster	6 miles Longview Jct. to MBTL switch. About 1.4 miles to pull entire train onto MBTL storage track.

Activity	Event	City	ST	Miles [a]	Running Time or Dwell Time [b]	MPH [c]	Work Activities[d]	Comments
	Secure Train	MBTL Loop	WA	Dwell	0:00		BNSF or UP crew secures train and either transported by automobile back to Vancouver, WA (BNSF) or Albina (UP) or board outbound train for return to Vancouver, WA or Albina	BNSF or UP crew may remain on duty to unload train or to move an empty train direct to dumper
Unloading	Prep for dumping	MBTL Loop	WA	Dwell	2:30		Mechanical inspection, train then waits on storage track until MBTL ready to unload.	Dwell time waiting to unload - Hellerworx estimate
	Begin Dumping	MBTL Loop	WA	0	0:00		MBTL crew positions train with first 2 cars positioned at dumper, indexer would move train through dumper stopping every 2 cars to dump,	
	Dumping Complet ed	MBTL Loop	WA	1	1:20	1	MBTL crew takes lead locomotives to end of loading loop, couple to empty train when unloading completed. From dumper, train proceeds into storage track awaiting outbound train crew	Unloading time estimate based on proposed rotary dumper specs of 8,267 ST/ hour and average train of 15,263 ST
Empty Movement within Port	Empty train prep	MBTL Loop	WA	Dwell	3:00		Mechanical inspection, Bad Order (cars with defects) repaired in place or switched out of train to Bad Order track. Train waits for outbound train slot. UP crew taxi from Albina or crew from inbound train boards outbound.	Mechanical inspection and switching out Bad Orders about 1 hour, balance of time waiting crew/train slot to depart, all Hellerworx estimates.
	Depart	MBTL Loop	WA	Dwell	0:00		Crew obtains authority from BNSF dispatcher to proceed on BNSF main line. BNSF dispatcher lines switches form Longview Jct - South leg of Y from Cowlitz River bridge. LVSW yard master lines switches and signals over LVSW to Longview Jct yard	

Activity	Event	City	ST	Miles [a]	Running Time or Dwell Time [b]	MPH [c]	Work Activities[d]	Comments
	Arrive	Longview Jct	WA	7.4	0:32	10	Train moves directly from MBTL over LVSW track and across Cowlitz River bridge over south leg of Y onto BNSF main line at Longview Jct.	BNSF currently improving northbound leg of Y at Longview Jct to increase radius- current tight curve sometimes causes empties to derail. Train does not depart MBTL until authority to proceed on BNSF main line is obtained from BNSF dispatcher. It would not typically stop at any point on LVSW between MBTL and Longview Jct.
	Depart	Longview Jct	WA	0	0:00		Train moves directly onto BNSF main line heading south toward Vancouver, WA	
Empty trains port to WA state line	Arrive	Vancouver	WA	35.2	2:00	20		
	Arrive	OR/WA Line	WA	0.7	0:30	1	Train moves on BNSF trackage rights to Albina Yard then back on UP, crew change	

Notes

[a] BNSF and UP Route miles from PC Rail 21 Coal/Bulk Familzed. Reynolds Lead miles from meeting with David Wolter 12.03.14 and Hellerworx estimate from Google Earth

[b] Hellerworx estimate

[c] MPH for main line movements - Hellerworx estimate based on BNSF coal unit train performance 53 week average reported to AAR, less Hellerworx estimated dwell time enroute
MPH for port area movements from Noise Report Sept 2014 P20 and Hellerworx estimate
Meeting with LVSW David Wolter 12.03.14

[d] Work activities from BNSF, UP and LVSW work activity from Hellerworx experience and Meeting with LVSW David Wolter 12.03.14

Millennium Bulk Terminals—Longview SEPA Environmental Impact Statement

SEPA Rail Safety Technical Report

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Appendix A Rail Safety Data

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Acronyms and Abbreviations

Applicant	Millennium Bulk Terminals—Longview, LLC
BNSF	BNSF Railway Company
CFR	Code of Federal Regulations
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
LVSW	Longview Switching Company
mph	miles per hour
Port	Port of Longview
RCW	Revised Code of Washington
SEPA	Washington State Environmental Policy Act
UP	Union Pacific Railroad
USDOT	U.S. Department of Transportation
WAC	Washington Administrative Code
WUTC	Washington Utilities and Transportation Commission

Chapter 1
Introduction

This technical report assesses the potential rail safety impacts of the proposed Millennium Bulk Terminals—Longview project (Proposed Action) and No-Action Alternative. For the purposes of this assessment, rail safety refers to the number of train derailments and collisions that could lead to a loss of cargo. Collisions with trespassers are not included in this assessment. This technical report describes the regulatory setting, establishes the method for assessing potential rail safety impacts, presents the historical and current rail safety conditions in the study area, and assesses potential impacts. The SEPA Vehicle Transportation Technical Report (ICF International and DKS Associates 2016) addresses grade crossing safety.

1.1 Project Description

Millennium Bulk Terminals—Longview, LLC (Applicant) proposes to construct and operate a coal export terminal in Cowlitz County, Washington, along the Columbia River (Figure 1). The coal export terminal would receive coal from the Powder River Basin in Montana and Wyoming and the Uinta Basin in Utah and Colorado via rail, then load and transport the coal by ocean-going ships via the Columbia River and Pacific Ocean to overseas markets in Asia. The coal export terminal would be capable of receiving, stockpiling, blending, and loading coal by conveyor onto ships for export. Construction of the coal export terminal would begin in 2018. For the purpose of this analysis, it is assumed the coal export terminal would operate at full capacity in 2028.

The following subsections present a summary of the Proposed Action and No-Action Alternative. For detailed information on these alternatives, see the SEPA Alternatives Technical Report (ICF International 2016).

1.1.1 Proposed Action

The Proposed Action would develop a coal export terminal on 190 acres (project area). The project area is located within an existing 540-acre area currently leased by the Applicant at the former Reynolds Metals Company facility, and land currently owned by Bonneville Power Administration. The project area is adjacent to the Columbia River in unincorporated Cowlitz County, Washington near Longview city limits (Figure 2).

The Applicant currently and separately operates, and would continue to separately operate, a bulk product terminal on land leased by the Applicant. Industrial Way (State Route 432) provides vehicular access to the Applicant's leased land. The Reynolds Lead and the BNSF Spur, both operated by Longview Switching Company (LVSW),[1] provide rail access to the Applicant's leased area from a point on the BNSF Railway Company (BNSF) main line (Longview Junction, Washington) located to the east in Kelso, Washington. Ships access the Applicant's leased area via the Columbia River and berth at an existing dock (Dock 1) operated by the Applicant in the Columbia River.

[1] The Longview Switching Company (LVSW) is jointly owned by BNSF Railway Company (BNSF) and Union Pacific Railroad (UP).

Figure 1. Project Vicinity

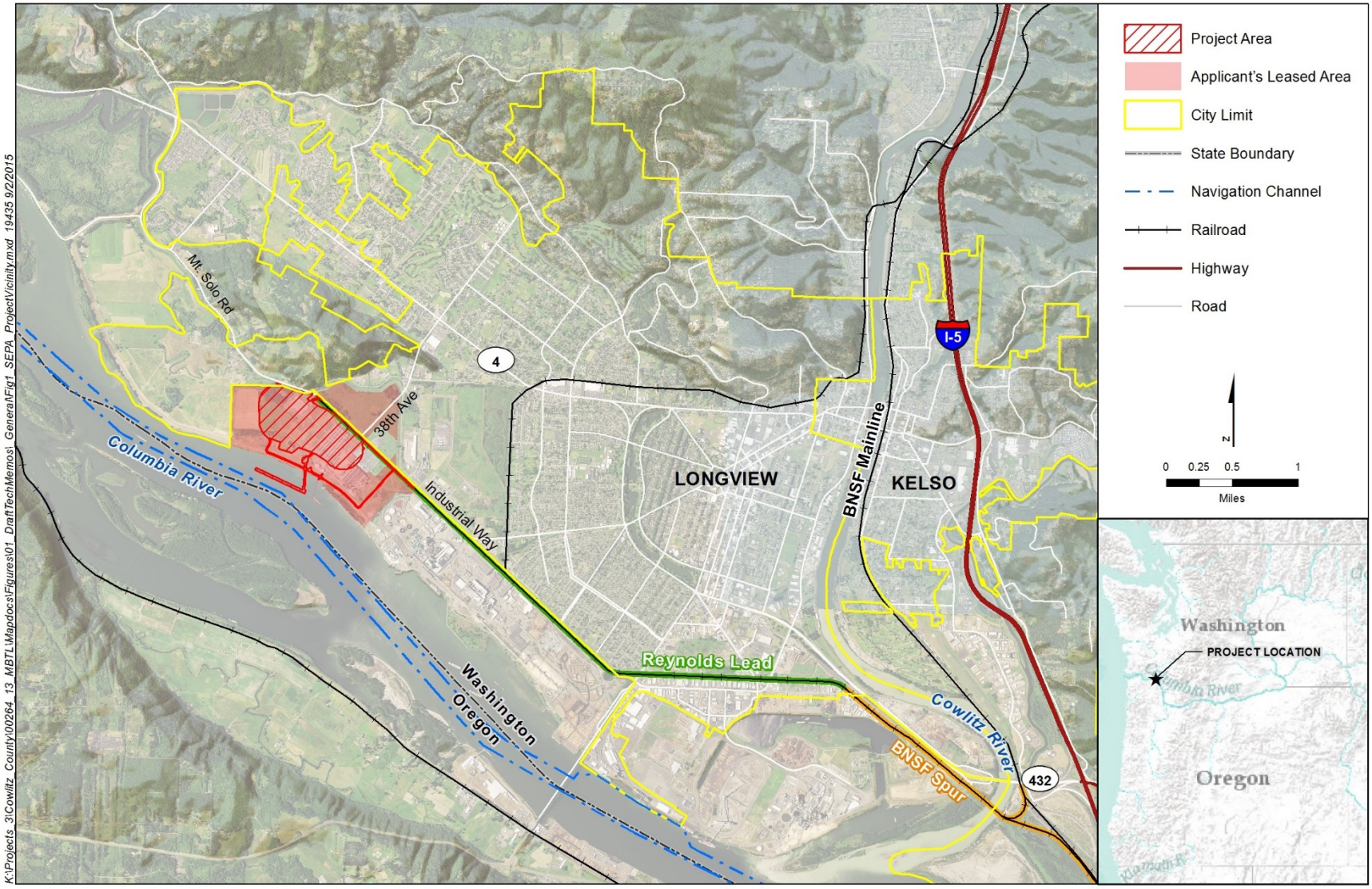
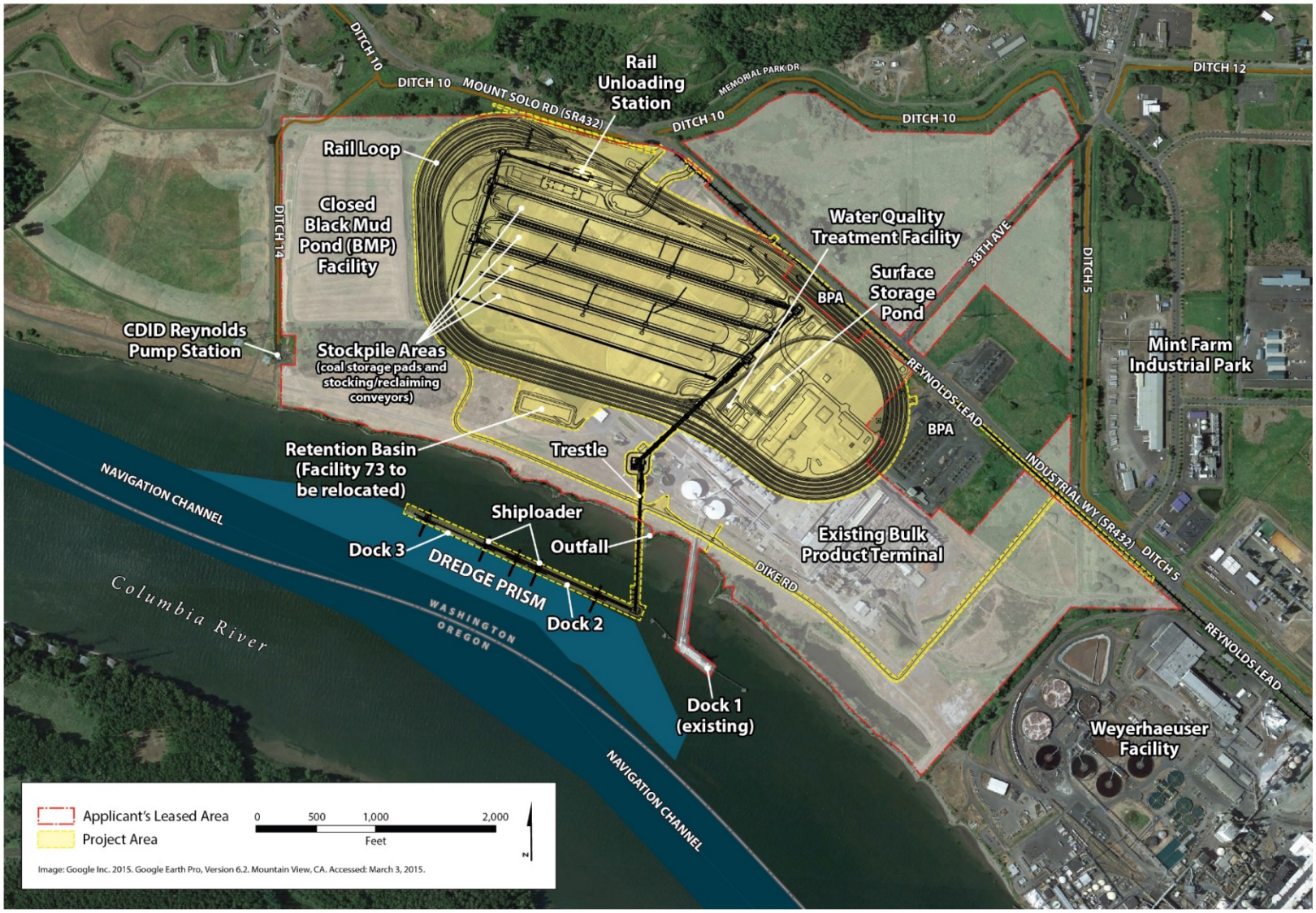


Figure 2. Proposed Action



Under the Proposed Action, BNSF or Union Pacific Railroad (UP) trains would transport coal in rail cars from the BNSF main line at Longview Junction, Washington, to the project area via the BNSF Spur and Reynolds Lead. Coal would be unloaded from rail cars, stockpiled and blended, and loaded by conveyor onto ocean-going ships at two new docks (Docks 2 and 3) on the Columbia River for export.

Once construction is complete, the Proposed Action would have an annual throughput capacity of up to 44 million metric tons.[2] The coal export terminal would consist of one operating rail track, eight rail tracks for the storage of rail cars, rail car unloading facilities, stockpile areas for coal storage, conveyor and reclaiming facilities, two new docks in the Columbia River (Docks 2 and 3), and ship-loading facilities on the two docks. Dredging of the Columbia River would be required to provide access to and from the Columbia River navigation channel and for berthing at the two new docks.

Vehicles would access the project area from Industrial Way (State Route 432). Ships would access the project area via the Columbia River and berth at one of the two new docks. Terminal operations would occur 24 hours per day, 7 days per week. The coal export terminal would be designed for a minimum 30-year period of operation.

1.1.2 No-Action Alternative

Under the No-Action Alternative, the proposed export terminal would not be constructed. Current operations of the bulk product terminal, which include the storage and transport of alumina and up to 150,000 metric tons per year of coal. Importing of alumina would continue and increase in the project area using Dock 1. The Applicant could expand the existing bulk product terminal onto the 190-acre project area, developing storage and shipment facilities to bulk product terminal operations. Coal and alumina would continue to be stored, transferred, and shipped. Additional bulk product transfers activities involving products such as calcine pet coke, coal tar pitch, cement, fly ash, and sand or gravel could also be pursued, and new or revised permits could be required. These operations would involve storage and upland transfer of bulk products, which would use existing or new buildings. Construction of new buildings could involve demolition and replacement of existing buildings and new or modified permits. Any new construction would be limited to uses allowed under existing Cowlitz County development regulations and federal and state permits.

1.2 Regulatory Setting

The jurisdictional authorities and corresponding regulations, statutes, and guidance for determining potential impacts on rail safety are summarized in Table 1. Those regulations pertaining to grade crossings are used in the SEPA Vehicle Transportation Technical Report (ICF International and DKS Associates 2016).

[2] A metric ton is the U.S. equivalent to a tonne per the International System of Units, or 1,000 kilograms or approximately 2,204.6 pounds.

Table 1. Regulations, Statutes, and Guidelines for Rail Safety

Regulation, Statute, Guideline	Description
Federal	
National Environmental Policy Act (42 USC 4321 *et seq*.)	Requires the consideration of potential environmental effects. NEPA implementation procedures are set forth in the President's Council on Environmental Quality's Regulations for Implementing NEPA (49 CFR 1105).
Federal Railroad Safety Act of 1970	Gives FRA rulemaking authority over all areas of rail line safety. FRA has designated that state and local law enforcement agencies have jurisdiction over most aspects of highway/rail grade crossings, including warning devices and traffic law enforcement.
Highway Safety Act and the Federal Railroad Safety Act	Gives FHWA and FRA regulatory jurisdiction over safety at federal highway/rail grade crossings. USDOT has promulgated rules addressing grade-crossing safety and provides funding for installation and improvement of warning devices. FRA has issued rules that impose minimum maintenance, inspection, and testing standards for at-grade crossing warning devices for highway/rail grade crossings on federal highways and state and local roads.
FRA General Regulations (49 CFR 200–299)	Regulates safety, including operations, engineers, and crew (e.g., control of alcohol and drug use), track, signaling, and rolling stock (e.g., locomotives and passenger and freight cars) for common carrier rail lines that are part of the general rail line system of transportation.
State	
Washington State Environmental Policy Act (WAC 197-11, RCW 43.21C)	Requires state and local agencies in Washington to identify potential environmental impacts that could result from governmental decisions.
Title 81, Transportation—Railroads, Employee Requirements and Regulations (RCW 81.40)	Establishes general requirements for railroad employee environment and working conditions, the minimum crew size for passenger trains, and requirements for flaggers..
Title 81, Transportation—Railroads, Crossings (RCW 81.53)	Establishes requirements and process for railroad construction and extensions that would cross any existing railroad or highway at grade. Includes approval from the commission.
Rail Companies—Clearances (480-60 WAC)	Establishes clearances for railroad companies operating in Washington State. Includes rules of practice and procedure, walkway clearances, side clearances, track clearances, side clearances, track clearances, and rules for operation of excess dimension loads.
Rail Companies—Operation (480-62 WAC)	Establishes operating procedures for railroad companies operating in Washington State. Includes general and procedural rules, safety rules, reporting requirement rules, and the establishment and distribution of a grade-crossing protective fund.

Regulation, Statute, Guideline	Description
Local	
Cowlitz County SEPA Regulations (CCC 19.11)	Provides for the implementation of SEPA in Cowlitz County.

Notes:
CFR = Code of Federal Regulations; FRA = Federal Railroad Administration; FHWA = Federal Highway Administration; USDOT = U.S. Department of Transportation; WAC = Washington Administrative Code; RCW = Revised Code of Washington; SEPA = Washington State Environmental Policy Act; CCC = Cowlitz County Code

1.3 Study Area

The study area for direct impacts on rail safety is the project area. The study area for indirect impacts on rail safety is the expected rail routes of Proposed Action-related trains within Washington State.

Chapter 2
Existing Conditions

This chapter describes the methods for assessing the existing conditions and determining impacts in the study area as they pertain to rail safety and existing conditions.

2.1 Methods

This section describes the sources of information and methods used to characterize the existing conditions and assess the potential impacts of the Proposed Action and No-Action Alternative on rail safety.

The analysis used existing rail accident data from the Federal Railroad Administration (FRA) as the basis for the rail safety and accident analysis. While the Washington Utilities and Transportation Commission (WUTC) gathers information on accidents that occur in Washington State, WUTC does not have the corresponding data on train miles within the state for determining accidents per million train miles. Such accident rates provided by FRA, broken down by track class, are the basis of the rail safety analysis. Appendix A describes the observed data on accident rates nationwide and accident counts specific to Washington State and Cowlitz County.[3]

A train accident for this analysis is defined as involving one or more railroads that have sustained combined track, equipment, and/or structural damage in excess of the reporting threshold. The FRA reporting threshold was $10,500 in 2015. Therefore, an accident includes a wide a variety of incident types and severity and is not limited to collisions or derailments.

Historically, accident rates (accidents per train mile) do not change dramatically from one year to the next, but generally trend downward over time due to improved control systems, communications, and inspection practices. As a result, using current data for future projections is conservative. Typically, year-to-year accident rates are more consistent than year-to-year traffic volumes on any specific route, which may vary substantially as new projects are added or demands change.

2.1.1 Data Sources

The following sources of information were used to evaluate the rail safety characteristics of the study area.

- **Train parameters** including the number of rail cars (125 rail cars per unit trains) were based on information provided by the Applicant and existing BNSF train operations.
- **Baseline train volumes** for the Reynolds Lead and BNSF Spur were collected from LVSW and field observations. BNSF main line volumes were collected from the *Washington State Rail Plan* (Washington State Department of Transportation 2014a). Year 2015 and 2028 volumes were estimated using a linear extrapolation based on 2010 volumes and 2035 projected volumes.

[3] Appendix A illustrates data for the most recent data available when the analysis was completed.

- **Future project-related train traffic** from the SEPA Rail Transportation Technical Report (ICF International and Hellerworx 2016), notably 8 loaded and 8 empty trains per day if the coal export terminal is constructed and operated at full terminal throughput in 2028.
- **Future train routes** compiled from the SEPA Rail Transportation Technical Report (ICF International and Hellerworx 2016), which used information from the *Washington State Rail Plan* (Washington State Department of Transportation 2014a) and *Washington State Freight Mobility Plan* (Washington State Department of Transportation 2014b).[4]
- **Accident rates** compiled by FRA for 2011 to 2014,[5] along with analyses by Liu et al. (2011), and Anderson and Barkan (2004) giving derailment rates by track class and discussing the impacts of track class, train length, and signal systems.

2.1.2 Impact Analysis

The following methods were used to evaluate the potential impacts of the Proposed Action and No-Action Alternative on rail safety (train accidents). For the purposes of this analysis, construction impacts are based on peak construction period, assumed to be in 2018, which would average 1.3 trains per day. Operations impacts are based on the maximum coal export terminal throughput capacity (up to 44 million metric tons per year), which would result in 8 loaded and 8 empty trains per day by 2028.

2.1.2.1 Accident Frequency

The analysis considered one construction scenario and two operations scenarios.

- **2018 Construction:** Average of 1.3 trains per day
- **2028 Baseline Conditions:** 2028 conditions without the Proposed Action
- **2028 Proposed Action:** Full train operations in 2028 (8 loaded and 8 empty trains per day on the Reynolds Lead, BNSF Spur, and BNSF main line)

Train accident rates are generally distinguished only by freight versus passenger service, not by specific cargoes. Both loaded and unloaded Proposed Action-related trains were evaluated, as well as other existing rail traffic where appropriate. Given that the project would operate *unit trains* of approximately 125 rail cars that would travel from the mines to the project area without being split up, trains would generally pass around or straight through yards without switching.

This analysis used both qualitative and quantitative methods to estimate accident rates for the scenarios. The number of accidents (primarily collisions and derailments) resulting from train operations based on accident rates from FRA were estimated. Rates, in combination with the specifics of the operations (e.g., number of trains, route length, track class), were analyzed to estimate the number of accidents per year. The analysis compared predicted rates (in accidents per million train miles) for all railroads with rates specific to BNSF and UP (as co-owners of LVSW) as

[4] In 2012, BNSF introduced a train operations protocol change to enhance the use of existing capacity by a directional running agreement using Stampede Pass for eastbound empty bulk trains. The strategy of directional running is to route all westbound-loaded unit trains (including coal) from Pasco to Vancouver via the Columbia River Gorge. Empty unit bulk trains (including coal) generated north of Vancouver including Cowlitz County are destined to return to Pasco and to points east via Stampede Pass.

[5] 2014 data were the most recent available data when the analysis was completed.

the first step in determining the appropriate accident rates with Proposed Action-related trains (Table 2).

Table 2. Nationwide Train Accident Rates

	Accident Rate per Million Train Miles		
Year	**All Railroads (Passenger and Freight Trains)**	**BNSF (Freight Trains)**	**UP (Freight Trains)**
2012	2.41	2.20	3.04
2013	2.43	2.11	3.02
2014	2.27	1.89	2.82

Notes:
Source: Federal Railroad Administration (2015).
BNSF = BNSF Railway Company; UP = Union Pacific Railroad

BNSF's accident rates are similar to but less frequent than the average for all railroads. UP has slightly higher accident rates. LVSW did not have any reported train accident data in the FRA database for 2012 to 2014; that is, there were no train accidents experienced in this time period on the Reynolds Lead or BNSF Spur. Given the rail transportation associated with the Proposed Action within Washington State would be on BNSF lines, a rate of 2 accidents per million train miles (the national average for BNSF over the last 2 years) was used as the starting point of the accident analysis. Specific train accident rates for BNSF in Washington State were not available because FRA data do not include train accident rates by state, only nationally. In addition, WUTC does not collect data for a Washington State accident rate to be calculated. For these reasons, the national average for BNSF over the last 2 years was used. FRA data include accident count by state (Appendix A) but does not include accident rate data by state.

The predicted number of accidents per year was calculated by multiplying segment length by the number of trains per year by the applicable accident rate. Thus, the derivation of accident rates is an important part of the overall analysis. Accident rates have been shown to vary considerably by track class, with higher accident rates (i.e., yielding more accidents for a given number of train miles) occurring on lower track classes. Lower track classes have lower maximum operating speeds, which can reduce the consequences of those accidents which occur.[6]

Liu et al. (2011) derived derailment rates by track class,[7] using the baseline rates provided by Anderson and Barkan (2004). They found the derailment rates for Track Class 3 were twice the average across all track classes. Derailment rates for Track Class 2 were six times the average for all track classes (accident rates increase with lower track classes generally due to lower track quality). Conversely, derailment rates for Track Class 5 were roughly a third of the overall average rates (accident rates decrease with higher track classes due to higher track quality and other factors).

[6] Train accidents are more likely to occur on lower track classes (which have lower maximum allowable speeds) because lower track classes are not designed and maintained to the same standards as higher track classes. Track Class 1 is restricted to 10 miles per hour (mph) for freight trains. Rail yards, branch lines, many short lines, and industrial track are typical places to see Track Class 1 track. Track Class 2 may have travel up to 25 mph for freight trains. Secondary main lines, branch lines, and many regional railroads may have track in this category.

[7] FRA's track safety standards establish nine specific classes of track (Class 1 to Class 9). Class of Track is based on standards for track structure and geometry, and inspection frequency. Each Class of Track has a maximum allowable operating speed for both freight and passenger trains. The higher the Class of Track, the greater the allowable track speed and the more stringent the track safety standards that apply.

Table 3. Railroad Track Classes

	Maximum Allowable Speed (mph)	
Class	**Freight Rail**	**Passenger Rail**
Excepted (X)	10	NA
1	10	15
2	25	30
3	40	60
4	60	80
5	80	90
6	NA	110
7	NA	125
8	NA	150
9	NA	200

Notes:
Source: 49 CFR Part 213.9 Classes of track: operating speed limits
mph = miles per hour; NA = not applicable

Anderson and Barkan (2004) found that the overall accident rate (collisions, derailments, and other types) on Track Class 3 was roughly twice the total rate for all track classes (the same pattern seen for just derailments), and the overall rate on Track Classes 4 and higher was roughly half the total rate for all track classes.

Data on accident rates by track class was used to generate a base accident rate for each segment. The Reynolds Lead and BNSF Spur are currently maintained in accordance with the Track Class 1 standard. LVSW plans to make improvements to the Reynolds Lead and BNSF Spur to Track Class 2 for full capacity operation of the Proposed Action (ICF International and Hellerworx 2016). The Reynolds Lead and BNSF Spur would be maintained as Track Class 1 if planned improvements are not made.

Using the base rate of two accidents per million train miles, a multiplier of six was then applied as an adjustment to better represent Track Class 2, as indicated by Anderson and Barkan (2004) and Liu et al. (2011), resulting in a rate of 12.0 accidents per million train miles for the Reynolds Lead and the BNSF Spur if improvements are made to Track Class 2. For the other segments in Washington State, it was assumed the track was Track Class 3, giving an accident rate of 4.0 accidents per million train miles when the multiplier of two is applied to the base rate.[8]

Accident rates for Track Class 1, which include the Reynolds Lead and BNSF Spur (without planned improvements), are more uncertain, given the small percentage of train miles that occur on such track. Moreover, many sources group Excepted Track (Class X) and Track Class 1 in their data collection making it harder to obtain accident rates specific to just Track Class 1. (Track Class X is excepted from many of the stated geometry and structural requirements and is thus limited to extremely low speeds.) As such, it is hard to predict accident rates for Track Class 1, but they could be 10 to 20 or more times higher than the base (total) accident rate. Thus, if the Reynolds Lead and

[8] Certain rail segments are Track Class 4, which has a much lower accident rate than Track Class 3, thus, making the assumption of Track Class 3 a conservative analysis.

the BNSF Spur are not improved, the estimates for the Reynolds Lead and the BNSF Spur presented in this report would increase by roughly a factor of 1.5 to 3 times higher than Track Class 2.

2.1.2.2 Accident Severity

Main line train accidents in Cowlitz County and Washington State with and without injuries and fatalities as an indicator of potential accident severity were reviewed. Based on FRA data (2015) as shown in Appendix A, there were two accidents in Cowlitz County in 2014, and neither involved an injury or fatality. One incident was in a yard with no derailment and the other involved a derailment of 11 rail cars on main line track. For Washington State, there were 36 accidents in 2014, two of which had an injury involved. Thirteen accidents were on main line track, and the remainder were in yards or on industry track. Derailments (main line and industry track) had 0 to 11 rail cars according to the available data.

2.2 Existing Conditions

As described in Section 1.1.1, *Proposed Action*, the project area is primarily located on 190 acres (project area) of a 540-acre existing industrial site (Applicant's leased area) near Longview, Washington. As shown in Figure 1, the project area is connected to the BNSF main line and Longview Junction (approximately 7.1 miles away) via the Reynolds Lead and the BNSF Spur. The Reynolds Lead currently serves several industries including Weyerhaeuser and North Pacific Paper Corporation, and existing operations in the Applicant's leased area.

The follow describes the BNSF Spur and Reynolds Lead.

- **BNSF Spur.** This section of track runs from the BNSF Seattle Subdivision main line switch at Longview Junction, across the Cowlitz River Bridge to the LVSW yard (Figure 1). Baseline traffic on the BNSF Spur is about 7 trains per day. The Port Industrial Rail Corridor connects with the BNSF Spur just east of the LVSW yard. Trains to or from various port facilities leave or enter the BNSF Spur at the Industrial Rail Corridor switch. The rest of the trains originate or terminate in the yard.
- **Reynolds Lead.** This section runs from the west end of the yard to the existing bulk product terminal (Figure 1). Baseline traffic is just over 2 trains per day, on average. Trains operating on the Reynolds Lead include an LVSW local crew switching industries along the Reynolds Lead 3 days per week and a local crew that delivers and picks up rail cars that are interchanged at two sidings west of California Way.

Table 4 provides key parameters of the BNSF Spur and Reynolds Lead, based on the SEPA Rail Transportation Technical Report (ICF International and Hellerworx 2016).

Table 4. Key Segment Parameters for Existing Traffic on BNSF lines in Washington State

Segment	Miles	Track Class	Estimated Baseline Trains per Day (2015)
Idaho/Washington Line to Spokane, WA	18.6	3[a]	70
Spokane, WA to Pasco, WA	145.5	3[a]	39
Pasco, WA to Vancouver, WA	221.4	3[a]	34
Vancouver, WA to Longview Junction, WA	34.8	3[a]	50
Longview Junction, WA to LVSW Yard	2.1	1	7
LVSW Yard to Project Area	5.0	1	2
Longview Junction, WA to Auburn, WA	118.6	3[a]	50
Auburn, WA to Yakima, WA	139.6	3[a]	7
Yakima, WA to Pasco, WA	89.4	3[a]	7

Notes:
[a] Track class for other segments in Washington State conservatively assumed to be Track Class 3 for the analysis.

Chapter 3
Impacts and Mitigation

This chapter describes the impacts on rail safety that would result from construction and operation of the Proposed Action and the impacts under the No-Action Alternative.

3.1 Impacts

This section describes the impacts on rail safety (train accidents) that could result from the Proposed Action and No-Action Alternative.

Under the Proposed Action, trains would travel along the Reynolds Lead and BNSF Spur as described in Chapter 2, *Existing Conditions*. Beyond Longview Junction, the main rail lines to and from the potential sources for the coal already exist and are currently in operation as illustrated in Figure 3.

Based on current operating practices, BNSF loaded and empty Proposed Action-related trains would travel via the same route between the coal mines in the Powder River Basin and Pasco, Washington. West of Pasco, loaded trains would move to the project area via BNSF's Columbia River Gorge route through Vancouver, Washington to Longview Junction. Empty trains would return from Longview Junction via BNSF's Stampede Pass route through Auburn, Washington, and Yakima, Washington, to Pasco. These routes are analyzed in this section. Estimates on a per-mile basis have also been developed so that they can be applied to other routes, if applicable.

Both loaded and empty Proposed Action-related trains on the UP would move via the same route between the Uinta Basin and Powder River Basin and the project area. Between Vancouver and Longview Junction, UP operates over the same track that carries BNSF trains, so no additional analysis was required for Proposed Action-related UP trains within Washington State.

As described previously, a train accident for this analysis is defined as involving one or more railroads that have sustained combined track, equipment, and/or structural damage in excess of the reporting threshold. The FRA reporting threshold was $10,500 in 2015. Therefore, an accident includes a wide a variety of incident types and severity and is not limited to collisions or derailments.

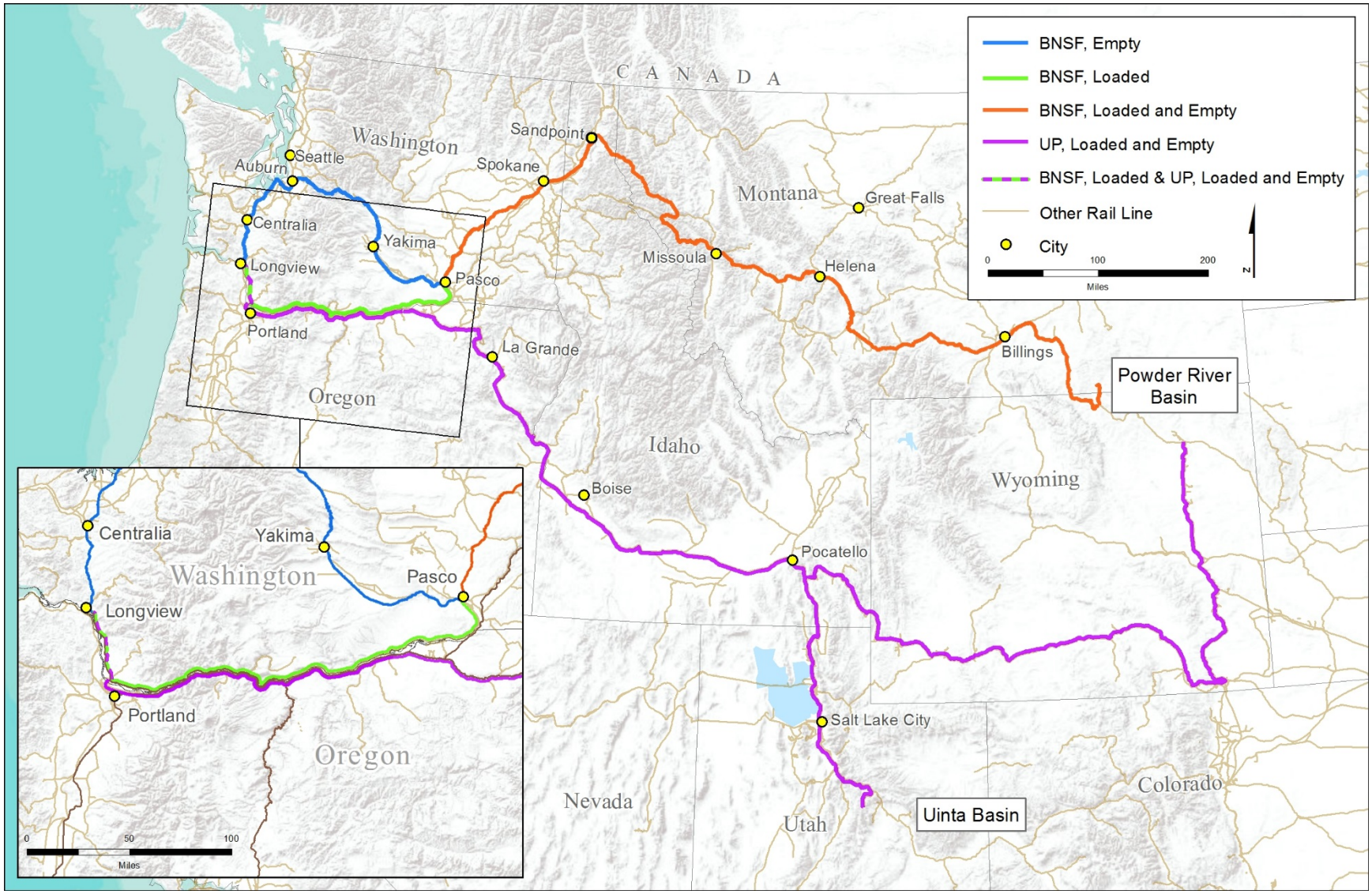
3.1.1 Proposed Action

Potential impacts on rail safety from the Proposed Action are described below.

3.1.1.1 Construction: Direct Impacts

As described previously, under the rail construction scenario, trains transporting construction materials would travel to and from the project area. Any accidents would be related to construction activities in the project area and would not result in a rail safety direct impact on the Reynolds Lead, BNSF Spur, or BNSF main line routes.

Figure 3. BNSF and Union Pacific Routes to and from the Project Area



3.1.1.2 Construction: Indirect Impacts

Construction of would result in the following indirect impacts.

Increase the Potential for Train Accidents

The Applicant has indicated materials needed for construction could be delivered by rail. This would require an estimated 350 loaded trains of 100 rail cars each to deliver rock. There would also be the same number of empty trains returning. All rail traffic would use the Reynolds Lead and BNSF Spur. Because the specific routes that would be used by Proposed Action-related trains are not known, a conservative estimate was used. The expected routes in Washington State for Proposed Action-related trains during operations were used to illustrate the possible range of accident frequencies for rail transportation of construction materials.

It is anticipated two-thirds of the rock would be transported during the first year of construction (2018), which would amount to approximately 467 one-way train trips (half loaded, half empty; an average of 1.3 trains per day). The numbers of accidents were predicted using the rates described in Section 2.1.2.1, *Accident Frequency,* and are presented in Table 5 for the major route segments.

Table 5. Predicted Construction Train Accidents during Peak Year of Construction

Segment	Length (miles)	Predicted Train Accidents[a]
Loaded Trains (Inbound Route)		
Idaho/Washington Line to Spokane, WA	18.6	0.03
Spokane, WA to Pasco, WA	145.5	0.27
Pasco, WA to Vancouver, WA	221.4	0.41
Vancouver, WA to Longview Junction, WA	34.8	0.07
Longview Junction, WA to LVSW Yard	2.1	0.01
LVSW Yard to Project Area	5.0	0.03
Empty Trains (Outbound Route)		
Project Area to LVSW Yard	5.0	0.03
LVSW Yard to Longview Junction, WA	2.1	0.01
Longview Junction, WA to Auburn, WA	118.6	0.22
Auburn, WA to Yakima, WA	139.6	0.26
Yakima, WA to Pasco, WA	89.4	0.17
Pasco, WA to Spokane, WA	145.5	0.27
Spokane, WA to Idaho/Washington Line	18.6	0.03

Notes:
[a] Accidents related to the construction of the Proposed Action; these would be additive to the baseline results.

Proposed Action-related construction rail traffic would have a relatively small increase on predicted train accidents.

3.1.1.3 Operations: Direct Impacts

During operations at full terminal capacity, 8 loaded trains would travel to the project area, and 8 empty trains would travel from the project area on average per day. These trains would maneuver along the rail loop in the project area. The predicted accident frequency within the project area was

not analyzed because the rail loop is in an industrial facility. Any rail accidents in the project area would be related to overall operations of the coal export terminal and would not affect rail safety on the Reynolds Lead, BNSF Spur, or BNSF main line.

3.1.1.4 Operations: Indirect Impacts

Operation of the Proposed Action would result in the following indirect impacts.

Increase the Potential for Train Accidents

The Proposed Action would yield predicted accidents per year. The predicted numbers are based on nationwide accident rates as described in Section 2.1, *Methods*; however, only inbound accidents would involve loaded trains. In addition, some accidents might involve standing derailments of a few rail cars.

The predicted accident frequencies on the Reynolds Lead and BNSF Spur in 2028 are shown in Table 6. The analysis is based on 8 loaded inbound trains per day and 8 empty outbound trains per day. As described previously, if the Reynolds Lead and BNSF Spur are not improved to Class 2 standards, the estimates for the Reynolds Lead and BNSF Spur would increase by roughly a factor of 1.5 to 3.

Table 6. Predicted Train Accidents per Year by Scenario

Segment	Length (miles)	Proposed Action-Related Trains 2028[a]	Baseline 2028
Loaded Trains (Inbound Route)			
Idaho/Washington Line to Spokane, WA	18.6	0.22	2.88
Spokane, WA to Pasco, WA	145.5	1.70	11.90
Pasco, WA to Vancouver, WA	221.4	2.59	15.52
Vancouver, WA to Longview Junction, WA	34.8	0.41	3.71
Longview Junction, WA to LVSW Yard	2.1	0.07	0.06
LVSW Yard to Project Area	5.0	0.18	0.04
Empty Trains (Outbound Route)			
Project Area to LVSW Yard	5.0	0.18	0.04[b]
LVSW Yard to Longview Junction, WA	2.1	0.07	0.06[b]
Longview Junction, WA to Auburn, WA	118.6	1.39	12.64
Auburn, WA to Yakima, WA	139.6	1.63	2.24
Yakima, WA to Pasco, WA	89.4	1.04	1.44
Pasco, WA to Spokane, WA	145.5	1.70	11.90[b]
Spokane, WA to Idaho/Washington Line	18.6	0.22	2.88[b]

Notes:
[a] Additive to Baseline 2028 results.
[b] Due to overlap of inbound and outbound routes on these segments, avoid double counting Baseline 2028 results in totals.

The predicted number of accidents on the Reynolds Lead and BNSF Spur is 0.25 accident per year for the loaded Proposed Action-related trains and 0.25 accident per year for empty Proposed Action-related trains. This is roughly one accident for each type of train (inbound and outbound) every 4 years. When added to the estimated 2028 baseline results, this suggests the Proposed

Action–related traffic would increase the chance of an accident from 0.11 accident per year to 0.61 accident per year for all traffic, inbound and outbound.

If a different route than those analyzed in this report were to be used, the number of estimated accidents per year could be calculated based on the trains per year on a particular segment multiplied by the length of the segment multiplied by the Track Class 3 accident rate of four per million train miles. If all inbound and outbound Proposed Action-related trains traveled through the Columbia River Gorge, the outbound accident frequencies would be the same as the inbound accident frequencies shown in Table 6 for the Proposed Action. If all inbound and outbound Proposed Action-related trains traveled across Stampede Pass, the inbound accidents frequencies would be the same as the outbound accident frequencies shown in Table 6 for the Proposed Action.

Not every accident of a loaded train would result in a coal spill. A collision or derailment could involve only a few rail cars or lead to a greater number of rail cars being derailed in certain circumstances. Not all rail cars that derail would end up in a position where some or all of their contents could be spilled, depending on the nature of the accident (such as size, speed, and terrain). As a result, a range of spill sizes could potentially occur from loaded trains, with smaller spills more likely than larger spills. In addition, spills on the Reynolds Lead or BNSF Spur would be expected to be small given the lower operating speeds, which yield less energetic collisions and derailments, and therefore fewer rail cars derailing and even fewer releasing cargo.

Available data (Liu et al. 2012) indicate that while the average number of rail cars derailed on main line track (all classes and speeds) for 2001 through 2010 was 8.4 cars, the number of rail cars on yard, siding, and industry track ranged from 4.3 to 5.7 rail cars. These types of track provide an indication of the consequences of derailments at very low speeds.

Cowlitz County Operations Impacts

Table 6 can also be used to determine the predicted frequency of accidents within Cowlitz County. In addition to the Reynolds Lead and BNSF Spur track, 51.6% of the route from Vancouver to Longview Junction, and 18% of the route from Longview Junction to Auburn are within Cowlitz County. The predicted numbers of annual accidents described below include all the track within Cowlitz County, including the Reynolds Lead and BNSF Spur track.

The predicted number of loaded Proposed Action-related train accidents is 0.46 per year, or roughly one every 2 years, recognizing that accidents do not necessarily involve spills. The predicted number of empty Proposed Action-related train accidents is slightly higher, at 0.50 per year, due to the greater number of miles within Cowlitz County on the return route.

The 2028 baseline traffic for the inbound and outbound routes in Cowlitz County has roughly 4.30 predicted accidents per year. The number of predicted accidents per year increases to 5.25 with Proposed Action-related trains, showing the smaller relative contribution of the project trains to overall rail safety when the other rail shipments on the routes are included.

Statewide Operations Impacts

Table 6 can also be used to determine the predicted frequency of accidents on the rail lines within Washington State, including Cowlitz County and the Reynolds Lead and BNSF Spur. When looking at outbound trains, the first two inbound segments within the state are also traveled, albeit in the opposite direction; the associated accident frequencies should not be double counted.

The predicted number of operations-related loaded Proposed Action-related train accidents within Washington State is 5.16 per year, again recognizing that not all accidents involve spills. The number of empty Proposed Action-related train accidents is higher, at 6.23 per year, due to the greater length of the return route.

When inbound and outbound accidents related to the Proposed Action are added to the total baseline traffic (for 2028), predicted accidents increase from 50.43 accidents per year to 61.81 accidents per year, showing the smaller relative contribution of Proposed Action-related trains to overall rail safety when the other shipments on the routes are included.

3.1.2 No-Action Alternative

Under the No-Action Alternative, the Applicant would not construct the coal export terminal. The Applicant would continue with current and proposed future increased operations in the project area. The project area could be developed for other industrial uses including an expanded bulk product terminal. The Applicant has indicated that, over the long term, it would expand the existing bulk product terminal and develop new facilities to handle more products such as calcine petroleum coke, coal tar pitch, and cement.

The No-Action Alternative would increase rail traffic by approximately 2 trains per day; therefore, the predicted number of accidents would be lower than the Proposed Action and higher than the baseline conditions (Table 6). Various types of rail cars would be needed for the range of expected cargoes. No-Action Alternative-related rail traffic would have various cargoes (mixed-load train). The potential for a mixed-load train derailment or accident on the Reynolds Lead or BNSF Spur would be lower than a unit train because mixed-load trains would not have as many rail cars as a unit train.

3.2 Mitigation

Based on the findings in this technical report, the co-lead agencies (Cowlitz County and Washington State Department of Ecology) developed potential Applicant mitigation measures. The SEPA Draft Environmental Impact Statement presents these mitigation measures.

Chapter 4
Permits

No permits related to rail safety would be required for the construction or operation of the Proposed Action.

Chapter 5
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Appendix A

Rail Safety Data

This appendix summarizes the rail accident data used in the rail safety analysis.

Observed Accident Rates

Rail accident data available from the Federal Railroad Administration (FRA) were used as the initial basis for the rail safety and accident analysis. The specific data analyzed were for 2012 through 2014, with the data compiled in 2015 (Federal Railroad Administration 2015), the most recent available data when the analysis was completed.

The following image shows the raw data as it appears in the FRA database for all railroads. FRA data includes accident counts at the state and county levels, but accident rates are calculated on a nationwide basis. The data of interest to the analysis are the total year rates for 2012, 2013, and 2014. The rates are per million train miles.

4/8/2015 Print

ACCIDENTS IN DESCENDING FREQUENCY BY CAUSE (By CALENDAR YEAR)
IMPORTANT: Rates calculated are National Level - they do not display for Region or State Geography

Selections: Railroad - All Railroads
State - All States County - All Counties
All Regions
All Causes / All Types of Accidents
All Track Types / All Track Classes
CALENDAR YEAR - 2015
Reporting Level - ALL
End Month of Report - December

	Total		Total Year Counts			Total Year Rates			YTD Counts Jan - Dec		% Change Over Time			YTD Rates To Dec	
	Accs	Pct of Total	2012	2013	2014	2012	2013	2014	2014	2015	2012 to 2014	2013 to 2014	To Dec 2014 2015	2014	2015
-----GRAND TOTAL.....	5,480	100.0	1,760	1,822	1,736	2.41	2.43	2.27	1,736	162	-1.4	-4.7	-90.7	2.27	2.58

The following two figures show the extracted data for BNSF Railway Company (BNSF) and Union Pacific Railroad (UP) for all track classes.

4/3/2015 Print

ACCIDENTS IN DESCENDING FREQUENCY BY CAUSE (By CALENDAR YEAR)
IMPORTANT: Rates calculated are National Level - they do not display for Region or State Geography

Selections: Railroad - BNSF Rwy Co. [BNSF]
State - All States County - All Counties
All Regions
All Causes / All Types of Accidents
All Track Types / All Track Classes
CALENDAR YEAR - 2015
Reporting Level - INDIVIDUAL
End Month of Report - December

	Total		Total Year Counts			Total Year Rates			YTD Counts Jan - Dec		% Change Over Time			YTD Rates To Dec	
	Accs	Pct of Total	2012	2013	2014	2012	2013	2014	2014	2015	2012 to 2014	2013 to 2014	To Dec 2014 2015	2014	2015
-----GRAND TOTAL.....	1,178	100.0	397	390	359	2.20	2.11	1.89	359	32	-9.6	-7.9	-91.1	1.89	2.42

4/3/2015 Print

2.09 - Train Accidents and Rates

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ACCIDENTS IN DESCENDING FREQUENCY BY CAUSE (By CALENDAR YEAR)
******IMPORTANT: Rates calculated are National Level - they do not display for Region or State Geography******

Selections: Railroad - Union Pacific RR Co. [UP]
State - All States County - All Counties
All Regions
All Causes / All Types of Accidents
All Track Types / All Track Classes
CALENDAR YEAR - 2015
Reporting Level - INDIVIDUAL
End Month of Report - December

	Total		Total Year Counts			Total Year Rates			YTD Counts Jan - Dec		% Change Over Time			YTD Rates To Dec	
	Accs	Pct of Total	2012	2013	2014	2012	2013	2014	2014	2015	2012 to 2014	2013 to 2014	To Dec 2014 2015	2014	2015
-----GRAND TOTAL.....	1,538	100.0	506	501	489	3.04	3.02	2.82	489	42	-3.4	-2.4	-91.4	2.82	3.01

The analysis compared the historic rates (in accidents per million train miles) for all railroads with rates specific to BNSF and UP as the first step in determining the appropriate accident rates for the Proposed Action (Table 1). The data Table 1 summarize the outputs from the FRA database.

Table 1. Train Accident Rates

	Accident Rate per Million Train Miles (FRA 2015)		
Year	**All Railroads**	**BNSF**	**UP**
2012	2.41	2.20	3.04
2013	2.43	2.11	3.02
2014	2.27	1.89	2.82

As shown in Table 1, BNSF's accident rates are similar to but lower (less frequent) than the average for all railroads. UP had slightly higher accident rates than BNSF. The Longview Switching Company (operator of the Reynolds Lead and BNSF Spur) did not have any data in the FRA database for 2012 through 2014; that is there were no train accidents experienced in this time period on the Reynolds Lead or BNSF Spur. Because Proposed Action-related rail traffic in Washington State would be on BNSF lines, a rate of 2 accidents per million train miles (the national average for BNSF over the last 2 years) was used as the starting point of the accident analysis. Specific accident rates for BNSF in Washington State were not available. These data were then supplemented with data from analyses by Liu et al. (2011) and Anderson and Barkan (2004), as these give derailment rates by track class.

Observed Accident Counts

In addition to extracting the nationwide accident rates from the FRA database, the analysis also included data on mainline accidents in Cowlitz County and Washington State with and without injuries and fatalities as an indicator of potential accident severity. The data extracted from the database are presented in Figure 1.

Figure 1. Washington State Accident Counts—All Railroads (2014)

Acc Nbr	Rpt RR	Report Number	Kld/Inj	Mo	Day	ST	County	Type Track	Trk Maint	Type Acc	Pri Cause	Cont Cause	Equip Damage	Track Damage	Kld	Inj	RR Equip	Spd Mph	Locos Der	Cars Der
1	ATK	131208	55A	01	06	WA	KING	Main	ATK	Der	T311		28,765	3,000	0	0	PASSENGER TRAIN	012	1	0
2	BNSF	NW0114106	55A	01	13	WA	KING	Main	BNSF	Der	E62C		10,296	125,161	0	0	FREIGHT TRAIN	058	0	2
3	TMBL	02042014A	55A	02	04	WA	PIERCE	Yard	PTOZ	Oth	M402	H307	15,000	0	0	0	YARD/SWITCHING	010	0	0
4	BNSF	NW0214105	55A	02	10	WA	KING	Industry	BNSF	Der	H307	H702	13,432	2,500	0	0	YARD/SWITCHING	005	0	1
5	BNSF	NW0214110	55A	02	16	WA	SPOKANE	Yard	BNSF	Der	H312		9,606	3,672	0	0	YARD/SWITCHING	004	0	1
6	TMBL	03012014A	55A	03	01	WA	PIERCE	Yard	TMBL	Oth	H021	H318	15,000	0	0	0	YARD/SWITCHING	002	0	0
7	BNSF	NW0314104	55A	03	10	WA	DOUGLAS	Main	BNSF	Der	E69C		4,278	280,000	0	0	FREIGHT TRAIN	054	0	1
8	BNSF	NW0414101	55A	04	03	WA	COWLITZ	Main	BNSF	Oth	S011		0	17,200	0	0	FREIGHT TRAIN	005	0	0
9	PSAP	PSA558914D	55A	04	29	WA	GRAYS HARBOR	Main	PSAP	Der	T110		126,000	26,000	0	0	FREIGHT TRAIN	005	0	6
10	PSAP	PSA563914D	55A	05	09	WA	GRAYS HARBOR	Main	PSAP	Der	T111		44,700	60,000	0	0	FREIGHT TRAIN	005	0	7
11	BNSF	NW0514106	55A	05	11	WA	COWLITZ	Yard	BNSF	Der	H704		2,200	14,812	0	0	FREIGHT TRAIN	010	0	11
12	PSAP	PSA567314D	55A	05	15	WA	GRAYS HARBOR	Main	PSAP	Der	T109		350,000	189,450	0	0	FREIGHT TRAIN	010	0	11
13	PSAP	PSA570414D	55A	05	21	WA	LEWIS	Yard	PSAP	Der	M599		5,000	69,000	0	0	YARD/SWITCHING	004	0	11
14	BNSF	NW0614102	55A	06	06	WA	PIERCE	Yard	BNSF	Coll	H307		20,559	0	0	0	YARD/SWITCHING	005	0	0
14	BNSF	NW0614102	55A	06	06	WA	PIERCE	Yard	BNSF	Coll	H307		500	0	0	0	YARD/SWITCHING	000	0	0
15	ATK	133106	55A	06	09	WA	LEWIS	Main	BNSF	Oth	M308		1,632	0	0	1	PASSENGER TRAIN	053	0	0
15	BNSF	NW0614200	55A	06	09	WA	LEWIS	Main	BNSF	Oth	M308		0	10,000	0	0	NOT RPD OR N/A	000	0	0
16	BNSF	NW0614109	55A	06	13	WA	KING	Yard	BNSF	Coll	H607		80,000	0	0	0	YARD/SWITCHING	007	1	0
16	BNSF	NW0614109	55A	06	13	WA	KING	Yard	BNSF	Coll	H607		45,514	20,500	0	0	YARD/SWITCHING	008	0	1
17	BNSF	NW0614123	55A	06	27	WA	CLARK	Yard	BNSF	Coll	H318		31,646	0	0	0	YARD/SWITCHING	010	0	0
17	BNSF	NW0614123	55A	06	27	WA	CLARK	Yard	BNSF	Coll	H318		25,143	0	0	0	YARD/SWITCHING	005	0	1
18	BNSF	NW0714105	55A	07	06	WA	SPOKANE	Yard	BNSF	Der	H524	H523	8,412	1,000	0	0	YARD/SWITCHING	010	0	8
18	BNSF	NW0714105	55A	07	06	WA	SPOKANE	Yard	BNSF	Der	H524	H523	2,576	0	0	0	CUT OF CARS	000	0	2
19	BNSF	NW0714109	55A	07	09	WA	BENTON	Main	BNSF	Der	T109		101,465	56,000	0	0	FREIGHT TRAIN	037	0	3
20	BNSF	NW0714102	55A	07	17	WA	SNOHOMISH	Yard	BNSF	Der	H607	H702	6,500	7,100	0	0	YARD/SWITCHING	005	0	4
21	BNSF	NW0714116	55A	07	24	WA	KING	Main	BNSF	Der	E65L		62,316	143,500	0	0	FREIGHT TRAIN	005	1	4
22	BNSF	NW0814106	55A	08	01	WA	SPOKANE	Yard	BNSF	Coll	H021		5,360	0	0	0	FREIGHT TRAIN	003	0	4
22	BNSF	NW0814106	55A	08	01	WA	SPOKANE	Yard	BNSF	Coll	H021		5,156	0	0	0	CUT OF CARS	005	0	1
23	TMBL	08152014A	55A	08	15	WA	THURSTON	Main	TMBL	Oth	M503		14,599	25,000	0	0	FREIGHT TRAIN	008	0	0
24	BNSF	NW0814122	55A	08	29	WA	PIERCE	Yard	BNSF	Oth	H318		9,305	0	0	0	CUT OF CARS	002	0	0
24	BNSF	NW0814122	55A	08	29	WA	PIERCE	Yard	BNSF	Oth	H318		2,200	0	0	0	YARD/SWITCHING	005	0	0
25	BNSF	NW0914101	55A	09	13	WA	CLARK	Yard	BNSF	Coll	H307		10,366	0	0	0	YARD/SWITCHING	008	0	0
25	BNSF	NW0914101	55A	09	13	WA	CLARK	Yard	BNSF	Coll	H307		10,200	0	0	0	LIGHT LOCO(S)	004	0	0
26	BNSF	NW0914107	55A	09	21	WA	FRANKLIN	Yard	BNSF	Coll	H306		77,159	11,156	0	0	FREIGHT TRAIN	010	0	0
26	BNSF	NW0914107	55A	09	21	WA	FRANKLIN	Yard	BNSF	Coll	H306		40,000	0	0	0	YARD/SWITCHING	002	0	0
27	BNSF	NW1114103	55A	11	04	WA	CHELAN	Yard	BNSF	Der	T207		11,726	5,000	0	0	FREIGHT TRAIN	008	0	5
28	BNSF	NW1114111	55A	11	11	WA	KING	Yard	BNSF	Der	M411		7,818	3,000	0	0	YARD/SWITCHING	010	0	3
29	BNSF	NW1114114	55A	11	13	WA	SPOKANE	Yard	BNSF	Der	H525		20,979	7,000	0	0	FREIGHT TRAIN	004	0	4
30	BNSF	NW1114200	55A	11	20	WA	LEWIS	Main	BNSF	Oth	M304		15,000	1,100	0	0	FREIGHT TRAIN	038	0	0
31	BNSF	NW1114201	55A	11	24	WA	SPOKANE	Main	BNSF	Oth	M303		15,000	0	0	1	MAINTENANCE CAR	005	0	0
32	BNSF	NW1214100	55A	12	03	WA	KING	Industry	XGNW	Der	M101		15,043	1,000	0	0	YARD/SWITCHING	004	0	6
33	BNSF	NW1214104	55A	12	07	WA	SPOKANE	Yard	BNSF	Coll	H306		8,295	0	0	0	YARD/SWITCHING	003	0	0
33	BNSF	NW1214104	55A	12	07	WA	SPOKANE	Yard	BNSF	Coll	H306		3,202	0	0	0	YARD/SWITCHING	003	0	0
34	BNSF	NW1214105	55A	12	09	WA	CLARK	Yard	BNSF	Oth	H702		0	40,945	0	0	LIGHT LOCO(S)	002	0	0
35	BNSF	NW1214107	55A	12	12	WA	KING	Yard	BNSF	Der	H318		17,124	1,000	0	0	YARD/SWITCHING	010	0	3
36	BNSF	NW1214109	55A	12	12	WA	SPOKANE	Yard	BNSF	Der	H312		19,199	0	0	0	YARD/SWITCHING	004	0	2

Based on the FRA data (2015), there were two accidents in Cowlitz County in 2014 (accidents 8 and 11 in Figure 1) and neither involved an injury or fatality. One incident was in a yard and the other involved a derailment of 11 rail cars on main line track. For Washington State, there were 36 accidents in 2014, two of which had an injury involved. Thirteen accidents were on main line track, the rest were in yards or on industry track. Derailments had 0 to 11 rail cars involved. Table 2 illustrates UTC data for crashes that occurred at highway rail grade crossings and along railroad rights-of-way in Washington State.

Table 2. Washington State Rail Crash Statistics

Year	Crossing Collisions	Crossing Injuries	Crossing Fatalities	Trespass Fatalities
2012	33	18	2	10
2013	20	10	4	17
2014	35	10	5	9

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Millennium Bulk Terminals—Longview SEPA Environmental Impact Statement

SEPA Vehicle Transportation Technical Report

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Acronyms and Abbreviations

AADT	annual average daily traffic
ADT	average daily traffic
AMR	American Medical Response
Applicant	Millennium Bulk Terminals—Longview, LLC
BNSF	BNSF Railway Company
CFR	Code of Federal Regulations
Corps	U.S. Army Corps of Engineers
County	Cowlitz County
EMS	emergency medical services
EMT	emergency medical technician
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
LOS	level of service
LVSW	Longview Switching Company
mph	miles per hour
NEPA	National Environmental Policy Act
NORPAC	North Pacific Paper Corporation
RCW	Revised Code of Washington
Reynolds facility	Reynolds Metal Company facility
SEPA	Washington State Environmental Policy Act
SR	State Route
UP	Union Pacific Railroad
USC	United States Code
USDOT	U.S. Department of Transportation
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation
WUTC	Washington Utilities and Transportation Commission

Chapter 1
Introduction

This technical report assesses the potential vehicle transportation impacts of the proposed Millennium Bulk Terminals—Longview project (Proposed Action) and No-Action Alternative. This report describes the regulatory setting, establishes the method for assessing potential vehicle transportation impacts, presents the historical and current vehicle transportation conditions in the study area, and assesses potential impacts.

1.1 Project Description

Millennium Bulk Terminals—Longview, LLC (Applicant) proposes to construct and operate a coal export terminal in Cowlitz County, Washington, along the Columbia River (Figure 1). The coal export terminal would receive coal from the Powder River Basin in Montana and Wyoming and the Uinta Basin in Utah and Colorado via rail, then load and transport the coal by ocean-going ships via the Columbia River and Pacific Ocean to overseas markets in Asia. The coal export terminal would be capable of receiving, stockpiling, blending, and loading coal by conveyor onto ships for export. Construction of the coal export terminal would begin in 2018. For the purpose of this analysis, it is assumed the coal export terminal would operate at full capacity in 2028.

The following subsections present a summary of the Proposed Action and No-Action Alternative. For detailed information on these alternatives, see the Washington State Environmental Policy Act (SEPA) Alternatives Technical Report (ICF International 2016).

1.1.1 Proposed Action

The Proposed Action would develop a coal export terminal on 190 acres (project area). The project area is located within an existing 540-acre area currently leased by the Applicant at the former Reynolds Metals Company facility (Reynolds facility), and land currently owned by Bonneville Power Administration. The project area is adjacent to the Columbia River in unincorporated Cowlitz County, Washington near Longview city limits (Figure 2).

The Applicant currently and separately operates, and would continue to separately operate, a bulk product terminal on land leased by the Applicant. Industrial Way (State Route [SR] 432) provides vehicular access to the Applicant's leased land. The Reynolds Lead and the BNSF Spur, both operated by Longview Switching Company (LVSW),[1] provide rail access to the Applicant's leased area from a point on the BNSF Railway Company (BNSF) main line (Longview Junction, Washington) located to the east in Kelso, Washington. Ships access the Applicant's leased area via the Columbia River and berth at an existing dock (Dock 1) operated by the Applicant in the Columbia River.

[1] LVSW is jointly owned by BNSF Railway Company (BNSF) and Union Pacific Railroad (UP).

Figure 1. Project Vicinity

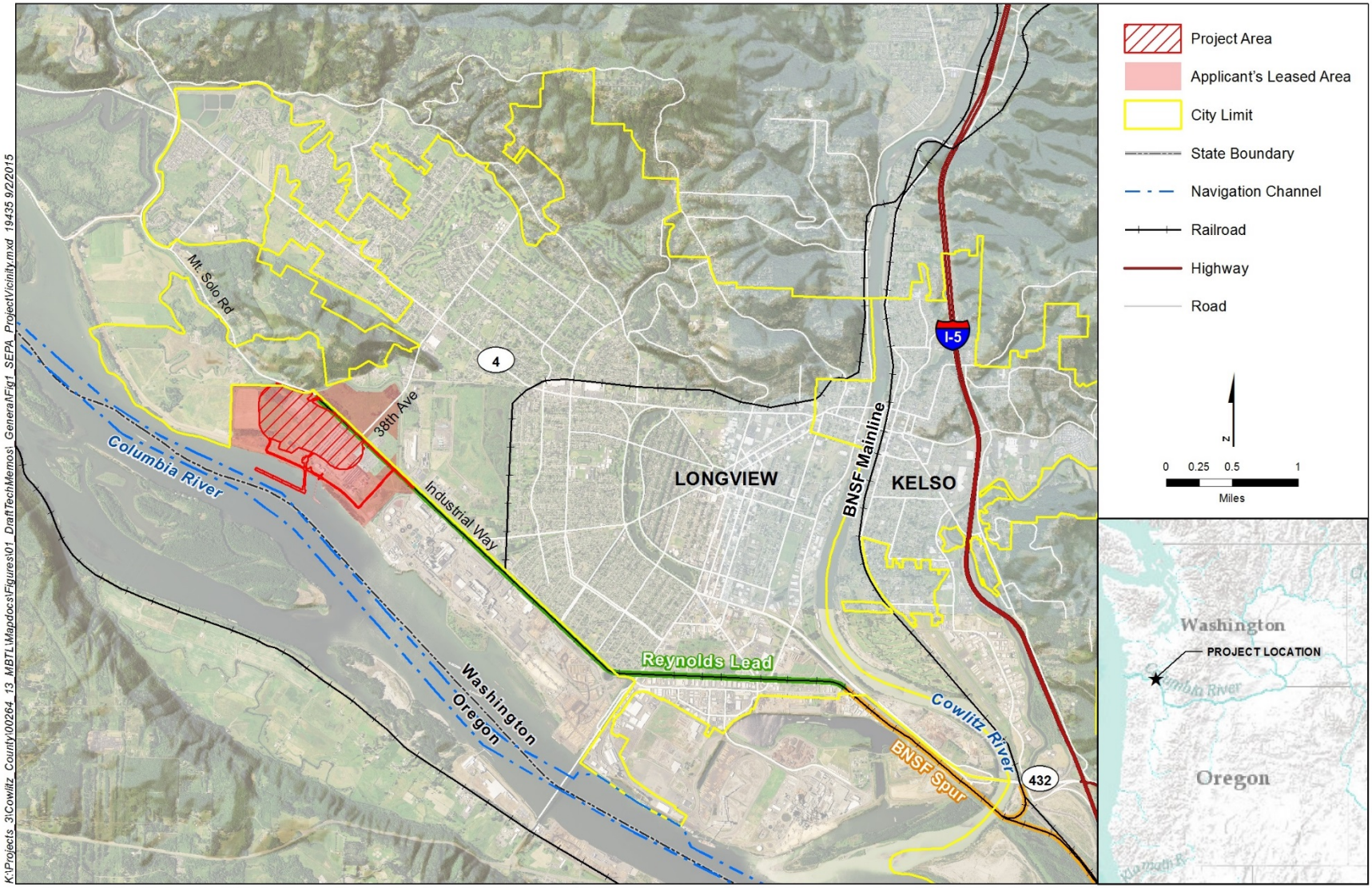
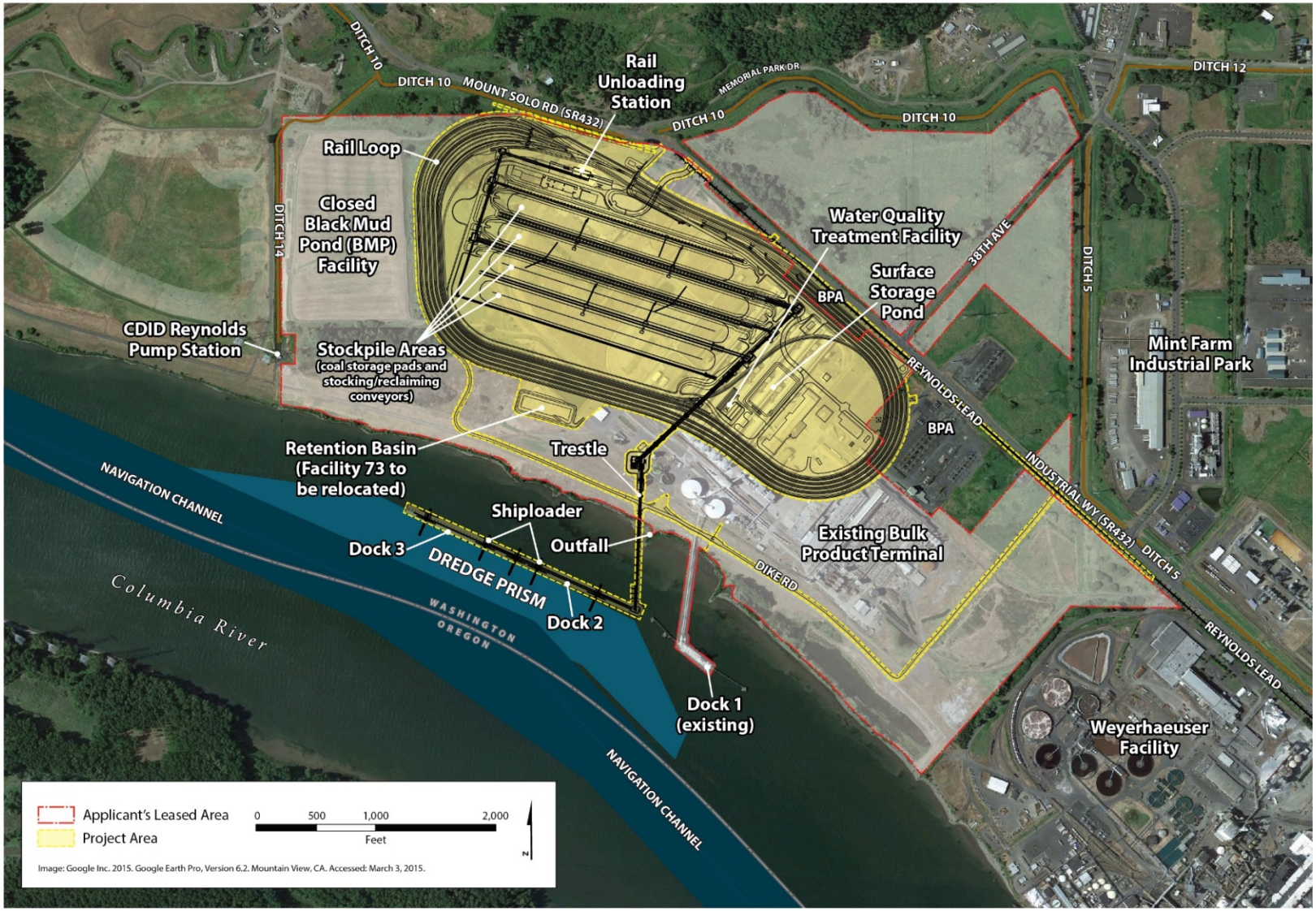


Figure 2. Proposed Action



Under the Proposed Action, BNSF or Union Pacific Railroad (UP) trains would transport coal in rail cars from the BNSF main line at Longview Junction, Washington, to the project area via the BNSF Spur and Reynolds Lead. Coal would be unloaded from rail cars, stockpiled and blended, and loaded by conveyor onto ocean-going ships at two new docks (Docks 2 and 3) on the Columbia River for export.

Once construction is complete, the Proposed Action would have an annual throughput capacity of up to 44 million metric tons.[2] The coal export terminal would consist of one operating rail track, eight rail tracks for the storage of rail cars, rail car unloading facilities, stockpile areas for coal storage, conveyor and reclaiming facilities, two new docks in the Columbia River (Docks 2 and 3), and ship-loading facilities on the two docks. Dredging of the Columbia River would be required to provide access to and from the Columbia River navigation channel and for berthing at the two new docks.

Vehicles would access the project area from Industrial Way (SR 432). Ships would access the project area via the Columbia River and berth at one of the two new docks. Terminal operations would occur 24 hours per day, 7 days per week. The coal export terminal would be designed for a minimum 30-year period of operation.

1.1.2 No-Action Alternative

Under the No-Action Alternative, the proposed export terminal would not be constructed. Current operations of the bulk product terminal, which include the storage and transport of alumina and up to 150,000 metric tons per year of coal. Importing of alumina would continue and increase in the project area using Dock 1. The Applicant could expand the existing bulk product terminal onto the 190-acre project area, developing storage and shipment facilities to bulk product terminal operations. Coal and alumina would continue to be stored, transferred, and shipped. Additional bulk product transfers activities involving products such as calcine pet coke, coal tar pitch, cement, fly ash, and sand or gravel could also be pursued, and new or revised permits could be required. These operations would involve storage and upland transfer of bulk products, which would use existing or new buildings. Construction of new buildings could involve demolition and replacement of existing buildings and new or modified permits. Any new construction would be limited to uses allowed under existing Cowlitz County development regulations and federal and state permits.

1.2 Regulatory Setting

Different jurisdictions are responsible for the regulation of highway/rail grade crossings. These jurisdictions and their regulations, statutes, and guidance that apply to grade crossings are summarized in Table 1.

[2] A metric ton is the U.S. equivalent to a tonne per the International System of Units, or 1,000 kilograms or approximately 2,204.6 pounds.

Table 1. Regulations, Statutes, and Guidelines for Highway/Rail Grade Crossings

Regulation, Statute, Guideline	Description
Federal	
National Environmental Policy Act (42 USC 4321 *et seq*.)	Requires the consideration of potential environmental effects. NEPA implementation procedures are set forth in the President's Council on Environmental Quality's Regulations for Implementing NEPA (49 CFR 1105).
Federal Railroad Safety Act of 1970	Gives FRA rulemaking authority over all areas of rail line safety. FRA has designated that state and local law enforcement agencies have jurisdiction over most aspects of highway/rail grade crossings, including warning devices and traffic law enforcement.
Highway Safety Act and the Federal Railroad Safety Act	Gives FHWA and FRA regulatory jurisdiction over safety at federal highway/rail grade crossings. USDOT has promulgated rules addressing grade-crossing safety and provides funding for installation and improvement of warning devices. All traffic control devices installed at railroad facilities involving federal aid projects must comply with 23 CFR 655F. On certain projects where federal funds are used for the installation of warning devices, those devices must include automatic gates and flashing light signals. FRA has issued rules that impose minimum maintenance, inspection, and testing standards for at-grade crossing warning devices for highway/rail grade crossings on federal highways and state and local roads (49 CFR 234–236).
Railroad-Highway Grade Crossing Handbook (Federal Highway Administration 2007); *Manual on Uniform Traffic Control Devices* (23 USC 109(d))	Guidance document on grade-crossing safety issues, including the selection and placement of warning devices and enforcement of traffic laws. Provides guidelines for traffic control devices that consider delay, roadway classification, average daily traffic, number of trains per day, and train speed at grade crossings.
State	
Washington State Environmental Policy Act (197-11 WAC, RCW 43.21C)	Requires state and local agencies in Washington to identify potential environmental impacts that could result from governmental decisions.
Washington State Department of Transportation, Design Manual M 22.01.10, November 2015, Chapter 1350, Railroad Grade Crossings	Sets forth requirements and guidance on the design and treatment of state highway-rail grade crossings.
Motor Vehicles, Rules of the Road (RCW 46.61.340)	Sets forth that train traffic has the right-of-way at grade crossings.
Washington Utilities and Transportation Commission	Inspects and issues violations for hazardous materials shipments; track, signal, and train control; and rail operations. WUTC also regulates the construction, closure, or modification of public railroad crossings. In addition, WUTC inspects and issues defect notices if a crossing does not meet minimum standards. However, WUTC has no jurisdiction over public crossings in first-class cities.[a]

Regulation, Statute, Guideline	Description
Local	
Cowlitz County SEPA Regulations (CCC 19.11)	Provide for the implementation of SEPA in Cowlitz County.
Railroad Trains Not to Block Streets (LMC 11.40.080)	Prohibits trains from using any street or highway for a period of time longer than five minutes, except trains or cars in motion other than those engaged in switching activities.

Notes:
[a] Per RCW 35.01.01, a first-class city is a city with a population of 10,000 or more at the time of organization or reorganization that has adopted a charter.
USC = United States Code; NEPA = National Environmental Policy Act; CFR = Code of Federal Regulations; Corps = U.S. Army Corps of Engineers; FRA = Federal Railroad Administration; FHWA = Federal Highway Administration; USDOT = U.S. Department of Transportation; WAC = Washington Administrative Code; RCW = Revised Code of Washington; WUTC = Washington Utilities and Transportation Commission; SEPA = Washington State Environmental Policy Act; CCC = Cowlitz County Code; LMC = Longview Municipal Code

1.3 Study Area

The study area for direct impacts is the project area. The study area for indirect impacts is active public and private at-grade crossings within Cowlitz County on the Reynolds Lead and BNSF Spur, and all at-grade public crossings on the BNSF main line. A review of selected at-grade crossings along the BNSF main line in Washington State is also considered.

1.3.1 Study Crossings

The analysis focused on 17 at-grade railroad crossings along the Reynolds Lead, BNSF Spur, and BNSF main line in Cowlitz County.

1.3.1.1 Reynolds Lead and BNSF Spur Study Crossings

The following identifies the study crossings along the Reynolds Lead and BNSF Spur in the study area. Although the project area is in Cowlitz County, all of the at-grade crossings are in the City of Longview.

- Project area access at 38th Avenue, just south of Industrial Way (SR 432), milepost 3.30.
- Weyerhaeuser Access at Washington Way, just south of SR 432 milepost 4.43.
- Weyerhaeuser North Pacific Paper Corporation (NORPAC) Access, just south of SR 432 milepost 4.76.
- Industrial Way (SR 432), milepost 5.90, just west of Oregon Way (SR 433).
- Oregon Way, 300 feet north of the Industrial Way/Oregon Way intersection.
- California Way, 460 feet north of Industrial Way.
- 3rd Avenue (SR 432), milepost 7.19, just north of the 3rd Avenue/Industrial Way intersection.
- Dike Road, just south of Tennant Way (SR 432).

1.3.1.2 BNSF Main Line Study Crossings

The following identifies the study crossings along the BNSF main line in Cowlitz County (all public road/rail at-grade crossings along the BNSF main line in Cowlitz County).

- Taylor Crane Road, 50 feet west of Barnes Drive in Castle Rock.
- Cowlitz Street, 350 feet west of Pioneer Avenue in Castle Rock.
- Cowlitz Gardens Road, west of Pacific Avenue in Kelso.
- Mill Street, west of 1st Avenue in Kelso.
- S River Road, west of Pacific Avenue in Kelso.
- Toteff Road/Port Road in Kalama.
- W Scott Avenue, 650 feet east of Pekin Road in Woodland.
- Davidson Avenue, east of Pekin Road in Woodland.
- Whalen Road, east of Kuhnis Road in Woodland.

1.3.1.3 Statewide Crossings

A review of selected at-grade crossings identified by the Washington State Department of Transportation (WSDOT) on the BNSF main line beyond Cowlitz County was also conducted. These statewide study crossings are at-grade state highway crossings or at-grade crossings near state highways.

Chapter 2
Existing Conditions

This chapter describes the methods for assessing the existing conditions and determining impacts in the study area as they pertain to vehicle transportation.

2.1 Methods

This section describes the sources of information and methods used to characterize the existing conditions and assess the potential impacts of the Proposed Action and No-Action Alternative on vehicle transportation.

2.1.1 Data Sources

The following sources of information were used to evaluate the vehicle transportation characteristics of the study area.

- U.S. Department of Transportation (USDOT) Grade Crossing Inventory, Federal Railroad Administration (FRA)
- Data provided by the Washington Utilities and Transportation Commission (WUTC)
- *SR 432 Highway Improvements and Rail Realignment Study* (Cowlitz-Wahkiakum Council of Governments 2014)
- *Traffic and Transportation Resource Report* (URS Corporation 2014) provided by the Applicant
- Data and information provided by the Applicant

2.1.2 Impact Analysis

The following methods were used to evaluate the potential impacts of the Proposed Action and No-Action Alternative on vehicle transportation. For the purposes of this analysis, construction impacts are based on the peak construction period and operations impacts are based on maximum throughput capacity (44 million metric tons per year).

2.1.2.1 No-Action Alternative Analysis

Regardless of whether the coal export terminal is built, the Applicant would continue to operate approximately 350 acres of the project area as a bulk product terminal, and increase commodity storage and shipment as described in Section 1.1.3, *No-Action Alternative*. The Applicant could expand the existing bulk product terminal onto the 190-acre project area, developing storage and shipment facilities to increase existing coal and alumina operations under current permits.

By 2018, the planned bulk product terminal activities would increase the average length of trains up to 575 feet along the Reynolds Lead and the BNSF Spur. By 2028, potential bulk product terminal activities would add 1.71 daily train trips to the Reynolds Lead (each trip approximately 2,068 feet long).

2.1.2.2 Construction Impact Analysis

The Applicant has identified three construction scenarios.

- **Truck.** If material is delivered by truck, it is assumed that approximately 88,000 truck trips would be required over the construction period. Approximately 56,000 loaded trucks would be needed during the peak construction year.
- **Rail.** If material is delivered by rail, it is assumed that approximately 35,000 loaded rail cars would be required over the construction period. Approximately two-thirds of the rail trips would occur during the peak construction year.
- **Barge.** If material is delivered by barge, it is assumed that approximately 1,130 barge trips would be required over the construction period. Approximately two-thirds of the barge trips would occur during the peak construction year. Because the project area does not have an existing barge dock, the material would be off-loaded at an existing dock elsewhere on the Columbia River and transported to the project area by truck.

The analysis analyzed all three scenarios.[3] Potential impacts on vehicle transportation during construction could occur because of construction-worker vehicle traffic and additional trucks or trains bringing preload materials to the project area. This analysis of potential impacts assumes the following, based primarily on information provided by the Applicant.

- Approximately 1.4 million cubic yards of material would be imported to the project area during the first year of construction.[4] No exporting of material would occur during the first year of construction.
- Approximately 200 construction workers would be on site daily in 2018, with the work shift ending at 5:00 p.m., and approximately 90% of the construction workers traveling in a single-occupancy vehicle. This would result in 180 outbound trips during the PM peak hour (AECOM 2015).
- If construction materials are delivered by truck (truck or barge construction scenario), approximately 56,000 trucks, or a maximum of 330 per day, would be required to deliver the preload material to the site during the first year of construction, which is assumed to be 2018. This estimate is based on a combination of the amount of space likely available on site for unloading material and the anticipated number of trucks available in the area capable of hauling preload material. Given that 56,000 trucks would be required to deliver the preload material in 2018, it would take approximately 170 working days for delivery. This would result in 42 inbound and 42 outbound trucks per hour (assuming deliveries occur evenly over an 8-hour workday) (AECOM 2015).
- If construction material is delivered by rail (rail construction scenario), approximately 23,333 loaded rail cars would be required to deliver the preload material to the site in 2018. Assuming 100-car rail trains, this would result in approximately 233 inbound and 233 outbound trains or an average of 1.3 trains per day (each approximately 6,219 feet long), in 2018 (URS Corporation 2014).

[3] The barge scenario includes the same assumptions as the truck scenario because materials would be transferred from barge to truck and delivered to the project area.

[4] A total of 2.1 million cubic yards of rock is expected to be imported over the duration of the construction period. For the purposes of the vehicle transportation analysis, the first year of construction was used because two-thirds of the volume is expected to be transported during the first year and represents the peak year.

2.1.2.3 Operations Impact Analysis

It is assumed that the coal export terminal would be operating in 2028 at the planned capacity of 44 million metric tons per year of coal throughput. Full operations of the coal export terminal would add 16 new daily train trips (8 loaded and 8 empty), each an average of 6,844 feet (approximately 1.3 miles) long. Based primarily on estimates provided by the Applicant, approximately 135 employees would be needed to operate the coal export terminal. Operations would occur 24 hours per day, 7 days per week, and 50% of the employees would exit and 30% would enter the site during the PM peak hour. This would result in 41 inbound and 68 outbound trips during the PM peak hour (URS Corporation 2014).

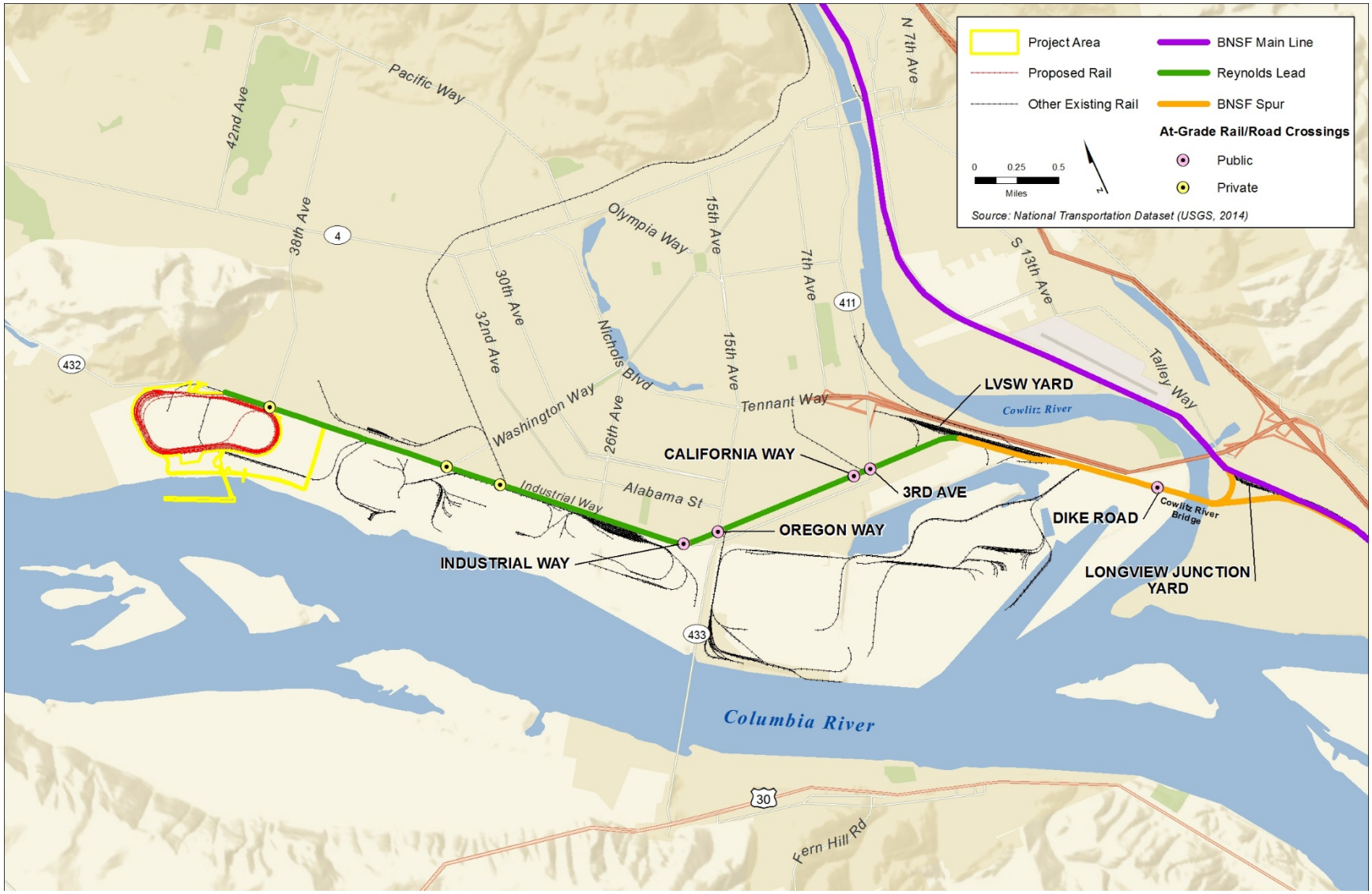
Reynolds Lead and BNSF Spur

The types and number of trains from Longview Junction to the project area for existing year and 2028 were developed from meetings with LVSW and the Port of Longview.

As described in the SEPA Rail Transportation Technical Report (ICF International and Hellerworx 2016), LVSW plans to upgrade the Reynolds Lead and part of the BNSF Spur as a separate action should it be warranted by increased rail traffic resulting from existing and future customers. Upgrades to the track would include adding ballast, replacing ties, and upgrading rail. These improvements would provide for safer operations and increased speed over the BNSF Spur and Reynolds Lead. LVSW would also install signals and upgrade the traffic control system to Centralized Traffic Control and add an electric, remotely operated switch from the BNSF Spur to the Reynolds Lead. Construction of these improvements would take approximately 6 months. Because these improvements are not certain, the vehicle transportation impact analysis analyzes current track infrastructure and with these planned track improvements. However, without planned track improvements to increase capacity, neither of the BNSF Spur or Reynolds Lead would have the capacity to handle all Proposed Action-related trains and the growth in baseline traffic. Proposed Action-related trains would add 16 trains per day on the Reynolds Lead and BNSF Spur for a total of approximately 23 trains on the BNSF Spur and 20 trains on the Reynolds Lead. Figure 3 illustrates the Reynolds Lead and BNSF Spur, and the study crossings along the Reynolds Lead and BNSF Spur.

The vehicle transportation analysis does not include the improvements identified in the *SR 432 Highway Improvements and Rail Realignment Study* completed in September 2014 (Cowlitz-Wahkiakum Council of Governments 2014). This study identified various design concepts to address safety, traffic congestion, system mobility and freight capacity issues where the rail and roadway systems overlap along the SR 432 industrial corridor. Various design concepts were developed and evaluated for rail and highway improvements to improve safety, mobility, congestion, and freight capacity. The top concept that emerged from this study was a grade-separated intersection at SR 432/SR 433. This project, called the Industrial Way/Oregon Way Intersection Project and led by Cowlitz County Public Works, is currently in the preliminary design and National Environmental Policy Act (NEPA) and Washington State Environmental Policy Act (SEPA) environmental compliance phase to address traffic congestion, freight mobility and safety issues at this intersection. The 2015 transportation package passed by the Washington State Senate includes $85 million to construct the preferred alternative identified after the conclusion of the NEPA and SEPA processes. This project was not included in the vehicle transportation analysis because a preferred alternative for the intersection has not been identified. The other concepts identified in the *Highway Improvements and Rail Realignment Study* were not included in the vehicle transportation analysis because funding for implementation has not been secured.

Figure 3. Reynolds Lead and BNSF Spur Study Crossings



BNSF Main Line in Cowlitz County

The types and number of baseline train traffic beyond Longview Junction were developed from the *Washington State Rail Plan* (WSDOT Rail Plan) (Washington State Department of Transportation 2014a) using linear extrapolation of 2010 and 2035 projected train traffic to 2018 and 2028. The analysis assumes 8 full inbound trains arrive at Longview Junction from the south on the BNSF main line and 8 empty trains travel north from Longview Junction on the BNSF main line. Other potential options could include all trains traveling to the north and all trains traveling to the south. Figure 4 illustrates the study crossings along the BNSF main line in Cowlitz County.

The analysis assumed that up to 2 Proposed Action-related trains could arrive during the PM peak hour by 2028 on the BNSF main line in Cowlitz County, meaning no more than 2 trains would be expected at the study crossings, regardless of the route. Therefore, to account for motor vehicle impacts associated with each of the train route, the analysis assumes 2 Proposed Action-related trains at each crossing along the BNSF main line during the PM peak hour. If all 16 daily train trips were routed to arrive and leave from the same direction, it would increase the weighted average train length by about 120 feet and increase the overall daily gate downtime between 14 and 20 minutes at BNSF main line study crossings.

Washington State

For the Washington State study area analysis, it was assumed that the rail routes would be the same as current BNSF and UP routes and as documented in WSDOT publications, including the WSDOT Rail Plan (Washington State Department of Transportation 2014a) and *Washington State Freight Mobility Plan* (Washington State Department of Transportation 2014b). In 2012, BNSF changed its train operations protocol to enhance use of existing capacity using directional running. This strategy routes all westbound-loaded unit trains (including coal) from Pasco via the Columbia River Gorge to Vancouver, Washington, where it continues on the BNSF north-south main line to its final destination. Empty unit bulk trains from north of Vancouver, including Cowlitz County, return to Pasco and to points east via Stampede Pass. The types and number of baseline train traffic were developed from the WSDOT Rail Plan using linear extrapolation of 2010 and 2035 projected train traffic.

2.1.2.4 Years and Scenarios

The years selected for analysis are 2018 and 2028, which allows the identification of potential impacts at rail-crossings associated with construction and operation of the Proposed Action, and helps determine if improvements would be necessary at study crossings. The following scenarios were analyzed.

- **2018 No-Action.** Assumes that the coal export terminal would not be constructed and that activities currently ongoing and planned for the existing bulk materials terminal within the Applicant's leased area would occur (summarized in Section 2.1.2.1, *No-Action Alternative Analysis*). It includes the motor vehicle and train volumes in Table 2.
- **2018 Proposed Action (Construction).** Represents conditions during the construction of the coal export terminal. It assumes the motor vehicle and train volumes from the 2018 No-Action scenario, but with the added traffic and rail growth related to construction of the Proposed Action discussed in Section 2.1.2.2, *Construction Impact Analysis*.

Figure 4. BNSF Main Line Study Crossings

It also assumes the planned project area activities included in the 2018 No-Action scenario. As discussed in Section 2.1.2.2, *Construction Impact Analysis*, this analysis includes two scenarios: that construction materials would be delivered by truck, and construction materials would be delivered by rail.

- **2028 No-Action.** Assumes that the coal export terminal would not be constructed, and includes the motor vehicle and train volumes from the 2018 No-Action scenario, but with 10 years of added vehicle traffic growth. It also assumes the planned bulk product terminal activities included in the 2018 No-Action scenario, and the potential future activities for the existing bulk product terminal discussed in Section 2.1.2.1, *No-Action Alternative Analysis*.
- **2028 Proposed Action.** Represents conditions during full operation of the Proposed Action. It includes the motor vehicle and train volumes from the 2028 No-Action scenario, but with the added traffic and train growth related to full operation of the coal export terminal discussed in Section 2.1.2.3, *Operations Impact Analysis.* It also assumes the planned and potential bulk product terminal activities included in the 2028 No-Action scenario. This analysis includes two scenarios: 1) current track infrastructure improvements along the Reynolds Lead, and 2) planned track infrastructure improvements along the Reynolds Lead that would increase the average train speed from 8 miles per hour (mph) to 10 mph at the Weyerhaeuser access crossing—opposite Washington Way, from 10 mph to 15 mph at the Weyerhaeuser NORPAC access crossing, from 10 mph to 20 mph at the Industrial Way and Oregon Way crossings, and from 8 mph to 15 mph at the California Way and 3rd Avenue crossings. No changes in train speed would be expected at the existing site access—opposite 38th Avenue, and at the Dike Road crossings.

2.1.2.5 Trip Distribution Analysis

The construction- and employee-related traffic was distributed onto the transportation network based on current traffic patterns near the project area. For the construction workers and full operation employees (Section 2.1.2.2, *Construction Impact Analysis,* and 2.1.2.3, *Operations Impact Analysis*), it is assumed that 60% of the traffic would arrive from the north using Washington Way (35%) and Oregon Way (25%), 15% from the south along Oregon Way, 20% from the east along 3rd Avenue, and 5% from the west along Industrial Way. For the construction materials delivered to the project area by truck (Section 2.1.2.2, *Construction Impact Analysis*) it is assumed that 75% of the trucks would arrive from the east using 3rd Avenue, and 25% from the south along Oregon Way.

2.1.2.6 Analysis of Baseline and Future Volumes at Railroad Crossings

Motor Vehicles

Table 2 includes the average daily traffic (ADT) and PM peak hour count data for all study crossings. Hourly traffic volumes over the course of 3 days were compared at select locations[5] to identify a peak hour. The analysis identified a peak hour between 4:00 and 5:00 p.m., with evening peak period traffic volumes more than 25% higher than those in the morning and afternoon.

[5] The hourly traffic volumes were based on volumes collected between March 5, 2013 and Marcy 7, 2013, at the following locations: 1) Industrial Way, west of Oregon Way; 2) Industrial Way, between Oregon Way and California Way; 3) 3rd Avenue, north of Industrial Way; and 4) Oregon Way, north of Industrial Way.

Table 2. Motor Vehicle and Train Volumes at Study Crossings

Crossing Name (USDOT Crossing ID)	Time Period	2018 No-Action Scenario		2018 Proposed Action (Construction - Truck Delivery) Scenario		2018 Proposed Action (Construction - Rail Delivery) Scenario		2028 No-Action Scenario		2028 Proposed Action (Operations) Scenario	
		Vehicle	Train	Vehicle	Train	Vehicle	Train	Vehicle	Train	Vehicle	Train
Study Crossings along the Reynolds Lead and BNSF Spur											
Project area at 38th Avenue	Per Day	200	2.3	2,850	2.3	2,000	3.6	250	4.0	1,340	20.0
	PM Peak	20	1	285	1	200	1	25	1	134	1 or 2
Weyerhaeuser access at Washington Way	Per Day	3,300	2.3	3,300	2.3	3,300	3.6	3,900	4.0	3,900	20.0
	PM Peak	330	1	330	1	330	1	390	1	390	1 or 2
Weyerhaeuser NORPAC access	Per Day	650	2.3	650	2.3	650	3.6	800	4.0	800	20.0
	PM Peak	65	1	65	1	65	1	80	1	80	1 or 2
Industrial Way-SR 432 (101806G)	Per Day	10,100	2.3	12,000	2.3	11,200	3.6	11,450	4.0	12,100	20.0
	PM Peak	1,010	1	1,200	1	1,120	1	1,145	1	1,210	1 or 2
Oregon Way-SR 433 (101805A)	Per Day	15,200	2.3	15,650	2.3	15,650	3.6	18,500	4.0	18,770	20.0
	PM Peak	1,520	1	1,565	1	1,565	1	1,850	1	1,877	1 or 2
California Way (101821J)	Per Day	4,050	2.3	4,050	2.3	4,050	3.6	4,800	4.0	4,800	20.0
	PM Peak	405	1	405	1	405	1	480	1	480	1 or 2
3rd Avenue-SR 432 (101826T)	Per Day	16,850	2.3	17,850	2.3	17,200	3.6	20,500	4.0	20,720	20.0
	PM Peak	1,685	1	1,785	1	1,720	1	2,050	1	2,072	1 or 2
Dike Road (101791U)	Per Day	950	7.1	950	7.1	950	8.4	1,100	7.1	1,100	23.1
	PM Peak	95	1	95	1	95	1	110	1	110	1 or 2
Public At-Grade Crossings along the BNSF Main Line in Cowlitz County											
Taylor Crane Road in Castle Rock (092481X)	Per Day	50	55.1	50	55.1	50	56.1	50	72.7	50	80.7
	PM Peak	5	3.9	5	3.9	5	4.9	5	4.6	5	6.6
Cowlitz Street in Castle Rock (092476B)	Per Day	1,200	55.1	1,200	55.1	1,200	56.1	1,450	72.7	1,450	80.7
	PM Peak	120	3.9	120	3.9	120	4.9	145	4.6	145	6.6

Crossing Name (USDOT Crossing ID)	Time Period	2018 No-Action Scenario		2018 Proposed Action (Construction - Truck Delivery) Scenario		2018 Proposed Action (Construction - Rail Delivery) Scenario		2028 No-Action Scenario		2028 Proposed Action (Operations) Scenario	
		Vehicle	Train	Vehicle	Train	Vehicle	Train	Vehicle	Train	Vehicle	Train
Cowlitz Gardens Road in Kelso (092466V)	Per Day	700	55.1	700	55.1	700	56.1	850	72.7	850	80.7
	PM Peak	70	3.9	70	3.9	70	4.9	85	4.6	85	6.6
Mill Street in Kelso (092458D)	Per Day	2,550	55.1	2,550	55.1	2,550	56.1	3,000	72.7	3,000	80.7
	PM Peak	255	3.9	255	3.9	255	4.9	300	4.6	300	6.6
S River Road in Kelso (092457W)	Per Day	1,850	55.1	1,850	55.1	1,850	56.1	2,200	72.7	2,200	80.7
	PM Peak	185	3.9	185	3.9	185	4.9	220	4.6	220	6.6
Toteff Road/ Port Road in Kalama (092446J)	Per Day	1,200	55.1	1,200	55.1	1,200	56.1	1,450	72.7	1,450	80.7
	PM Peak	120	3.9	120	3.9	120	4.9	145	4.6	145	6.6
W Scott Avenue in Woodland (092437K)	Per Day	2,650	55.1	2,650	55.1	2,650	56.1	3,100	72.7	3,100	80.7
	PM Peak	265	3.9	265	3.9	265	4.9	310	4.6	310	6.6
Davidson Avenue in Woodland (092435W)	Per Day	2,000	55.1	2,000	55.1	2,000	56.1	2,350	72.7	2,350	80.7
	PM Peak	200	4	200	3.9	200	4.9	235	4.6	235	6.6
Whalen Road in Woodland (092434P)	Per Day	1,550	55.1	1,550	55.1	1,550	56.1	1,800	72.7	1,800	80.7
	PM Peak	155	3.9	155	3.9	155	4.9	180	4.6	180	6.6

The data also indicated that the PM peak hour represents approximately 10% of the daily traffic volumes at these locations. This factor was used to covert count data from peak hour to ADT or vice versa.

For the at-grade crossing analysis, PM peak hour vehicle traffic count data was obtained from recent studies for 12 of the study crossings (Cowlitz-Wahkiakum Council of Governments 2014; URS Corporation 2014; Washington State Department of Transportation 2014c; DKS Associates 2013). Where recent traffic count data were unavailable (at the Dike Road, Taylor Crane Road, Cowlitz Street, Cowlitz Gardens Road, and Whalen Road study crossings), average daily traffic volumes were obtained from the FRA or WUTC databases (as a conservative approach, the database with the higher volume was used for each study crossing), and converted to PM peak hour with the 10% factor.

Future traffic volumes for the analysis years included a combination of background traffic, as well as growth associated with the Proposed Action as discussed in Section 2.1.2.2, *Construction Impact Analysis,* and 2.1.2.3, *Operations Impact Analysis*. Background traffic was estimated by developing a linear growth rate between existing and forecast traffic volumes in the immediate area (Cowlitz-Wahkiakum Council of Governments 2014). These data suggest that traffic volumes are forecast to increase at a rate of 2% annually. For comparison purposes, a 2% annual growth rate was applied to expand older count data to reflect baseline traffic conditions in the *SR 432 Highway Improvements and Rail Realignment Study* (Cowlitz-Wahkiakum Council of Governments 2014). Therefore, the 2% annual growth rate was applied to the collected count data to develop 2018 No-Action scenario traffic volumes, and to the 2018 No-Action scenario traffic volumes for 10 years to develop year 2028 No-Action scenario traffic volumes.

Trains

Estimated freight train volume and operational information for the No-Action Alternative along the Reynolds Lead and BNSF Spur was provided by LVSW (Wolter pers. comm.). Freight train volumes along the BNSF main line for the No-Action Alternative were extrapolated linearly from the WSDOT Rail Plan (Washington State Department of Transportation 2014a), and evenly distributed throughout the day (daily freight train volume per 24 hours). Passenger rail volumes were from existing Amtrak schedules (10 trains per day, including 8 Cascades trains, and 2 Coast Starlight trains), with 2 trains passing during the PM peak hour (1 Cascades train, and 1 Coast Starlight train per existing schedules). No increase in passenger rail service was assumed in the future. Unlike passenger trains, freight trains do not run on a schedule. Railroad companies evaluate each situation and dispatch trains based on a number of criteria, including available crew, number of cars, cost of fuel, and overall revenue. Analysis and projection of rail impact operations requires analyzing the rail traffic and developing typical operations. To analyze the highest potential vehicle delay impacts that could occur related to the Proposed Action, an analysis of vehicle delay during the PM peak traffic hour was completed.

An average of 2 non-Proposed Action-related trains per day would be expected over study crossings on the Reynolds Lead, and 7 at the Dike Road study crossing (along the BNSF Spur) under the 2018 No-Action and 2018 Construction (truck delivery) scenarios. One non-Proposed Action-related train could travel along the BNSF Spur and Reynolds Lead during the PM peak hour. The BNSF main line would have around 55 non-Proposed Action-related trains per day by 2018. It was assumed that 4 non-Proposed Action-related trains would travel during the PM peak hour.

The 2018 Construction (rail delivery) scenario would add an average of 1.3 train trips per day, as documented in Section 2.1.2.2, *Construction Impact Analysis*. It was assumed that this train could travel during the PM peak hour.

The 2028 No-Action scenario would include approximately 2 additional non-Proposed Action-related trains per day on the Reynolds Lead, as documented in Section 2.1.2.1, *No-Action Alternative Analysis.* Overall, 4 trains per day would be expected along the Reynolds Lead, and 7 at the Dike Road study crossing (along the BNSF Spur) in the 2028 No-Action scenario. One non-Proposed Action-related train could travel along the BNSF Spur and Reynolds Lead during the PM peak hour. The BNSF main line would include approximately 18 additional non-Proposed Action-related trains per day in the 2028 No-Action scenario, with 73 non-Proposed Action-related trains expected per day in the 2028 No-Action scenario. It was assumed that 5 non-Proposed Action-related trains would travel during the PM peak hour.

The Proposed Action would add approximately 16 additional trains per day, as documented in Section 2.1.2.3, *Operations Impact Analysis*. Up to 2 Proposed Action-related trains could travel along the Reynolds Lead, BNSF Spur, and BNSF main line during the PM peak hour. Table 2 includes the daily and PM peak train crossings for 2018 and 2028.

2.1.2.7 Railroad Crossing Performance Measures

The following performance measures were used to identify impacts at the railroad crossings.

Level of Service

A vehicle level of service (LOS) impact was defined as a study crossing that operates below LOS D under the Proposed Action that would not otherwise operate below LOS D under the No-Action Alternative for the same year. LOS represents a "report card" rating (A through F) based on the delay experienced by vehicles at an intersection, or in this case, a railroad crossing, as shown in Table 3. LOS A, B, and C indicate conditions where traffic moves without significant delays. LOS D and E represent progressively worse operating conditions. LOS F represents conditions where average vehicle delay has become excessive and demand has exceeded capacity.

Table 3. Grade Crossing Level of Service

Level of Service (LOS)	Average Total Delay (seconds/vehicle)
A	<= 10
B	> 10 and <= 20
C	> 20 and <= 35
D	> 35 and <= 55
E	> 55 and <= 80
F	> 80

Notes:
Source: Transportation Resource Board 2000:Exhibit 16-2

The Cities of Kelso (2015), Longview, Woodland (2005), and the WSDOT (2010) use a peak hour standard of LOS D or better. The transportation element of the *City of Longview Comprehensive Plan* (December 2006) defines a capacity deficiency on arterial segments as a volume-to-capacity ratio of 0.85 or higher (representing a generalized LOS D or worse). As a conservative approach, the LOS D

standard was applied to all of the at-grade railroad crossings, regardless of the street functional classification or jurisdiction.

For the PM peak hour analysis, the traffic operating conditions at the study crossings were determined based on the *2000 Highway Capacity Manual* (Transportation Research Board 2000) methodology for signalized intersections (the railroad crossings were assumed to be pre-timed traffic signals). The conditions reported include the estimated average vehicle delay, and LOS of the study crossings. Available signal timing information for the intersections adjacent to the rail crossings were incorporated into this analysis. For the 24-hour analysis, similar delay thresholds, based on the LOS definitions found in the *2000 Highway Capacity Manual* methodology for signalized intersections, were used to assess the average delay experienced per vehicle at each rail crossing. The average delay per vehicle in a 24-hour period (in seconds) for a rail crossing was determined based on the average number of daily trains, average train length, train speed, and average daily traffic volumes in both directions.

Queue

A vehicle queuing impact was defined as a queue extending from a study crossing that exceeds available storage length (to an adjacent intersection) under the Proposed Action that would not otherwise exceed the available storage under the No-Action alternative from the same year. The available storage along the roadways approaching the study crossings and at nearby intersections is shown in Table 4.

Queuing analysis was conducted using SimTraffic 8, which estimates the 95th percentile vehicle queue lengths, or the queue length that would not be exceeded in 95% of the queues formed during the PM peak hour. Note that SimTraffic 8 was unable to be fully calibrated and verified based on field conditions because no trains were observed crossing during the PM peak hour. However, estimated queues were verified based on the relationship between observed queues during nonpeak conditions, and traffic volumes at that time. This relationship was compared to PM peak hour traffic volumes to help verify the estimated baseline queue lengths.

Accident Probability

An accident probability analysis was conducted for the study crossings in Cowlitz County and statewide crossings using the FRA GradeDec.Net web-based software, which estimates the predicted annual accident probability at a crossing in a year. The software uses the USDOT's Accident Prediction and Severity model. This module estimates accident probability-based grade-crossing features available in FRA's nationwide inventory of at-grade crossings, including the type of crossing protection in place, historical accident data at the crossing, vehicle traffic volumes, the number of roadway lanes and train tracks, the number of trains per day, and train speed. Other physical factors that affect the frequency of collisions at a crossing, such as available sight distance, or vehicle storage between adjacent intersections, are not direct inputs in this module. However, the accident history at these crossings would likely reflect these characteristics. Such characteristics would not be affected by the Proposed Action, which would only alter the number of trains per day and vehicle traffic volumes (at some grade crossings). This analysis provides a frame of reference for crossings by estimating accident probability, but does not identify these crossings as unsafe. A vehicle safety impact was defined as a study crossing that would have a predicted accident probability above 0.04 under the Proposed Action that would be at or below 0.04 under the No-Action scenario.

Table 4. Estimated Vehicle Storage Lengths

Crossing Name (USDOT Crossing ID)	Roadway Movement	Available Storage before Impacting nearby Intersection (feet)	Intersection Affected by Queue from Crossing	Intersection Movement	Available Storage (feet)
Project area access at 38th Avenue	NB	>1,000 (private driveway)	Industrial Way/ 38th Avenue	WBL	180
	SB	<20		EBR	180
Weyerhaeuser access at Washington Way	NB	>1,000 (private driveway)	Industrial Way/ Washington Way	WBL	180
				EBR	20
	SB	<20		SBT	150
Weyerhaeuser NORPAC access	NB	>1,000 (private driveway)	Industrial Way/ NORPAC access	WBL	80
	SB	<20		EBR	200
Industrial Way-SR 432 (101806G)	NB	120	Industrial Way/ Weyerhaeuser	EBL	>1,000 (private driveway)
	SB	>1,000		NBT	730
Oregon Way-SR 433 (101805A)	NB	220	Industrial Way/ Oregon Way	NBT	>1,000
				EBL	85
				WBR	0
	SB	700	Oregon Way/ Alabama Street	EBR	N/A
				WBL	
				SBT	
California Way (101821J)	NB	400	Industrial Way/ California Way	N/A	N/A
	SB	>1,000			
3rd Avenue-SR 432 (101826T)	NB	400	3rd Avenue/ Industrial Way	WBR	170
				NBT	240
			Industrial Way/ California Way	SBL	130
	SB	>1,000		NBR	100
				EBT	>1,000
Dike Road (101791U)	NB	>1,000	None	N/A	N/A
	SB	200			

Crossing Name (USDOT Crossing ID)	Roadway Movement	Available Storage before Impacting nearby Intersection (feet)	Intersection Affected by Queue from Crossing	Intersection Movement	Available Storage (feet)
Public At-Grade Crossings along the BNSF Main Line in Cowlitz County					
Taylor Crane Road in Castle Rock (092481X)	EB	300	None	N/A	N/A
	WB	50			
Cowlitz Street in Castle Rock (092476B)	EB	440	None	N/A	N/A
	WB	260			
Cowlitz Gardens Road in Kelso (092466V)	EB	50	None	N/A	N/A
	WB	50			
Mill Street in Kelso (092458D)	EB	>1,000	None	N/A	N/A
	WB	250			
S River Road in Kelso (092457W)	EB	120	Pacific Avenue/ S River Road	SBR	0
	WB	60		NBL	0
Toteff Road/ Port Road in Kalama (092446J)	EB	>1,000	None	N/A	N/A
	WB	900			
W Scott Avenue in Woodland (092437K)	EB	580	None	N/A	N/A
	WB	720			
Davidson Avenue in Woodland (092435W)	EB	120	None	N/A	N/A
	WB	330			
Whalen Road in Woodland (092434P)	EB	180	None	N/A	N/A
	WB	800			

Notes:
USDOT = U.S. Department of Transportation; NB = northbound; SB = southbound; EB = eastbound; WB = westbound; WBT= westbound through; EBR= eastbound right; SBT = southbound through; EBL= eastbound left; NBT = northbound through; SBL = southbound left; NBR = northbound right; EBT= eastbound through; N/A = not applicable

2.2 Existing Conditions

The existing environmental conditions related to vehicle transportation in the study area are described below.

Table 5 provides vehicle and train traffic information at the five public at-grade crossings on the Reynolds Lead and BNSF Spur, and three private crossings on the Reynolds Lead, including the entrance to the project area and the traffic associated with these crossings. Table 5 also presents information for vehicle and train traffic at all nine public at-grade crossings on the BNSF main line in Cowlitz County that would be used by Proposed Action-related train traffic to and from the project area. Relevant roadway characteristics also are listed, including roadway functional classifications and number of lanes at the crossing. Information on at-grade crossing and roadway performance is presented in Chapter 3, *Impacts and Mitigation*.

Ten years of collision records (2003 to 2013) for the at-grade railroad crossings along the BNSF main line, Reynolds Lead, and BNSF Spur in Cowlitz County were obtained from FRA and WSDOT databases. The data identified one collision involving a train near the project area, at the Washington Way crossing, just south of the Industrial Way intersection. The crossing is ungated, and located less than 50 feet from Industrial Way. The collision involved a vehicle stopped at the traffic signal, beyond the stop bar and on the track, getting struck by a train. The collision resulted in property damage only.

A collision involving a train also occurred at the Cowlitz Gardens Road crossing on the BNSF main line. This crossing is gated, and located less than 75 feet from Pacific Avenue. The collision involved an inoperable vehicle stopped on the tracks, getting struck by a train. The collision resulted in property damage only.

2.2.1 Emergency Services

The Cowlitz 2 Fire & Rescue District, the Longview Fire Department, and American Medical Response (AMR) provide emergency medical services (EMS) and fire protection for the project area. Figure 5 illustrates the location of fire stations in the vicinity of the project area.

Cowlitz 2 Fire & Rescue

Cowlitz 2 Fire & Rescue serves approximately 34,000 citizens in the City of Kelso and unincorporated Cowlitz County and responds to approximately 4,100 calls per year (Cowlitz 2 Fire & Rescue 2015). The district is staffed by approximately 120 full-time and volunteer members in five active fire stations, two of which are staffed with full-time emergency medical technicians (EMTs) and paramedic firefighters. Volunteer firefighter EMTs also respond on an on-call basis.

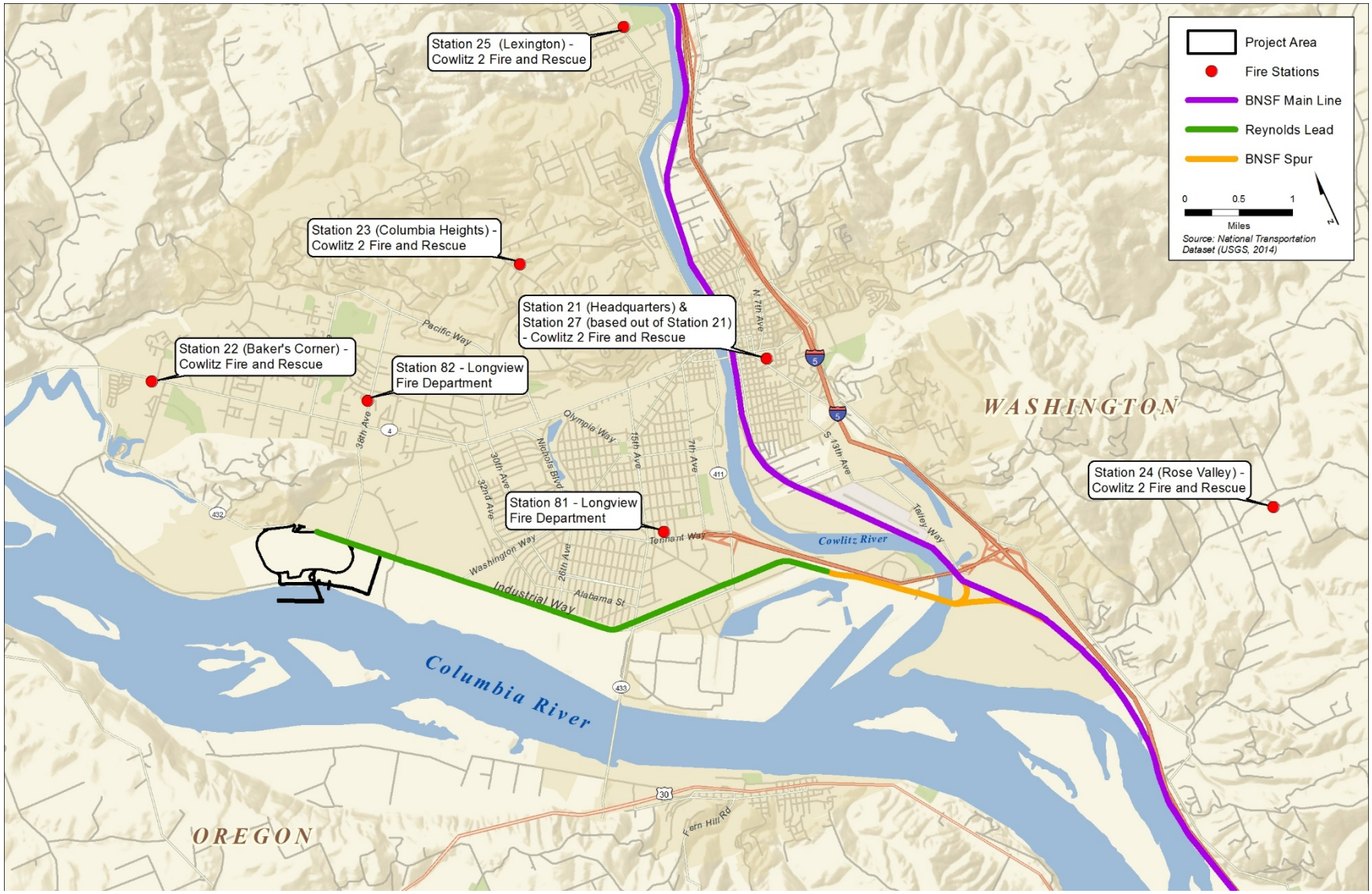
Table 5. At-Grade Crossing and Roadway Characteristics

Crossing Name (USDOT Crossing ID)	Roadway				Railroad (Trains)	
	2018 ADT	Functional Classification[a]	Lanes	Protection[b]	2018 Crossings per day	Average Speed (mph)[c]
Study Crossings along the Reynolds Lead and BNSF Spur						
Project area access at 38th Avenue	200	Private	2	None	2.3	5 (freight)
Weyerhaeuser access at Washington Way	3,300	Private	4	None	2.3	8 (freight)
Weyerhaeuser NORPAC access	650	Private	2	None	2.3	10 (freight)
Industrial Way- SR 432 (101806G)	10,100	Principal Arterial	2	Overhead Lights	2.3	10 (freight)
Oregon Way- SR 433 (101805A)	15,200	Principal Arterial	4	Gates/ Overhead Lights	2.3	10 (freight)
California Way (101821J)	4,050	Minor Arterial	2	Overhead Lights	2.3	8 (freight)
3rd Avenue- SR 432 (101826T)	16,850	Principal Arterial	4	Gates/ Overhead Lights	2.3	8 (freight)
Dike Road (101791U)	950	Local	2	Overhead Lights	7.1	10 (freight)
Public At-Grade Crossings along the BNSF Main Line in Cowlitz County						
Taylor Crane Road in Castle Rock (092481X)	50	Local	2	None	55.1	50 (freight); 50 (passenger)
Cowlitz Street in Castle Rock (092476B)	1,200	Minor Collector	2	Gates/ Overhead Lights	55.1	50 (freight); 50 (passenger)
Cowlitz Gardens Road in Kelso (092466V)	700	Local	2	Gates	55.1	60 (freight); 75 (passenger)
Mill Street in Kelso (092458D)	2,550	Local	2	Gates	55.1	40 (freight); 40 (passenger)
S River Road in Kelso (092457W)	1,850	Local	2	Gates	55.1	40 (freight); 40 (passenger)
Toteff Road/ Port Road in Kalama (092446J)	1,200	Local	2	Gates/ Overhead Lights	55.1	60 (freight); 79 (passenger)
W Scott Avenue in Woodland (092437K)	2,650	Minor Arterial	2	Gates	55.1	60 (freight); 75 (passenger)

Crossing Name (USDOT Crossing ID)	Roadway				Railroad (Trains)	
	2018 ADT	Functional Classification[a]	Lanes	Protection[b]	2018 Crossings per day	Average Speed (mph)[c]
Davidson Avenue in Woodland (092435W)	2,000	Minor Arterial	2	Gates	55.1	60 (freight); 75 (passenger)
Whalen Road in Woodland (092434P)	1,550	Minor Arterial	2	Gates	55.1	60 (freight); 75 (passenger)

Notes:
[a] Source: City of Longview 2015; City of Kelso 2006; City of Castle Rock 2006; City of Woodland 2005
[b] Source: Field observations
[c] Source: SEPA Rail Transportation Technical Report (ICF International and Hellerworx 2016) and Washington Utilities and Transportation Commission 2015.
ADT = average daily traffic; mph = miles per hour

Figure 5. Emergency Services Providers



The district includes the following stations and equipment.

- Station 21 (Headquarters for Cowlitz 2 Fire & Rescue) is staffed with 27 full-time personnel and includes a main response fire engine, a volunteer/reserve-ready fire engine, an advanced life support ambulance, and a reserve-ready advanced life support ambulance. This station includes three rotating shifts 24 hours a day, 7 days a week, 365 days a year. During each shift, at least eight personnel staff a variety of equipment.
- Station 22 (Baker's Corner) is a volunteer station and includes a main response fire engine, a 3,000-gallon water supply, an EMS/wildland response vehicle, and an EMS response ambulance. This is an all-volunteer station that serves as crucial first response before additional help arrives.
- Station 23 (Columbia Heights) is staffed full time by firefighter/EMT, firefighter/paramedic, and volunteer personnel and includes a main response fire engine, an EMS/wildland response vehicle, an advanced life support ambulance, a basic life support ambulance, and a hazardous materials response apparatus.
- Station 24 (Rose Valley) is a volunteer station and includes a main response fire engine and an EMS/wildland response vehicle. This is an all-volunteer station that serves as crucial first response before additional help arrives.
- Station 25 (Lexington) Station 25 is a volunteer station and includes an initial response fire engine, a 2,000-gallon water supply, and an EMS/wildland response vehicle. This is an all-volunteer station that serves as crucial first response before additional help arrives.
- Station 27 (Kelso) is a volunteer station and includes a main response fire engine and a 3,000-gallon water supply. This is an all-volunteer station that backs up personnel at Station 21 (Headquarters) when they are on calls.

Longview Fire Department

The Longview Fire Department serves approximately 36,000 citizens spread over 14.7 square miles of urban/suburban development. The department is staffed with 39 full-time EMT/firefighters, and four paramedic/firefighters. Paramedic transport service is provided within the City of Longview by AMR, a private provider. The Longview Fire Department responds to approximately 4,500 calls per year from two fire stations (City of Longview 2015). The department includes the following stations and equipment.

- Station 81 is located at 740 Commerce Avenue in Longview. A minimum of six line firefighters and one battalion chief are on duty 24 hours a day. The station includes an aerial ladder truck and a fire engine.
- Station 82 is located at 2355 38th Avenue in Longview. This station has a minimum of three line firefighters on duty 24 hours a day, with a maximum of five firefighters. The station primarily responds to the west end of Longview; however, it responds as backup to Station 81, as needed. The station includes one fire engine.

American Medical Response

AMR is a private ambulance company that provides emergency and nonemergency medical transport service for the project area. AMR includes approximately 35 paramedics and EMTs, and handles an average of 7,500 calls annually (American Medical Response 2015). The medical transport vehicles are based out of the facility near the Cowlitz Highway intersection with Long Avenue.

2.2.2 Washington State

As described in Section 2.1.2.3, *Operations Impact* Analysis, Proposed Action-related BNSF trains from the Powder River Basin would cross Washington State from east of Spokane (Washington State–Idaho border) to the project area in Cowlitz County. Loaded and empty UP trains to and from the Powder River Basin and Uinta Basin would travel north from Vancouver, Washington. WSDOT provided a list of statewide crossings of interest during the project's SEPA scoping process for crossings along the proposed rail routes. These study crossings are at-grade state highway crossings or at-grade crossings near state highways. Table 6 summarizes the existing conditions at these study crossings, including existing estimated annual average daily traffic (AADT), freight and passenger train speed at the crossings, and estimated number of trains per day.[6]

[6] The geographic location of these crossings are illustrated in Chapter 3, *Impacts and Mitigation,* Figure 6.

Table 6. Existing Conditions at Selected Crossings Outside of Cowlitz County

#[a]	Road Crossing	USDOT/FRA Crossing ID[b]	Railroad Milepost[b]	Estimated 2015 AADT[c]	Freight Train Speed (mph)[b]	Passenger Train Speed (mph)[b]	Estimated 2015 Trains per Day[d]
Spokane County							
1	Idaho Road	066236B	53.4	2,650	60	70	70
2	McKinzey Road	066239W	56.2	2,600	60	79	70
3	Harvard Road	066240R	56.8	8,400	60	79	70
4	Barker Road	066244T	58.9	13,900	60	79	70
5	Flora Road	066245A	59.9	6,600	60	79	70
6	Pines Road-SR 27	066367E	62.9	29,700	60	79	70
7	University Road	066371U	64.0	2,450	60	79	70
8	Park Road	066377K	66.1	16,400	60	79	70
9	Pine Street	066315M	15.8	750	35	35	39
10	F Street/Cheney-Spangle	065970L	16.4	3,650	35	35	39
11	Cheney-Plaza Road	065971T	16.8	1,050	35	35	39
Adams County							
12	Paha Packard Road	089665U	74.2	100	60	79	39
13	Kahlotus Road	089670R	80.6	300	60	79	39
14	1st Street	089672E	81.8	500	50	60	39
15	Wilbur/City Road	089673L	82.1	550	50	60	39
Franklin County							
16	Eltopia Road W	089699N	129.1	350	60	79	39
17	Sagemoor Road	089700F	134.2	450	60	79	39
Benton County							
18	East 3rd Avenue	090031U	229.2	2,800	35	35	34
19	Dague Road-East 25th Avenue	090035W	227.5	800	60	60	34
20	Perkins Road	090036D	226.4	700	60	60	34
21	Bowles Road	090038S	225.7	2,450	60	60	34
22	Cochran Road	090039Y	225.0	100	60	60	34

#[a]	Road Crossing	USDOT/FRA Crossing ID[b]	Railroad Milepost[b]	Estimated 2015 AADT[c]	Freight Train Speed (mph)[b]	Passenger Train Speed (mph)[b]	Estimated 2015 Trains per Day[d]
23	Finley Road	090040T	224.5	3,100	60	60	34
24	Whitcomb Island	090061L	171.9	50	60	60	34
Klickitat County							
25	Maple Street	090169V	75.7	850	45	45	34
26	Walnut Street	090168N	75.5	1,400	45	45	34
27	South Dock Grade Road	090164L	74.2	100	55	60	34
Skamania County							
28	Indian Crossing	090159P	65.9	100	55	60	34
29	Home Valley Park	090155M	59.6	50	55	60	34
30	Cemetery Xing	090151K	54.7	50	N/A	N/A	34
31	Russell Avenue	090148C	53.9	350	20	20	34
32	Skamania Landing/Butler Road	090135B	43.3	100	60	60	34
33	Walker/Skamania Landing	090134U	42.6	150	60	60	34
34	St Cloud Road	090133M	39.7	N/A	N/A	N/A	34
Lewis County							
35	SR 506-7th Street	092484T	77.8	1,400	50	75	50
36	Walnut Street – SR 505/603	092493S	71.6	2,850	50	50	50
37	E Locust Street	092519S	54.2	2,800	40	40	50
38	Main Street	092520L	54.1	2,650	40	40	50
39	Maple Street	092521T	53.8	3,500	40	40	50
40	Big Hanaford Road	092524N	51.8	2,550	10	N/A	50

#[a]	Road Crossing	USDOT/FRA Crossing ID[b]	Railroad Milepost[b]	Estimated 2015 AADT[c]	Freight Train Speed (mph)[b]	Passenger Train Speed (mph)[b]	Estimated 2015 Trains per Day[d]
Yakima County							
41	Jones Road East	099178A	79.4	1,600	55	40	7
42	Indian Church	104523U	63.8	2,450	55	40	7
43	SR241/Reservation	104534G	52.2	2,850	55	40	7
44	Gulden Road	104536V	51.1	300	55	40	7

Notes:

[a] See Chapter 3, *Impacts and Mitigation,* Figure 6, for crossing location.

[b] Source: Washington Utilities Transportation Commission 2015.

[c] Source: Washington Utilities Transportation Commission 2015; Federal Railroad Administration 2015. The data source with the most recent AADT was used and a 2% growth rate was applied to adjust to 2015.

[d] Washington State Department of Transportation 2014b. Linear extrapolation of 2010 and 2035 projected train traffic to 2015 volumes.

USDOT = U.S. Department of Transportation; FRA = Federal Railroad Administration; AADT = annual average daily traffic; mph = miles per hour; N/A = data not available

Chapter 3
Impacts and Mitigation

This chapter describes the impacts on vehicle transportation that would result from construction and operation of the Proposed Action and the No-Action Alternative.

3.1 Impacts

This section describes the impacts on vehicle transportation that could result from the Proposed Action and No-Action Alternative.

As described previously, railroad companies evaluate each situation and dispatch trains based on various criteria. The analysis analyzes a 24-hour average delay to illustrate the delay for the average vehicle. To analyze the highest potential vehicle delay impacts that could occur related to the Proposed Action, an analysis of vehicle delay during the PM peak traffic hour was completed. The PM peak hour analysis assumes Proposed Action-related trains would pass during the peak hour, and represents a worst-case analysis and a scenario that would likely not occur daily. See Appendix A, Vehicle Transportation Technical Data, for the analysis data.

3.1.1 Proposed Action

Potential impacts on vehicle transportation from the Proposed Action are described below.

3.1.1.1 Construction: Direct and Indirect Impacts

An estimated 180 PM peak hour motor vehicle trips are estimated as a result of peak construction activities with the rail construction scenario, or an estimated 260 PM peak hour motor vehicle trips with the truck or barge construction scenario. These vehicles would access the project area via the private driveway opposite 38th Avenue or a new driveway on Industrial Way. Parking would be provided for construction workers in the Applicant's leased area. All vehicle transportation impacts during construction would occur outside the project area and, therefore, are considered indirect impacts. Construction of the Proposed Action would result in the following indirect impacts.

Cause Vehicle Delays from Rail Construction Traffic

An average of 2 non-Proposed Action-related trains per day would be expected over study crossings on the Reynolds Lead, and 7 at the Dike Road study crossing (along the BNSF Spur) in the 2018 No-Action and 2018 Construction (truck delivery) scenarios. One non-Proposed Action-related train could pass during the PM peak hour. The weighted average length of these trains would be approximately 2,000 feet along the Reynolds Lead, and 5,000 feet along the BNSF Spur. The BNSF main line would have around 55 non-Proposed Action-related trains per day by 2018, with a weighted average length of over 5,100 feet. It is assumed that 4 non-Proposed Action-related trains could pass during the PM peak hour. Table 7 shows the anticipated weighted average train lengths and total gate downtime at the study crossings for 2018.

Table 7. Study Crossing Characteristics—2018 Construction Scenario

Crossing Name (USDOT Crossing ID)	Time Period	2018 No-Action		2018 Proposed Action (Truck Delivery)		2018 Proposed Action (Rail Delivery)	
		Weighted Average Train Length (feet)	Total Gate Downtime (minutes)	Weighted Average Train Length (feet)	Total Gate Downtime (minutes)	Weighted Average Train Length (feet)	Total Gate Downtime (minutes)
Study Crossings along the Reynolds Lead and BNSF Spur							
Project area access at 38th Avenue	Per Day	2,024	11.6	2,024	11.6	3,530	30.3
	PM Peak		5.10		5.1	6,219	14.6
Weyerhaeuser access at Washington Way	Per Day	2,024	7.7	2,024	7.7	3,530	19.6
	PM Peak		3.4		3.4	6,219	9.3
Weyerhaeuser NORPAC access	Per Day	2,024	6.4	2,024	6.4	3,530	16.0
	PM Peak		2.8		2.8	6,219	7.6
Industrial Way-SR 432 (101806G)	Per Day	2,024	6.4	2,024	6.4	3,530	16.0
	PM Peak		2.8		2.8	6,219	7.6
Oregon Way-SR 433 (101805A)	Per Day	2,024	6.4	2,024	6.4	3,530	16.0
	PM Peak		2.8		2.8	6,219	7.6
California Way (101821J)	Per Day	2,041	7.8	2,041	7.8	3,541	19.7
	PM Peak		3.4		3.4	6,219	9.3
3rd Avenue-SR 432 (101826T)	Per Day	2,041	7.8	2,041	7.8	3,541	19.7
	PM Peak		3.4		3.4	6,219	9.3
Dike Road (101791U)	Per Day	4,919	43.4	4,919	43.4	5,116	53.0
	PM Peak		6.1		6.1	6,219	7.6
Public At-Grade Crossings along the BNSF Main Line in Cowlitz County							
Taylor Crane Road in Castle Rock (092481X)	Per Day	5,160	92.2	5,160	92.2	5,178	94.1
	PM Peak	3,425	5.0	3,425	5.0	3,995	6.9
Cowlitz Street in Castle Rock (092476B)	Per Day	5,160	92.2	5,160	92.2	5,178	94.1
	PM Peak	3,425	5.0	3,425	5.0	3,995	6.9
Cowlitz Gardens Road in Kelso (092466V)	Per Day	5,160	79.1	5,160	79.1	5,178	80.7
	PM Peak	3,425	4.4	3,425	4.4	3,995	6.1

Crossing Name (USDOT Crossing ID)	Time Period	2018 No-Action		2018 Proposed Action (Truck Delivery)		2018 Proposed Action (Rail Delivery)	
		Weighted Average Train Length (feet)	Total Gate Downtime (minutes)	Weighted Average Train Length (feet)	Total Gate Downtime (minutes)	Weighted Average Train Length (feet)	Total Gate Downtime (minutes)
Mill Street in Kelso (092458D)	Per Day	5,160	108.3	5,160	108.3	5,178	110.6
	PM Peak	3,425	5.7	3,425	5.7	3,995	8.0
S River Road in Kelso (092457W)	Per Day	5,160	108.3	5,160	108.3	5,178	110.6
	PM Peak	3,425	5.7	3,425	5.7	3,995	8.0
Toteff Road/ Port Road in Kalama (092446J)	Per Day	5,160	78.5	5,160	78.5	5,178	80.1
	PM Peak	3,425	4.4	3,425	4.4	3,995	6.1
W Scott Avenue in Woodland (092437K)	Per Day	5,160	79.1	5,160	79.1	5,178	80.7
	PM Peak	3,425	4.4	3,425	4.4	3,995	6.1
Davidson Avenue in Woodland (092435W)	Per Day	5,160	79.1	5,160	79.1	5,178	80.7
	PM Peak	3,425	4.4	3,425	4.4	3,995	6.1
Whalen Road in Woodland (092434P)	Per Day	5,160	79.1	5,160	79.1	5,178	80.7
	PM Peak	3,425	4.4	3,425	4.4	3,995	6.1

Total gate downtime would be up to 8 minutes per day (3 minutes during the PM peak hour) at public crossings along the Reynolds Lead, 12 minutes per day (5 minutes during the PM peak hour) at private crossings along the Reynolds Lead, 43 minutes per day (6 minutes during the PM peak hour) at the Dike Road crossing along the BNSF Spur, and up to 108 minutes per day (6 minutes during the PM peak hour) along the BNSF main line in the 2018 No-Action and 2018 Construction (truck delivery) scenarios.

The 2018 Construction (rail delivery) scenario would add approximately 1 additional train per day, as documented in Section 2.1.2.2, *Construction Impact Analysis*. This train could pass during the PM peak hour. The additional train would take between 8 and 9 minutes to pass through the public street study crossings along the Reynolds Lead and BNSF Spur, and around 2 minutes to pass through the study crossings along the BNSF main line. This would increase the total gate downtime up to 12 minutes during an average day for the public study crossings along the Reynolds Lead, up to 19 minutes during an average day for the private study crossings along the Reynolds Lead, and up to 2 minutes during an average day along the BNSF main line during the first year of construction of the Proposed Action.

Table 8 shows the estimated average delay per vehicle and LOS that would be experienced during the PM peak hour at each of the study crossings for the 2018 Construction scenario for preload material delivery by truck or by rail, with the estimated 2018 No-Action scenario conditions provided for reference.

As shown, construction activities would not result in any material change in vehicle delay at at-grade crossings on the Reynolds Lead, BNSF Spur, and BNSF main line if preload material is delivered by truck. Should delivery of preload material by rail occur during the PM peak hour, the average delay per vehicle would increase, with forecast LOS dropping below LOS D at three of the study crossings on the Reynolds Lead. The length of the construction preload material train, estimated at 6,419 feet, and the slow track speeds at the California Way, 3rd Avenue (SR 432) and project area access (opposite 38th Avenue) study crossings (between 5 and 8 mph), would contribute to the vehicle LOS impacts. No vehicle LOS impacts are forecast at study crossings along the BNSF main line.

Table 9 shows the estimated average delay per vehicle and LOS that would be experienced during a 24-hour period at each of the study crossings in 2018. As shown, the average delay per vehicle expected over a 24-hour period is very low under each of the 2018 scenarios, illustrating that most drivers over the course of a day would not be delayed by a train at the study crossings. However, if a train crosses during the PM peak hour, it could cause substantial delay to drivers, as indicated in Table 8.

Table 8. Estimated Vehicle Delay and LOS—2018 Construction Scenario (PM Peak Hour)

		2018 No-Action		2018 Proposed Action (Truck Delivery)		2018 Proposed Action (Rail Delivery)	
USDOT Crossing ID	**Crossing Name**	**Delay (seconds)**	**LOS**	**Delay (seconds)**	**LOS**	**Delay (seconds)**	**LOS[a]**
Study Crossings along the Reynolds Lead and BNSF Spur							
Private	Project area access at 38th Avenue	14.9	B	15.7	B	126.6	**F**
Private	Weyerhaeuser access at Washington Way	6.9	A	6.9	A	51.9	D
Private	Weyerhaeuser NORPAC access	4.8	A	4.8	A	33.7	C
101806G	Industrial Way (SR 432)	7.6	A	8.3	A	52.8	D
101805A	Oregon Way (SR 433)	6.3	A	6.5	A	45.2	D
101821J	California Way	7.6	A	7.6	A	56.4	**E**
101826T	3rd Avenue (SR 432)	10.6	B	11.2	B	79.7	**E**
101791U	Dike Road	22.3	C	22.3	C	33.6	C
Public At-Grade Crossings along the BNSF Main Line in Cowlitz County							
092481X	Taylor Crane Road in Castle Rock	7.3	A	7.3	A	20.6	C
092476B	Cowlitz Street in Castle Rock	7.7	A	7.7	A	21.6	C
092466V	Cowlitz Gardens Road in Kelso	5.9	A	5.9	A	16.4	B
092458D	Mill Street in Kelso	10.7	B	10.7	B	31.0	C
092457W	S River Road in Kelso	10.4	B	10.4	B	30.1	C
092446J	Toteff Road/Port Road in Kalama	5.9	A	5.9	A	16.8	B
092437K	W Scott Avenue in Woodland	6.6	A	6.6	A	18.3	B
092435W	Davidson Avenue in Woodland	6.2	A	6.2	A	17.4	B
092434P	Whalen Road in Woodland	6.1	A	6.1	A	17.0	B

Notes:

[a] **Bolded**, **shaded gray** values indicate a vehicle LOS impact (a study crossing that operates below LOS D under the Proposed Action that would not otherwise operate below LOS D under the No-Action Alternative from the same year).

Delay = average delay per vehicle at worst roadway approach to the crossing; LOS = level of service of worst roadway approach to the crossing

Table 9. Estimated Vehicle Delay and LOS—2018 Construction Scenario (24-Hour Average)

		2018 No-Action		2018 Proposed Action (Truck Delivery)		2018 Proposed Action (Rail Delivery)	
USDOT Crossing ID	**Crossing Name**	**Delay (seconds)**	**LOS**	**Delay (seconds)**	**LOS**	**Delay (seconds)**	**LOS**
Study Crossings along the Reynolds Lead and BNSF Spur							
Private	Project area access at 38th Avenue	1.2	A	1.3	A	5.7	A
Private	Weyerhaeuser access at Washington Way	0.6	A	0.6	A	2.4	A
Private	Weyerhaeuser NORPAC access	0.4	A	0.4	A	1.5	A
101806G	Industrial Way (SR 432)	0.4	A	0.5	A	1.8	A
101805A	Oregon Way (SR 433)	0.4	A	0.4	A	1.7	A
101821J	California Way	0.6	A	0.6	A	2.5	A
101826T	3rd Avenue (SR 432)	0.6	A	0.6	A	2.6	A
101791U	Dike Road	5.7	A	5.7	A	7.2	A
Public At-Grade Crossings along the BNSF Main Line in Cowlitz County							
092481X	Taylor Crane Road in Castle Rock	3.2	A	3.2	A	3.3	A
092476B	Cowlitz Street in Castle Rock	3.3	A	3.3	A	3.4	A
092466V	Cowlitz Gardens Road in Kelso	2.4	A	2.4	A	2.5	A
092458D	Mill Street in Kelso	4.8	A	4.8	A	4.9	A
092457W	S River Road in Kelso	4.7	A	4.7	A	4.8	A
092446J	Toteff Road/ Port Road in Kalama	2.4	A	2.4	A	2.5	A
092437K	W Scott Avenue in Woodland	2.5	A	2.5	A	2.6	A
092435W	Davidson Avenue in Woodland	2.5	A	2.5	A	2.5	A
092434P	Whalen Road in Woodland	2.5	A	2.5	A	2.5	A

Notes:
Delay = average delay per vehicle over 24-hour period, in seconds; LOS = level of service of railroad crossing

Table 10 shows the estimated vehicle queue lengths that would be experienced during the PM peak hour at each of the study crossings during construction in 2018 for preload material delivery by truck or by rail, with the estimated 2018 No-Action scenario conditions provided for reference.

As shown, vehicle queues extending from six study crossings (all along the Reynolds Lead) could affect seven nearby intersections with 2018 No-Action scenario trains during the PM peak hour. The affected intersections include Industrial Way/38th Avenue, Industrial Way/Washington Way, Industrial Way/NORPAC access, Industrial Way/Weyerhaeuser Access, Industrial Way/Oregon Way, 3rd Avenue/Industrial Way, and Industrial Way/California Way. Vehicle queues at these intersections could exceed available storage at four approaches, including the eastbound right turn from Industrial Way to the Weyerhaeuser Access (opposite Washington Way), the eastbound left turn and westbound right turn from Industrial Way to Oregon Way, and the northbound through movement at the 3rd Avenue/Industrial Way intersection. These queues could potentially block other movements at these intersections that would otherwise not be affected by train crossing events.

Construction activities would not result in any material change in vehicle queue lengths if preload material is delivered by truck. Should delivery of preload material by rail occur during the PM peak hour, the estimated vehicle queue lengths would increase at rail crossings along high volume roadways, with queues extending nearly 1,000 feet beyond those expected with 2018 No-Action and 2018 Construction (via truck) scenario trains at the Industrial Way (SR 432), Oregon Way (SR 433), and 3rd Avenue (SR 432) study crossings. The length of the construction preload material train, estimated at 6,419 feet, and the slow track speeds at the Industrial Way (SR 432), Oregon Way (SR 433), 3rd Avenue (SR 432) study crossings (between 8 and 10 mph), would contribute to the increased vehicle queue lengths.

Two additional intersections would be affected by vehicle queues extending from rail crossings with 2018 Construction (via rail) scenario trains during the PM peak hour (beyond those affected by 2018 No-Action scenario trains), including Oregon Way/Alabama Street, and Pacific Avenue/S River Road. However, vehicle queues at the nine affected intersections would exceed available storage at only one additional approach beyond those affected by 2018 No-Action scenario trains, the southbound through movement at Industrial Way/Washington Way. This queue could potentially block the southbound left turn from Washington Way to Industrial Way, a movement that would otherwise not be affected by train-crossing events.

Table 10. Estimated Vehicle Queue Lengths—2018 Construction Scenario (PM Peak Hour)[a]

Crossing Name (USDOT Crossing ID)	Road MVMT[b]	2018 No-Action	2018 Truck	2018 Rail	Intersection Affected by Queue from Crossing	Intersection MVMT[c]	2018 No-Action	2018 Truck	2018 Rail
		Estimated Crossing Queue Length (feet)					Estimated Intersection Queue Length (feet)		
Study Crossings along the Reynolds Lead and BNSF Spur									
Project area access- opposite 38th Avenue	NB	40	1,960	2,480	Industrial Way/ 38th Avenue	WBL	20	20	20
	SB	20	20	20		EBR	20	20	20
Weyerhaeuser access- opposite Washington Way	NB	140	160	460	Industrial Way/ Washington Way	WBL	120	120	140
						EBR	40	40	40
	SB	120	120	160		SBT	60	60	160
Weyerhaeuser NORPAC access	NB	60	60	140	Industrial Way/ NORPAC access	WBL	20	20	20
	SB	20	20	20		EBR	20	20	20
Industrial Way- SR 432 (101806G)	NB	360	360	420	Industrial Way/ Weyerhaeuser	EBL	140	140	240
	SB	280	360	1,220		NBT	240	240	300
Oregon Way- SR 433 (101805A)	NB	660	640	2,460	Industrial Way/ Oregon Way	NBT	440	420	2,240
						EBL	180	240	240
						WBR	100	100	100
	SB	200	220	960	Oregon Way/ Alabama Street	EBR	N/A	N/A	120
						WBL			100
						SBT			260
California Way (101821J)	NB	100	100	260	Industrial Way/ California Way	N/A	N/A	N/A	N/A
	SB	120	140	600					
3rd Avenue- SR 432 (101826T)	NB	1,040	1,060	1,640	3rd Avenue/ Industrial Way	WBR	60	60	80
						NBT	640	660	1,240
					Industrial Way/ California Way	SBL	120	120	140
	SB	240	280	1,240		NBR	60	60	60
						EBT	400	420	1,000
Dike Road (101791U)	NB	60	60	100	None	N/A	N/A	N/A	N/A
	SB	100	100	120					

Crossing Name (USDOT Crossing ID)	Road MVMT[b]	2018 No-Action	2018 Truck	2018 Rail	Intersection Affected by Queue from Crossing	Intersection MVMT[c]	2018 No-Action	2018 Truck	2018 Rail
		Estimated Crossing Queue Length (feet)					Estimated Intersection Queue Length (feet)		
Public At-Grade Crossings along the BNSF Main Line in Cowlitz County									
Taylor Crane Road in Castle Rock (092481X)	EB	20	20	20	None	N/A	N/A	N/A	N/A
	WB	20	20	20					
Cowlitz Street in Castle Rock (092476B)	EB	40	40	40	None	N/A	N/A	N/A	N/A
	WB	40	40	60					
Cowlitz Gardens Road in Kelso (092466V)	EB	20	20	20	None	N/A	N/A	N/A	N/A
	WB	20	20	20					
Mill Street in Kelso (092458D)	EB	80	80	100	None	N/A	N/A	N/A	N/A
	WB	100	100	120					
S River Road in Kelso (092457W)	EB	40	40	80	Pacific Avenue/ S River Road	SBR	N/A	N/A	40
	WB	60	60	100		NBL			40
Toteff Road/ Port Road in Kalama (092446J)	EB	40	40	40	None	N/A	N/A	N/A	N/A
	WB	40	40	60					
W Scott Avenue in Woodland (092437K)	EB	40	40	60	None	N/A	N/A	N/A	N/A
	WB	100	100	120					
Davidson Avenue in Woodland (092435W)	EB	60	60	60	None	N/A	N/A	N/A	N/A
	WB	40	40	40					
Whalen Road in Woodland (092434P)	EB	40	40	40	None	N/A	N/A	N/A	N/A
	WB	60	60	60					

Notes:

[a] Shaded gray values indicate a study crossing or intersection queue that exceeds available storage. Shaded black values indicate a project impact.

[b] MVMT = roadway movement approaching the rail crossing; NB = northbound; SB = southbound; EB = eastbound; WB = westbound

[c] MVMT = movement at nearby intersection affected by queue from rail crossing; NBL = northbound left; NBR = northbound right; NBT = northbound through; SBL = southbound left; SBR = southbound right; SBT = southbound through; EBL= eastbound left; EBR= eastbound right; EBT= eastbound through; WBL= westbound left; WBR= westbound right; WBT= westbound through

3.1.1.2 Operations: Direct Impacts

Approximately 109 PM peak hour motor vehicle trips are estimated as a result of operation of the Proposed Action. These vehicles would access the project area via the private driveway opposite 38th Avenue or at the existing driveway on Industrial Way approximately 0.5 mile west of the 38th Avenue driveway. Access roads in the project area would be designed to allow two-way traffic for standard vehicles. All roadways and parking areas would be designed and constructed to the standards appropriate for loading and capacity requirements. All regularly used roads accessing the buildings and facilities in the project area would be sealed with asphalt pavement. Paving would be designed to accommodate mobile equipment loadings. Surfacing of unpaved areas would be used to control soil erosion by wind and water.

3.1.1.3 Operations: Indirect Impacts

All vehicle transportation impacts during operations would occur outside the project area and, therefore, are considered indirect impacts. Full operation of the Proposed Action would result in the following indirect impacts.

Cause Vehicle Delays from Rail Traffic

The Proposed Action would add approximately 16 additional trains per day (up to 2 during the PM peak hour) in 2028, as documented in Section 2.1.2.3, *Operations Impact Analysis.* Analysis of the study crossing in 2028 was estimated both with and without planned track infrastructure along the Reynolds Lead. Planned track improvements would increase the average train speed from 8 mph to 10 mph at the Weyerhaeuser access crossing opposite Washington Way, from 10 mph to 15 mph at the Weyerhaeuser NORPAC access crossing, from 10 mph to 20 mph at the Industrial Way and Oregon Way crossings, and from 8 mph to 15 mph at the California Way and 3rd Avenue crossings. No changes in train speed would occur at the existing site access opposite 38th Avenue and Dike Road crossings. Table 11 shows study crossing characteristics in 2028.

Table 11. Study Crossing Characteristics—2028 Operations

Crossing Name (USDOT Crossing ID)	Time Period	2028 No-Action		2028 Operations (with Current Track Infrastructure)		2028 Operations (with Planned Track Infrastructure)	
		Weighted Average Train Length (feet)	Total Gate Downtime (minutes)	Weighted Average Train Length (feet)	Total Gate Downtime (minutes)	Weighted Average Train Length (feet)	Total Gate Downtime (minutes)
Study Crossings along the Reynolds Lead and BNSF Spur							
Project area access at 38th Avenue	Per Day	2,043	20.5	5,886	277.4	5,886	277.4
	PM Peak		5.1	6,844	16.0	6,844	16.0
Weyerhaeuser access at Washington Way	Per Day	2,043	13.6	5,886	177.1	5,886	143.7
	PM Peak		3.4	6,844	10.2	6,844	8.3
Weyerhaeuser NORPAC access	Per Day	2,043	11.2	5,886	143.7	5,886	99.1
	PM Peak		2.8	6,844	8.3	6,844	5.7
Industrial Way- SR 432 (101806G)	Per Day	2,043	11.2	5,886	143.7	5,886	76.8
	PM Peak		2.8	6,844	8.3	6,844	4.4
Oregon Way- SR 433 (101805A)	Per Day	2,043	11.2	5,886	143.7	5,886	76.8
	PM Peak		2.8	6,844	8.3	6,844	4.4
California Way (101821J)	Per Day	2,053	13.6	5,888	177.2	5,888	99.2
	PM Peak		3.4	6,844	10.2	6,844	5.7
3rd Avenue- SR 432 (101826T)	Per Day	2,053	13.6	5,888	177.2	5,888	99.2
	PM Peak		3.4	6,844	10.22	6,844	5.7
Dike Road (101791U)	Per Day	4,919	43.4	6,251	175.8	6,251	175.8
	PM Peak		6.1	6,844	8.3	6,844	8.3
Public At-Grade Crossings along the BNSF Main Line in Cowlitz County							
Taylor Crane Road in Castle Rock (092481X)	Per Day	5,396	125.5	5,539	141.9	5,539	141.9
	PM Peak	3,837	6.3	4,748	10.4	4,748	10.4
Cowlitz Street in Castle Rock (092476B)	Per Day	5,396	125.5	5,539	141.9	5,539	141.9
	PM Peak	3,837	6.3	4,748	10.4	4,748	10.4
	Per Day	5,396	108.2	5,539	122.5	5,539	122.5

Crossing Name (USDOT Crossing ID)	Time Period	2028 No-Action		2028 Operations (with Current Track Infrastructure)		2028 Operations (with Planned Track Infrastructure)	
		Weighted Average Train Length (feet)	Total Gate Downtime (minutes)	Weighted Average Train Length (feet)	Total Gate Downtime (minutes)	Weighted Average Train Length (feet)	Total Gate Downtime (minutes)
Cowlitz Gardens Road in Kelso (092466V)	PM Peak	3,837	5.6	4,748	9.2	4,748	9.2
Mill Street in Kelso (092458D)	Per Day	5,396	147.8	5,539	167.3	5,539	167.3
	PM Peak	3,837	7.3	4,748	12.2	4,748	12.2
S River Road in Kelso (092457W)	Per Day	5,396	147.8	5,539	167.3	5,539	167.3
	PM Peak	3,837	7.3	4,748	12.2	4,748	12.2
Toteff Road/ Port Road in Kalama (092446J)	Per Day	5,396	107.5	5,539	121.8	5,539	121.8
	PM Peak	3,837	5.6	4,748	9.2	4,748	9.2
W Scott Avenue in Woodland (092437K)	Per Day	5,396	108.2	5,539	122.5	5,539	122.5
	PM Peak	3,837	5.6	4,748	9.2	4,748	9.2
Davidson Avenue in Woodland (092435W)	Per Day	5,396	108.2	5,539	122.5	5,539	122.5
	PM Peak	3,837	5.6	4,748	9.2	4,748	9.2
Whalen Road in Woodland (092434P)	Per Day	5,396	108.2	5,539	122.5	5,539	122.5
	PM Peak	3,837	5.6	4,748	9.2	4,748	9.2

A Proposed Action-related train would take between 8 and 10 minutes to pass through the public study crossings along the Reynolds Lead with current track infrastructure, and between 4 and 6 minutes with planned track infrastructure. Trains under full operation of the Proposed Action would take about 8 minutes to cross Dike Road along the BNSF Spur, and around 2 minutes to pass through the study crossings along the BNSF main line. Overall, the 16 additional Proposed Action-related trains would increase the total gate downtime over 130 minutes during an average day for the public study crossings along the Reynolds Lead and BNSF Spur, up to 250 minutes during an average day for the private study crossings along the Reynolds Lead, and up to 20 minutes during an average day along the BNSF main line. The planned track infrastructure along the Reynolds Lead would reduce the total gate downtime at the Weyerhaeuser NORPAC access, Industrial Way-SR 432 (101806G), Oregon Way- SR 433 (101805A), California Way (101821J), and 3rd Avenue-SR 432 (101826T) study crossings.

Table 12 shows the estimated average delay per vehicle and LOS that would be experienced during the PM peak hour at each of the study crossings in 2028 with the Proposed Action, with the estimated 2028 No-Action scenario conditions provided for reference.

As shown, the increased rail activity associated with the Proposed Action would increase average delay per vehicle during the PM peak hour, with forecasted LOS dropping below D at six of the study crossings on the Reynolds Lead with existing track infrastructure. The length of the Proposed Action-related trains, estimated at 6,844 feet, and the slow track speeds (between 5 and 10 mph), would contribute to the vehicle LOS impacts.

The planned track infrastructure along the Reynolds Lead would address all of the vehicle LOS impacts at the public study crossings, assuming 1 Proposed Action-related train on the Reynolds Lead during the PM peak hour. Only the project area access (opposite 38th Avenue) study crossing would operate below LOS D. Vehicle LOS impacts are still forecasted at this study crossing since track speeds would not increase with the planned track infrastructure along the Reynolds Lead.

However, four of the study crossings would have vehicle LOS impacts with 2 Proposed Action-related trains on the Reynolds Lead during the PM peak hour, with planned track infrastructure. It should be noted that track speeds at two of these study crossings (project area access- opposite 38th Avenue, and Dike Road) would not be increased with the planned track infrastructure along the Reynolds Lead.

Vehicle LOS impacts are also forecasted at the Mill Street and S River Road study crossings in Kelso, along the BNSF main line. These crossings are forecast to be slightly over standard, mainly due to the slower track speeds for both freight and passenger trains (40 mph).

Table 13 shows the estimated average delay per vehicle and LOS that would be experienced during a 24-hour period at each of the study crossings in 2028. As shown, the average delay per vehicle expected over a 24-hour period is very low under the 2028 No-Action scenario and 2028 Proposed Action (with planned track infrastructure) scenario. However, the average delay per vehicle expected over a 24-hour period is higher under the 2028 Proposed Action (with existing track infrastructure) scenario, corresponding with the PM peak hour results.

Table 12. Estimated Vehicle Delay and LOS—2028 Operations (PM Peak Hour)[a]

Crossing Name (USDOT Crossing ID)	2028 No-Action		2028 Operations (Current Track Infrastructure and 1 Peak Hour Proposed Action-Related Train)		2028 Operations (Planned Track Infrastructure[b] and 1 Peak Hour Proposed Action-Related Train)		2028 Operations (Planned Track Infrastructure[b] and 2 Peak Hour Proposed Action-Related Trains)	
	Delay	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS
Study Crossings along the Reynolds Lead and BNSF Spur								
Project area access at 38th Ave	14.9	B	149.2	**F**	149.2	**F**	265.3	**F**
Weyerhaeuser access at Washington Way	6.9	A	62.7	**E**	41.3	D	73.4	**E**
Weyerhaeuser NORPAC access	4.9	A	40.7	**D**	19.3	B	34.2	C
Industrial Way- SR 432 (101806G)	8.3	A	67.8	**E**	19.7	B	34.6	C
Oregon Way- SR 433 (101805A)	6.9	A	58.0	**E**	16.6	B	29.3	C
California Way (101821J)	7.8	A	69.4	**E**	21.7	C	38.5	D
3rd Avenue- SR 432 (101826T)	12.2	B	107.8	**F**	33.9	C	59.9	**E**
Dike Road (101791U)	22.4	C	40.5	D	40.5	D	72.0	**E**
Public At-Grade Crossings along the BNSF Main Line in Cowlitz County								
Taylor Crane Road in Castle Rock (092481X)	19.4	B	N/A	N/A	N/A	N/A	42.4	D
Cowlitz Street in Castle Rock (092476B)	20.5	C	N/A	N/A	N/A	N/A	44.7	D
Cowlitz Gardens Road in Kelso (092466V)	15.5	B	N/A	N/A	N/A	N/A	33.9	C
Mill Street in Kelso (092458D)	29.4	C	N/A	N/A	N/A	N/A	65.3	**E**
S River Road in Kelso (092457W)	28.4	C	N/A	N/A	N/A	N/A	63.3	**E**
Toteff Road/ Port Road in Kalama (092446J)	15.9	B	N/A	N/A	N/A	N/A	34.7	C
W Scott Avenue in Woodland (092437K)	17.6	B	N/A	N/A	N/A	N/A	38.8	D

Crossing Name (USDOT Crossing ID)	2028 No-Action		2028 Operations (Current Track Infrastructure and 1 Peak Hour Proposed Action-Related Train)		2028 Operations (Planned Track Infrastructure[b] and 1 Peak Hour Proposed Action-Related Train)		2028 Operations (Planned Track Infrastructure[b] and 2 Peak Hour Proposed Action-Related Trains)	
	Delay	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS
Davidson Avenue in Woodland (092435W)	16.6	B	N/A	N/A	N/A	N/A	36.7	D
Whalen Road in Woodland (092434P)	16.1	B	N/A	N/A	N/A	N/A	35.6	D

Notes:

[a] **Bolded**, **shaded gray** values indicate a vehicle LOS impact (a study crossing that operates below LOS D under the Proposed Action that would not otherwise operate below LOS D under the No-Action Alternative from the same year).

[b] Planned track infrastructure along the Reynolds Lead would increase the average train speed from 8 mph to 10 mph at the Weyerhaeuser access crossing—opposite Washington Way, from 10 mph to 15 mph at the Weyerhaeuser NORPAC access crossing, from 10 mph to 20 mph at the Industrial Way and Oregon Way crossings, and from 8 mph to 15 mph at the California Way and 3rd Avenue crossings. No changes in train speed would occur at the existing site access—opposite 38th Avenue and Dike Road crossings.

Delay = average delay per vehicle at worst approach; LOS = level of service of worst approach

Table 13. Estimated Vehicle Delay and LOS—2028 Operations (24-Hour Average)[a]

USDOT Crossing ID	Crossing Name	2028 No-Action		2028 Operations (with Current Track Infrastructure)		2028 Operations (with Planned Track Infrastructure[b])	
		Delay	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS
Study Crossings along the Reynolds Lead and BNSF Spur							
Private	Project area access at 38th Ave	2.2	A	83.5	**F**	83.5	**F**
Private	Weyerhaeuser access at Washington Way	1.0	A	34.7	C	22.8	C
Private	Weyerhaeuser NORPAC access	0.7	A	22.0	C	10.5	B
101806G	Industrial Way (SR 432)	0.8	A	26.2	C	7.5	A
101805A	Oregon Way (SR 433)	0.8	A	25.0	C	7.2	A
101821J	California Way	1.1	A	36.8	D	11.5	B
101826T	3rd Avenue (SR 432)	1.1	A	38.7	D	12.1	B
101791U	Dike Road	5.7	A	28.8	C	28.8	C
Public At-Grade Crossings along the BNSF Main Line in Cowlitz County							
092481X	Taylor Crane Road in Castle Rock	4.5	A	5.2	A	5.2	A
092476B	Cowlitz Street in Castle Rock	4.7	A	5.4	A	5.4	A
092466V	Cowlitz Gardens Road in Kelso	3.4	A	4.0	A	4.0	A
092458D	Mill Street in Kelso	6.9	A	7.9	A	7.9	A
092457W	S River Road in Kelso	6.7	A	7.7	A	7.7	A
092446J	Toteff Road/ Port Road in Kalama	3.5	A	4.0	A	4.0	A
092437K	W Scott Avenue in Woodland	3.6	A	4.2	A	4.2	A
092435W	Davidson Avenue in Woodland	3.5	A	4.1	A	4.1	A
092434P	Whalen Road in Woodland	3.5	A	4.0	A	4.0	A

Notes:

[a] **Bolded**, **shaded gray** values indicate a vehicle LOS impact (a study crossing that operates below LOS D under the Proposed Action that would not otherwise operate below LOS D under the No-Action Alternative from the same year).

[b] Planned track infrastructure along the Reynolds Lead would increase the average train speed from 8 mph to 10 mph at the Weyerhaeuser access crossing—opposite Washington Way, from 10 mph to 15 mph at the Weyerhaeuser NORPAC access crossing, from 10 mph to 20 mph at the Industrial Way and Oregon Way crossings, and from 8 mph to 15 mph at the California Way and 3rd Avenue crossings. No changes in train speed would occur at the existing site access—opposite 38th Avenue and Dike Road crossings.

Delay = Average delay per vehicle over 24-hour period, in seconds; LOS = level of service of railroad crossing

Table 14 shows the estimated vehicle queue lengths that would be experienced during the PM peak hour at each of the study crossings in 2028. The increased rail activity associated with the Proposed Action (existing track infrastructure) would increase vehicle queues at rail crossings along high volume roadways, with queues similar to those estimated with 2018 Construction (via rail) scenario trains, extending nearly 1,000 feet beyond those expected with 2028 No-Action scenario trains at the Industrial Way (SR 432), Oregon Way (SR 433), and 3rd Avenue (SR 432) study crossings. The length of the Proposed Action-related trains, estimated at 6,844 feet, and the slow track speeds (between 8 and 10 mph), would contribute to the increased vehicle queue lengths.

One additional intersection would be affected by vehicle queues extending from rail crossings with Proposed Action-related trains (existing track infrastructure) during the PM peak hour (beyond those affected by 2028 No-Action scenario trains), Oregon Way/Alabama Street. Vehicle queues at the 9 affected intersections (all previously identified as being affected with 2018 trains) would exceed available storage at one additional approach beyond those affected by 2028 No-Action scenario trains, the southbound through movement at Industrial Way/Washington Way. This queue could potentially block the southbound left turn from Washington Way to Industrial Way, a movement that would otherwise not be affected by train crossing events.

The planned track infrastructure along the Reynolds Lead would reduce vehicle queues at the study crossings between the Weyerhaeuser access (opposite Washington Way) and 3rd Avenue (SR 432), assuming 1 Proposed Action-related train on the Reynolds Lead during the PM peak hour. Vehicle queues would be between 700 and 1,000 feet shorter than those estimated with the existing track infrastructure along the Reynolds Lead. However, vehicle queues would still exceed available storage at the four of the five approaches identified with the existing track infrastructure. Note that Table 14 shows estimated vehicle queue lengths with the planned track infrastructure and 1 Proposed Action-related train on the Reynolds Lead during the PM peak hour. With 2 Proposed Action-related trains on the Reynolds Lead during the PM peak hour, vehicle queues extending from study crossings would be similar to those estimated with the existing track infrastructure, despite the track improvements.

Table 14. Estimated Vehicle Queue Lengths—2028 Operations (PM Peak Hour)[a]

Crossing Name (USDOT Crossing ID)	Road MVMT[b]	2028 No-Action	2028 Exist. Infras.	2028 Plan. Infras.	Intersection Affected by Queue from Crossing	Intersection MVMT[c]	2028 No-Action	2028 Exist. Infras.	2028 Plan. Infras.
		Estimated Crossing Queue Length (feet)					Estimated Intersection Queue Length (feet)		
Study Crossings along the Reynolds Lead and BNSF Spur									
Project area access at 38th Avenue	NB	40	1,120	1,240	Industrial Way/ 38th Avenue	WBL	20	160	180
	SB	20	160	200		EBR	20	20	20
Weyerhaeuser access-opposite Washington Way	NB	280	760	480	Industrial Way/ Washington Way	WBL	120	180	140
						EBR	40	40	40
	SB	120	240	200		SBT	60	240	180
Weyerhaeuser NORPAC access	NB	60	160	100	Industrial Way/ NORPAC access	WBL	20	20	20
	SB	20	20	20		EBR	20	20	20
Industrial Way- SR 432 (101806G)	NB	380	500	420	Industrial Way/ Weyerhaeuser	EBL	140	200	120
	SB	340	1,200	520		NBT	260	380	300
Oregon Way- SR 433 (101805A)	NB	880	2,140	1,460	Industrial Way/ Oregon Way	NBT	660	1,920	1,220
						EBL	180	240	200
						WBR	100	100	100
	SB	440	1,580	800	Oregon Way/ Alabama Street	EBR	N/A	280	120
						WBL		560	100
						SBT		880	100
California Way (101821J)	NB	100	240	180	Industrial Way/ California Way	N/A	N/A	N/A	N/A
	SB	160	660	380					
3rd Avenue- SR 432 (101826T)	NB	1,400	1,720	600	3rd Avenue/ Industrial Way	WBR	60	120	80
						NBT	1,000	1,320	200
					Industrial Way/ California Way	SBL	120	120	N/A
	SB	340	1,740	820		NBR	80	80	
						EBT	760	1,080	

Crossing Name (USDOT Crossing ID)	Road MVMT[b]	2028 No-Action	2028 Exist. Infras.	2028 Plan. Infras.	Intersection Affected by Queue from Crossing	Intersection MVMT[c]	2028 No-Action	2028 Exist. Infras.	2028 Plan. Infras.
		Estimated Crossing Queue Length (feet)					Estimated Intersection Queue Length (feet)		
Dike Road (101791U)	NB	60	80	100	None	N/A	N/A	N/A	N/A
	SB	100	120	140					
Public At-Grade Crossings along the BNSF Main Line in Cowlitz County									
Taylor Crane Road in Castle Rock (092481X)	EB	20	20	20	None	N/A	N/A	N/A	N/A
	WB	20	20	20					
Cowlitz Street in Castle Rock (092476B)	EB	40	60	60	None	N/A	N/A	N/A	N/A
	WB	80	80	80					
Cowlitz Gardens Road in Kelso (092466V)	EB	20	40	40	None	N/A	N/A	N/A	N/A
	WB	20	40	40					
Mill Street in Kelso (092458D)	EB	100	160	160	None	N/A	N/A	N/A	N/A
	WB	160	240	240					
S River Road in Kelso (092457W)	EB	80	120	120	Pacific Avenue/S River Road	SBR	60	100	100
	WB	120	180	180		NBL	40	40	40
Toteff Road/ Port Road in Kalama (092446J)	EB	40	60	60	None	N/A	N/A	N/A	N/A
	WB	60	80	80					
W Scott Avenue in Woodland (092437K)	EB	60	100	100	None	N/A	N/A	N/A	N/A
	WB	140	200	200					
Davidson Avenue in Woodland (092435W)	EB	100	120	120	None	N/A	N/A	N/A	N/A
	WB	60	80	80					
Whalen Road in Woodland (092434P)	EB	60	60	60	None	N/A	N/A	N/A	N/A
	WB	80	80	80					

Notes:

[a] Shaded gray values indicate a study crossing or intersection with a queue that exceeds available storage. Shaded black values indicate a project impact.

[b] MVMT= Roadway movement approaching the rail crossing; NB = northbound; SB = southbound; EB = eastbound; WB = westbound

[c] MVMT= Movement at nearby intersection affected by queue from rail crossing; NBL = northbound left; NBR = northbound right; NBT = northbound through; SBL = southbound left; SBR = southbound right; SBT = southbound through; EBL = eastbound left; EBR = eastbound right; EBT = eastbound through; WBL = westbound left; WBR = westbound right; WBT = westbound through; N/A = not available

Cause Delay to Emergency Vehicle Response from Rail Traffic

EMS and fire protection response times would be affected by increased delay at at-grade crossings as a result of the Proposed Action.

2018 Construction Scenario

During construction, should delivery of preload material by rail occur during the PM peak hour, the average delay per stopped vehicle would be estimated at less than 80 seconds at public at-grade crossings along the Reynolds Lead, and generally less than 20 seconds at public at-grade crossings along the BNSF Spur and BNSF main line. This corresponds to an increase by approximately 60 seconds or less at public at-grade crossings along the Reynolds Lead, and less than 30 seconds along the BNSF Spur and BNSF main line compared to the 2018 No-Action scenario. Construction activities would not result in any material change in vehicle delay at at-grade crossings on the Reynolds Lead, BNSF Spur, and BNSF main line if preload material is delivered by truck.

Total gate downtime would be up to 8 minutes per day at public crossings along the Reynolds Lead, 43 minutes per day at the Dike Road crossing along the BNSF Spur, and up to 108 minutes per day along the BNSF main line under the 2018 No-Action and 2018 Construction (truck delivery) scenarios. If preload material is delivered by rail, total gate downtime would be up to 12 minutes longer per day at public crossings along the Reynolds Lead and BNSF Spur, and up to 2 minutes longer per day along the BNSF main line compared to the 2018 No-Action scenario. Over the course of a day, a 1% increase in probability of EMS and fire protection response vehicles being delayed at study crossings along the Reynolds Lead, BNSF Spur, and BNSF main line is anticipated with 2018 Construction (via rail) scenario trains.

2028 Operations

The average delay during the PM peak hour per stopped vehicle during operations in 2028 would be estimated at less than 110 seconds at public at-grade crossings along the Reynolds Lead, and generally less than 60 seconds at public at-grade crossings along the BNSF Spur and BNSF main line. This corresponds to an increase by approximately 90 seconds or less at public at-grade crossings along the Reynolds Lead, and less than 40 seconds along the BNSF Spur and BNSF main line compared to the 2028 No Action scenario. With the planned track infrastructure, the average delay during the PM peak hour per stopped vehicle would be estimated to increase by less than 50 seconds at public at-grade crossings along the Reynolds Lead.

Total gate downtime would be up to 14 minutes per day at public crossings along the Reynolds Lead, 43 minutes per day at the Dike Road crossing along the BNSF Spur, and up to 148 minutes per day along the BNSF main line in the 2028 No-Action scenario. Under full operations, trains would increase total gate downtime over 130 minutes during an average day for the public study crossings along the Reynolds Lead and BNSF Spur, and up to 20 minutes during an average day along the BNSF main line compared to the 2028 No-Action scenario. The planned track infrastructure along the Reynolds Lead would reduce the total gate downtime at the Industrial Way (SR 432), Oregon Way (SR 433), California Way, and 3rd Avenue (SR 432) study crossings.

Over the course of a day, a 10% increase in probability of EMS and fire protection response vehicles being delayed at study crossings along the Reynolds Lead and BNSF Spur, and 1% increase at study crossings along the BNSF main line is anticipated with the Proposed Action (with existing track

infrastructure) trains. The planned track infrastructure along the Reynolds Lead would reduce the probability of EMS and fire protection response vehicles of being delayed at the Industrial Way (SR 432), Oregon Way (SR 433), California Way, and 3rd Avenue (SR 432) study crossings by around 5%.

Overall, the Proposed Action could have an adverse impact on emergency vehicle response time, especially without planned track improvements, depending on the location of the origin and destination of the response incident in relation to the at-grade crossings that would be anticipated to experience increased gate downtime.

Increase Predicted Accident Probability

An accident probability analysis was conducted using the FRA GradeDec.Net web-based software. GradeDec.Net contains a predicted accident probability module based on the USDOT accident prediction and severity formula. This module predicts accident probability based on a nationwide inventory of roadway/railroad grade crossings, the type of crossing protection in place, historical accident data at the crossing, distribution of daily traffic volumes, and the number of trains per day. The module calculates the number of predicted accidents (fatal, injury, property damage only, and total) in a year. The predicted accident probability is based on data at the time of the analysis. The predicted accident probability could change over time, such changes to accidents, traffic volumes, and train traffic.

For this analysis, a predicted accident probability of 0.04 per year, or one every 25 years, was used as a performance measure for when grade-separation should be considered at study crossings for safety reasons. This was based on a peer review of similar applications of the FRA GradeDec.Net module. The predicted accident probability based on current safety protection for each at-grade study is summarized in Table 15 for both construction and operations of the Proposed Action, with No-Action Alternative conditions shown for reference.

As shown, the predicted accident probability was found to be above 0.04 accidents per year with existing crossing safety protection at the 3rd Avenue (SR 432) study crossing along the Reynolds Lead. At full operation of the Proposed Action, trains would increase the predicted accident probability above 0.04 accidents per year at this study crossing.

3.1.1.4 Washington State Study Area

As described in Section 2.1.2.3, *Operations Impact Analysis,* Proposed Action-related BNSF trains would cross Washington State from the Washington State–Idaho border (east of Spokane) to the project area in Cowlitz County. Loaded and empty UP trains to and from the Powder River Basin and Uinta Basin would travel north from Vancouver, Washington. Section 2.2.2, *Washington State Study Area*, identified a list of statewide crossings of interest during the project's SEPA scoping process for crossings along the proposed rail routes. Table 16 illustrates the 2028 estimated baseline trains per day at these study crossings and the estimated number of trains per day with the Proposed Action in 2028. Figure 6 illustrates the rail routes and the study crossings. Appendix B, Data for Selected Crossings Outside of Cowlitz County, provides additional data on the study crossings.

Table 15. At-Grade Crossing Safety Assessment

Crossing Name (USDOT Crossing ID)	Predicted Accidents (accidents/year)				
	2018 No-Action	2018 Proposed Action (Truck Delivery)	2018 Proposed Action (Rail Delivery)	2028 No-Action	2028 Operations
Study Crossings along the Reynolds Lead and BNSF Spur					
Project area access at 38th Avenue	0.008	0.019	0.020	0.011	0.035
Weyerhaeuser access at Washington Way	0.014	0.014	0.017	0.018	0.027
Weyerhaeuser NORPAC access	0.012	0.012	0.015	0.016	0.031
Industrial Way- SR 432 (101806G)	0.013	0.014	0.016	0.016	0.025
Oregon Way- SR 433 (101805A)	0.018	0.018	0.021	0.022	0.038
California Way (101821J)	0.010	0.010	0.012	0.012	0.020
3rd Avenue- SR 432 (101826T)	0.021	0.021	0.025	0.026	**0.042**
Dike Road (101791U)	0.014	0.014	0.014	0.014	0.020
At-Grade Public Crossings along the BNSF Main Line in Cowlitz County					
Taylor Crane Road in Castle Rock (092481X)	0.017	0.017	0.017	0.020	0.021
Cowlitz Street in Castle Rock (092476B)	0.027	0.027	0.028	0.031	0.032
Cowlitz Gardens Road in Kelso (092466V)	0.027	0.027	0.028	0.031	0.032
Mill Street in Kelso (092458D)	0.035	0.035	0.036	0.038	0.039
S River Road in Kelso (092457W)	0.033	0.033	0.033	0.037	0.039
Toteff Road/ Port Road in Kalama (092446J)	0.027	0.027	0.028	0.031	0.032
W Scott Avenue in Woodland (092437K)	0.032	0.032	0.032	0.036	0.037
Davidson Avenue in Woodland (092435W)	0.031	0.031	0.031	0.034	0.036
Whalen Road in Woodland (092434P)	0.029	0.029	0.029	0.033	0.034

Notes:
Bolded, shaded gray values indicate a vehicle safety impact (a study crossing that would have a predicted accident probability above 0.04 under the Proposed Action that would be at or below 0.04 under the No-Action Alternative from the same year).

Table 16. 2028 Conditions at Selected Crossings Outside of Cowlitz County

#[a]	Road Crossing	USDOT/FRA Crossing ID[b]	Freight Train Speed[b]	2015 Estimated Trains Per Day[c]	2028 Projected Baseline Trains Per Day[c]	2028 Projected Trains Per Day with Proposed Action	2028 Increase in Trains Per Day with Proposed Action
Spokane County							
1	Idaho Road	066236B	60	70	106	122	13%
2	McKinzey Road	066239W	60	70	106	122	13%
3	Harvard Road	066240R	60	70	106	122	13%
4	Barker Road	066244T	60	70	106	122	13%
5	Flora Road	066245A	60	70	106	122	13%
6	Pines Road-SR 27	066367E	60	70	106	122	13%
7	University Road	066371U	60	70	106	122	13%
8	Park Road	066377K	60	70	106	122	13%
9	Pine Street	066315M	35	39	56	72	22%
10	F Street/Cheney-Spangle	065970L	35	39	56	72	22%
11	Cheney-Plaza Road	065971T	35	39	56	72	22%
Adams County							
12	Paha Packard Road	089665U	60	39	56	72	22%
13	Kahlotus Road	089670R	60	39	56	72	22%
14	1st Street	089672E	50	39	56	72	22%
15	Wilbur/City Road	089673L	50	39	56	72	22%
Franklin County							
16	Eltopia Road W	089699N	60	39	56	72	22%
17	Sagemoor Road	089700F	60	39	56	72	22%
Benton County							
18	East 3rd Avenue	090031U	35	34	48	56	14%
19	Dague Road-East 25th Avenue	090035W	60	34	48	56	14%
20	Perkins Road	090036D	60	34	48	56	14%

#[a]	Road Crossing	USDOT/FRA Crossing ID[b]	Freight Train Speed[b]	2015 Estimated Trains Per Day[c]	2028 Projected Baseline Trains Per Day[c]	2028 Projected Trains Per Day with Proposed Action	2028 Increase in Trains Per Day with Proposed Action
21	Bowles Road	090038S	60	34	48	56	14%
22	Cochran Road	090039Y	60	34	48	56	14%
23	Finley Road	090040T	60	34	48	56	14%
24	Whitcomb Island	090061L	60	34	48	56	14%
Klickitat County							
25	Maple Street	090169V	45	34	48	56	14%
26	Walnut Street	090168N	45	34	48	56	14%
27	South Dock Grade Road	090164L	55	34	48	56	14%
Skamania County							
28	Indian Crossing	090159P	55	34	48	56	14%
29	Home Valley Park	090155M	55	34	48	56	14%
30	Cemetery Xing	090151K	N/A	34	48	56	14%
31	Russell Avenue	090148C	20	34	48	56	14%
32	Skamania Landing/Butler Road	090135B	60	34	48	56	14%
33	Walker/Skamania Landing	090134U	60	34	48	56	14%
34	St Cloud Road	090133M	N/A	34	48	56	14%
Lewis County							
35	SR 506-7th Street	092484T	50	50	73	81	10%
36	Walnut Street – SR 505/603	092493S	50	50	73	81	10%
37	E Locust Street	092519S	40	50	73	81	10%
38	Main Street	092520L	40	50	73	81	10%
39	Maple Street	092521T	40	50	73	81	10%
40	Big Hanaford Road	092524N	10	50	73	81	10%

#[a]	Road Crossing	USDOT/FRA Crossing ID[b]	Freight Train Speed[b]	2015 Estimated Trains Per Day[c]	2028 Projected Baseline Trains Per Day[c]	2028 Projected Trains Per Day with Proposed Action	2028 Increase in Trains Per Day with Proposed Action
Yakima County							
41	Jones Road East	099178A	55	7	11	19	42%
42	Indian Church	104523U	55	7	11	19	42%
43	SR241/Reservation	104534G	55	7	11	19	42%
44	Gulden Road	104536V	55	7	11	19	42%

Notes:
[a] See Figure 6 for crossing location.
[b] Source: Washington Utilities Transportation Commission 2015.
[c] Washington State Department of Transportation 2014b. Linear extrapolation of 2010 and 2035 projected train traffic to 2015 volumes.
N/A = data not available

Figure 6. Selected At-Grade Crossings Beyond Cowlitz County

Vehicle Delay

As illustrated in Table 16, the Proposed Action would add 16 trains per day to the crossings in Spokane, Adams, and Franklin Counties (between the Washington State-Idaho border east of Spokane and Pasco, Washington) and would increase daily rail traffic by approximately 13% and 22%, depending on location. Between Pasco and Cowlitz County (study crossings in Benton, Klickitat, and Skamania Counties), the Proposed Action would add 8 trains per day and increase daily rail traffic by approximately 14%. At the Lewis County study crossings, the Proposed Action would add 8 trains per day and increase daily rail traffic by approximately 10%, and between Auburn and Pasco (Yakima County study crossings), the Proposed Action would increase daily rail traffic by approximately 44%.

Proposed Action-related trains would be approximately 1.3 miles long, and would take the following approximate times to pass at study crossings.[7]

- 10 mph: 8.5 minutes
- 20 mph: 4.75 minutes
- 30 mph: 3.25minutes
- 40 mph: 2.75 minutes
- 50 mph: 2.25 minutes
- 60 mph: 2.0 minutes

Vehicle delay would increase between the Washington State-Idaho border and Cowlitz County because the Proposed Action would add 8 or 16 trains daily (depending on location) to existing BNSF rail routes as shown in Figure 6. Proposed Action-related trains would also be longer (approximately 1.3 miles long) than average BNSF freight train length (approximately 1.2 miles long). Assuming Proposed Action-related trains travel at the same freight train speeds identified in Table 16, the five study crossings with the largest increase in daily vehicle delay compared to baseline 2028 conditions would be the following.[8]

- Big Hanaford Road, Lewis County (8 Proposed Action-related trains daily, 10 mph)
- Pine Street, Spokane County (16 Proposed Action-related trains daily, 35 mph)
- F Street/Cheney-Spangle, Spokane County (16 Proposed Action-related trains daily, 35 mph)
- Cheney-Plaza Road, Spokane County (16 Proposed Action-related trains daily, 35 mph)
- Russel Avenue, Skamania County (8 Proposed Action-related trains daily, 20 mph)

When factoring in existing AADT, the five study crossings with the largest increase in vehicle delay compared to the baseline 2028 conditions would be the following.

- Pines Road-SR 27, Spokane County (16 Proposed Action-related trains daily)

[7] Assumes gate closing 30 seconds before train would pass through grade crossing and 12 seconds after the train passes the crossing. See Table 16 for existing freight train speeds.

[8] Calculated by multiplying the existing freight train speed at the study crossing (Table 16) by the number of daily Proposed Action-related trains.

- Park Road, Spokane County (16 Proposed Action-related trains daily)
- Barker Road, Spokane County (16 Proposed Action-related trains daily)
- Harvard Road, Spokane County (16 Proposed Action Proposed Action-related trains daily)
- Flora Road, Spokane County (16 Proposed Action-related trains daily)

The combination of high AADTs and 16 trains per day would cause these study crossings to have the highest increase in vehicle delay per vehicle of the study crossings.

Because the frequency of train traffic on BNSF routes would increase from Proposed Action-related trains, the probability of an increase in emergency response time at all crossings would also increase because crossings would be blocked more frequently. This impact would only occur if an emergency vehicle experienced a delay related to Proposed Action-related train that would occur on average 8 or 16 times a day, depending on location. The potential for the Proposed Action to affect emergency response would also depend on whether the dispatched emergency vehicle would need to cross the rail line and the availability of alternative routes if a Proposed Action-related train occupies the crossing at the time of the emergency call.

Vehicle Safety

The accident probability analysis was conducted for the statewide study crossings using the FRA GradeDec.Net web-based software, which estimates the predicted annual accident probability for at-grade crossings in a year. The accident probability was estimated to be above 0.04 accidents per year with existing crossing safety protection at ten of the 44 statewide study crossings without Proposed Action-related trains (Table 17).

Proposed Action-related trains would increase the accident probability at all at-grade crossings because eight or 16 Proposed Action-related trains would pass at each crossing depending on location, and the Proposed Action would not change crossing protection at the study crossings. The accident probability analysis found that none of the statewide study crossings would have an accident probability above 0.04 with Proposed Action-related trains that would be at or below 0.04 under the No-Action Alternative in 2028.

Table 17. 2028 Statewide At-Grade Crossing Safety Assessment

#[a]	Road Crossing	USDOT/FRA Crossing ID	Accident Probability (accidents/year) 2028 No-Action	2028 Proposed Action
Spokane County				
1	Idaho Road	066236B	0.041	0.042
2	McKenzie Road	066239W	0.041	0.042
3	Harvard Road	066240R	0.049	0.051
4	Barker Road	066244T	0.049	0.051
5	Flora Road	066245A	0.044	0.045
6	Pines Road-SR 27	066367E	0.061	0.062
7	University Road	066371U	0.037	0.038
8	Park Road	066377K	0.122	0.125
9	Pine Street	066315M	0.029	0.032
10	F Street/Cheney-Spangle	065970L	0.091	0.096
11	Cheney-Plaza Road	065971T	0.025	0.028
Adams County				
12	Paha Packard Road	089665U	0.015	0.016
13	Kahlotus Road	089670R	0.022	0.024
14	1st Street	089672E	0.021	0.024
15	Wilbur/City Road	089673L	0.025	0.027
Franklin County				
16	Eltopia Road W	089699N	0.020	0.022
17	Sagemoor Road	089700F	0.021	0.023
Benton County				
18	East 3rd Avenue	090031U	0.033	0.034
19	Dague Road-East 25th Avenue	090035W	0.023	0.024
20	Perkins Road	090036D	0.059	0.061
21	Bowles Road	090038S	0.029	0.030
22	Cochran Road	090039Y	0.014	0.015
23	Finley Road	090040T	0.030	0.032
24	Whitcomb Island	090061L	0.012	0.012
Klickitat County				
25	Maple Street	090169V	0.032	0.033
26	Walnut Street	090168N	0.025	0.026
27	South Dock Grade Road	090164L	0.014	0.015
Skamania County				
28	Indian Crossing	090159P	0.016	0.017
29	Home Valley Park	090155M	0.012	0.012
30	Cemetery Xing	090151K	0.019	0.020
31	Russell Avenue	090148C	0.024	0.025

#[a]	Road Crossing	USDOT/FRA Crossing ID	Accident Probability (accidents/year) 2028 No-Action	2028 Proposed Action
32	Skamania Landing/Butler Road	090135B	0.010	0.011
33	Walker/Skamania Landing	090134U	0.011	0.012
34	St Cloud Road	090133M	0.006	0.007
Lewis County				
35	SR 506-7th Street	092484T	0.033	0.034
36	Walnut Street – SR 505/603	092493S	0.037	0.038
37	E Locust Street	092519S	0.135	0.138
38	Main Street	092520L	0.037	0.038
39	Maple Street	092521T	0.039	0.039
40	Big Hanaford Road	092524N	0.037	0.038
Yakima County				
41	Jones Road East	099178A	0.015	0.019
42	Indian Church	104523U	0.017	0.021
43	SR241/Reservation	104534G	0.020	0.024
44	Gulden Road	104536V	0.010	0.012

3.1.2 No-Action Alternative

Under the No-Action Alternative, the Applicant would not construct the coal export terminal vehicle transportation impacts related to construction and operation of the coal export terminal would not occur. The Applicant would continue with current and future increased operations in the project area. The project area could be developed for other industrial uses including an expanded bulk product terminal or other industrial uses. The Applicant has indicated that, over the long term, it would expand the existing bulk product terminal and develop new facilities to handle more products such as calcine petroleum coke, coal tar pitch, and cement, as described in the SEPA Alternatives Technical Report (ICF International 2016). The Applicant's planned growth would require approximately two additional trains per day on the Reynolds Lead.

Anticipated No-Action Alternative conditions for vehicle LOS for 2018 are shown in Tables 8 and 9. As shown, all study crossings would operate with an LOS B or better along the Reynolds Lead, LOS C at the Dike Road crossing along the BNSF Spur, and LOS B or better along the BNSF main line during the PM peak hour. All study crossings would operate with an LOS A over a 24-hour period.

Table 10 shows the estimated vehicle queue lengths for the 2018 No-Action scenario. Vehicle queues extending from six study crossings (all along the Reynolds Lead) would affect seven nearby intersections with 2018 No-Action scenario trains during the PM peak hour. The affected intersections include Industrial Way/38th Avenue, Industrial Way/Washington Way, Industrial Way/ NORPAC access, Industrial Way/Weyerhaeuser Access, Industrial Way/Oregon Way, 3rd Avenue/Industrial Way, and Industrial Way/California Way. Vehicle queues at these intersections would exceed available storage at four approaches, including the eastbound right turn from Industrial Way to the Weyerhaeuser Access (opposite Washington Way), the eastbound left turn and westbound right turn from Industrial Way to Oregon Way, and the northbound through movement

at the 3rd Avenue/Industrial Way intersection. These queues could potentially block other movements at these intersections that would otherwise not be affected by train crossing events.

Table 11 shows the anticipated weighted average train lengths and total gate downtime at the study crossings for 2028. The 2028 No-Action scenario would include approximately 2 additional non-Proposed Action-related trains per day on the Reynolds Lead, as documented in Section 2.1.2.1, *No-Action Alternative Analysis.* Overall, 4 trains per day are expected along the Reynolds Lead (1 during the PM peak hour), and 7 (1 during the PM peak hour) at the Dike Road study crossing (along the BNSF Spur) under the 2028 No-Action scenario. The weighted average length of these trains would be around 2,000 feet along the Reynolds Lead, and 5,000 feet along the BNSF Spur. The BNSF main line would include approximately 16 additional non-Proposed Action-related trains per day under the 2028 No-Action scenario, as estimated from the WSDOT Rail Plan (Washington State Department of Transportation 2014a). The BNSF main line would have 73 non-Proposed Action-related trains per day (5 during the PM peak hour) under the 2028 No-Action scenario, with a weighted average length of nearly 5,400 feet.

Total gate downtime would be up to 14 minutes per day (3 minutes during the PM peak hour) at public crossings along the Reynolds Lead, 20 minutes per day (5 minutes during the PM peak hour) at private crossings along the Reynolds Lead, 43 minutes per day (6 minutes during the PM peak hour) at the Dike Road crossing along the BNSF Spur, and up to 148 minutes per day (7 minutes during the PM peak hour) along the BNSF main line under the 2028 No-Action scenario.

The predicted accident probability under 2018 No-Action scenario conditions are shown in Table 15. The predicted accident probability for the No-Action Alternative was found to be below 0.04 accidents per year with existing crossing safety protection at the study crossings.

The 2028 No-Action scenario would include approximately 2 additional non-Proposed Action-related trains per day on the Reynolds Lead, as documented in Section 2.1.2.1, *No-Action Alternative Analysis.* The estimated conditions for vehicle LOS for 2028 No-Action scenario are shown in Tables 12 and 13. As shown, all study crossings would operate with an LOS B or better along the Reynolds Lead, and LOS C or better along the BNSF Spur and BNSF main line during the PM peak hour. All study crossings would operate with an LOS A over a 24-hour period.

Table 14 shows the estimated vehicle queue lengths for the 2028 No-Action scenario. Vehicle queues would be up to 400 feet longer beyond those identified with the 2018 No-Action scenario trains. Vehicle queues extending from seven study crossings (six along the Reynolds Lead and one along the BNSF main line) would affect eight nearby intersections with 2028 No-Action scenario trains during the PM peak hour. All of the affected intersections were previously identified as being affected with 2018 trains, including Industrial Way/38th Avenue, Industrial Way/Washington Way, Industrial Way/NORPAC access, Industrial Way/Weyerhaeuser Access, Industrial Way/Oregon Way, 3rd Avenue/Industrial Way, Industrial Way/California Way, and Pacific Avenue/S River Road. Vehicle queues at these intersections would exceed available storage at the four approaches identified with the 2018 No-Action scenario trains, including the westbound right turn from Industrial Way to the Weyerhaeuser Access (opposite Washington Way), the eastbound left turn and westbound right turn from Industrial Way to Oregon Way, and the northbound through movement at the 3rd Avenue/Industrial Way intersection. These queues could potentially block other movements at these intersections that would otherwise not be affected by train crossing events.

The predicted accident probability for the 2028 No-Action scenario conditions are shown in Table 15. The predicted accident probability for the No-Action Alternative was found to be below 0.04 accidents per year with existing crossing safety protection at the study crossings.

3.2 Mitigation

Based on the findings in this technical report, the co-lead agencies (Cowlitz County and Washington State Department of Ecology) developed potential Applicant mitigation measures. In addition, the Applicant has committed to voluntary measures to mitigate potential impacts. The SEPA Draft Environmental Impact Statement presents these mitigation measures.

Chapter 4
Required Permits

No permits related to vehicle transportation would be required for construction and operation of the Proposed Action.

Chapter 5
References

5.1 Written References

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5.2 Personal Communications

Wolter, Dave. General Manager. Longview Switching Company. December 3, 2014—In person meeting with ICF International.

Appendix A

Vehicle Transportation Technical Data

Weighted Average Train Length

		2018 No-Action Alternative	2018 Construction (Truck)	2018 Construction (Rail)	2028 No-Action Alternative (current infra)	2028 On-Site Alternative (current infra)	2028 On-Site Alternative (planned infra)
Spur Line							
Project site access (opposite 38th Avenue)	Daily	2,024	2,024	3,530	2,043	5,886	5,886
	P.M. Peak	2,024	2,024	6,219	2,043	6,844	6,844
Weyerhaeuser access (opposite Washington Way)	Daily	2,024	2,024	3,530	2,043	5,886	5,886
	P.M. Peak	2,024	2,024	6,219	2,043	6,844	6,844
Weyerhaeuser Norpac Access	Daily	2,024	2,024	3,530	2,043	5,886	5,886
	P.M. Peak	2,024	2,024	6,219	2,043	6,844	6,844
Industrial Way (SR 432)	Daily	2,024	2,024	3,530	2,043	5,886	5,886
	P.M. Peak	2,024	2,024	6,219	2,043	6,844	6,844
Oregon Way (SR 433)	Daily	2,024	2,024	3,530	2,043	5,886	5,886
	P.M. Peak	2,024	2,024	6,219	2,043	6,844	6,844
California Way	Daily	2,041	2,041	3,541	2,053	5,888	5,888
	P.M. Peak	2,041	2,041	6,219	2,053	6,844	6,844
3rd Avenue (SR 432)	Daily	2,041	2,041	3,541	2,053	5,888	5,888
	P.M. Peak	2,041	2,041	6,219	2,053	6,844	6,844
Dike Road	Daily	4,919	4,919	5,116	4,919	6,251	6,251
	P.M. Peak	4,919	4,919	6,219	4,919	6,844	6,844

Weighted Average Train Length

		2018 No-Action Alternative	2018 Construction (Truck)	2018 Construction (Rail)	2028 No-Action Alternative (current infra)	2028 On-Site Alternative (current infra)	2028 On-Site Alternative (planned infra)
Mainline							
Taylor Crane Road (Castle Rock)	Daily	5,160	5,160	5,178	5,396	5,539	5,539
	P.M. Peak	3,425	3,425	3,995	3,837	4,748	4,748
Cowlitz Avenue (Castle Rock)	Daily	5,160	5,160	5,178	5,396	5,539	5,539
	P.M. Peak	3,425	3,425	3,995	3,837	4,748	4,748
Cowlitz Gardens Road (Kelso)	Daily	5,160	5,160	5,178	5,396	5,539	5,539
	P.M. Peak	3,425	3,425	3,995	3,837	4,748	4,748
Mill Street (Kelso)	Daily	5,160	5,160	5,178	5,396	5,539	5,539
	P.M. Peak	3,425	3,425	3,995	3,837	4,748	4,748
S River Road/ Yew Street (Kelso)	Daily	5,160	5,160	5,178	5,396	5,539	5,539
	P.M. Peak	3,425	3,425	3,995	3,837	4,748	4,748
Toteff Road/Port Road (Kalama)	Daily	5,160	5,160	5,178	5,396	5,539	5,539
	P.M. Peak	3,425	3,425	3,995	3,837	4,748	4,748
W Scott Avenue (Woodland)	Daily	5,160	5,160	5,178	5,396	5,539	5,539
	P.M. Peak	3,425	3,425	3,995	3,837	4,748	4,748
Davidson Avenue (Woodland)	Daily	5,160	5,160	5,178	5,396	5,539	5,539
	P.M. Peak	3,425	3,425	3,995	3,837	4,748	4,748
Whalen Road (Woodland)	Daily	5,160	5,160	5,178	5,396	5,539	5,539
	P.M. Peak	3,425	3,425	3,995	3,837	4,748	4,748

Weighted Average Speed

Spur Line	2018 No-Action Alternative	2018 Construction (Truck Delivery)	2018 Construction (Rail Delivery)	2028 No-Action Alternative (with current track infrastructure)	2028 On-Site Alternative (with current track infrastructure)	2028 On-Site Alternative (with planned track infrastructure)	2028 On-Site Alternative (with planned track infrastructure)
Spur Line	Daily	Daily	Daily	Daily	Daily	Daily	Daily
Project site access (opposite 38th Avenue)	5	5	5	5	5	5	5
Weyerhaeuser access (opposite Washington Way)	8	8	8	8	8	10	10
Weyerhaeuser Norpac Access	10	10	10	10	10	15	15
Industrial Way (SR 432)	10	10	10	10	10	20	20
Oregon Way (SR 433)	10	10	10	10	10	20	20
California Way	8	8	8	8	8	15	15
3rd Avenue (SR 432)	8	8	8	8	8	15	15
Dike Road	10	10	10	10	10	10	10
Mainline	Daily	Daily	Daily	Daily	Daily	Daily	Daily
Taylor Crane Road (Castle Rock)	50	50	50	50	50	50	50
Cowlitz Avenue (Castle Rock)	50	50	50	50	50	50	50
Cowlitz Gardens Road (Kelso)	63	63	63	62	62	62	62
Mill Street (Kelso)	40	40	40	40	40	40	40
S River Road/ Yew Street (Kelso)	40	40	40	40	40	40	40
Toteff Road/Port Road (Kalama)	63	63	63	63	62	62	62
W Scott Avenue (Woodland)	63	63	63	62	62	62	62
Davidson Avenue (Woodland)	63	63	63	62	62	62	62
Whalen Road (Woodland)	63	63	63	62	62	62	62

Weighted Average Speed

Spur Line	2018 No-Action Alternative	2018 Construction (Truck Delivery)	2018 Construction (Rail Delivery)	2028 No-Action Alternative (with current track infrastructure)	2028 On-Site Alternative (with current track infrastructure)	2028 On-Site Alternative (with planned track infrastructure)	2028 On-Site Alternative (with planned track infrastructure)
Spur Line	P.M. Peak	P.M. Peak	P.M. Peak	P.M. Peak	P.M. Peak	P.M. Peak	P.M. Peak
Project site access (opposite 38th Avenue)	5	5	5	5	5	5	5
Weyerhaeuser access (opposite Washington Way)	8	8	8	8	8	10	10
Weyerhaeuser Norpac Access	10	10	10	10	10	15	15
Industrial Way (SR 432)	10	10	10	10	10	20	20
Oregon Way (SR 433)	10	10	10	10	10	20	20
California Way	8	8	8	8	8	15	15
3rd Avenue (SR 432)	8	8	8	8	8	15	15
Dike Road	10	10	10	10	10	10	10
Mainline	P.M. Peak	P.M. Peak	P.M. Peak	P.M. Peak	P.M. Peak	P.M. Peak	P.M. Peak
Taylor Crane Road (Castle Rock)	50	50	50	50	50	50	50
Cowlitz Avenue (Castle Rock)	50	50	50	50	50	50	50
Cowlitz Gardens Road (Kelso)	68	68	66	67	65	65	65
Mill Street (Kelso)	40	40	40	40	40	40	40
S River Road/ Yew Street (Kelso)	40	40	40	40	40	40	40
Toteff Road/Port Road (Kalama)	70	70	68	68	66	66	66
W Scott Avenue (Woodland)	68	68	66	67	65	65	65
Davidson Avenue (Woodland)	68	68	66	67	65	65	65
Whalen Road (Woodland)	68	68	66	67	65	65	65

2018 No-Action Alternative Daily

Crossing ID	Street	Number of Daily Trains	Average Train Length (feet)	Train Speed (mph)	Gate Down-Time per Day (min)	Average daily traffic in both directions (veh/day)	Average delay per vehicle in a 24-hour period (sec/veh)	Level of service
	Spur Line							
	Project site access (opposite 38th Avenue)	2.28	2,024	5	11.62	200	1.2	A
	Weyerhaeuser access (opposite Washington Way)	2.28	2,024	8	7.69	3300	0.6	A
	Weyerhaeuser Norpac Access	2.28	2,024	10	6.38	650	0.4	A
101806G	Industrial Way (SR 432)	2.28	2,024	10	6.38	10100	0.4	A
101805A	Oregon Way (SR 433)	2.28	2,024	10	6.38	15200	0.4	A
101821J	California Way	2.28	2,041	8	7.75	4050	0.6	A
101826T	3rd Avenue (SR 432)	2.28	2,041	8	7.75	16850	0.6	A
101791U	Dike Road	7.12	4,919	10	43.38	950	5.7	A
	Mainline							
092481X	Taylor Crane Road (Castle Rock)	55.10	5160	50	92.16	50	3.2	A
092476B	Cowlitz Avenue (Castle Rock)	55.10	5160	50	92.16	1200	3.3	A
092466V	Cowlitz Gardens Road (Kelso)	55.10	5160	63	79.06	700	2.4	A
092458D	Mill Street (Kelso)	55.10	5160	40	108.31	2550	4.8	A
092457W	S River Road/ Yew Street (Kelso)	55.10	5160	40	108.31	1850	4.7	A
092446J	Toteff Road/Port Road (Kalama)	55.10	5160	63	78.47	1200	2.4	A
092437K	W Scott Avenue (Woodland)	55.10	5160	63	79.06	2650	2.5	A
092435W	Davidson Avenue (Woodland)	55.10	5160	63	79.06	2000	2.5	A
092434P	Whalen Road (Woodland)	55.10	5160	63	79.06	1550	2.5	A

2018 Construction (Truck Delivery)

Crossing ID	Street	Number of Daily Trains	Average Train Length (feet)	Train Speed (mph)	Gate Down-Time per Day (min)	Average daily traffic in both directions (veh/day)	Average delay per vehicle in a 24-hour period (sec/veh)	Level of service
	Spur Line							
	Project site access (opposite 38th Avenue)	2.28	2,024	5	11.62	2850	1.3	A
	Weyerhaeuser access (opposite Washington Way)	2.28	2,024	8	7.69	3300	0.6	A
	Weyerhaeuser Norpac Access	2.28	2,024	10	6.38	650	0.4	A
101806G	Industrial Way (SR 432)	2.28	2,024	10	6.38	12000	0.5	A
101805A	Oregon Way (SR 433)	2.28	2,024	10	6.38	15650	0.4	A
101821J	California Way	2.28	2,041	8	7.75	4050	0.6	A
101826T	3rd Avenue (SR 432)	2.28	2,041	8	7.75	17850	0.6	A
101791U	Dike Road	7.12	4,919	10	43.38	950	5.7	A
	Mainline							
092481X	Taylor Crane Road (Castle Rock)	55.10	5160	50	92.16	50	3.2	A
092476B	Cowlitz Avenue (Castle Rock)	55.10	5160	50	92.16	1200	3.3	A
092466V	Cowlitz Gardens Road (Kelso)	55.10	5160	63	79.06	700	2.4	A
092458D	Mill Street (Kelso)	55.10	5160	40	108.31	2550	4.8	A
092457W	S River Road/ Yew Street (Kelso)	55.10	5160	40	108.31	1850	4.7	A
092446J	Toteff Road/Port Road (Kalama)	55.10	5160	63	78.47	1200	2.4	A
092437K	W Scott Avenue (Woodland)	55.10	5160	63	79.06	2650	2.5	A
092435W	Davidson Avenue (Woodland)	55.10	5160	63	79.06	2000	2.5	A
092434P	Whalen Road (Woodland)	55.10	5160	63	79.06	1550	2.5	A

2018 Construction (Rail Delivery)

Crossing ID	Street	Number of Daily Trains	Average Train Length (feet)	Train Speed (mph)	Gate Down-Time per Day (min)	Average daily traffic in both directions (veh/day)	Average delay per vehicle in a 24-hour period (sec/veh)	Level of service
	Spur Line							
	Project site access (opposite 38th Avenue)	3.56	3,530	5	30.31	2000	5.7	A
	Weyerhaeuser access (opposite Washington Way)	3.56	3,530	8	19.61	3300	2.4	A
	Weyerhaeuser Norpac Access	3.56	3,530	10	16.04	650	1.5	A
101806G	Industrial Way (SR 432)	3.56	3,530	10	16.04	11200	1.8	A
101805A	Oregon Way (SR 433)	3.56	3,530	10	16.04	15650	1.7	A
101821J	California Way	3.56	3,541	8	19.67	4050	2.5	A
101826T	3rd Avenue (SR 432)	3.56	3,541	8	19.67	17200	2.6	A
101791U	Dike Road	8.40	5,116	10	53.04	950	7.2	A
	Mainline							
092481X	Taylor Crane Road (Castle Rock)	56.10	5178	50	94.07	50	3.3	A
092476B	Cowlitz Avenue (Castle Rock)	56.10	5178	50	94.07	1200	3.4	A
092466V	Cowlitz Gardens Road (Kelso)	56.10	5178	63	80.72	700	2.5	A
092458D	Mill Street (Kelso)	56.10	5178	40	110.58	2550	4.9	A
092457W	S River Road/ Yew Street (Kelso)	56.10	5178	40	110.58	1850	4.8	A
092446J	Toteff Road/Port Road (Kalama)	56.10	5178	63	80.13	1200	2.5	A
092437K	W Scott Avenue (Woodland)	56.10	5178	63	80.72	2650	2.6	A
092435W	Davidson Avenue (Woodland)	56.10	5178	63	80.72	2000	2.5	A
092434P	Whalen Road (Woodland)	56.10	5178	63	80.72	1550	2.5	A

2028 No-Action Alternative (with current track infrastructure)

Crossing ID	Street	Number of Daily Trains	Average Train Length (feet)	Train Speed (mph)	Gate Down-Time per Day (min)	Average daily traffic in both directions (veh/day)	Average delay per vehicle in a 24-hour period (sec/veh)	Level of service
	Spur Line							
	Project site access (opposite 38th Avenue)	3.99	2,043	5	20.51	250	2.2	A
	Weyerhaeuser access (opposite Washington Way)	3.99	2,043	8	13.57	3900	1.0	A
	Weyerhaeuser Norpac Access	3.99	2,043	10	11.25	800	0.7	A
101806G	Industrial Way (SR 432)	3.99	2,043	10	11.25	11450	0.8	A
101805A	Oregon Way (SR 433)	3.99	2,043	10	11.25	18500	0.8	A
101821J	California Way	3.99	2,053	8	13.63	4800	1.1	A
101826T	3rd Avenue (SR 432)	3.99	2,053	8	13.63	20500	1.1	A
101791U	Dike Road	7.12	4,919	10	43.38	1100	5.7	A
	Mainline							
092481X	Taylor Crane Road (Castle Rock)	72.70	5396	50	125.50	50	4.5	A
092476B	Cowlitz Avenue (Castle Rock)	72.70	5396	50	125.50	1450	4.7	A
092466V	Cowlitz Gardens Road (Kelso)	72.70	5396	62	108.17	850	3.4	A
092458D	Mill Street (Kelso)	72.70	5396	40	147.79	3000	6.9	A
092457W	S River Road/ Yew Street (Kelso)	72.70	5396	40	147.79	2200	6.7	A
092446J	Toteff Road/Port Road (Kalama)	72.70	5396	63	107.54	1450	3.5	A
092437K	W Scott Avenue (Woodland)	72.70	5396	62	108.17	3100	3.6	A
092435W	Davidson Avenue (Woodland)	72.70	5396	62	108.17	2350	3.5	A
092434P	Whalen Road (Woodland)	72.70	5396	62	108.17	1800	3.5	A

2028 On-Site Alternative (with current track infrastructure)

Crossing ID	Street	Number of Daily Trains	Average Train Length (feet)	Train Speed (mph)	Gate Down-Time per Day (min)	Average daily traffic in both directions (veh/day)	Average delay per vehicle in a 24-hour period (sec/veh)	Level of service
	Spur Line							
	Project site access (opposite 38th Avenue)	19.99	5,886	5	277.39	1340	83.5	F
	Weyerhaeuser access (opposite Washington Way)	19.99	5,886	8	177.11	3900	34.7	C
	Weyerhaeuser Norpac Access	19.99	5,886	10	143.69	800	22.0	C
101806G	Industrial Way (SR 432)	19.99	5,886	10	143.69	12100	26.2	C
101805A	Oregon Way (SR 433)	19.99	5,886	10	143.69	18770	25.0	C
101821J	California Way	19.99	5,888	8	177.17	4800	36.8	D
101826T	3rd Avenue (SR 432)	19.99	5,888	8	177.17	20720	38.7	D
101791U	Dike Road	23.12	6,251	10	175.81	1100	28.8	C
	Mainline							
092481X	Taylor Crane Road (Castle Rock)	80.70	5539	50	141.94	50	5.2	A
092476B	Cowlitz Avenue (Castle Rock)	80.70	5539	50	141.94	1450	5.4	A
092466V	Cowlitz Gardens Road (Kelso)	80.70	5539	62	122.47	850	4.0	A
092458D	Mill Street (Kelso)	80.70	5539	40	167.34	3000	7.9	A
092457W	S River Road/ Yew Street (Kelso)	80.70	5539	40	167.34	2200	7.7	A
092446J	Toteff Road/Port Road (Kalama)	80.70	5539	62	121.82	1450	4.0	A
092437K	W Scott Avenue (Woodland)	80.70	5539	62	122.47	3100	4.2	A
092435W	Davidson Avenue (Woodland)	80.70	5539	62	122.47	2350	4.1	A
092434P	Whalen Road (Woodland)	80.70	5539	62	122.47	1800	4.0	A

2028 On-Site Alternative (with planned track infrastructure)

Crossing ID	Street	Number of Daily Trains	Average Train Length (feet)	Train Speed (mph)	Gate Down-Time per Day (min)	Average daily traffic in both directions (veh/day)	Average delay per vehicle in a 24-hour period (sec/veh)	Level of service
	Spur Line							
	Project site access (opposite 38th Avenue)	19.99	5,886	5	277.39	1340	83.5	F
	Weyerhaeuser access (opposite Washington Way)	19.99	5,886	10	143.69	3900	22.8	C
	Weyerhaeuser Norpac Access	19.99	5,886	15	99.13	800	10.5	B
101806G	Industrial Way (SR 432)	19.99	5,886	20	76.84	12100	7.5	A
101805A	Oregon Way (SR 433)	19.99	5,886	20	76.84	18770	7.2	A
101821J	California Way	19.99	5,888	15	99.16	4800	11.5	B
101826T	3rd Avenue (SR 432)	19.99	5,888	15	99.16	20720	12.1	B
101791U	Dike Road	23.12	6,251	10	175.81	1100	28.8	C
	Mainline							
092481X	Taylor Crane Road (Castle Rock)	80.70	5539	50	141.94	50	5.2	A
092476B	Cowlitz Avenue (Castle Rock)	80.70	5539	50	141.94	1450	5.4	A
092466V	Cowlitz Gardens Road (Kelso)	80.70	5539	62	122.47	850	4.0	A
092458D	Mill Street (Kelso)	80.70	5539	40	167.34	3000	7.9	A
092457W	S River Road/ Yew Street (Kelso)	80.70	5539	40	167.34	2200	7.7	A
092446J	Toteff Road/Port Road (Kalama)	80.70	5539	62	121.82	1450	4.0	A
092437K	W Scott Avenue (Woodland)	80.70	5539	62	122.47	3100	4.2	A
092435W	Davidson Avenue (Woodland)	80.70	5539	62	122.47	2350	4.1	A
092434P	Whalen Road (Woodland)	80.70	5539	62	122.47	1800	4.0	A

2018 No-Action Alternative PM Peak Hour

Crossing ID	Street	Number of PM Peak Hour Trains					Total Number of PM Peak Hour Trains	Gate Down-Time PM Peak (min)
	Spur Line	Existing	MBTL	BNSF	Cascades	Coast Starlight		
	Project site access (opposite 38th Avenue)	1	0	0	0	0	1.00	5.10
	Weyerhaeuser access (opposite Washington Way)	1	0	0	0	0	1.00	3.37
	Weyerhaeuser Norpac Access	1	0	0	0	0	1.00	2.80
101806G	Industrial Way (SR 432)	1	0	0	0	0	1.00	2.80
101805A	Oregon Way (SR 433)	1	0	0	0	0	1.00	2.80
101821J	California Way	1	0	0	0	0	1.00	3.40
101826T	3rd Avenue (SR 432)	1	0	0	0	0	1.00	3.40
101791U	Dike Road	1	0	0	0	0	1.00	6.09
	Mainline							
092489X	Taylor Crane Road (Castle Rock)	0	0	1.9	1	1	3.90	4.99
092476B	Cowlitz Avenue (Castle Rock)	0	0	1.9	1	1	3.90	4.99
092466V	Cowlitz Gardens Road (Kelso)	0	0	1.9	1	1	3.90	4.42
092458D	Mill Street (Kelso)	0	0	1.9	1	1	3.90	5.74
092457W	S River Road/ Yew Street (Kelso)	0	0	1.9	1	1	3.90	5.74
092446J	Toteff Road/Port Road (Kalama)	0	0	1.9	1	1	3.90	4.40
092437K	W Scott Avenue (Woodland)	0	0	1.9	1	1	3.90	4.42
092435W	Davidson Avenue (Woodland)	0	0	1.9	1	1	3.90	4.42
092434P	Whalen Road (Woodland)	0	0	1.9	1	1	3.90	4.42

2018 Construction PM Peak Hour (Truck Delivery)

Crossing ID	Street	Number of PM Peak Hour Trains					Total Number of PM Peak Hour Trains	Gate Down-Time PM Peak (min)
	Spur Line	Existing	MBTL	BNSF	Cascades	Coast Starlight		
	Project site access (opposite 38th Avenue)	1	0	0	0	0	1.00	5.10
	Weyerhaeuser access (opposite Washington Way)	1	0	0	0	0	1.00	3.37
	Weyerhaeuser Norpac Access	1	0	0	0	0	1.00	2.80
101806G	Industrial Way (SR 432)	1	0	0	0	0	1.00	2.80
101805A	Oregon Way (SR 433)	1	0	0	0	0	1.00	2.80
101821J	California Way	1	0	0	0	0	1.00	3.40
101826T	3rd Avenue (SR 432)	1	0	0	0	0	1.00	3.40
101791U	Dike Road	1	0	0	0	0	1.00	6.09
	Mainline							
092489X	Taylor Crane Road (Castle Rock)	0	0	1.9	1	1	3.90	4.99
092476B	Cowlitz Avenue (Castle Rock)	0	0	1.9	1	1	3.90	4.99
092466V	Cowlitz Gardens Road (Kelso)	0	0	1.9	1	1	3.90	4.42
092458D	Mill Street (Kelso)	0	0	1.9	1	1	3.90	5.74
092457W	S River Road/ Yew Street (Kelso)	0	0	1.9	1	1	3.90	5.74
092446J	Toteff Road/Port Road (Kalama)	0	0	1.9	1	1	3.90	4.40
092437K	W Scott Avenue (Woodland)	0	0	1.9	1	1	3.90	4.42
092435W	Davidson Avenue (Woodland)	0	0	1.9	1	1	3.90	4.42
092434P	Whalen Road (Woodland)	0	0	1.9	1	1	3.90	4.42

2018 Construction PM Peak Hour (Rail Delivery)

Crossing ID	Street	Number of PM Peak Hour Trains					Total Number of PM Peak Hour Trains	Gate Down-Time PM Peak (min)
	Spur Line	Existing	MBTL Const.	BNSF	Cascades	Coast Starlight		
	Project site access (opposite 38th Avenue)	0	1.00	0	0	0	1.00	14.63
	Weyerhaeuser access (opposite Washington Way)	0	1.00	0	0	0	1.00	9.33
	Weyerhaeuser Norpac Access	0	1.00	0	0	0	1.00	7.57
101806G	Industrial Way (SR 432)	0	1.00	0	0	0	1.00	7.57
101805A	Oregon Way (SR 433)	0	1.00	0	0	0	1.00	7.57
101821J	California Way	0	1.00	0	0	0	1.00	9.33
101826T	3rd Avenue (SR 432)	0	1.00	0	0	0	1.00	9.33
101791U	Dike Road	0	1.00	0	0	0	1.00	7.57
	Mainline							
092489X	Taylor Crane Road (Castle Rock)	0	1.00	1.9	1	1	4.90	6.90
092476B	Cowlitz Avenue (Castle Rock)	0	1.00	1.9	1	1	4.90	6.90
092466V	Cowlitz Gardens Road (Kelso)	0	1.00	1.9	1	1	4.90	6.09
092458D	Mill Street (Kelso)	0	1.00	1.9	1	1	4.90	8.01
092457W	S River Road/ Yew Street (Kelso)	0	1.00	1.9	1	1	4.90	8.01
092446J	Toteff Road/Port Road (Kalama)	0	1.00	1.9	1	1	4.90	6.08
092437K	W Scott Avenue (Woodland)	0	1.00	1.9	1	1	4.90	6.09
092435W	Davidson Avenue (Woodland)	0	1.00	1.9	1	1	4.90	6.09
092434P	Whalen Road (Woodland)	0	1.00	1.9	1	1	4.90	6.09

2028 No-Action Alternative PM Peak Hour (with current track infrastructure)

Crossing ID	Street	Number of PM Peak Hour Trains					Total Number of PM Peak Hour Trains	Gate Down-Time PM Peak (min)
	Spur Line	Existing	MBTL	BNSF	Cascades	Coast Starlight		
	Project site access (opposite 38th Avenue)	1	0	0	0	0	1.00	5.14
	Weyerhaeuser access (opposite Washington Way)	1	0	0	0	0	1.00	3.40
	Weyerhaeuser Norpac Access	1	0	0	0	0	1.00	2.82
101806G	Industrial Way (SR 432)	1	0	0	0	0	1.00	2.82
101805A	Oregon Way (SR 433)	1	0	0	0	0	1.00	2.82
101821J	California Way	1	0	0	0	0	1.00	3.42
101826T	3rd Avenue (SR 432)	1	0	0	0	0	1.00	3.42
101791U	Dike Road	1	0	0	0	0	1.00	6.09
	Mainline							
092489X	Taylor Crane Road (Castle Rock)	0	0	2.6	1	1	4.60	6.31
092476B	Cowlitz Avenue (Castle Rock)	0	0	2.6	1	1	4.60	6.31
092466V	Cowlitz Gardens Road (Kelso)	0	0	2.6	1	1	4.60	5.58
092458D	Mill Street (Kelso)	0	0	2.6	1	1	4.60	7.31
092457W	S River Road/ Yew Street (Kelso)	0	0	2.6	1	1	4.60	7.31
092446J	Toteff Road/Port Road (Kalama)	0	0	2.6	1	1	4.60	5.57
092437K	W Scott Avenue (Woodland)	0	0	2.6	1	1	4.60	5.58
092435W	Davidson Avenue (Woodland)	0	0	2.6	1	1	4.60	5.58
092434P	Whalen Road (Woodland)	0	0	2.6	1	1	4.60	5.58

2028 On-Site Alternative PM Peak Hour (with current track infrastructure)

Crossing ID	Street	Number of PM Peak Hour Trains					Total Number of PM Peak Hour Trains	Gate Down-Time PM Peak (min)
	Spur Line	Existing	MBTL	BNSF	Cascades	Coast Starlight		
	Project site access (opposite 38th Avenue)	0	1	0	0	0	1.00	16.05
	Weyerhaeuser access (opposite Washington Way)	0	1	0	0	0	1.00	10.22
	Weyerhaeuser Norpac Access	0	1	0	0	0	1.00	8.28
101806G	Industrial Way (SR 432)	0	1	0	0	0	1.00	8.28
101805A	Oregon Way (SR 433)	0	1	0	0	0	1.00	8.28
101821J	California Way	0	1	0	0	0	1.00	10.22
101826T	3rd Avenue (SR 432)	0	1	0	0	0	1.00	10.22
101791U	Dike Road	0	1	0	0	0	1.00	8.28
	Mainline							
092489X	Taylor Crane Road (Castle Rock)	0	2	2.6	1	1	6.60	10.42
092476B	Cowlitz Avenue (Castle Rock)	0	2	2.6	1	1	6.60	10.42
092466V	Cowlitz Gardens Road (Kelso)	0	2	2.6	1	1	6.60	9.17
092458D	Mill Street (Kelso)	0	2	2.6	1	1	6.60	12.20
092457W	S River Road/ Yew Street (Kelso)	0	2	2.6	1	1	6.60	12.20
092446J	Toteff Road/Port Road (Kalama)	0	2	2.6	1	1	6.60	9.16
092437K	W Scott Avenue (Woodland)	0	2	2.6	1	1	6.60	9.17
092435W	Davidson Avenue (Woodland)	0	2	2.6	1	1	6.60	9.17
092434P	Whalen Road (Woodland)	0	2	2.6	1	1	6.60	9.17

2028 On-Site Alternative PM Peak Hour (with planned track infrastructure)- 1 MBTL Train

Crossing ID	Street	Number of PM Peak Hour Trains					Total Number of PM Peak Hour Trains	Gate Down-Time PM Peak (min)
	Spur Line	Existing	MBTL	BNSF	Cascades	Coast Starlight		
	Project site access (opposite 38th Avenue)	0	1	0	0	0	1.00	16.05
	Weyerhaeuser access (opposite Washington Way)	0	1	0	0	0	1.00	8.28
	Weyerhaeuser Norpac Access	0	1	0	0	0	1.00	5.68
101806G	Industrial Way (SR 432)	0	1	0	0	0	1.00	4.39
101805A	Oregon Way (SR 433)	0	1	0	0	0	1.00	4.39
101821J	California Way	0	1	0	0	0	1.00	5.68
101826T	3rd Avenue (SR 432)	0	1	0	0	0	1.00	5.68
101791U	Dike Road	0	1	0	0	0	1.00	8.28
	Mainline							
092489X	Taylor Crane Road (Castle Rock)	0	2	2.6	1	1	6.60	10.42
092476B	Cowlitz Avenue (Castle Rock)	0	2	2.6	1	1	6.60	10.42
092466V	Cowlitz Gardens Road (Kelso)	0	2	2.6	1	1	6.60	9.17
092458D	Mill Street (Kelso)	0	2	2.6	1	1	6.60	12.20
092457W	S River Road/ Yew Street (Kelso)	0	2	2.6	1	1	6.60	12.20
092446J	Toteff Road/Port Road (Kalama)	0	2	2.6	1	1	6.60	9.16
092437K	W Scott Avenue (Woodland)	0	2	2.6	1	1	6.60	9.17
092435W	Davidson Avenue (Woodland)	0	2	2.6	1	1	6.60	9.17
092434P	Whalen Road (Woodland)	0	2	2.6	1	1	6.60	9.17

2028 On-Site Alternative PM Peak Hour (with planned track infrastructure)- 2 MBTL Trains

Crossing ID	Street	Number of PM Peak Hour Trains					Total Number of PM Peak Hour Trains	Gate Down-Time PM Peak (min)
	Spur Line	Existing	MBTL	BNSF	Cascades	Coast Starlight		
	Project site access (opposite 38th Avenue)	0	2	0	0	0	2.00	32.11
	Weyerhaeuser access (opposite Washington Way)	0	2	0	0	0	2.00	16.55
	Weyerhaeuser Norpac Access	0	2	0	0	0	2.00	11.37
101806G	Industrial Way (SR 432)	0	2	0	0	0	2.00	8.78
101805A	Oregon Way (SR 433)	0	2	0	0	0	2.00	8.78
101821J	California Way	0	2	0	0	0	2.00	11.37
101826T	3rd Avenue (SR 432)	0	2	0	0	0	2.00	11.37
101791U	Dike Road	0	2	0	0	0	2.00	16.55
	Mainline							
092489X	Taylor Crane Road (Castle Rock)	0	2	2.6	1	1	6.60	10.42
092476B	Cowlitz Avenue (Castle Rock)	0	2	2.6	1	1	6.60	10.42
092466V	Cowlitz Gardens Road (Kelso)	0	2	2.6	1	1	6.60	9.17
092458D	Mill Street (Kelso)	0	2	2.6	1	1	6.60	12.20
092457W	S River Road/ Yew Street (Kelso)	0	2	2.6	1	1	6.60	12.20
092446J	Toteff Road/Port Road (Kalama)	0	2	2.6	1	1	6.60	9.16
092437K	W Scott Avenue (Woodland)	0	2	2.6	1	1	6.60	9.17
092435W	Davidson Avenue (Woodland)	0	2	2.6	1	1	6.60	9.17
092434P	Whalen Road (Woodland)	0	2	2.6	1	1	6.60	9.17

Traffic Volumes- PM Peak

Study Crossing	2018 No Action	2018 Construction, via truck	2018 Construction, via rail	2028 No Action	2028 Proposed Action
38th Avenue	20	285	200	25	134
Washington Way	330	330	330	390	390
Weyerhaeuser Norpac Entrance	65	65	65	80	80
Industrial Way/SR432	1,010	1,200	1,120	1,145	1,210
SR433-Oregon Way	1,520	1,565	1,565	1,850	1,877
California Way	405	405	405	480	480
3rd Ave-SR 432	1,685	1,785	1,720	2,050	2,072
Dike Rd	95	95	95	110	110
Taylor Crane Road	5	5	5	5	5
Cowlitz Ave	120	120	120	145	145
Cowlitz Garden	70	70	70	85	85
Mill St	255	255	255	300	300
S River St/Yew St	185	185	185	220	220
Toteff-Hendrick	120	120	120	145	145
W Scott Ave	265	265	265	310	310
Davidson Avenue	200	200	200	235	235
Whalen Rd	155	155	155	180	180

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	17	0	0	3	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.91			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			4590			1863	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			4590			1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	0	0	0	20	0	0	17	0	0	3	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	17	0	0	3	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	13%	13%	13%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					304.0			2892.0			2892.0	
Effective Green, g (s)					304.0			2892.0			2892.0	
Actuated g/C Ratio					0.10			0.90			0.90	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					180			4148			1683	
v/s Ratio Prot					c0.01			c0.00			0.00	
v/s Ratio Perm												
v/c Ratio					0.11			0.00			0.00	
Uniform Delay, d1					1324.4			14.9			14.8	
Progression Factor					0.16			1.00			1.00	
Incremental Delay, d2					1.2			0.0			0.0	
Delay (s)					207.6			14.9			14.8	
Level of Service					F			B			B	
Approach Delay (s)		0.0			207.6			14.9			14.8	
Approach LOS		A			F			B			B	

Intersection Summary			
HCM 2000 Control Delay	111.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.01		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		↑↑↑			↑↑			↑			↑	
Volume (vph)	0	217	0	0	113	0	0	0	0	0	20	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0						2.0	
Lane Util. Factor		0.91			0.95						1.00	
Frt		1.00			1.00						1.00	
Flt Protected		1.00			1.00						1.00	
Satd. Flow (prot)		4988			3539						1900	
Flt Permitted		1.00			1.00						1.00	
Satd. Flow (perm)		4988			3539						1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	241	0	0	126	0	0	0	0	0	20	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	241	0	0	126	0	0	0	0	0	20	0
Heavy Vehicles (%)	4%	4%	4%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA						NA	
Protected Phases		1 3			1 3			2			2	
Permitted Phases												
Actuated Green, G (s)		2996.0			2996.0						200.0	
Effective Green, g (s)		2996.0			2996.0						200.0	
Actuated g/C Ratio		0.94			0.94						0.06	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		4670			3313						118	
v/s Ratio Prot		c0.05			0.04						c0.01	
v/s Ratio Perm												
v/c Ratio		0.05			0.04						0.17	
Uniform Delay, d1		6.8			6.7						1421.3	
Progression Factor		1.00			1.00						0.00	
Incremental Delay, d2		0.0			0.0						3.1	
Delay (s)		6.9			6.8						3.2	
Level of Service		A			A						A	
Approach Delay (s)		6.9			6.8			0.0			3.2	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	6.6	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.06		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	14.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	57	0	0	8	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1863			1863	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1863			1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	0	20	0	0	64	0	0	9	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	64	0	0	9	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					166.0			3030.0			3030.0	
Effective Green, g (s)					166.0			3030.0			3030.0	
Actuated g/C Ratio					0.05			0.95			0.95	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					98			1764			1764	
v/s Ratio Prot					c0.01			c0.03			0.00	
v/s Ratio Perm												
v/c Ratio					0.20			0.04			0.01	
Uniform Delay, d1					1453.7			4.7			4.5	
Progression Factor					0.01			1.00			1.05	
Incremental Delay, d2					4.6			0.0			0.0	
Delay (s)					23.2			4.7			4.8	
Level of Service					C			A			A	
Approach Delay (s)		0.0			23.2			4.7			4.8	
Approach LOS		A			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	8.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.04		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	443	0	0	567	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1810			1743	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1810			1743	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	20	0	0	482	0	0	616	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	482	0	0	616	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	5%	5%	5%	9%	9%	9%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					166.0			3030.0			3030.0	
Effective Green, g (s)					166.0			3030.0			3030.0	
Actuated g/C Ratio					0.05			0.95			0.95	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					98			1713			1650	
v/s Ratio Prot					c0.01			0.27			c0.35	
v/s Ratio Perm												
v/c Ratio					0.20			0.28			0.37	
Uniform Delay, d1					1453.7			6.2			7.0	
Progression Factor					0.00			1.00			1.00	
Incremental Delay, d2					4.6			0.4			0.6	
Delay (s)					4.8			6.6			7.6	
Level of Service					A			A			A	
Approach Delay (s)		0.0			4.8			6.6			7.6	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	39.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	856	0	0	664	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.95			0.95	
Frpb, ped/bikes					1.00			1.00			1.00	
Flpb, ped/bikes					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			3539			3539	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			3539			3539	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	20	0	0	930	0	0	722	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	930	0	0	722	0
Confl. Bikes (#/hr)									766			
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					166.0			3030.0			3030.0	
Effective Green, g (s)					166.0			3030.0			3030.0	
Actuated g/C Ratio					0.05			0.95			0.95	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					98			3350			3350	
v/s Ratio Prot					c0.01			c0.26			0.20	
v/s Ratio Perm												
v/c Ratio					0.20			0.28			0.22	
Uniform Delay, d1					1453.7			6.1			5.7	
Progression Factor					0.02			1.00			1.00	
Incremental Delay, d2					4.6			0.2			0.1	
Delay (s)					39.4			6.3			5.8	
Level of Service					D			A			A	
Approach Delay (s)		0.0			39.4			6.3			5.8	
Approach LOS		A			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	6.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.27		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	33.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	196	0	0	209	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1743			1845	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1743			1845	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	0	0	0	0	20	0	0	211	0	0	225	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	211	0	0	225	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	9%	9%	9%	3%	3%	3%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					200.0			2996.0			2996.0	
Effective Green, g (s)					200.0			2996.0			2996.0	
Actuated g/C Ratio					0.06			0.94			0.94	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					118			1631			1727	
v/s Ratio Prot					c0.01			0.12			c0.12	
v/s Ratio Perm												
v/c Ratio					0.17			0.13			0.13	
Uniform Delay, d1					1421.3			7.4			7.4	
Progression Factor					0.01			1.00			1.00	
Incremental Delay, d2					3.1			0.2			0.2	
Delay (s)					12.4			7.6			7.6	
Level of Service					B			A			A	
Approach Delay (s)		0.0			12.4			7.6			7.6	
Approach LOS		A			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.13		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	21.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	1033	0	0	652	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.95			0.95	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			3195			3112	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			3195			3112	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	0	20	0	0	1161	0	0	733	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	1161	0	0	733	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	13%	13%	13%	16%	16%	16%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					200.0			2996.0			2996.0	
Effective Green, g (s)					200.0			2996.0			2996.0	
Actuated g/C Ratio					0.06			0.94			0.94	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					118			2991			2913	
v/s Ratio Prot					c0.01			c0.36			0.24	
v/s Ratio Perm												
v/c Ratio					0.17			0.39			0.25	
Uniform Delay, d1					1421.3			10.2			8.5	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					3.1			0.4			0.2	
Delay (s)					1424.4			10.6			8.7	
Level of Service					F			B			A	
Approach Delay (s)		0.0			1424.4			10.6			8.7	
Approach LOS		A			F			B			A	

Intersection Summary			
HCM 2000 Control Delay	24.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	38.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	20	0	0	20	0	0	38	0	0	57	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		950			950			1727			1727	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		950			950			1727			1727	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	20	0	0	20	0	0	38	0	0	57	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	20	0	0	20	0	0	38	0	0	57	0
Heavy Vehicles (%)	100%	100%	100%	100%	100%	100%	10%	10%	10%	10%	10%	10%
Turn Type		NA			NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)		367.0			367.0			2829.0			2829.0	
Effective Green, g (s)		367.0			367.0			2829.0			2829.0	
Actuated g/C Ratio		0.11			0.11			0.88			0.88	
Clearance Time (s)		2.0			2.0							
Lane Grp Cap (vph)		108			108			1526			1526	
v/s Ratio Prot		0.02			c0.02			0.02			c0.03	
v/s Ratio Perm												
v/c Ratio		0.19			0.19			0.02			0.04	
Uniform Delay, d1		1281.3			1281.3			22.0			22.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		3.7			3.7			0.0			0.0	
Delay (s)		1285.0			1285.0			22.0			22.3	
Level of Service		F			F			C			C	
Approach Delay (s)		1285.0			1285.0			22.0			22.3	
Approach LOS		F			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	396.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.05		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		↑			↑			↑↑↑			↑	
Volume (vph)	0	0	0	0	20	0	0	239	0	0	3	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.91			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			4396			1863	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			4396			1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	0	0	0	20	0	0	244	0	0	3	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	244	0	0	3	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	18%	18%	18%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					304.0			2892.0			2892.0	
Effective Green, g (s)					304.0			2892.0			2892.0	
Actuated g/C Ratio					0.10			0.90			0.90	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					180			3972			1683	
v/s Ratio Prot					c0.01			c0.06			0.00	
v/s Ratio Perm												
v/c Ratio					0.11			0.06			0.00	
Uniform Delay, d1					1324.4			15.7			14.8	
Progression Factor					0.16			1.00			1.00	
Incremental Delay, d2					1.2			0.0			0.0	
Delay (s)					207.6			15.7			14.8	
Level of Service					F			B			B	
Approach Delay (s)		0.0			207.6			15.7			14.8	
Approach LOS		A			F			B			B	

Intersection Summary			
HCM 2000 Control Delay	30.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.07		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	14.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		↑↑↑			↑↑			↑			↑	
Volume (vph)	0	217	0	0	113	0	0	0	0	0	20	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0						2.0	
Lane Util. Factor		0.91			0.95						1.00	
Frt		1.00			1.00						1.00	
Flt Protected		1.00			1.00						1.00	
Satd. Flow (prot)		4988			3539						1900	
Flt Permitted		1.00			1.00						1.00	
Satd. Flow (perm)		4988			3539						1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	241	0	0	126	0	0	0	0	0	20	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	241	0	0	126	0	0	0	0	0	20	0
Heavy Vehicles (%)	4%	4%	4%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA						NA	
Protected Phases		1 3			1 3			2			2	
Permitted Phases												
Actuated Green, G (s)		2996.0			2996.0						200.0	
Effective Green, g (s)		2996.0			2996.0						200.0	
Actuated g/C Ratio		0.94			0.94						0.06	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		4670			3313						118	
v/s Ratio Prot		c0.05			0.04						c0.01	
v/s Ratio Perm												
v/c Ratio		0.05			0.04						0.17	
Uniform Delay, d1		6.8			6.7						1421.3	
Progression Factor		1.00			1.00						0.00	
Incremental Delay, d2		0.0			0.0						3.1	
Delay (s)		6.9			6.8						3.2	
Level of Service		A			A						A	
Approach Delay (s)		6.9			6.8			0.0			3.2	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	6.6	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.06		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	14.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	57	0	0	8	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1863			1863	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1863			1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	0	20	0	0	64	0	0	9	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	64	0	0	9	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					166.0			3030.0			3030.0	
Effective Green, g (s)					166.0			3030.0			3030.0	
Actuated g/C Ratio					0.05			0.95			0.95	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					98			1764			1764	
v/s Ratio Prot					c0.01			c0.03			0.00	
v/s Ratio Perm												
v/c Ratio					0.20			0.04			0.01	
Uniform Delay, d1					1453.7			4.7			4.5	
Progression Factor					0.01			1.00			1.05	
Incremental Delay, d2					4.6			0.0			0.0	
Delay (s)					23.2			4.7			4.8	
Level of Service					C			A			A	
Approach Delay (s)		0.0			23.2			4.7			4.8	
Approach LOS		A			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	8.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.04		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	593	0	0	567	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1638			1652	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1638			1652	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	20	0	0	645	0	0	616	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	645	0	0	616	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	16%	16%	16%	15%	15%	15%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					166.0			3030.0			3030.0	
Effective Green, g (s)					166.0			3030.0			3030.0	
Actuated g/C Ratio					0.05			0.95			0.95	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					98			1550			1564	
v/s Ratio Prot					c0.01			c0.39			0.37	
v/s Ratio Perm												
v/c Ratio					0.20			0.42			0.39	
Uniform Delay, d1					1453.7			7.5			7.2	
Progression Factor					0.00			1.00			1.00	
Incremental Delay, d2					4.6			0.8			0.7	
Delay (s)					4.8			8.3			7.9	
Level of Service					A			A			A	
Approach Delay (s)		0.0			4.8			8.3			7.9	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	8.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	41.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	901	0	0	664	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.95			0.95	
Frpb, ped/bikes					1.00			1.00			1.00	
Flpb, ped/bikes					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			3539			3539	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			3539			3539	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	20	0	0	979	0	0	722	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	979	0	0	722	0
Confl. Bikes (#/hr)									766			
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					166.0			3030.0			3030.0	
Effective Green, g (s)					166.0			3030.0			3030.0	
Actuated g/C Ratio					0.05			0.95			0.95	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					98			3350			3350	
v/s Ratio Prot					c0.01			c0.28			0.20	
v/s Ratio Perm												
v/c Ratio					0.20			0.29			0.22	
Uniform Delay, d1					1453.7			6.2			5.7	
Progression Factor					0.02			1.00			1.00	
Incremental Delay, d2					4.6			0.2			0.1	
Delay (s)					39.4			6.5			5.8	
Level of Service					D			A			A	
Approach Delay (s)		0.0			39.4			6.5			5.8	
Approach LOS		A			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	6.6	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.29		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	34.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	196	0	0	209	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1743			1845	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1743			1845	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	0	0	0	0	20	0	0	211	0	0	225	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	211	0	0	225	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	9%	9%	9%	3%	3%	3%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					200.0			2996.0			2996.0	
Effective Green, g (s)					200.0			2996.0			2996.0	
Actuated g/C Ratio					0.06			0.94			0.94	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					118			1631			1727	
v/s Ratio Prot					c0.01			0.12			c0.12	
v/s Ratio Perm												
v/c Ratio					0.17			0.13			0.13	
Uniform Delay, d1					1421.3			7.4			7.4	
Progression Factor					0.01			1.00			1.00	
Incremental Delay, d2					3.1			0.2			0.2	
Delay (s)					12.4			7.6			7.6	
Level of Service					B			A			A	
Approach Delay (s)		0.0			12.4			7.6			7.6	
Approach LOS		A			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.13		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	21.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	1100	0	0	652	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.95			0.95	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			3139			3112	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			3139			3112	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	0	20	0	0	1236	0	0	733	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	1236	0	0	733	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	15%	15%	15%	16%	16%	16%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					200.0			2996.0			2996.0	
Effective Green, g (s)					200.0			2996.0			2996.0	
Actuated g/C Ratio					0.06			0.94			0.94	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					118			2938			2913	
v/s Ratio Prot					c0.01			c0.39			0.24	
v/s Ratio Perm												
v/c Ratio					0.17			0.42			0.25	
Uniform Delay, d1					1421.3			10.7			8.5	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					3.1			0.4			0.2	
Delay (s)					1424.4			11.2			8.7	
Level of Service					F			B			A	
Approach Delay (s)		0.0			1424.4			11.2			8.7	
Approach LOS		A			F			B			A	

Intersection Summary			
HCM 2000 Control Delay	24.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	40.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	20	0	0	20	0	0	38	0	0	57	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		950			950			1727			1727	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		950			950			1727			1727	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	20	0	0	20	0	0	38	0	0	57	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	20	0	0	20	0	0	38	0	0	57	0
Heavy Vehicles (%)	100%	100%	100%	100%	100%	100%	10%	10%	10%	10%	10%	10%
Turn Type		NA			NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)		367.0			367.0			2829.0			2829.0	
Effective Green, g (s)		367.0			367.0			2829.0			2829.0	
Actuated g/C Ratio		0.11			0.11			0.88			0.88	
Clearance Time (s)		2.0			2.0							
Lane Grp Cap (vph)		108			108			1526			1526	
v/s Ratio Prot		0.02			c0.02			0.02			c0.03	
v/s Ratio Perm												
v/c Ratio		0.19			0.19			0.02			0.04	
Uniform Delay, d1		1281.3			1281.3			22.0			22.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		3.7			3.7			0.0			0.0	
Delay (s)		1285.0			1285.0			22.0			22.3	
Level of Service		F			F			C			C	
Approach Delay (s)		1285.0			1285.0			22.0			22.3	
Approach LOS		F			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	396.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.05		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	197	0	0	3	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.91			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			4590			1863	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			4590			1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	0	0	0	20	0	0	201	0	0	3	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	201	0	0	3	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	13%	13%	13%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					961.0			2235.0			2235.0	
Effective Green, g (s)					961.0			2235.0			2235.0	
Actuated g/C Ratio					0.30			0.70			0.70	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					570			3205			1301	
v/s Ratio Prot					c0.01			c0.04			0.00	
v/s Ratio Perm												
v/c Ratio					0.04			0.06			0.00	
Uniform Delay, d1					791.6			152.2			145.7	
Progression Factor					0.24			1.00			1.00	
Incremental Delay, d2					0.1			0.0			0.0	
Delay (s)					187.9			152.2			145.7	
Level of Service					F			F			F	
Approach Delay (s)		0.0			187.9			152.2			145.7	
Approach LOS		A			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	155.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.05		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		↑↑↑			↑↑			↑			↑	
Volume (vph)	0	217	0	0	113	0	0	0	0	0	20	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0						2.0	
Lane Util. Factor		0.91			0.95						1.00	
Frt		1.00			1.00						1.00	
Flt Protected		1.00			1.00						1.00	
Satd. Flow (prot)		4988			3539						1900	
Flt Permitted		1.00			1.00						1.00	
Satd. Flow (perm)		4988			3539						1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	241	0	0	126	0	0	0	0	0	20	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	241	0	0	126	0	0	0	0	0	20	0
Heavy Vehicles (%)	4%	4%	4%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA						NA	
Protected Phases		1 3			1 3			2			2	
Permitted Phases												
Actuated Green, G (s)		2585.0			2585.0						611.0	
Effective Green, g (s)		2585.0			2585.0						611.0	
Actuated g/C Ratio		0.81			0.81						0.19	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		4029			2858						362	
v/s Ratio Prot		c0.05			0.04						c0.01	
v/s Ratio Perm												
v/c Ratio		0.06			0.04						0.06	
Uniform Delay, d1		62.1			61.3						1058.5	
Progression Factor		1.00			1.00						0.00	
Incremental Delay, d2		0.0			0.0						0.3	
Delay (s)		62.1			61.3						0.4	
Level of Service		E			E						A	
Approach Delay (s)		62.1			61.3			0.0			0.4	
Approach LOS		E			E			A			A	

Intersection Summary			
HCM 2000 Control Delay	58.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.06		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	14.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	57	0	0	8	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1863			1863	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1863			1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	0	20	0	0	64	0	0	9	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	64	0	0	9	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					495.0			2701.0			2701.0	
Effective Green, g (s)					495.0			2701.0			2701.0	
Actuated g/C Ratio					0.15			0.84			0.84	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					293			1572			1572	
v/s Ratio Prot					c0.01			c0.03			0.00	
v/s Ratio Perm												
v/c Ratio					0.07			0.04			0.01	
Uniform Delay, d1					1155.5			40.3			39.1	
Progression Factor					0.02			1.00			1.04	
Incremental Delay, d2					0.4			0.0			0.0	
Delay (s)					25.7			40.3			40.9	
Level of Service					C			D			D	
Approach Delay (s)		0.0			25.7			40.3			40.9	
Approach LOS		A			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	37.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.04		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	551	0	0	567	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1727			1652	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1727			1652	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	20	0	0	599	0	0	616	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	599	0	0	616	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	10%	10%	10%	15%	15%	15%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					495.0			2701.0			2701.0	
Effective Green, g (s)					495.0			2701.0			2701.0	
Actuated g/C Ratio					0.15			0.84			0.84	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					293			1457			1394	
v/s Ratio Prot					c0.01			0.35			c0.37	
v/s Ratio Perm												
v/c Ratio					0.07			0.41			0.44	
Uniform Delay, d1					1155.5			59.6			62.1	
Progression Factor					0.00			1.00			1.00	
Incremental Delay, d2					0.4			0.9			1.0	
Delay (s)					0.6			60.4			63.1	
Level of Service					A			E			E	
Approach Delay (s)		0.0			0.6			60.4			63.1	
Approach LOS		A			A			E			E	

Intersection Summary			
HCM 2000 Control Delay	60.8	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	39.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	901	0	0	664	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.95			0.95	
Frpb, ped/bikes					1.00			1.00			1.00	
Flpb, ped/bikes					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			3539			3539	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			3539			3539	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	20	0	0	979	0	0	722	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	979	0	0	722	0
Confl. Bikes (#/hr)									766			
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					495.0			2701.0			2701.0	
Effective Green, g (s)					495.0			2701.0			2701.0	
Actuated g/C Ratio					0.15			0.84			0.84	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					293			2987			2987	
v/s Ratio Prot					c0.01			c0.28			0.20	
v/s Ratio Perm												
v/c Ratio					0.07			0.33			0.24	
Uniform Delay, d1					1155.5			53.8			48.9	
Progression Factor					0.08			1.00			1.00	
Incremental Delay, d2					0.4			0.3			0.2	
Delay (s)					93.6			54.1			49.1	
Level of Service					F			D			D	
Approach Delay (s)		0.0			93.6			54.1			49.1	
Approach LOS		A			F			D			D	

Intersection Summary			
HCM 2000 Control Delay	52.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.29		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	34.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	196	0	0	209	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1743			1845	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1743			1845	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	0	0	0	0	20	0	0	211	0	0	225	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	211	0	0	225	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	9%	9%	9%	3%	3%	3%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					611.0			2585.0			2585.0	
Effective Green, g (s)					611.0			2585.0			2585.0	
Actuated g/C Ratio					0.19			0.81			0.81	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					362			1408			1490	
v/s Ratio Prot					c0.01			0.12			c0.12	
v/s Ratio Perm												
v/c Ratio					0.06			0.15			0.15	
Uniform Delay, d1					1058.5			67.2			67.3	
Progression Factor					0.01			1.00			1.00	
Incremental Delay, d2					0.3			0.2			0.2	
Delay (s)					8.2			67.5			67.5	
Level of Service					A			E			E	
Approach Delay (s)		0.0			8.2			67.5			67.5	
Approach LOS		A			A			E			E	

Intersection Summary			
HCM 2000 Control Delay	64.9	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.13		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	21.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	1069	0	0	652	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.95			0.95	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			3195			3112	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			3195			3112	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	0	20	0	0	1201	0	0	733	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	1201	0	0	733	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	13%	13%	13%	16%	16%	16%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					611.0			2585.0			2585.0	
Effective Green, g (s)					611.0			2585.0			2585.0	
Actuated g/C Ratio					0.19			0.81			0.81	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					362			2580			2513	
v/s Ratio Prot					c0.01			c0.38			0.24	
v/s Ratio Perm												
v/c Ratio					0.06			0.47			0.29	
Uniform Delay, d1					1058.5			94.7			77.3	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					0.3			0.6			0.3	
Delay (s)					1058.8			95.3			77.6	
Level of Service					F			F			E	
Approach Delay (s)		0.0			1058.8			95.3			77.6	
Approach LOS		A			F			F			E	

Intersection Summary			
HCM 2000 Control Delay	98.5	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	39.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	20	0	0	20	0	0	38	0	0	57	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		950			950			1727			1727	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		950			950			1727			1727	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	20	0	0	20	0	0	38	0	0	57	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	20	0	0	20	0	0	38	0	0	57	0
Heavy Vehicles (%)	100%	100%	100%	100%	100%	100%	10%	10%	10%	10%	10%	10%
Turn Type		NA			NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)		495.0			495.0			2701.0			2701.0	
Effective Green, g (s)		495.0			495.0			2701.0			2701.0	
Actuated g/C Ratio		0.15			0.15			0.84			0.84	
Clearance Time (s)		2.0			2.0							
Lane Grp Cap (vph)		146			146			1457			1457	
v/s Ratio Prot		0.02			c0.02			0.02			c0.03	
v/s Ratio Perm												
v/c Ratio		0.14			0.14			0.03			0.04	
Uniform Delay, d1		1168.0			1168.0			39.8			40.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.9			1.9			0.0			0.1	
Delay (s)		1170.0			1170.0			39.8			40.3	
Level of Service		F			F			D			D	
Approach Delay (s)		1170.0			1170.0			39.8			40.3	
Approach LOS		F			F			D			D	

Intersection Summary			
HCM 2000 Control Delay	374.9	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.05		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		↑			↑			↑↑↑			↑	
Volume (vph)	0	0	0	0	20	0	0	21	0	0	4	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.91			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			4590			1863	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			4590			1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	0	0	0	20	0	0	21	0	0	4	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	21	0	0	4	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	13%	13%	13%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					304.0			2892.0			2892.0	
Effective Green, g (s)					304.0			2892.0			2892.0	
Actuated g/C Ratio					0.10			0.90			0.90	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					180			4148			1683	
v/s Ratio Prot					c0.01			c0.00			0.00	
v/s Ratio Perm												
v/c Ratio					0.11			0.01			0.00	
Uniform Delay, d1					1324.4			14.9			14.9	
Progression Factor					0.16			1.00			1.00	
Incremental Delay, d2					1.2			0.0			0.0	
Delay (s)					207.6			14.9			14.9	
Level of Service					F			B			B	
Approach Delay (s)		0.0			207.6			14.9			14.9	
Approach LOS		A			F			B			B	

Intersection Summary			
HCM 2000 Control Delay	100.5	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.02		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	256	0	0	134	0	0	0	0	0	20	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0						2.0	
Lane Util. Factor		0.91			0.95						1.00	
Frt		1.00			1.00						1.00	
Flt Protected		1.00			1.00						1.00	
Satd. Flow (prot)		4988			3539						1900	
Flt Permitted		1.00			1.00						1.00	
Satd. Flow (perm)		4988			3539						1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	284	0	0	149	0	0	0	0	0	20	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	284	0	0	149	0	0	0	0	0	20	0
Heavy Vehicles (%)	4%	4%	4%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA						NA	
Protected Phases		1 3			1 3			2			2	
Permitted Phases												
Actuated Green, G (s)		2996.0			2996.0						200.0	
Effective Green, g (s)		2996.0			2996.0						200.0	
Actuated g/C Ratio		0.94			0.94						0.06	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		4670			3313						118	
v/s Ratio Prot		c0.06			0.04						c0.01	
v/s Ratio Perm												
v/c Ratio		0.06			0.04						0.17	
Uniform Delay, d1		6.9			6.8						1421.3	
Progression Factor		1.00			1.00						0.00	
Incremental Delay, d2		0.0			0.0						3.1	
Delay (s)		6.9			6.8						3.2	
Level of Service		A			A						A	
Approach Delay (s)		6.9			6.8			0.0			3.2	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	6.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.07		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	14.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	70	0	0	10	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1863			1863	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1863			1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	0	20	0	0	79	0	0	11	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	79	0	0	11	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					166.0			3030.0			3030.0	
Effective Green, g (s)					166.0			3030.0			3030.0	
Actuated g/C Ratio					0.05			0.95			0.95	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					98			1764			1764	
v/s Ratio Prot					c0.01			c0.04			0.01	
v/s Ratio Perm												
v/c Ratio					0.20			0.04			0.01	
Uniform Delay, d1					1453.7			4.7			4.5	
Progression Factor					0.01			1.00			1.08	
Incremental Delay, d2					4.6			0.0			0.0	
Delay (s)					23.2			4.8			4.9	
Level of Service					C			A			A	
Approach Delay (s)		0.0			23.2			4.8			4.9	
Approach LOS		A			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	8.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.05		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	502	0	0	643	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1810			1743	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1810			1743	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	20	0	0	546	0	0	699	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	546	0	0	699	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	5%	5%	5%	9%	9%	9%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					166.0			3030.0			3030.0	
Effective Green, g (s)					166.0			3030.0			3030.0	
Actuated g/C Ratio					0.05			0.95			0.95	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					98			1713			1650	
v/s Ratio Prot					c0.01			0.30			c0.40	
v/s Ratio Perm												
v/c Ratio					0.20			0.32			0.42	
Uniform Delay, d1					1453.7			6.5			7.5	
Progression Factor					0.00			1.00			1.00	
Incremental Delay, d2					4.6			0.5			0.8	
Delay (s)					4.8			7.0			8.3	
Level of Service					A			A			A	
Approach Delay (s)		0.0			4.8			7.0			8.3	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	43.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	1042	0	0	808	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.95			0.95	
Frpb, ped/bikes					1.00			1.00			1.00	
Flpb, ped/bikes					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			3539			3539	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			3539			3539	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	20	0	0	1133	0	0	878	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	1133	0	0	878	0
Confl. Bikes (#/hr)									766			
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					166.0			3030.0			3030.0	
Effective Green, g (s)					166.0			3030.0			3030.0	
Actuated g/C Ratio					0.05			0.95			0.95	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					98			3350			3350	
v/s Ratio Prot					c0.01			c0.32			0.25	
v/s Ratio Perm												
v/c Ratio					0.20			0.34			0.26	
Uniform Delay, d1					1453.7			6.6			6.0	
Progression Factor					0.02			1.00			1.00	
Incremental Delay, d2					4.6			0.3			0.2	
Delay (s)					39.4			6.9			6.2	
Level of Service					D			A			A	
Approach Delay (s)		0.0			39.4			6.9			6.2	
Approach LOS		A			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	6.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.33		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	38.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	232	0	0	248	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1743			1845	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1743			1845	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	0	0	0	0	20	0	0	249	0	0	267	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	249	0	0	267	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	9%	9%	9%	3%	3%	3%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					200.0			2996.0			2996.0	
Effective Green, g (s)					200.0			2996.0			2996.0	
Actuated g/C Ratio					0.06			0.94			0.94	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					118			1631			1727	
v/s Ratio Prot					c0.01			0.14			c0.14	
v/s Ratio Perm												
v/c Ratio					0.17			0.15			0.15	
Uniform Delay, d1					1421.3			7.6			7.6	
Progression Factor					0.01			1.00			1.00	
Incremental Delay, d2					3.1			0.2			0.2	
Delay (s)					12.4			7.8			7.8	
Level of Service					B			A			A	
Approach Delay (s)		0.0			12.4			7.8			7.8	
Approach LOS		A			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	8.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.16		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	23.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	1257	0	0	793	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.95			0.95	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			3195			3112	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			3195			3112	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	0	20	0	0	1412	0	0	891	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	1412	0	0	891	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	13%	13%	13%	16%	16%	16%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					200.0			2996.0			2996.0	
Effective Green, g (s)					200.0			2996.0			2996.0	
Actuated g/C Ratio					0.06			0.94			0.94	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					118			2991			2913	
v/s Ratio Prot					c0.01			c0.44			0.29	
v/s Ratio Perm												
v/c Ratio					0.17			0.47			0.31	
Uniform Delay, d1					1421.3			11.7			9.1	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					3.1			0.5			0.3	
Delay (s)					1424.4			12.2			9.4	
Level of Service					F			B			A	
Approach Delay (s)		0.0			1424.4			12.2			9.4	
Approach LOS		A			F			B			A	

Intersection Summary			
HCM 2000 Control Delay	23.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	44.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	20	0	0	20	0	0	44	0	0	66	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		950			950			1727			1727	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		950			950			1727			1727	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	20	0	0	20	0	0	44	0	0	66	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	20	0	0	20	0	0	44	0	0	66	0
Heavy Vehicles (%)	100%	100%	100%	100%	100%	100%	10%	10%	10%	10%	10%	10%
Turn Type		NA			NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)		367.0			367.0			2829.0			2829.0	
Effective Green, g (s)		367.0			367.0			2829.0			2829.0	
Actuated g/C Ratio		0.11			0.11			0.88			0.88	
Clearance Time (s)		2.0			2.0							
Lane Grp Cap (vph)		108			108			1526			1526	
v/s Ratio Prot		0.02			c0.02			0.03			c0.04	
v/s Ratio Perm												
v/c Ratio		0.19			0.19			0.03			0.04	
Uniform Delay, d1		1281.3			1281.3			22.1			22.4	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		3.7			3.7			0.0			0.1	
Delay (s)		1285.0			1285.0			22.1			22.4	
Level of Service		F			F			C			C	
Approach Delay (s)		1285.0			1285.0			22.1			22.4	
Approach LOS		F			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	359.0	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.06		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	89	0	0	45	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.91			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			4590			1863	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			4590			1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	0	0	0	20	0	0	91	0	0	46	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	91	0	0	46	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	13%	13%	13%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					961.0			2235.0			2235.0	
Effective Green, g (s)					961.0			2235.0			2235.0	
Actuated g/C Ratio					0.30			0.70			0.70	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					570			3205			1301	
v/s Ratio Prot					c0.01			0.02			c0.02	
v/s Ratio Perm												
v/c Ratio					0.04			0.03			0.04	
Uniform Delay, d1					791.6			148.4			149.2	
Progression Factor					0.24			1.00			1.00	
Incremental Delay, d2					0.1			0.0			0.1	
Delay (s)					187.9			148.5			149.2	
Level of Service					F			F			F	
Approach Delay (s)		0.0			187.9			148.5			149.2	
Approach LOS		A			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	153.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.04		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		↑↑↑			↑↑			↑			↑	
Volume (vph)	0	256	0	0	134	0	0	0	0	0	20	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0						2.0	
Lane Util. Factor		0.91			0.95						1.00	
Frt		1.00			1.00						1.00	
Flt Protected		1.00			1.00						1.00	
Satd. Flow (prot)		4988			3539						1900	
Flt Permitted		1.00			1.00						1.00	
Satd. Flow (perm)		4988			3539						1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	284	0	0	149	0	0	0	0	0	20	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	284	0	0	149	0	0	0	0	0	20	0
Heavy Vehicles (%)	4%	4%	4%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA						NA	
Protected Phases		1 3			1 3			2			2	
Permitted Phases												
Actuated Green, G (s)		2585.0			2585.0						611.0	
Effective Green, g (s)		2585.0			2585.0						611.0	
Actuated g/C Ratio		0.81			0.81						0.19	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		4029			2858						362	
v/s Ratio Prot		c0.06			0.04						c0.01	
v/s Ratio Perm												
v/c Ratio		0.07			0.05						0.06	
Uniform Delay, d1		62.7			61.7						1058.5	
Progression Factor		1.00			1.00						0.00	
Incremental Delay, d2		0.0			0.0						0.3	
Delay (s)		62.7			61.7						0.4	
Level of Service		E			E						A	
Approach Delay (s)		62.7			61.7			0.0			0.4	
Approach LOS		E			E			A			A	

Intersection Summary			
HCM 2000 Control Delay	59.6	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.07		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	14.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	70	0	0	10	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1863			1863	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1863			1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	0	20	0	0	79	0	0	11	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	79	0	0	11	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					495.0			2701.0			2701.0	
Effective Green, g (s)					495.0			2701.0			2701.0	
Actuated g/C Ratio					0.15			0.84			0.84	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					293			1572			1572	
v/s Ratio Prot					c0.01			c0.04			0.01	
v/s Ratio Perm												
v/c Ratio					0.07			0.05			0.01	
Uniform Delay, d1					1155.5			40.6			39.1	
Progression Factor					0.02			1.00			1.00	
Incremental Delay, d2					0.4			0.1			0.0	
Delay (s)					25.7			40.7			39.1	
Level of Service					C			D			D	
Approach Delay (s)		0.0			25.7			40.7			39.1	
Approach LOS		A			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	37.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.05		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	543	0	0	667	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1810			1743	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1810			1743	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	20	0	0	590	0	0	725	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	590	0	0	725	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	5%	5%	5%	9%	9%	9%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					495.0			2701.0			2701.0	
Effective Green, g (s)					495.0			2701.0			2701.0	
Actuated g/C Ratio					0.15			0.84			0.84	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					293			1527			1471	
v/s Ratio Prot					c0.01			0.33			c0.42	
v/s Ratio Perm												
v/c Ratio					0.07			0.39			0.49	
Uniform Delay, d1					1155.5			57.7			66.6	
Progression Factor					0.00			1.00			1.00	
Incremental Delay, d2					0.4			0.7			1.2	
Delay (s)					0.6			58.5			67.8	
Level of Service					A			E			E	
Approach Delay (s)		0.0			0.6			58.5			67.8	
Approach LOS		A			A			E			E	

Intersection Summary			
HCM 2000 Control Delay	62.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	45.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	1059	0	0	818	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.95			0.95	
Frpb, ped/bikes					1.00			1.00			1.00	
Flpb, ped/bikes					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			3539			3539	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			3539			3539	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	20	0	0	1151	0	0	889	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	1151	0	0	889	0
Confl. Bikes (#/hr)									766			
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					495.0			2701.0			2701.0	
Effective Green, g (s)					495.0			2701.0			2701.0	
Actuated g/C Ratio					0.15			0.84			0.84	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					293			2987			2987	
v/s Ratio Prot					c0.01			c0.33			0.25	
v/s Ratio Perm												
v/c Ratio					0.07			0.39			0.30	
Uniform Delay, d1					1155.5			57.7			52.0	
Progression Factor					0.08			1.00			1.00	
Incremental Delay, d2					0.4			0.4			0.3	
Delay (s)					93.6			58.0			52.2	
Level of Service					F			E			D	
Approach Delay (s)		0.0			93.6			58.0			52.2	
Approach LOS		A			F			E			D	

Intersection Summary			
HCM 2000 Control Delay	55.9	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	39.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	232	0	0	248	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1743			1845	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1743			1845	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	0	0	0	0	20	0	0	249	0	0	267	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	249	0	0	267	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	9%	9%	9%	3%	3%	3%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					611.0			2585.0			2585.0	
Effective Green, g (s)					611.0			2585.0			2585.0	
Actuated g/C Ratio					0.19			0.81			0.81	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					362			1408			1490	
v/s Ratio Prot					c0.01			0.14			c0.14	
v/s Ratio Perm												
v/c Ratio					0.06			0.18			0.18	
Uniform Delay, d1					1058.5			68.9			69.1	
Progression Factor					0.01			1.00			1.00	
Incremental Delay, d2					0.3			0.3			0.3	
Delay (s)					8.2			69.2			69.4	
Level of Service					A			E			E	
Approach Delay (s)		0.0			8.2			69.2			69.4	
Approach LOS		A			A			E			E	

Intersection Summary			
HCM 2000 Control Delay	67.0	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.16		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	23.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	1271	0	0	801	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.95			0.95	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			3195			3112	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			3195			3112	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	0	20	0	0	1428	0	0	900	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	1428	0	0	900	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	13%	13%	13%	16%	16%	16%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					611.0			2585.0			2585.0	
Effective Green, g (s)					611.0			2585.0			2585.0	
Actuated g/C Ratio					0.19			0.81			0.81	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					362			2580			2513	
v/s Ratio Prot					c0.01			c0.45			0.29	
v/s Ratio Perm												
v/c Ratio					0.06			0.55			0.36	
Uniform Delay, d1					1058.5			106.9			83.2	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					0.3			0.9			0.4	
Delay (s)					1058.8			107.8			83.6	
Level of Service					F			F			F	
Approach Delay (s)		0.0			1058.8			107.8			83.6	
Approach LOS		A			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	106.6	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	45.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	20	0	0	20	0	0	44	0	0	66	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		950			950			1727			1727	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		950			950			1727			1727	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	20	0	0	20	0	0	44	0	0	66	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	20	0	0	20	0	0	44	0	0	66	0
Heavy Vehicles (%)	100%	100%	100%	100%	100%	100%	10%	10%	10%	10%	10%	10%
Turn Type		NA			NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)		495.0			495.0			2701.0			2701.0	
Effective Green, g (s)		495.0			495.0			2701.0			2701.0	
Actuated g/C Ratio		0.15			0.15			0.84			0.84	
Clearance Time (s)		2.0			2.0							
Lane Grp Cap (vph)		146			146			1457			1457	
v/s Ratio Prot		0.02			c0.02			0.03			c0.04	
v/s Ratio Perm												
v/c Ratio		0.14			0.14			0.03			0.05	
Uniform Delay, d1		1168.0			1168.0			39.9			40.5	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.9			1.9			0.0			0.1	
Delay (s)		1170.0			1170.0			40.0			40.5	
Level of Service		F			F			D			D	
Approach Delay (s)		1170.0			1170.0			40.0			40.5	
Approach LOS		F			F			D			D	

Intersection Summary			
HCM 2000 Control Delay	341.5	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.06		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		↑			↑			↑↑↑			↑	
Volume (vph)	0	0	0	0	20	0	0	89	0	0	45	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.91			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			4590			1863	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			4590			1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	0	0	0	20	0	0	91	0	0	46	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	91	0	0	46	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	13%	13%	13%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					961.0			2235.0			2235.0	
Effective Green, g (s)					961.0			2235.0			2235.0	
Actuated g/C Ratio					0.30			0.70			0.70	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					570			3205			1301	
v/s Ratio Prot					c0.01			0.02			c0.02	
v/s Ratio Perm												
v/c Ratio					0.04			0.03			0.04	
Uniform Delay, d1					791.6			148.4			149.2	
Progression Factor					0.01			1.00			1.00	
Incremental Delay, d2					0.1			0.0			0.1	
Delay (s)					4.1			148.5			149.2	
Level of Service					A			F			F	
Approach Delay (s)		0.0			4.1			148.5			149.2	
Approach LOS		A			A			F			F	

Intersection Summary			
HCM 2000 Control Delay	130.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.04		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		↑↑↑			↑↑			↑			↑	
Volume (vph)	0	256	0	0	134	0	0	0	0	0	20	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0						2.0	
Lane Util. Factor		0.91			0.95						1.00	
Frt		1.00			1.00						1.00	
Flt Protected		1.00			1.00						1.00	
Satd. Flow (prot)		4988			3539						1900	
Flt Permitted		1.00			1.00						1.00	
Satd. Flow (perm)		4988			3539						1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	284	0	0	149	0	0	0	0	0	20	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	284	0	0	149	0	0	0	0	0	20	0
Heavy Vehicles (%)	4%	4%	4%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA						NA	
Protected Phases		1 3			1 3			2			2	
Permitted Phases												
Actuated Green, G (s)		2701.0			2701.0						495.0	
Effective Green, g (s)		2701.0			2701.0						495.0	
Actuated g/C Ratio		0.84			0.84						0.15	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		4210			2987						293	
v/s Ratio Prot		c0.06			0.04						c0.01	
v/s Ratio Perm												
v/c Ratio		0.07			0.05						0.07	
Uniform Delay, d1		41.3			40.6						1155.5	
Progression Factor		1.00			1.00						0.00	
Incremental Delay, d2		0.0			0.0						0.4	
Delay (s)		41.3			40.6						0.4	
Level of Service		D			D						A	
Approach Delay (s)		41.3			40.6			0.0			0.4	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	39.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.07		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	14.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	70	0	0	10	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1863			1863	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1863			1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	0	20	0	0	79	0	0	11	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	79	0	0	11	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					339.0			2857.0			2857.0	
Effective Green, g (s)					339.0			2857.0			2857.0	
Actuated g/C Ratio					0.11			0.89			0.89	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					201			1663			1663	
v/s Ratio Prot					c0.01			c0.04			0.01	
v/s Ratio Perm												
v/c Ratio					0.10			0.05			0.01	
Uniform Delay, d1					1292.6			19.2			18.5	
Progression Factor					2.10			1.00			1.02	
Incremental Delay, d2					1.0			0.1			0.0	
Delay (s)					2721.3			19.3			18.9	
Level of Service					F			B			B	
Approach Delay (s)		0.0			2721.3			19.3			18.9	
Approach LOS		A			F			B			B	

Intersection Summary			
HCM 2000 Control Delay	510.5	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.05		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	543	0	0	667	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1810			1743	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1810			1743	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	20	0	0	590	0	0	725	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	590	0	0	725	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	5%	5%	5%	9%	9%	9%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					261.0			2935.0			2935.0	
Effective Green, g (s)					261.0			2935.0			2935.0	
Actuated g/C Ratio					0.08			0.92			0.92	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					154			1660			1598	
v/s Ratio Prot					c0.01			0.33			c0.42	
v/s Ratio Perm												
v/c Ratio					0.13			0.36			0.45	
Uniform Delay, d1					1364.1			16.3			18.8	
Progression Factor					0.03			1.00			1.00	
Incremental Delay, d2					1.7			0.6			0.9	
Delay (s)					38.3			16.9			19.7	
Level of Service					D			B			B	
Approach Delay (s)		0.0			38.3			16.9			19.7	
Approach LOS		A			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	18.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	45.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	1059	0	0	818	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.95			0.95	
Frpb, ped/bikes					1.00			1.00			1.00	
Flpb, ped/bikes					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			3539			3539	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			3539			3539	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	20	0	0	1151	0	0	889	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	1151	0	0	889	0
Confl. Bikes (#/hr)									766			
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					261.0			2935.0			2935.0	
Effective Green, g (s)					261.0			2935.0			2935.0	
Actuated g/C Ratio					0.08			0.92			0.92	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					154			3245			3245	
v/s Ratio Prot					c0.01			c0.33			0.25	
v/s Ratio Perm												
v/c Ratio					0.13			0.35			0.27	
Uniform Delay, d1					1364.1			16.3			14.7	
Progression Factor					0.15			1.00			1.00	
Incremental Delay, d2					1.7			0.3			0.2	
Delay (s)					201.2			16.6			14.9	
Level of Service					F			B			B	
Approach Delay (s)		0.0			201.2			16.6			14.9	
Approach LOS		A			F			B			B	

Intersection Summary			
HCM 2000 Control Delay	17.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	39.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	232	0	0	248	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1743			1845	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1743			1845	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	0	0	0	0	20	0	0	249	0	0	267	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	249	0	0	267	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	9%	9%	9%	3%	3%	3%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					339.0			2857.0			2857.0	
Effective Green, g (s)					339.0			2857.0			2857.0	
Actuated g/C Ratio					0.11			0.89			0.89	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					201			1556			1647	
v/s Ratio Prot					c0.01			0.14			c0.14	
v/s Ratio Perm												
v/c Ratio					0.10			0.16			0.16	
Uniform Delay, d1					1292.6			21.4			21.5	
Progression Factor					0.01			1.00			1.00	
Incremental Delay, d2					1.0			0.2			0.2	
Delay (s)					12.6			21.7			21.7	
Level of Service					B			C			C	
Approach Delay (s)		0.0			12.6			21.7			21.7	
Approach LOS		A			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	21.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.16		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	23.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	1271	0	0	801	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.95			0.95	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			3195			3112	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			3195			3112	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	0	20	0	0	1428	0	0	900	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	1428	0	0	900	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	13%	13%	13%	16%	16%	16%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					339.0			2857.0			2857.0	
Effective Green, g (s)					339.0			2857.0			2857.0	
Actuated g/C Ratio					0.11			0.89			0.89	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					201			2852			2778	
v/s Ratio Prot					c0.01			c0.45			0.29	
v/s Ratio Perm												
v/c Ratio					0.10			0.50			0.32	
Uniform Delay, d1					1292.6			33.2			25.9	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					1.0			0.6			0.3	
Delay (s)					1293.6			33.9			26.2	
Level of Service					F			C			C	
Approach Delay (s)		0.0			1293.6			33.9			26.2	
Approach LOS		A			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	41.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	45.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	20	0	0	20	0	0	44	0	0	66	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		950			950			1727			1727	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		950			950			1727			1727	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	20	0	0	20	0	0	44	0	0	66	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	20	0	0	20	0	0	44	0	0	66	0
Heavy Vehicles (%)	100%	100%	100%	100%	100%	100%	10%	10%	10%	10%	10%	10%
Turn Type		NA			NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)		495.0			495.0			2701.0			2701.0	
Effective Green, g (s)		495.0			495.0			2701.0			2701.0	
Actuated g/C Ratio		0.15			0.15			0.84			0.84	
Clearance Time (s)		2.0			2.0							
Lane Grp Cap (vph)		146			146			1457			1457	
v/s Ratio Prot		0.02			c0.02			0.03			c0.04	
v/s Ratio Perm												
v/c Ratio		0.14			0.14			0.03			0.05	
Uniform Delay, d1		1168.0			1168.0			39.9			40.5	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.9			1.9			0.0			0.1	
Delay (s)		1170.0			1170.0			40.0			40.5	
Level of Service		F			F			D			D	
Approach Delay (s)		1170.0			1170.0			40.0			40.5	
Approach LOS		F			F			D			D	

Intersection Summary			
HCM 2000 Control Delay	341.5	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.06		
Actuated Cycle Length (s)	3200.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	21	187	2	43	333	118	4	16	69	44	0	28
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.9	4.0		4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00		0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95		1.00
Satd. Flow (prot)	1641	1727	1468	1752	1845	1568	1597	1681	1429	1805		1615
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95		1.00
Satd. Flow (perm)	1641	1727	1468	1752	1845	1568	1597	1681	1429	1805		1615
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	21	191	2	44	340	120	4	16	70	45	0	29
RTOR Reduction (vph)	0	0	1	0	0	0	0	0	65	0	0	26
Lane Group Flow (vph)	21	191	1	44	340	120	4	16	5	45	0	3
Heavy Vehicles (%)	10%	10%	10%	3%	3%	3%	13%	13%	13%	0%	0%	0%
Turn Type	Prot	NA	Perm	Prot	NA	Free	Prot	NA	Perm	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			Free			4			8
Actuated Green, G (s)	0.5	18.2	18.2	1.2	18.9	39.8	0.5	2.9	2.9	1.5		3.9
Effective Green, g (s)	0.5	18.2	18.2	1.2	18.9	39.8	0.5	2.9	3.0	1.5		3.9
Actuated g/C Ratio	0.01	0.46	0.46	0.03	0.47	1.00	0.01	0.07	0.08	0.04		0.10
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0		4.0
Vehicle Extension (s)	0.2	2.1	2.1	0.2	1.9		0.2	0.2	0.2	0.2		0.2
Lane Grp Cap (vph)	20	789	671	52	876	1568	20	122	107	68		158
v/s Ratio Prot	0.01	0.11		c0.03	c0.18		0.00	0.01		c0.02		
v/s Ratio Perm			0.00			c0.08			0.00			0.00
v/c Ratio	1.05	0.24	0.00	0.85	0.39	0.08	0.20	0.13	0.05	0.66		0.02
Uniform Delay, d1	19.6	6.6	5.9	19.2	6.7	0.0	19.5	17.3	17.1	18.9		16.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	217.8	0.1	0.0	68.3	0.1	0.1	1.8	0.2	0.1	17.1		0.0
Delay (s)	237.4	6.7	5.9	87.5	6.8	0.1	21.2	17.4	17.1	36.0		16.2
Level of Service	F	A	A	F	A	A	C	B	B	D		B
Approach Delay (s)		29.3			12.3			17.4			28.3	
Approach LOS		C			B			B			C	

Intersection Summary			
HCM 2000 Control Delay	18.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	39.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	40.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations		↑↑↑			↑↑			↑			↑	
Volume (vph)	0	256	0	0	134	0	0	0	0	0	20	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0						2.0	
Lane Util. Factor		0.91			0.95						1.00	
Frt		1.00			1.00						1.00	
Flt Protected		1.00			1.00						1.00	
Satd. Flow (prot)		4988			3539						1900	
Flt Permitted		1.00			1.00						1.00	
Satd. Flow (perm)		4988			3539						1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	284	0	0	149	0	0	0	0	0	20	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	284	0	0	149	0	0	0	0	0	20	0
Heavy Vehicles (%)	4%	4%	4%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA						NA	
Protected Phases		1 3			1 3			2			2	
Permitted Phases												
Actuated Green, G (s)		1301.0			1301.0						495.0	
Effective Green, g (s)		1301.0			1301.0						495.0	
Actuated g/C Ratio		0.72			0.72						0.28	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		3605			2557						522	
v/s Ratio Prot		c0.06			0.04						c0.01	
v/s Ratio Perm												
v/c Ratio		0.08			0.06						0.04	
Uniform Delay, d1		73.3			72.2						478.1	
Progression Factor		1.00			1.00						0.00	
Incremental Delay, d2		0.0			0.0						0.1	
Delay (s)		73.4			72.3						0.1	
Level of Service		E			E						A	
Approach Delay (s)		73.4			72.3			0.0			0.1	
Approach LOS		E			E			A			A	

Intersection Summary			
HCM 2000 Control Delay	69.8	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.07		
Actuated Cycle Length (s)	1800.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	14.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	70	0	0	10	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1863			1863	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1863			1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	0	20	0	0	79	0	0	11	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	79	0	0	11	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					339.0			1457.0			1457.0	
Effective Green, g (s)					339.0			1457.0			1457.0	
Actuated g/C Ratio					0.19			0.81			0.81	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					357			1507			1507	
v/s Ratio Prot					c0.01			c0.04			0.01	
v/s Ratio Perm												
v/c Ratio					0.06			0.05			0.01	
Uniform Delay, d1					599.2			34.1			32.9	
Progression Factor					2.12			1.00			1.01	
Incremental Delay, d2					0.3			0.1			0.0	
Delay (s)					1271.3			34.2			33.3	
Level of Service					F			C			C	
Approach Delay (s)		0.0			1271.3			34.2			33.3	
Approach LOS		A			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	259.0	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.05		
Actuated Cycle Length (s)	1800.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	543	0	0	667	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1810			1743	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1810			1743	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	20	0	0	590	0	0	725	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	590	0	0	725	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	5%	5%	5%	9%	9%	9%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					261.0			1535.0			1535.0	
Effective Green, g (s)					261.0			1535.0			1535.0	
Actuated g/C Ratio					0.14			0.85			0.85	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					275			1543			1486	
v/s Ratio Prot					c0.01			0.33			c0.42	
v/s Ratio Perm												
v/c Ratio					0.07			0.38			0.49	
Uniform Delay, d1					664.9			28.9			33.4	
Progression Factor					0.05			1.00			1.00	
Incremental Delay, d2					0.5			0.7			1.1	
Delay (s)					34.4			29.7			34.6	
Level of Service					C			C			C	
Approach Delay (s)		0.0			34.4			29.7			34.6	
Approach LOS		A			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	32.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	1800.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	45.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	1059	0	0	818	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.95			0.95	
Frpb, ped/bikes					1.00			1.00			1.00	
Flpb, ped/bikes					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			3539			3539	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			3539			3539	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	20	0	0	1151	0	0	889	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	1151	0	0	889	0
Confl. Bikes (#/hr)									766			
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					261.0			1535.0			1535.0	
Effective Green, g (s)					261.0			1535.0			1535.0	
Actuated g/C Ratio					0.14			0.85			0.85	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					275			3017			3017	
v/s Ratio Prot					c0.01			c0.33			0.25	
v/s Ratio Perm												
v/c Ratio					0.07			0.38			0.29	
Uniform Delay, d1					664.9			28.9			26.1	
Progression Factor					0.27			1.00			1.00	
Incremental Delay, d2					0.5			0.4			0.2	
Delay (s)					179.8			29.3			26.3	
Level of Service					F			C			C	
Approach Delay (s)		0.0			179.8			29.3			26.3	
Approach LOS		A			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	29.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	1800.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	39.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	232	0	0	248	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1743			1845	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1743			1845	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	0	0	0	0	20	0	0	249	0	0	267	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	249	0	0	267	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	9%	9%	9%	3%	3%	3%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					339.0			1457.0			1457.0	
Effective Green, g (s)					339.0			1457.0			1457.0	
Actuated g/C Ratio					0.19			0.81			0.81	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					357			1410			1493	
v/s Ratio Prot					c0.01			0.14			c0.14	
v/s Ratio Perm												
v/c Ratio					0.06			0.18			0.18	
Uniform Delay, d1					599.2			38.1			38.2	
Progression Factor					0.02			1.00			1.00	
Incremental Delay, d2					0.3			0.3			0.3	
Delay (s)					10.8			38.4			38.5	
Level of Service					B			D			D	
Approach Delay (s)		0.0			10.8			38.4			38.5	
Approach LOS		A			B			D			D	

Intersection Summary			
HCM 2000 Control Delay	37.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.16		
Actuated Cycle Length (s)	1800.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	23.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	20	0	0	1271	0	0	801	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			0.95			0.95	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			3195			3112	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			3195			3112	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	0	20	0	0	1428	0	0	900	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	20	0	0	1428	0	0	900	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	13%	13%	13%	16%	16%	16%
Turn Type					NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)					339.0			1457.0			1457.0	
Effective Green, g (s)					339.0			1457.0			1457.0	
Actuated g/C Ratio					0.19			0.81			0.81	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)					357			2586			2518	
v/s Ratio Prot					c0.01			c0.45			0.29	
v/s Ratio Perm												
v/c Ratio					0.06			0.55			0.36	
Uniform Delay, d1					599.2			59.1			46.0	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					0.3			0.9			0.4	
Delay (s)					599.5			59.9			46.4	
Level of Service					F			E			D	
Approach Delay (s)		0.0			599.5			59.9			46.4	
Approach LOS		A			F			E			D	

Intersection Summary			
HCM 2000 Control Delay	59.3	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	1800.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	45.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	20	0	0	20	0	0	44	0	0	66	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		950			950			1727			1727	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		950			950			1727			1727	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	20	0	0	20	0	0	44	0	0	66	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	20	0	0	20	0	0	44	0	0	66	0
Heavy Vehicles (%)	100%	100%	100%	100%	100%	100%	10%	10%	10%	10%	10%	10%
Turn Type		NA			NA			NA			NA	
Protected Phases		2			2			1 3			1 3	
Permitted Phases												
Actuated Green, G (s)		495.0			495.0			1301.0			1301.0	
Effective Green, g (s)		495.0			495.0			1301.0			1301.0	
Actuated g/C Ratio		0.28			0.28			0.72			0.72	
Clearance Time (s)		2.0			2.0							
Lane Grp Cap (vph)		261			261			1248			1248	
v/s Ratio Prot		0.02			c0.02			0.03			c0.04	
v/s Ratio Perm												
v/c Ratio		0.08			0.08			0.04			0.05	
Uniform Delay, d1		483.2			483.2			71.0			71.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.6			0.6			0.1			0.1	
Delay (s)		483.8			483.8			71.0			72.0	
Level of Service		F			F			E			E	
Approach Delay (s)		483.8			483.8			71.0			72.0	
Approach LOS		F			F			E			E	

Intersection Summary			
HCM 2000 Control Delay	181.5	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.06		
Actuated Cycle Length (s)	1800.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	13.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: Main Line & Taylor Crane Road

10/8/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2	0	0	3	0	0	0	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0						2.0	
Lane Util. Factor		1.00			1.00						1.00	
Frt		1.00			1.00						1.00	
Flt Protected		1.00			1.00						1.00	
Satd. Flow (prot)		1863			1863						1900	
Flt Permitted		1.00			1.00						1.00	
Satd. Flow (perm)		1863			1863						1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	2	0	0	3	0	0	0	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	2	0	0	3	0	0	0	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA						NA	
Protected Phases		1 3 5			1 3 5			2 4			2 4	
Permitted Phases												
Actuated Green, G (s)		1638.0			1638.0						154.0	
Effective Green, g (s)		1638.0			1638.0						154.0	
Actuated g/C Ratio		0.91			0.91						0.09	
Clearance Time (s)												
Lane Grp Cap (vph)		1695			1695						162	
v/s Ratio Prot		0.00			c0.00						c0.03	
v/s Ratio Perm												
v/c Ratio		0.00			0.00						0.31	
Uniform Delay, d1		7.3			7.3						773.0	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		0.0			0.0						4.9	
Delay (s)		7.3			7.3						777.9	
Level of Service		A			A						F	
Approach Delay (s)		7.3			7.3			0.0			777.9	
Approach LOS		A			A			A			F	

Intersection Summary			
HCM 2000 Control Delay	707.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.03		
Actuated Cycle Length (s)	1800.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: Main Line & Cowlitz St E/Cowitz St E

10/8/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	48	0	0	72	0	0	0	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0						2.0	
Lane Util. Factor		1.00			1.00						1.00	
Frt		1.00			1.00						1.00	
Flt Protected		1.00			1.00						1.00	
Satd. Flow (prot)		1863			1863						1900	
Flt Permitted		1.00			1.00						1.00	
Satd. Flow (perm)		1863			1863						1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	53	0	0	80	0	0	0	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	53	0	0	80	0	0	0	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA						NA	
Protected Phases		1 3 5			1 3 5			2 4			2 4	
Permitted Phases												
Actuated Green, G (s)		1638.0			1638.0						154.0	
Effective Green, g (s)		1638.0			1638.0						154.0	
Actuated g/C Ratio		0.91			0.91						0.09	
Clearance Time (s)												
Lane Grp Cap (vph)		1695			1695						162	
v/s Ratio Prot		0.03			c0.04						c0.03	
v/s Ratio Perm												
v/c Ratio		0.03			0.05						0.31	
Uniform Delay, d1		7.5			7.6						773.0	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		0.0			0.1						4.9	
Delay (s)		7.5			7.7						777.9	
Level of Service		A			A						F	
Approach Delay (s)		7.5			7.7			0.0			777.9	
Approach LOS		A			A			A			F	

Intersection Summary			
HCM 2000 Control Delay	218.1	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.07		
Actuated Cycle Length (s)	1800.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	13.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	0	0	0	50	0	0	28	0	0	42	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					2.0			2.0			2.0	
Lane Util. Factor					1.00			1.00			1.00	
Frt					1.00			1.00			1.00	
Flt Protected					1.00			1.00			1.00	
Satd. Flow (prot)					1900			1863			1863	
Flt Permitted					1.00			1.00			1.00	
Satd. Flow (perm)					1900			1863			1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	0	0	50	0	0	31	0	0	47	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	50	0	0	31	0	0	47	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type					NA			NA			NA	
Protected Phases		2 4			2 4			1 3 5			1 3 5	
Permitted Phases												
Actuated Green, G (s)					135.0			1657.0			1657.0	
Effective Green, g (s)					135.0			1657.0			1657.0	
Actuated g/C Ratio					0.08			0.92			0.92	
Clearance Time (s)												
Lane Grp Cap (vph)					142			1714			1714	
v/s Ratio Prot					c0.03			0.02			c0.03	
v/s Ratio Perm												
v/c Ratio					0.35			0.02			0.03	
Uniform Delay, d1					791.0			5.8			5.8	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					6.7			0.0			0.0	
Delay (s)					797.7			5.8			5.9	
Level of Service					F			A			A	
Approach Delay (s)		0.0			797.7			5.8			5.9	
Approach LOS		A			F			A			A	

Intersection Summary			
HCM 2000 Control Delay	315.1	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.05		
Actuated Cycle Length (s)	1800.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	102	0	0	153	0	0	0	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0						2.0	
Lane Util. Factor		1.00			1.00						1.00	
Frt		1.00			1.00						1.00	
Flt Protected		1.00			1.00						1.00	
Satd. Flow (prot)		1863			1863						1900	
Flt Permitted		1.00			1.00						1.00	
Satd. Flow (perm)		1863			1863						1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	113	0	0	170	0	0	0	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	113	0	0	170	0	0	0	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA						NA	
Protected Phases		1 3 5			1 3 5			2 4			2 4	
Permitted Phases												
Actuated Green, G (s)		1614.0			1614.0						178.0	
Effective Green, g (s)		1614.0			1614.0						178.0	
Actuated g/C Ratio		0.90			0.90						0.10	
Clearance Time (s)												
Lane Grp Cap (vph)		1670			1670						187	
v/s Ratio Prot		0.06			c0.09						c0.03	
v/s Ratio Perm												
v/c Ratio		0.07			0.10						0.27	
Uniform Delay, d1		10.2			10.6						750.6	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		0.1			0.1						3.5	
Delay (s)		10.3			10.7						754.1	
Level of Service		B			B						F	
Approach Delay (s)		10.3			10.7			0.0			754.1	
Approach LOS		B			B			A			F	

Intersection Summary			
HCM 2000 Control Delay	122.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.12		
Actuated Cycle Length (s)	1800.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	18.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	74	0	0	111	0	0	0	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0						2.0	
Lane Util. Factor		1.00			1.00						1.00	
Frt		1.00			1.00						1.00	
Flt Protected		1.00			1.00						1.00	
Satd. Flow (prot)		1863			1863						1900	
Flt Permitted		1.00			1.00						1.00	
Satd. Flow (perm)		1863			1863						1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	82	0	0	123	0	0	0	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	82	0	0	123	0	0	0	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA						NA	
Protected Phases		1 3 5			1 3 5			2 4			2 4	
Permitted Phases												
Actuated Green, G (s)		1614.0			1614.0						178.0	
Effective Green, g (s)		1614.0			1614.0						178.0	
Actuated g/C Ratio		0.90			0.90						0.10	
Clearance Time (s)												
Lane Grp Cap (vph)		1670			1670						187	
v/s Ratio Prot		0.04			c0.07						c0.03	
v/s Ratio Perm												
v/c Ratio		0.05			0.07						0.27	
Uniform Delay, d1		10.1			10.3						750.6	
Progression Factor		1.00			1.00						0.00	
Incremental Delay, d2		0.1			0.1						3.4	
Delay (s)		10.1			10.4						4.8	
Level of Service		B			B						A	
Approach Delay (s)		10.1			10.4			0.0			4.8	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	9.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.09		
Actuated Cycle Length (s)	1800.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	15.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	48	0	0	72	0	0	0	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0						2.0	
Lane Util. Factor		1.00			1.00						1.00	
Frt		1.00			1.00						1.00	
Flt Protected		1.00			1.00						1.00	
Satd. Flow (prot)		1863			1863						1900	
Flt Permitted		1.00			1.00						1.00	
Satd. Flow (perm)		1863			1863						1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	53	0	0	80	0	0	0	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	53	0	0	80	0	0	0	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA						NA	
Protected Phases		1 3 5			1 3 5			2 4			2 4	
Permitted Phases												
Actuated Green, G (s)		1657.0			1657.0						135.0	
Effective Green, g (s)		1657.0			1657.0						135.0	
Actuated g/C Ratio		0.92			0.92						0.08	
Clearance Time (s)												
Lane Grp Cap (vph)		1714			1714						142	
v/s Ratio Prot		0.03			c0.04						c0.03	
v/s Ratio Perm												
v/c Ratio		0.03			0.05						0.35	
Uniform Delay, d1		5.8			5.9						791.0	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		0.0			0.1						6.7	
Delay (s)		5.9			6.0						797.7	
Level of Service		A			A						F	
Approach Delay (s)		5.9			6.0			0.0			797.7	
Approach LOS		A			A			A			F	

Intersection Summary			
HCM 2000 Control Delay	222.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.07		
Actuated Cycle Length (s)	1800.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	13.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	88	0	0	177	0	0	0	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0						2.0	
Lane Util. Factor		1.00			1.00						1.00	
Frt		1.00			1.00						1.00	
Flt Protected		1.00			1.00						1.00	
Satd. Flow (prot)		1776			1759						1900	
Flt Permitted		1.00			1.00						1.00	
Satd. Flow (perm)		1776			1759						1900	
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	104	0	0	208	0	0	0	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	104	0	0	208	0	0	0	0	0	50	0
Heavy Vehicles (%)	7%	7%	7%	8%	8%	8%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA						NA	
Protected Phases		1 3 5			1 3 5			2 4			2 4	
Permitted Phases												
Actuated Green, G (s)		1657.0			1657.0						135.0	
Effective Green, g (s)		1657.0			1657.0						135.0	
Actuated g/C Ratio		0.92			0.92						0.08	
Clearance Time (s)												
Lane Grp Cap (vph)		1634			1619						142	
v/s Ratio Prot		0.06			c0.12						c0.03	
v/s Ratio Perm												
v/c Ratio		0.06			0.13						0.35	
Uniform Delay, d1		6.0			6.4						791.0	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		0.1			0.2						6.7	
Delay (s)		6.1			6.6						797.7	
Level of Service		A			A						F	
Approach Delay (s)		6.1			6.6			0.0			797.7	
Approach LOS		A			A			A			F	

Intersection Summary			
HCM 2000 Control Delay	115.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.15		
Actuated Cycle Length (s)	1800.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	19.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	124	0	0	76	0	0	0	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0						2.0	
Lane Util. Factor		1.00			1.00						1.00	
Frt		1.00			1.00						1.00	
Flt Protected		1.00			1.00						1.00	
Satd. Flow (prot)		1881			1900						1900	
Flt Permitted		1.00			1.00						1.00	
Satd. Flow (perm)		1881			1900						1900	
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	144	0	0	88	0	0	0	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	144	0	0	88	0	0	0	0	0	50	0
Heavy Vehicles (%)	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA						NA	
Protected Phases		1 3 5			1 3 5			2 4			2 4	
Permitted Phases												
Actuated Green, G (s)		1657.0			1657.0						135.0	
Effective Green, g (s)		1657.0			1657.0						135.0	
Actuated g/C Ratio		0.92			0.92						0.08	
Clearance Time (s)												
Lane Grp Cap (vph)		1731			1749						142	
v/s Ratio Prot		c0.08			0.05						c0.03	
v/s Ratio Perm												
v/c Ratio		0.08			0.05						0.35	
Uniform Delay, d1		6.2			6.0						791.0	
Progression Factor		1.00			1.00						0.86	
Incremental Delay, d2		0.1			0.1						6.4	
Delay (s)		6.2			6.0						687.0	
Level of Service		A			A						F	
Approach Delay (s)		6.2			6.0			0.0			687.0	
Approach LOS		A			A			A			F	

Intersection Summary			
HCM 2000 Control Delay	126.9	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.10		
Actuated Cycle Length (s)	1800.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	16.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	62	0	0	93	0	0	0	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0						2.0	
Lane Util. Factor		1.00			1.00						1.00	
Frt		1.00			1.00						1.00	
Flt Protected		1.00			1.00						1.00	
Satd. Flow (prot)		1863			1863						1900	
Flt Permitted		1.00			1.00						1.00	
Satd. Flow (perm)		1863			1863						1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	69	0	0	103	0	0	0	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	69	0	0	103	0	0	0	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA						NA	
Protected Phases		1 3 5			1 3 5			2 4			2 4	
Permitted Phases												
Actuated Green, G (s)		1657.0			1657.0						135.0	
Effective Green, g (s)		1657.0			1657.0						135.0	
Actuated g/C Ratio		0.92			0.92						0.08	
Clearance Time (s)												
Lane Grp Cap (vph)		1714			1714						142	
v/s Ratio Prot		0.04			c0.06						c0.03	
v/s Ratio Perm												
v/c Ratio		0.04			0.06						0.35	
Uniform Delay, d1		5.9			6.0						791.0	
Progression Factor		1.00			1.00						0.29	
Incremental Delay, d2		0.0			0.1						6.4	
Delay (s)		5.9			6.1						236.5	
Level of Service		A			A						F	
Approach Delay (s)		5.9			6.1			0.0			236.5	
Approach LOS		A			A			A			F	

Intersection Summary			
HCM 2000 Control Delay	57.9	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.08		
Actuated Cycle Length (s)	1800.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	14.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: Main Line & Taylor Crane Road

10/8/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2	0	0	3	0	0	0	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0						2.0	
Lane Util. Factor		1.00			1.00						1.00	
Frt		1.00			1.00						1.00	
Flt Protected		1.00			1.00						1.00	
Satd. Flow (prot)		1863			1863						1900	
Flt Permitted		1.00			1.00						1.00	
Satd. Flow (perm)		1863			1863						1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	2	0	0	3	0	0	0	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	2	0	0	3	0	0	0	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA						NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2	
Permitted Phases												
Actuated Green, G (s)		1713.0			1713.0						112.0	
Effective Green, g (s)		1713.0			1713.0						112.0	
Actuated g/C Ratio		0.86			0.86						0.06	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		1595			1595						106	
v/s Ratio Prot		0.00			c0.00						c0.03	
v/s Ratio Perm												
v/c Ratio		0.00			0.00						0.47	
Uniform Delay, d1		20.6			20.6						915.3	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		0.0			0.0						14.3	
Delay (s)		20.6			20.6						929.6	
Level of Service		C			C						F	
Approach Delay (s)		20.6			20.6			0.0			929.6	
Approach LOS		C			C			A			F	

Intersection Summary			
HCM 2000 Control Delay	847.0	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.03		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: Main Line & Cowlitz St E/Cowitz St E

10/8/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	48	0	0	72	0	0	0	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0						2.0	
Lane Util. Factor		1.00			1.00						1.00	
Frt		1.00			1.00						1.00	
Flt Protected		1.00			1.00						1.00	
Satd. Flow (prot)		1863			1863						1900	
Flt Permitted		1.00			1.00						1.00	
Satd. Flow (perm)		1863			1863						1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	53	0	0	80	0	0	0	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	53	0	0	80	0	0	0	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA						NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2	
Permitted Phases												
Actuated Green, G (s)		1713.0			1713.0						112.0	
Effective Green, g (s)		1713.0			1713.0						112.0	
Actuated g/C Ratio		0.86			0.86						0.06	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		1595			1595						106	
v/s Ratio Prot		0.03			c0.04						c0.03	
v/s Ratio Perm												
v/c Ratio		0.03			0.05						0.47	
Uniform Delay, d1		21.2			21.5						915.3	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		0.0			0.1						14.3	
Delay (s)		21.2			21.6						929.6	
Level of Service		C			C						F	
Approach Delay (s)		21.2			21.6			0.0			929.6	
Approach LOS		C			C			A			F	

Intersection Summary			
HCM 2000 Control Delay	269.6	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.07		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	13.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	50	0	0	50	0	0	28	0	0	42	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1900			1900			1863			1863	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1900			1900			1863			1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	50	0	0	50	0	0	31	0	0	47	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	50	0	0	50	0	0	31	0	0	47	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type		NA			NA			NA			NA	
Protected Phases		4 6			2			1 3 5 7			1 3 5 7	
Permitted Phases												
Actuated Green, G (s)		143.0			98.0			1747.0			1747.0	
Effective Green, g (s)		143.0			98.0			1747.0			1747.0	
Actuated g/C Ratio		0.07			0.05			0.87			0.87	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)		135			93			1627			1627	
v/s Ratio Prot		c0.03			c0.03			0.02			c0.03	
v/s Ratio Perm												
v/c Ratio		0.37			0.54			0.02			0.03	
Uniform Delay, d1		885.6			928.9			16.3			16.4	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		7.6			20.5			0.0			0.0	
Delay (s)		893.2			949.4			16.3			16.4	
Level of Service		F			F			B			B	
Approach Delay (s)		893.2			949.4			16.3			16.4	
Approach LOS		F			F			B			B	

Intersection Summary			
HCM 2000 Control Delay	524.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.08		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	102	0	0	153	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1863			1863			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1863			1863			1900			1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	113	0	0	170	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	113	0	0	170	0	0	50	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2	
Permitted Phases												
Actuated Green, G (s)		1665.0			1665.0			190.0			133.0	
Effective Green, g (s)		1665.0			1665.0			190.0			133.0	
Actuated g/C Ratio		0.83			0.83			0.10			0.07	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		1550			1550			180			126	
v/s Ratio Prot		0.06			c0.09			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.07			0.11			0.28			0.40	
Uniform Delay, d1		29.9			30.9			841.2			895.0	
Progression Factor		1.00			1.00			0.00			1.00	
Incremental Delay, d2		0.1			0.1			3.7			9.1	
Delay (s)		30.0			31.0			5.0			904.1	
Level of Service		C			C			A			F	
Approach Delay (s)		30.0			31.0			5.0			904.1	
Approach LOS		C			C			A			F	

Intersection Summary			
HCM 2000 Control Delay	141.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.14		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	18.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	74	0	0	111	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1863			1863			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1863			1863			1900			1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	82	0	0	123	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	82	0	0	123	0	0	50	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2	
Permitted Phases												
Actuated Green, G (s)		1665.0			1665.0			190.0			133.0	
Effective Green, g (s)		1665.0			1665.0			190.0			133.0	
Actuated g/C Ratio		0.83			0.83			0.10			0.07	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		1550			1550			180			126	
v/s Ratio Prot		0.04			c0.07			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.05			0.08			0.28			0.40	
Uniform Delay, d1		29.3			30.0			841.2			895.0	
Progression Factor		1.00			1.00			1.00			0.00	
Incremental Delay, d2		0.1			0.1			3.8			8.5	
Delay (s)		29.4			30.1			845.0			9.5	
Level of Service		C			C			F			A	
Approach Delay (s)		29.4			30.1			845.0			9.5	
Approach LOS		C			C			F			A	

Intersection Summary			
HCM 2000 Control Delay	160.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.12		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	15.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	48	0	0	72	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1863			1863			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1863			1863			1900			1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	53	0	0	80	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	53	0	0	80	0	0	50	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2	
Permitted Phases												
Actuated Green, G (s)		1747.0			1747.0			143.0			98.0	
Effective Green, g (s)		1747.0			1747.0			143.0			98.0	
Actuated g/C Ratio		0.87			0.87			0.07			0.05	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		1627			1627			135			93	
v/s Ratio Prot		0.03			c0.04			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.03			0.05			0.37			0.54	
Uniform Delay, d1		16.5			16.7			885.6			928.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.0			0.1			7.6			20.5	
Delay (s)		16.5			16.8			893.2			949.4	
Level of Service		B			B			F			F	
Approach Delay (s)		16.5			16.8			893.2			949.4	
Approach LOS		B			B			F			F	

Intersection Summary			
HCM 2000 Control Delay	404.9	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.10		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	13.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	88	0	0	177	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1776			1759			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1776			1759			1900			1900	
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	104	0	0	208	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	104	0	0	208	0	0	50	0	0	50	0
Heavy Vehicles (%)	7%	7%	7%	8%	8%	8%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2	
Permitted Phases												
Actuated Green, G (s)		1747.0			1747.0			143.0			98.0	
Effective Green, g (s)		1747.0			1747.0			143.0			98.0	
Actuated g/C Ratio		0.87			0.87			0.07			0.05	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		1551			1536			135			93	
v/s Ratio Prot		0.06			c0.12			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.07			0.14			0.37			0.54	
Uniform Delay, d1		17.0			18.1			885.6			928.9	
Progression Factor		1.00			1.00			0.01			1.00	
Incremental Delay, d2		0.1			0.2			7.2			20.5	
Delay (s)		17.1			18.3			12.6			949.4	
Level of Service		B			B			B			F	
Approach Delay (s)		17.1			18.3			12.6			949.4	
Approach LOS		B			B			B			F	

Intersection Summary			
HCM 2000 Control Delay	130.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.17		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	19.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	124	0	0	76	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1881			1900			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1881			1900			1900			1900	
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	144	0	0	88	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	144	0	0	88	0	0	50	0	0	50	0
Heavy Vehicles (%)	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2	
Permitted Phases												
Actuated Green, G (s)		1747.0			1747.0			143.0			98.0	
Effective Green, g (s)		1747.0			1747.0			143.0			98.0	
Actuated g/C Ratio		0.87			0.87			0.07			0.05	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		1643			1659			135			93	
v/s Ratio Prot		c0.08			0.05			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.09			0.05			0.37			0.54	
Uniform Delay, d1		17.3			16.8			885.6			928.9	
Progression Factor		1.00			1.00			0.02			0.01	
Incremental Delay, d2		0.1			0.1			7.2			17.7	
Delay (s)		17.4			16.8			21.0			28.4	
Level of Service		B			B			C			C	
Approach Delay (s)		17.4			16.8			21.0			28.4	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	19.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.13		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	16.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	62	0	0	93	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1863			1863			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1863			1863			1900			1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	69	0	0	103	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	69	0	0	103	0	0	50	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2	
Permitted Phases												
Actuated Green, G (s)		1747.0			1747.0			143.0			98.0	
Effective Green, g (s)		1747.0			1747.0			143.0			98.0	
Actuated g/C Ratio		0.87			0.87			0.07			0.05	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		1627			1627			135			93	
v/s Ratio Prot		0.04			c0.06			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.04			0.06			0.37			0.54	
Uniform Delay, d1		16.6			16.9			885.6			928.9	
Progression Factor		1.00			1.00			1.00			0.01	
Incremental Delay, d2		0.0			0.1			7.6			17.7	
Delay (s)		16.7			17.0			893.2			28.5	
Level of Service		B			B			F			C	
Approach Delay (s)		16.7			17.0			893.2			28.5	
Approach LOS		B			B			F			C	

Intersection Summary			
HCM 2000 Control Delay	180.1	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.11		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	14.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: Main Line & Taylor Crane Road

10/8/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2	0	0	3	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1863			1863			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1863			1863			1900			1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	2	0	0	3	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	2	0	0	3	0	0	50	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2	
Permitted Phases												
Actuated Green, G (s)		1722.0			1722.0			154.0			112.0	
Effective Green, g (s)		1722.0			1722.0			154.0			112.0	
Actuated g/C Ratio		0.86			0.86			0.08			0.06	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		1604			1604			146			106	
v/s Ratio Prot		0.00			c0.00			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.00			0.00			0.34			0.47	
Uniform Delay, d1		19.3			19.4			875.0			915.3	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.0			0.0			6.3			14.3	
Delay (s)		19.3			19.4			881.3			929.6	
Level of Service		B			B			F			F	
Approach Delay (s)		19.3			19.4			881.3			929.6	
Approach LOS		B			B			F			F	

Intersection Summary			
HCM 2000 Control Delay	863.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.05		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: Main Line & Cowlitz St E/Cowitz St E

10/8/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	58	0	0	87	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1863			1863			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1863			1863			1900			1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	64	0	0	97	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	64	0	0	97	0	0	50	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2	
Permitted Phases												
Actuated Green, G (s)		1722.0			1722.0			154.0			112.0	
Effective Green, g (s)		1722.0			1722.0			154.0			112.0	
Actuated g/C Ratio		0.86			0.86			0.08			0.06	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		1604			1604			146			106	
v/s Ratio Prot		0.03			c0.05			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.04			0.06			0.34			0.47	
Uniform Delay, d1		20.0			20.4			875.0			915.3	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.0			0.1			6.3			14.3	
Delay (s)		20.1			20.5			881.3			929.6	
Level of Service		C			C			F			F	
Approach Delay (s)		20.1			20.5			881.3			929.6	
Approach LOS		C			C			F			F	

Intersection Summary			
HCM 2000 Control Delay	359.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.11		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	14.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	50	0	0	50	0	0	34	0	0	51	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1900			1900			1863			1863	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1900			1900			1863			1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	50	0	0	50	0	0	38	0	0	57	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	50	0	0	50	0	0	38	0	0	57	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type		NA			NA			NA			NA	
Protected Phases		4 6			2			1 3 5 7			1 3 5 7	
Permitted Phases												
Actuated Green, G (s)		135.0			98.0			1755.0			1755.0	
Effective Green, g (s)		135.0			98.0			1755.0			1755.0	
Actuated g/C Ratio		0.07			0.05			0.88			0.88	
Clearance Time (s)					2.0							
Lane Grp Cap (vph)		128			93			1634			1634	
v/s Ratio Prot		c0.03			c0.03			0.02			c0.03	
v/s Ratio Perm												
v/c Ratio		0.39			0.54			0.02			0.03	
Uniform Delay, d1		893.1			928.9			15.3			15.5	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		8.7			20.5			0.0			0.0	
Delay (s)		901.8			949.4			15.3			15.5	
Level of Service		F			F			B			B	
Approach Delay (s)		901.8			949.4			15.3			15.5	
Approach LOS		F			F			B			B	

Intersection Summary			
HCM 2000 Control Delay	482.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.08		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	120	0	0	180	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1863			1863			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1863			1863			1900			1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	133	0	0	200	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	133	0	0	200	0	0	50	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2	
Permitted Phases												
Actuated Green, G (s)		1677.0			1677.0			178.0			133.0	
Effective Green, g (s)		1677.0			1677.0			178.0			133.0	
Actuated g/C Ratio		0.84			0.84			0.09			0.07	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		1562			1562			169			126	
v/s Ratio Prot		0.07			c0.11			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.09			0.13			0.30			0.40	
Uniform Delay, d1		28.1			29.2			852.4			895.0	
Progression Factor		1.00			1.00			0.00			1.00	
Incremental Delay, d2		0.1			0.2			4.3			9.1	
Delay (s)		28.2			29.4			6.3			904.1	
Level of Service		C			C			A			F	
Approach Delay (s)		28.2			29.4			6.3			904.1	
Approach LOS		C			C			A			F	

Intersection Summary			
HCM 2000 Control Delay	127.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.16		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	19.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	88	0	0	132	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1863			1863			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1863			1863			1900			1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	98	0	0	147	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	98	0	0	147	0	0	50	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2	
Permitted Phases												
Actuated Green, G (s)		1677.0			1677.0			178.0			133.0	
Effective Green, g (s)		1677.0			1677.0			178.0			133.0	
Actuated g/C Ratio		0.84			0.84			0.09			0.07	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		1562			1562			169			126	
v/s Ratio Prot		0.05			c0.08			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.06			0.09			0.30			0.40	
Uniform Delay, d1		27.5			28.3			852.4			895.0	
Progression Factor		1.00			1.00			1.00			0.00	
Incremental Delay, d2		0.1			0.1			4.4			8.5	
Delay (s)		27.6			28.4			856.8			9.5	
Level of Service		C			C			F			A	
Approach Delay (s)		27.6			28.4			856.8			9.5	
Approach LOS		C			C			F			A	

Intersection Summary			
HCM 2000 Control Delay	145.5	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.13		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	16.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	58	0	0	87	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1863			1863			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1863			1863			1900			1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	64	0	0	97	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	64	0	0	97	0	0	50	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2	
Permitted Phases												
Actuated Green, G (s)		1755.0			1755.0			135.0			98.0	
Effective Green, g (s)		1755.0			1755.0			135.0			98.0	
Actuated g/C Ratio		0.88			0.88			0.07			0.05	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		1634			1634			128			93	
v/s Ratio Prot		0.03			c0.05			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.04			0.06			0.39			0.54	
Uniform Delay, d1		15.5			15.8			893.1			928.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.0			0.1			8.7			20.5	
Delay (s)		15.6			15.9			901.8			949.4	
Level of Service		B			B			F			F	
Approach Delay (s)		15.6			15.9			901.8			949.4	
Approach LOS		B			B			F			F	

Intersection Summary			
HCM 2000 Control Delay	364.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.11		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	14.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	103	0	0	207	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1776			1759			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1776			1759			1900			1900	
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	121	0	0	244	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	121	0	0	244	0	0	50	0	0	50	0
Heavy Vehicles (%)	7%	7%	7%	8%	8%	8%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2	
Permitted Phases												
Actuated Green, G (s)		1755.0			1755.0			135.0			98.0	
Effective Green, g (s)		1755.0			1755.0			135.0			98.0	
Actuated g/C Ratio		0.88			0.88			0.07			0.05	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		1558			1543			128			93	
v/s Ratio Prot		0.07			c0.14			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.08			0.16			0.39			0.54	
Uniform Delay, d1		16.1			17.4			893.1			928.9	
Progression Factor		1.00			1.00			0.01			1.00	
Incremental Delay, d2		0.1			0.2			8.2			20.5	
Delay (s)		16.2			17.6			13.6			949.4	
Level of Service		B			B			B			F	
Approach Delay (s)		16.2			17.6			13.6			949.4	
Approach LOS		B			B			B			F	

Intersection Summary			
HCM 2000 Control Delay	117.0	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.19		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	20.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	148	0	0	87	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1881			1900			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1881			1900			1900			1900	
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	172	0	0	101	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	172	0	0	101	0	0	50	0	0	50	0
Heavy Vehicles (%)	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2	
Permitted Phases												
Actuated Green, G (s)		1755.0			1755.0			135.0			98.0	
Effective Green, g (s)		1755.0			1755.0			135.0			98.0	
Actuated g/C Ratio		0.88			0.88			0.07			0.05	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		1650			1667			128			93	
v/s Ratio Prot		c0.09			0.05			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.10			0.06			0.39			0.54	
Uniform Delay, d1		16.5			15.8			893.1			928.9	
Progression Factor		1.00			1.00			0.02			0.01	
Incremental Delay, d2		0.1			0.1			8.2			17.7	
Delay (s)		16.6			15.9			21.9			28.4	
Level of Service		B			B			C			C	
Approach Delay (s)		16.6			15.9			21.9			28.4	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	18.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.14		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	17.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	72	0	0	108	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1863			1863			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1863			1863			1900			1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	80	0	0	120	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	80	0	0	120	0	0	50	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2	
Permitted Phases												
Actuated Green, G (s)		1755.0			1755.0			135.0			98.0	
Effective Green, g (s)		1755.0			1755.0			135.0			98.0	
Actuated g/C Ratio		0.88			0.88			0.07			0.05	
Clearance Time (s)											2.0	
Lane Grp Cap (vph)		1634			1634			128			93	
v/s Ratio Prot		0.04			c0.06			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.05			0.07			0.39			0.54	
Uniform Delay, d1		15.7			16.0			893.1			928.9	
Progression Factor		1.00			1.00			1.00			0.01	
Incremental Delay, d2		0.1			0.1			8.7			17.7	
Delay (s)		15.7			16.1			901.8			28.5	
Level of Service		B			B			F			C	
Approach Delay (s)		15.7			16.1			901.8			28.5	
Approach LOS		B			B			F			C	

Intersection Summary			
HCM 2000 Control Delay	165.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.12		
Actuated Cycle Length (s)	2000.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	15.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: Main Line & Taylor Crane Road

10/8/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2	0	0	3	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1863			1863			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1863			1863			1900			1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	2	0	0	3	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	2	0	0	3	0	0	50	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2 8	
Permitted Phases												
Actuated Green, G (s)		1499.0			1499.0			163.0			224.0	
Effective Green, g (s)		1499.0			1499.0			163.0			224.0	
Actuated g/C Ratio		0.79			0.79			0.09			0.12	
Clearance Time (s)												
Lane Grp Cap (vph)		1469			1469			163			224	
v/s Ratio Prot		0.00			c0.00			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.00			0.00			0.31			0.22	
Uniform Delay, d1		42.4			42.4			815.5			759.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.0			0.0			4.8			2.3	
Delay (s)		42.4			42.4			820.3			761.5	
Level of Service		D			D			F			F	
Approach Delay (s)		42.4			42.4			820.3			761.5	
Approach LOS		D			D			F			F	

Intersection Summary			
HCM 2000 Control Delay	755.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.05		
Actuated Cycle Length (s)	1900.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: Main Line & Cowlitz St E/Cowitz St E

10/8/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	58	0	0	87	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1863			1863			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1863			1863			1900			1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	64	0	0	97	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	64	0	0	97	0	0	50	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2 8	
Permitted Phases												
Actuated Green, G (s)		1499.0			1499.0			163.0			224.0	
Effective Green, g (s)		1499.0			1499.0			163.0			224.0	
Actuated g/C Ratio		0.79			0.79			0.09			0.12	
Clearance Time (s)												
Lane Grp Cap (vph)		1469			1469			163			224	
v/s Ratio Prot		0.03			c0.05			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.04			0.07			0.31			0.22	
Uniform Delay, d1		43.8			44.6			815.5			759.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			0.1			4.8			2.3	
Delay (s)		43.9			44.7			820.3			761.5	
Level of Service		D			D			F			F	
Approach Delay (s)		43.9			44.7			820.3			761.5	
Approach LOS		D			D			F			F	

Intersection Summary			
HCM 2000 Control Delay	330.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.11		
Actuated Cycle Length (s)	1900.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	14.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	0	50	0	0	50	0	0	34	0	0	51	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1900			1900			1863			1863	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1900			1900			1863			1863	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	50	0	0	50	0	0	38	0	0	57	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	50	0	0	50	0	0	38	0	0	57	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type		NA			NA			NA			NA	
Protected Phases		4 6			2 8			1 3 5 7			1 3 5 7	
Permitted Phases												
Actuated Green, G (s)		143.0			196.0			1547.0			1547.0	
Effective Green, g (s)		143.0			196.0			1547.0			1547.0	
Actuated g/C Ratio		0.08			0.10			0.81			0.81	
Clearance Time (s)												
Lane Grp Cap (vph)		143			196			1516			1516	
v/s Ratio Prot		c0.03			c0.03			0.02			c0.03	
v/s Ratio Perm												
v/c Ratio		0.35			0.26			0.03			0.04	
Uniform Delay, d1		834.3			784.8			33.5			33.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		6.6			3.1			0.0			0.0	
Delay (s)		841.0			787.9			33.5			33.9	
Level of Service		F			F			C			C	
Approach Delay (s)		841.0			787.9			33.5			33.9	
Approach LOS		F			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	434.1	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.08		
Actuated Cycle Length (s)	1900.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	120	0	0	180	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1863			1863			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1863			1863			1900			1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	133	0	0	200	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	133	0	0	200	0	0	50	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2 8	
Permitted Phases												
Actuated Green, G (s)		1430.0			1430.0			190.0			266.0	
Effective Green, g (s)		1430.0			1430.0			190.0			266.0	
Actuated g/C Ratio		0.75			0.75			0.10			0.14	
Clearance Time (s)												
Lane Grp Cap (vph)		1402			1402			190			266	
v/s Ratio Prot		0.07			c0.11			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.09			0.14			0.26			0.19	
Uniform Delay, d1		62.6			65.1			790.3			721.6	
Progression Factor		1.00			1.00			0.26			1.00	
Incremental Delay, d2		0.1			0.2			3.3			1.6	
Delay (s)		62.7			65.3			210.2			723.2	
Level of Service		E			E			F			F	
Approach Delay (s)		62.7			65.3			210.2			723.2	
Approach LOS		E			E			F			F	

Intersection Summary			
HCM 2000 Control Delay	157.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.16		
Actuated Cycle Length (s)	1900.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	19.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	88	0	0	132	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1863			1863			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1863			1863			1900			1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	98	0	0	147	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	98	0	0	147	0	0	50	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2 8	
Permitted Phases												
Actuated Green, G (s)		1430.0			1430.0			190.0			266.0	
Effective Green, g (s)		1430.0			1430.0			190.0			266.0	
Actuated g/C Ratio		0.75			0.75			0.10			0.14	
Clearance Time (s)												
Lane Grp Cap (vph)		1402			1402			190			266	
v/s Ratio Prot		0.05			c0.08			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.07			0.10			0.26			0.19	
Uniform Delay, d1		61.4			63.1			790.3			721.6	
Progression Factor		1.00			1.00			1.00			0.04	
Incremental Delay, d2		0.1			0.2			3.3			1.5	
Delay (s)		61.5			63.3			793.6			31.9	
Level of Service		E			E			F			C	
Approach Delay (s)		61.5			63.3			793.6			31.9	
Approach LOS		E			E			F			C	

Intersection Summary			
HCM 2000 Control Delay	164.1	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.13		
Actuated Cycle Length (s)	1900.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	16.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	58	0	0	87	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1863			1863			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1863			1863			1900			1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	64	0	0	97	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	64	0	0	97	0	0	50	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2 8	
Permitted Phases												
Actuated Green, G (s)		1547.0			1547.0			143.0			196.0	
Effective Green, g (s)		1547.0			1547.0			143.0			196.0	
Actuated g/C Ratio		0.81			0.81			0.08			0.10	
Clearance Time (s)												
Lane Grp Cap (vph)		1516			1516			143			196	
v/s Ratio Prot		0.03			c0.05			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.04			0.06			0.35			0.26	
Uniform Delay, d1		34.0			34.6			834.3			784.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			0.1			6.6			3.1	
Delay (s)		34.0			34.7			841.0			787.9	
Level of Service		C			C			F			F	
Approach Delay (s)		34.0			34.7			841.0			787.9	
Approach LOS		C			C			F			F	

Intersection Summary			
HCM 2000 Control Delay	333.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.11		
Actuated Cycle Length (s)	1900.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	14.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	103	0	0	207	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1776			1759			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1776			1759			1900			1900	
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	121	0	0	244	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	121	0	0	244	0	0	50	0	0	50	0
Heavy Vehicles (%)	7%	7%	7%	8%	8%	8%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2 8	
Permitted Phases												
Actuated Green, G (s)		1545.0			1545.0			143.0			196.0	
Effective Green, g (s)		1545.0			1545.0			143.0			196.0	
Actuated g/C Ratio		0.81			0.81			0.08			0.10	
Clearance Time (s)												
Lane Grp Cap (vph)		1444			1430			143			196	
v/s Ratio Prot		0.07			c0.14			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.08			0.17			0.35			0.26	
Uniform Delay, d1		35.6			38.5			834.3			784.8	
Progression Factor		1.00			1.00			0.00			1.00	
Incremental Delay, d2		0.1			0.3			6.3			3.1	
Delay (s)		35.7			38.8			10.1			787.9	
Level of Service		D			D			B			F	
Approach Delay (s)		35.7			38.8			10.1			787.9	
Approach LOS		D			D			B			F	

Intersection Summary			
HCM 2000 Control Delay	115.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.19		
Actuated Cycle Length (s)	1900.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	20.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	148	0	0	87	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1881			1900			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1881			1900			1900			1900	
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	172	0	0	101	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	172	0	0	101	0	0	50	0	0	50	0
Heavy Vehicles (%)	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2 8	
Permitted Phases												
Actuated Green, G (s)		1545.0			1545.0			143.0			196.0	
Effective Green, g (s)		1545.0			1545.0			143.0			196.0	
Actuated g/C Ratio		0.81			0.81			0.08			0.10	
Clearance Time (s)												
Lane Grp Cap (vph)		1529			1545			143			196	
v/s Ratio Prot		c0.09			0.05			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.11			0.07			0.35			0.26	
Uniform Delay, d1		36.5			35.0			834.3			784.8	
Progression Factor		1.00			1.00			0.01			0.05	
Incremental Delay, d2		0.1			0.1			6.3			3.1	
Delay (s)		36.7			35.1			14.6			41.1	
Level of Service		D			D			B			D	
Approach Delay (s)		36.7			35.1			14.6			41.1	
Approach LOS		D			D			B			D	

Intersection Summary			
HCM 2000 Control Delay	33.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.14		
Actuated Cycle Length (s)	1900.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	17.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	72	0	0	108	0	0	50	0	0	50	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		2.0			2.0			2.0			2.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			1.00			1.00			1.00	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1863			1863			1900			1900	
Flt Permitted		1.00			1.00			1.00			1.00	
Satd. Flow (perm)		1863			1863			1900			1900	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	80	0	0	120	0	0	50	0	0	50	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	80	0	0	120	0	0	50	0	0	50	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA			NA			NA	
Protected Phases		1 3 5 7			1 3 5 7			4 6			2 8	
Permitted Phases												
Actuated Green, G (s)		1545.0			1545.0			143.0			196.0	
Effective Green, g (s)		1545.0			1545.0			143.0			196.0	
Actuated g/C Ratio		0.81			0.81			0.08			0.10	
Clearance Time (s)												
Lane Grp Cap (vph)		1514			1514			143			196	
v/s Ratio Prot		0.04			c0.06			c0.03			c0.03	
v/s Ratio Perm												
v/c Ratio		0.05			0.08			0.35			0.26	
Uniform Delay, d1		34.7			35.4			834.3			784.8	
Progression Factor		1.00			1.00			1.00			0.62	
Incremental Delay, d2		0.1			0.1			6.6			3.1	
Delay (s)		34.7			35.6			841.0			487.7	
Level of Service		C			D			F			F	
Approach Delay (s)		34.7			35.6			841.0			487.7	
Approach LOS		C			D			F			F	

Intersection Summary			
HCM 2000 Control Delay	244.9	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.12		
Actuated Cycle Length (s)	1900.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	15.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Intersection: 1: Weyerhaeuser & Industrial Way

Movement	SE	NW	NW	NE
Directions Served	TR	L	T	LR
Maximum Queue (ft)	3	54	516	150
Average Queue (ft)	0	10	35	67
95th Queue (ft)	3	37	255	122
Link Distance (ft)	116	745	745	484
Upstream Blk Time (%)			0	
Queuing Penalty (veh)			0	
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: Oregon Way & Industrial Way

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	NB
Directions Served	L	T	T	R	L	L	T	R	L	T	T	R
Maximum Queue (ft)	222	253	265	97	297	683	952	78	278	391	616	250
Average Queue (ft)	94	117	115	4	154	201	473	49	140	177	196	137
95th Queue (ft)	179	208	215	51	254	449	894	99	234	306	431	254
Link Distance (ft)		745				1239	1239				2473	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	140		400	400	310			25	235	235		120
Storage Blk Time (%)	6	5			0	0	59	14	1	3	23	6
Queuing Penalty (veh)	23	20			0	1	95	47	4	23	197	50

Intersection: 2: Oregon Way & Industrial Way

Movement	SB	SB	SB
Directions Served	L	T	TR
Maximum Queue (ft)	206	259	257
Average Queue (ft)	64	180	181
95th Queue (ft)	153	274	276
Link Distance (ft)		236	236
Upstream Blk Time (%)	0	5	6
Queuing Penalty (veh)	0	16	18
Storage Bay Dist (ft)	170		
Storage Blk Time (%)	0	16	
Queuing Penalty (veh)	1	9	

Intersection: 4: Oregon Way & Spur Line

Movement	WB	NB	NB	SB	SB
Directions Served	T	T	T	T	T
Maximum Queue (ft)	179	247	246	397	399
Average Queue (ft)	8	17	17	37	36
95th Queue (ft)	71	118	118	195	191
Link Distance (ft)	4581	236	236	702	702
Upstream Blk Time (%)		3	3		
Queuing Penalty (veh)		11	11		
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 5: Oregon Way & Alabama Street

Movement	EB	WB	NB	NB	SB	SB
Directions Served	LTR	LTR	L	TR	L	TR
Maximum Queue (ft)	114	116	77	4	50	17
Average Queue (ft)	47	43	25	0	14	1
95th Queue (ft)	93	85	60	3	41	7
Link Distance (ft)	233	852		702		887
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)			175		165	
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 9: California Way & Spur Line

Movement	WB	SE	NW
Directions Served	T	T	T
Maximum Queue (ft)	137	276	240
Average Queue (ft)	5	16	13
95th Queue (ft)	48	117	102
Link Distance (ft)	464	2581	404
Upstream Blk Time (%)			0
Queuing Penalty (veh)			0
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 10: Industrial Way & Spur Line

Movement	WB	SE	NW
Directions Served	T	T	T
Maximum Queue (ft)	154	554	124
Average Queue (ft)	7	41	11
95th Queue (ft)	64	269	68
Link Distance (ft)	993	2678	116
Upstream Blk Time (%)			3
Queuing Penalty (veh)			19
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 12: Industrial Way & Washington Way

Movement	EB	EB	EB	WB	WB	SE	SE	SE	NW	NW
Directions Served	L	T	R	L	T	L	T	R	L	TR
Maximum Queue (ft)	25	59	42	68	90	90	139	52	198	475
Average Queue (ft)	12	30	10	19	18	26	47	8	31	181
95th Queue (ft)	27	53	29	49	66	68	108	32	110	354
Link Distance (ft)	7	7	7		1347		1220			1630
Upstream Blk Time (%)	16	42	10							
Queuing Penalty (veh)	11	31	7							
Storage Bay Dist (ft)				90		210		25	160	
Storage Blk Time (%)				0	1		9	1		8
Queuing Penalty (veh)				0	1		10	3		3

Intersection: 16: Columbia Ave & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	188	226	74	204	184	120	105
Average Queue (ft)	78	96	13	74	78	55	37
95th Queue (ft)	153	177	48	158	159	100	79
Link Distance (ft)	420	420		379	379	398	
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)			105				130
Storage Blk Time (%)			0	2		0	0
Queuing Penalty (veh)			0	0		0	0

Intersection: 20: California Way & Industrial Way

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	T	R	L	T	R
Maximum Queue (ft)	269	505	492	79	78	73	55	20	67	164	62	163
Average Queue (ft)	136	174	185	16	20	13	9	1	15	60	3	47
95th Queue (ft)	254	393	385	51	56	46	37	10	49	125	33	104
Link Distance (ft)		843	843		237	237		684			404	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	150			150			60		60	165		300
Storage Blk Time (%)	11	9					1		1	0		
Queuing Penalty (veh)	53	16					0		0	0		

Intersection: 22: 3rd Avenue & Spur Line

Movement	WB	NB	NB	SB	SB
Directions Served	T	T	T	T	T
Maximum Queue (ft)	324	385	376	502	476
Average Queue (ft)	155	31	30	40	38
95th Queue (ft)	309	195	192	239	227
Link Distance (ft)	2590	370	370	1726	1726
Upstream Blk Time (%)		3	3		
Queuing Penalty (veh)		15	16		
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 24: Industrial Way & Douglas Street

Movement	SE	SW
Directions Served	L	LR
Maximum Queue (ft)	32	45
Average Queue (ft)	3	19
95th Queue (ft)	18	48
Link Distance (ft)		100
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)	195	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 25: Douglas Street & Alder Street

Movement	NW	NE
Directions Served	LT	LR
Maximum Queue (ft)	7	44
Average Queue (ft)	0	22
95th Queue (ft)	6	50
Link Distance (ft)	681	100
Upstream Blk Time (%)		0
Queuing Penalty (veh)		0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 29: Spur Line & Washington Way

Movement	EB	EB	EB	WB	WB	NW
Directions Served	T	T	T	T	T	T
Maximum Queue (ft)	114	195	112	21	30	81
Average Queue (ft)	13	38	9	1	2	3
95th Queue (ft)	66	131	50	8	14	32
Link Distance (ft)		674	674	7	7	1681
Upstream Blk Time (%)				4	5	
Queuing Penalty (veh)				2	3	
Storage Bay Dist (ft)	140					
Storage Blk Time (%)	0	4				
Queuing Penalty (veh)	0	3				

Intersection: 31: Weyerhaeuser Access & Spur Line

Movement	NW	NE	SW
Directions Served	T	T	T
Maximum Queue (ft)	126	76	9
Average Queue (ft)	19	9	0
95th Queue (ft)	105	45	6
Link Distance (ft)	5597	313	10
Upstream Blk Time (%)			1
Queuing Penalty (veh)			0
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 33: Weyerhaeuser Access & Industrial Way

Movement	NW	NE
Directions Served	L	LR
Maximum Queue (ft)	22	24
Average Queue (ft)	1	19
95th Queue (ft)	12	33
Link Distance (ft)		10
Upstream Blk Time (%)		9
Queuing Penalty (veh)		5
Storage Bay Dist (ft)	80	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 37: Weyerhaeuser Access 2 & Industrial Way

Movement	NE
Directions Served	R
Maximum Queue (ft)	33
Average Queue (ft)	11
95th Queue (ft)	35
Link Distance (ft)	26
Upstream Blk Time (%)	1
Queuing Penalty (veh)	0
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 39: Industrial Way & Prudential Blvd

Movement	SE	SE	NW	NW	SW
Directions Served	L	T	T	T	L
Maximum Queue (ft)	14	90	84	64	111
Average Queue (ft)	1	23	28	19	48
95th Queue (ft)	8	64	69	54	87
Link Distance (ft)		2438	513	513	1261
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)	170				
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 41: Hoehne Avenue & Industrial Way

Movement	NE
Directions Served	R
Maximum Queue (ft)	32
Average Queue (ft)	10
95th Queue (ft)	35
Link Distance (ft)	26
Upstream Blk Time (%)	1
Queuing Penalty (veh)	0
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 45: International Way & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	213	237	73	225	207	59	122
Average Queue (ft)	85	97	20	74	81	21	52
95th Queue (ft)	175	187	57	167	173	51	96
Link Distance (ft)	746	746		304	304	973	
Upstream Blk Time (%)				0			
Queuing Penalty (veh)				0			
Storage Bay Dist (ft)			150				150
Storage Blk Time (%)				1			0
Queuing Penalty (veh)				0			0

Intersection: 47: Fiber Way & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	236	240	114	238	240	110	195
Average Queue (ft)	142	155	43	85	106	42	99
95th Queue (ft)	237	245	89	189	210	86	166
Link Distance (ft)	208	208		295	295	975	975
Upstream Blk Time (%)	2	3		0	0		
Queuing Penalty (veh)	11	16		0	0		
Storage Bay Dist (ft)			150				
Storage Blk Time (%)			0	1			
Queuing Penalty (veh)			0	1			

Intersection: 48: Industrial Way

Movement	EB	WB	NB	SB
Directions Served	T	T	R	R
Maximum Queue (ft)	4	4	123	73
Average Queue (ft)	0	0	48	22
95th Queue (ft)	0	4	93	58
Link Distance (ft)	1239	420	236	90
Upstream Blk Time (%)				0
Queuing Penalty (veh)				0
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 49: 38th Avenue & Industrial Way

Movement	SE	SE	NW	NW	NE	NE	NE	SW	SW
Directions Served	L	T	L	T	L	T	R	L	R
Maximum Queue (ft)	48	57	23	86	13	58	28	59	45
Average Queue (ft)	12	9	2	21	1	12	2	24	16
95th Queue (ft)	36	33	11	61	7	41	16	52	42
Link Distance (ft)		1112		2438	3	3	3		
Upstream Blk Time (%)					0	3	0		
Queuing Penalty (veh)					0	0	0		
Storage Bay Dist (ft)	115		155					150	200
Storage Blk Time (%)									
Queuing Penalty (veh)									

Intersection: 50: Aluminum Access 1/38th Avenue & Spur Line

Movement	NW	NE	NE	NE	SW
Directions Served	T	T	T	T	T
Maximum Queue (ft)	240	9	49	16	10
Average Queue (ft)	14	0	3	1	0
95th Queue (ft)	101	6	25	12	6
Link Distance (ft)	5784		335		3
Upstream Blk Time (%)					1
Queuing Penalty (veh)					0
Storage Bay Dist (ft)		35		25	
Storage Blk Time (%)		1	4	2	
Queuing Penalty (veh)		0	0	0	

Intersection: 55: Industrial Way

Movement	NB	SB
Directions Served	R	R
Maximum Queue (ft)	48	60
Average Queue (ft)	7	22
95th Queue (ft)	32	53
Link Distance (ft)	99	87
Upstream Blk Time (%)	0	0
Queuing Penalty (veh)	0	0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 56: Industrial Way & 3rd Avenue

Movement	NW	NW	NE	NE	SW	SW	SW
Directions Served	L	R	T	TR	L	T	T
Maximum Queue (ft)	85	64	233	231	116	376	360
Average Queue (ft)	24	18	55	68	13	158	156
95th Queue (ft)	65	49	157	163	69	306	299
Link Distance (ft)		2710	237	237		370	370
Upstream Blk Time (%)			1	1		2	2
Queuing Penalty (veh)			6	7		6	5
Storage Bay Dist (ft)	175				250		
Storage Blk Time (%)						4	
Queuing Penalty (veh)						0	

Intersection: 59: Industrial Way

Movement	EB	EB	WB	WB	NB
Directions Served	T	T	T	TR	R
Maximum Queue (ft)	138	135	15	13	128
Average Queue (ft)	15	16	1	0	52
95th Queue (ft)	77	76	15	13	99
Link Distance (ft)	304	304	208	208	118
Upstream Blk Time (%)					1
Queuing Penalty (veh)					0
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 61: Industrial Way

Movement	SB	SE
Directions Served	LR	L
Maximum Queue (ft)	104	30
Average Queue (ft)	40	2
95th Queue (ft)	75	15
Link Distance (ft)	1001	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		150
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 64: Industrial Way

Movement	EB	WB	WB	SB
Directions Served	T	T	T	R
Maximum Queue (ft)	14	9	98	37
Average Queue (ft)	0	0	3	13
95th Queue (ft)	10	7	92	39
Link Distance (ft)	295	843	843	88
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 69: Dike Road & Spur Line

Movement	SE	NW	NE	SW
Directions Served	T	T	T	T
Maximum Queue (ft)	559	668	115	198
Average Queue (ft)	268	294	9	18
95th Queue (ft)	563	676	59	111
Link Distance (ft)	2166	1050	476	433
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 777

Intersection: 1: Weyerhaeuser & Industrial Way

Movement	SE	NW	NW	NE
Directions Served	TR	L	T	LR
Maximum Queue (ft)	44	59	512	194
Average Queue (ft)	3	12	33	66
95th Queue (ft)	23	43	235	141
Link Distance (ft)	116	745	745	484
Upstream Blk Time (%)			0	
Queuing Penalty (veh)			0	
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: Oregon Way & Industrial Way

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	NB
Directions Served	L	T	T	R	L	L	T	R	L	T	T	R
Maximum Queue (ft)	237	352	309	108	314	580	827	76	289	401	549	250
Average Queue (ft)	133	159	143	4	160	209	420	51	140	179	197	138
95th Queue (ft)	232	287	258	62	259	488	833	99	237	304	403	251
Link Distance (ft)		745				1239	1239				2473	
Upstream Blk Time (%)						0	0					
Queuing Penalty (veh)						0	1					
Storage Bay Dist (ft)	140		400	400	310			25	235	235		120
Storage Blk Time (%)	15	10	0		0	1	59	15	1	3	25	8
Queuing Penalty (veh)	80	50	0		1	1	95	50	7	20	208	62

Intersection: 2: Oregon Way & Industrial Way

Movement	SB	SB	SB
Directions Served	L	T	TR
Maximum Queue (ft)	217	255	272
Average Queue (ft)	59	177	190
95th Queue (ft)	144	270	284
Link Distance (ft)		236	236
Upstream Blk Time (%)	0	4	6
Queuing Penalty (veh)	0	14	20
Storage Bay Dist (ft)	170		
Storage Blk Time (%)	0	13	
Queuing Penalty (veh)	0	8	

Intersection: 4: Oregon Way & Spur Line

Movement	WB	NB	NB	SB	SB
Directions Served	T	T	T	T	T
Maximum Queue (ft)	170	242	243	394	403
Average Queue (ft)	9	17	17	35	39
95th Queue (ft)	68	117	117	200	210
Link Distance (ft)	4581	236	236	702	702
Upstream Blk Time (%)		3	2		
Queuing Penalty (veh)		11	11		
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 5: Oregon Way & Alabama Street

Movement	EB	WB	NB	NB	NB	SB	SB	SB
Directions Served	LTR	LTR	L	T	TR	L	T	TR
Maximum Queue (ft)	122	100	74	4	4	49	4	13
Average Queue (ft)	47	41	23	0	0	13	0	1
95th Queue (ft)	89	79	57	4	3	40	5	6
Link Distance (ft)	233	852		702	702		3090	3090
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)			175			165		
Storage Blk Time (%)								
Queuing Penalty (veh)								

Intersection: 9: California Way & Spur Line

Movement	WB	SE	NW
Directions Served	T	T	T
Maximum Queue (ft)	164	314	221
Average Queue (ft)	6	16	12
95th Queue (ft)	58	125	94
Link Distance (ft)	464	2581	404
Upstream Blk Time (%)			0
Queuing Penalty (veh)			0
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 10: Industrial Way & Spur Line

Movement	WB	SE	NW
Directions Served	T	T	T
Maximum Queue (ft)	149	734	121
Average Queue (ft)	8	53	11
95th Queue (ft)	68	356	65
Link Distance (ft)	993	2678	116
Upstream Blk Time (%)			4
Queuing Penalty (veh)			19
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 12: Industrial Way & Washington Way

Movement	EB	EB	EB	WB	WB	WB	SE	SE	SE	NW	NW
Directions Served	L	T	R	L	T	R	L	T	R	L	TR
Maximum Queue (ft)	48	64	39	72	75	5	199	255	54	211	516
Average Queue (ft)	12	32	10	21	15	0	61	81	9	31	196
95th Queue (ft)	32	55	29	53	49	5	147	186	37	105	379
Link Distance (ft)	7	7	7		1347	1347		1220			1630
Upstream Blk Time (%)	15	52	11								
Queuing Penalty (veh)	11	38	8								
Storage Bay Dist (ft)				90			210		25	160	
Storage Blk Time (%)				0	0		0	15	1		10
Queuing Penalty (veh)				0	0		2	24	4		3

Intersection: 16: Columbia Ave & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	208	240	86	189	196	130	98
Average Queue (ft)	83	101	16	73	80	55	38
95th Queue (ft)	163	186	58	155	160	101	80
Link Distance (ft)	420	420		379	379	398	
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)			105				130
Storage Blk Time (%)			0	2		0	0
Queuing Penalty (veh)			1	0		0	0

Intersection: 20: California Way & Industrial Way

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	T	R	L	T	R
Maximum Queue (ft)	267	554	569	96	88	87	67	17	61	162	25	155
Average Queue (ft)	127	202	213	18	21	13	12	1	15	56	2	48
95th Queue (ft)	239	422	428	59	62	52	48	10	48	121	15	104
Link Distance (ft)		843	843		237	237		684			404	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	150			150			60		60	165		300
Storage Blk Time (%)	9	12		0	0		1		0	0		
Queuing Penalty (veh)	43	21		0	0		0		0	0		

Intersection: 22: 3rd Avenue & Spur Line

Movement	WB	NB	NB	SB	SB
Directions Served	T	T	T	T	T
Maximum Queue (ft)	312	377	376	545	562
Average Queue (ft)	149	31	31	46	48
95th Queue (ft)	313	192	192	266	278
Link Distance (ft)	2590	370	370	3244	3244
Upstream Blk Time (%)		3	3		
Queuing Penalty (veh)		18	18		
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 24: Industrial Way & Douglas Street

Movement	SE	SW
Directions Served	L	LR
Maximum Queue (ft)	32	56
Average Queue (ft)	4	21
95th Queue (ft)	21	51
Link Distance (ft)		100
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)	195	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 25: Douglas Street & Alder Street

Movement	NW	NE
Directions Served	LT	LR
Maximum Queue (ft)	3	44
Average Queue (ft)	0	23
95th Queue (ft)	3	50
Link Distance (ft)	681	100
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 29: Spur Line & Washington Way

Movement	EB	EB	EB	WB	WB	NW
Directions Served	T	T	T	T	T	T
Maximum Queue (ft)	119	216	89	22	32	96
Average Queue (ft)	13	50	9	1	2	6
95th Queue (ft)	71	167	45	9	16	53
Link Distance (ft)		1874	1874	7	7	1681
Upstream Blk Time (%)				5	4	
Queuing Penalty (veh)				3	2	
Storage Bay Dist (ft)	140					
Storage Blk Time (%)	0	6				
Queuing Penalty (veh)	0	4				

Intersection: 31: Weyerhaeuser Access & Spur Line

Movement	NW	NE	SW
Directions Served	T	T	T
Maximum Queue (ft)	146	94	8
Average Queue (ft)	21	11	0
95th Queue (ft)	109	52	5
Link Distance (ft)	5597	313	10
Upstream Blk Time (%)			1
Queuing Penalty (veh)			0
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 33: Weyerhaeuser Access & Industrial Way

Movement	NW	NE
Directions Served	L	LR
Maximum Queue (ft)	30	26
Average Queue (ft)	1	19
95th Queue (ft)	13	33
Link Distance (ft)		10
Upstream Blk Time (%)		11
Queuing Penalty (veh)		7
Storage Bay Dist (ft)	80	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 37: Weyerhaeuser Access 2 & Industrial Way

Movement	NE
Directions Served	R
Maximum Queue (ft)	35
Average Queue (ft)	12
95th Queue (ft)	37
Link Distance (ft)	26
Upstream Blk Time (%)	1
Queuing Penalty (veh)	0
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 39: Industrial Way & Prudential Blvd

Movement	SE	SE	NW	NW	SW
Directions Served	L	T	T	T	L
Maximum Queue (ft)	12	112	102	79	114
Average Queue (ft)	1	38	32	22	50
95th Queue (ft)	7	89	75	61	89
Link Distance (ft)		2438	513	513	1261
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)	170				
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 41: Hoehne Avenue & Industrial Way

Movement	NE
Directions Served	R
Maximum Queue (ft)	35
Average Queue (ft)	10
95th Queue (ft)	35
Link Distance (ft)	26
Upstream Blk Time (%)	1
Queuing Penalty (veh)	0
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 45: International Way & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	224	229	98	214	208	69	113
Average Queue (ft)	89	102	22	78	84	21	51
95th Queue (ft)	188	199	70	174	176	56	91
Link Distance (ft)	746	746		304	304	973	
Upstream Blk Time (%)				0	0		
Queuing Penalty (veh)				0	0		
Storage Bay Dist (ft)			150				150
Storage Blk Time (%)			0	1			0
Queuing Penalty (veh)			0	0			0

Intersection: 47: Fiber Way & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	232	238	148	237	272	124	219
Average Queue (ft)	151	166	50	92	112	41	104
95th Queue (ft)	245	253	110	205	226	94	180
Link Distance (ft)	208	208		295	295	975	975
Upstream Blk Time (%)	3	4		0	0		
Queuing Penalty (veh)	16	22		0	0		
Storage Bay Dist (ft)			150				
Storage Blk Time (%)			0	2			
Queuing Penalty (veh)			1	1			

Intersection: 48: Industrial Way

Movement	WB	WB	NB	SB
Directions Served	T	T	R	R
Maximum Queue (ft)	7	7	126	65
Average Queue (ft)	1	1	49	24
95th Queue (ft)	9	11	95	60
Link Distance (ft)	420	420	236	90
Upstream Blk Time (%)				0
Queuing Penalty (veh)				0
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 49: 38th Avenue & Industrial Way

Movement	SE	SE	NW	NW	NE	NE	NE	SW	SW
Directions Served	L	T	L	T	L	T	R	L	R
Maximum Queue (ft)	46	75	23	93	39	35	85	59	49
Average Queue (ft)	12	14	2	28	5	4	21	25	18
95th Queue (ft)	36	48	12	75	24	20	67	53	45
Link Distance (ft)		2312		2438	3	3	3		
Upstream Blk Time (%)					1	1	9		
Queuing Penalty (veh)					1	1	7		
Storage Bay Dist (ft)	115		155					150	200
Storage Blk Time (%)		0		0					
Queuing Penalty (veh)		0		0					

Intersection: 50: Aluminum Access 1/38th Avenue & Spur Line

Movement	NW	NE	NE	NE	SW
Directions Served	T	T	T	T	T
Maximum Queue (ft)	261	17	1487	83	13
Average Queue (ft)	17	1	845	44	1
95th Queue (ft)	117	12	1947	82	8
Link Distance (ft)	5784		1565		3
Upstream Blk Time (%)			36		1
Queuing Penalty (veh)			0		0
Storage Bay Dist (ft)		35		25	
Storage Blk Time (%)			12	72	
Queuing Penalty (veh)			19	114	

Intersection: 55: Industrial Way

Movement	NB	SB
Directions Served	R	R
Maximum Queue (ft)	45	61
Average Queue (ft)	8	22
95th Queue (ft)	32	52
Link Distance (ft)	99	87
Upstream Blk Time (%)	0	0
Queuing Penalty (veh)	0	0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 56: Industrial Way & 3rd Avenue

Movement	NW	NW	NE	NE	SW	SW	SW
Directions Served	L	R	T	TR	L	T	T
Maximum Queue (ft)	88	71	245	245	126	368	366
Average Queue (ft)	24	17	67	73	16	154	162
95th Queue (ft)	65	49	170	173	74	301	307
Link Distance (ft)		2710	237	237		370	370
Upstream Blk Time (%)			2	2		2	2
Queuing Penalty (veh)			9	10		6	6
Storage Bay Dist (ft)	175				250		
Storage Blk Time (%)						4	
Queuing Penalty (veh)						0	

Intersection: 59: Industrial Way

Movement	EB	EB	WB	WB	NB
Directions Served	T	T	T	TR	R
Maximum Queue (ft)	174	170	4	6	144
Average Queue (ft)	20	25	0	0	55
95th Queue (ft)	98	103	4	8	115
Link Distance (ft)	304	304	208	208	118
Upstream Blk Time (%)	0				4
Queuing Penalty (veh)	0				0
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 61: Industrial Way

Movement	SB	SE
Directions Served	LR	L
Maximum Queue (ft)	108	30
Average Queue (ft)	44	2
95th Queue (ft)	88	15
Link Distance (ft)	1001	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		150
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 64: Industrial Way

Movement	WB	SB
Directions Served	T	R
Maximum Queue (ft)	8	39
Average Queue (ft)	0	11
95th Queue (ft)	10	36
Link Distance (ft)	843	88
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 69: Dike Road & Spur Line

Movement	SE	NW	NE	SW
Directions Served	T	T	T	T
Maximum Queue (ft)	560	527	101	147
Average Queue (ft)	257	215	8	12
95th Queue (ft)	540	476	51	81
Link Distance (ft)	2167	1049	673	625
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 1081

Intersection: 1: Weyerhaeuser & Industrial Way

Movement	SE	NW	NW	NE
Directions Served	TR	L	T	LR
Maximum Queue (ft)	29	104	534	293
Average Queue (ft)	2	15	56	92
95th Queue (ft)	14	67	302	247
Link Distance (ft)	116	745	745	484
Upstream Blk Time (%)			0	2
Queuing Penalty (veh)			1	0
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: Oregon Way & Industrial Way

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	NB
Directions Served	L	T	T	R	L	L	T	R	L	T	T	R
Maximum Queue (ft)	239	450	370	203	365	1275	1284	78	384	535	3436	250
Average Queue (ft)	136	152	128	13	166	570	809	53	162	240	606	148
95th Queue (ft)	244	338	279	103	310	1369	1526	98	320	450	2236	289
Link Distance (ft)		745				1239	1239				3651	
Upstream Blk Time (%)						6	15				2	
Queuing Penalty (veh)						24	64				0	
Storage Bay Dist (ft)	140		400	400	310			25	235	235		120
Storage Blk Time (%)	23	7	0		1	3	57	22	4	15	35	10
Queuing Penalty (veh)	105	31	0		2	5	92	73	26	95	294	79

Intersection: 2: Oregon Way & Industrial Way

Movement	SB	SB	SB
Directions Served	L	T	TR
Maximum Queue (ft)	224	263	265
Average Queue (ft)	65	180	186
95th Queue (ft)	163	316	322
Link Distance (ft)		236	236
Upstream Blk Time (%)	0	17	19
Queuing Penalty (veh)	0	56	64
Storage Bay Dist (ft)	170		
Storage Blk Time (%)	0	27	
Queuing Penalty (veh)	1	15	

Intersection: 4: Oregon Way & Spur Line

Movement	WB	NB	NB	SB	SB
Directions Served	T	T	T	T	T
Maximum Queue (ft)	112	246	246	717	718
Average Queue (ft)	7	41	41	210	216
95th Queue (ft)	48	189	190	662	670
Link Distance (ft)	4581	236	236	702	702
Upstream Blk Time (%)		11	11	7	7
Queuing Penalty (veh)		48	50	22	24
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 5: Oregon Way & Alabama Street

Movement	EB	WB	NB	NB	SB	SB	SB
Directions Served	LTR	LTR	L	TR	L	T	TR
Maximum Queue (ft)	150	126	92	13	127	492	509
Average Queue (ft)	53	45	24	0	15	40	44
95th Queue (ft)	120	95	66	8	69	235	250
Link Distance (ft)	233	852		702		3149	3149
Upstream Blk Time (%)	1						
Queuing Penalty (veh)	0						
Storage Bay Dist (ft)			175		165		
Storage Blk Time (%)						4	
Queuing Penalty (veh)						1	

Intersection: 9: California Way & Spur Line

Movement	WB	SE	NW
Directions Served	T	T	T
Maximum Queue (ft)	156	939	315
Average Queue (ft)	6	129	56
95th Queue (ft)	56	600	247
Link Distance (ft)	464	2581	404
Upstream Blk Time (%)			1
Queuing Penalty (veh)			2
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 10: Industrial Way & Spur Line

Movement	WB	SE	NW
Directions Served	T	T	T
Maximum Queue (ft)	103	1950	120
Average Queue (ft)	6	251	19
95th Queue (ft)	50	1216	88
Link Distance (ft)	993	2678	116
Upstream Blk Time (%)			12
Queuing Penalty (veh)			68
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 12: Industrial Way & Washington Way

Movement	EB	EB	EB	WB	WB	SE	SE	SE	NW	NW
Directions Served	L	T	R	L	T	L	T	R	L	TR
Maximum Queue (ft)	34	60	50	137	236	271	416	50	212	574
Average Queue (ft)	11	27	10	25	38	80	96	10	42	214
95th Queue (ft)	29	55	31	78	157	217	319	37	144	562
Link Distance (ft)	7	7	7		1347		1220			1630
Upstream Blk Time (%)	17	47	12							0
Queuing Penalty (veh)	12	34	9							1
Storage Bay Dist (ft)				90		210		25	160	
Storage Blk Time (%)				1	8	4	13	6	3	12
Queuing Penalty (veh)				0	4	15	22	29	15	4

Intersection: 16: Columbia Ave & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	211	240	98	252	264	130	107
Average Queue (ft)	78	100	16	92	99	57	42
95th Queue (ft)	163	196	73	240	247	108	88
Link Distance (ft)	420	420		379	379	398	
Upstream Blk Time (%)				2	2		
Queuing Penalty (veh)				7	7		
Storage Bay Dist (ft)			105				130
Storage Blk Time (%)				6		0	0
Queuing Penalty (veh)				1		0	0

Intersection: 20: California Way & Industrial Way

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	T	R	L	T	R
Maximum Queue (ft)	275	862	877	77	102	94	74	46	83	201	343	334
Average Queue (ft)	177	490	498	15	17	12	11	2	18	55	18	54
95th Queue (ft)	343	1018	1022	52	62	54	46	25	58	136	148	168
Link Distance (ft)		843	843		237	237		684			404	
Upstream Blk Time (%)		14	15								0	0
Queuing Penalty (veh)		78	81								0	0
Storage Bay Dist (ft)	150			150			60		60	165		300
Storage Blk Time (%)	38	30			0		0	0	3	1		1
Queuing Penalty (veh)	181	51			0		0	0	0	2		0

Intersection: 22: 3rd Avenue & Spur Line

Movement	WB	NB	NB	SB	SB
Directions Served	T	T	T	T	T
Maximum Queue (ft)	265	374	379	1575	1569
Average Queue (ft)	102	69	70	362	363
95th Queue (ft)	241	303	306	1224	1228
Link Distance (ft)	2590	370	370	3309	3309
Upstream Blk Time (%)		14	14		
Queuing Penalty (veh)		70	74		
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 24: Industrial Way & Douglas Street

Movement	SE	NW	SW
Directions Served	L	TR	LR
Maximum Queue (ft)	33	14	54
Average Queue (ft)	4	0	20
95th Queue (ft)	20	14	50
Link Distance (ft)		2660	100
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)	195		
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 25: Douglas Street & Alder Street

Movement	NW	NE
Directions Served	LT	LR
Maximum Queue (ft)	12	52
Average Queue (ft)	1	23
95th Queue (ft)	8	51
Link Distance (ft)	681	100
Upstream Blk Time (%)		0
Queuing Penalty (veh)		0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 29: Spur Line & Washington Way

Movement	EB	EB	EB	WB	WB	NW
Directions Served	T	T	T	T	T	T
Maximum Queue (ft)	190	548	282	26	47	101
Average Queue (ft)	37	142	41	3	5	5
95th Queue (ft)	144	453	186	15	28	51
Link Distance (ft)		2483	2483	7	7	1681
Upstream Blk Time (%)				15	14	
Queuing Penalty (veh)				8	8	
Storage Bay Dist (ft)	140					
Storage Blk Time (%)	2	28				
Queuing Penalty (veh)	1	19				

Intersection: 31: Weyerhaeuser Access & Spur Line

Movement	NW	NE	SW
Directions Served	T	T	T
Maximum Queue (ft)	93	195	26
Average Queue (ft)	6	30	2
95th Queue (ft)	45	131	13
Link Distance (ft)	5597	313	10
Upstream Blk Time (%)		0	7
Queuing Penalty (veh)		0	1
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 33: Weyerhaeuser Access & Industrial Way

Movement	NW	NW	NE
Directions Served	L	T	LR
Maximum Queue (ft)	18	30	24
Average Queue (ft)	1	2	17
95th Queue (ft)	8	40	33
Link Distance (ft)		466	10
Upstream Blk Time (%)			11
Queuing Penalty (veh)			6
Storage Bay Dist (ft)	80		
Storage Blk Time (%)		0	
Queuing Penalty (veh)		0	

Intersection: 37: Weyerhaeuser Access 2 & Industrial Way

Movement	NE
Directions Served	R
Maximum Queue (ft)	34
Average Queue (ft)	12
95th Queue (ft)	38
Link Distance (ft)	26
Upstream Blk Time (%)	2
Queuing Penalty (veh)	0
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 39: Industrial Way & Prudential Blvd

Movement	SE	NW	NW	SW
Directions Served	T	T	T	L
Maximum Queue (ft)	104	84	75	111
Average Queue (ft)	33	26	20	51
95th Queue (ft)	81	65	57	89
Link Distance (ft)	2438	513	513	1261
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 41: Hoehne Avenue & Industrial Way

Movement	NE
Directions Served	R
Maximum Queue (ft)	33
Average Queue (ft)	10
95th Queue (ft)	34
Link Distance (ft)	26
Upstream Blk Time (%)	1
Queuing Penalty (veh)	0
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 45: International Way & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	597	608	81	254	274	214	192
Average Queue (ft)	148	158	20	81	88	36	61
95th Queue (ft)	426	439	59	192	205	138	130
Link Distance (ft)	746	746		304	304	973	
Upstream Blk Time (%)	1	1		0	0		
Queuing Penalty (veh)	5	5		0	1		
Storage Bay Dist (ft)			150				150
Storage Blk Time (%)				2		2	1
Queuing Penalty (veh)				0		2	0

Intersection: 47: Fiber Way & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	239	245	139	294	303	114	603
Average Queue (ft)	171	180	46	97	117	43	165
95th Queue (ft)	263	267	112	234	260	89	412
Link Distance (ft)	208	208		295	295	975	975
Upstream Blk Time (%)	17	19		0	0		
Queuing Penalty (veh)	83	92		1	1		
Storage Bay Dist (ft)			150				
Storage Blk Time (%)			1	3			
Queuing Penalty (veh)			2	1			

Intersection: 48: Industrial Way

Movement	WB	WB	NB	SB
Directions Served	T	T	R	R
Maximum Queue (ft)	345	363	123	111
Average Queue (ft)	77	88	50	35
95th Queue (ft)	312	333	97	90
Link Distance (ft)	420	420	236	90
Upstream Blk Time (%)	2	2		9
Queuing Penalty (veh)	9	9		0
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 49: 38th Avenue & Industrial Way

Movement	SE	SE	NW	NW	NE	NE	NE	SW	SW
Directions Served	L	T	L	T	L	T	R	L	R
Maximum Queue (ft)	57	85	30	115	33	39	84	57	42
Average Queue (ft)	13	16	3	27	5	6	19	25	15
95th Queue (ft)	40	56	17	77	24	27	65	53	41
Link Distance (ft)		2262		2438	3	3	3		
Upstream Blk Time (%)					2	2	10		
Queuing Penalty (veh)					1	1	7		
Storage Bay Dist (ft)	115		155					150	200
Storage Blk Time (%)		0		0					
Queuing Penalty (veh)		0		0					

Intersection: 50: Aluminum Access 1/38th Avenue & Spur Line

Movement	NW	NE	NE	NE	SW
Directions Served	T	T	T	T	T
Maximum Queue (ft)	267	39	2030	82	20
Average Queue (ft)	17	2	1073	42	2
95th Queue (ft)	117	22	2479	79	12
Link Distance (ft)	5784		2279		3
Upstream Blk Time (%)			18		9
Queuing Penalty (veh)			0		0
Storage Bay Dist (ft)		35		25	
Storage Blk Time (%)		1	9	74	
Queuing Penalty (veh)		2	12	97	

Intersection: 55: Industrial Way

Movement	EB	EB	WB	WB	NB	SB
Directions Served	T	T	T	T	R	R
Maximum Queue (ft)	48	39	53	52	49	69
Average Queue (ft)	3	3	9	9	7	25
95th Queue (ft)	40	34	99	102	33	60
Link Distance (ft)	379	379	746	746	99	87
Upstream Blk Time (%)					0	2
Queuing Penalty (veh)					0	0
Storage Bay Dist (ft)						
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 56: Industrial Way & 3rd Avenue

Movement	NW	NW	NE	NE	SW	SW	SW
Directions Served	L	R	T	TR	L	T	T
Maximum Queue (ft)	94	118	246	244	214	399	395
Average Queue (ft)	25	27	102	110	26	186	188
95th Queue (ft)	69	85	232	231	130	405	406
Link Distance (ft)		2710	237	237		370	370
Upstream Blk Time (%)			13	12		11	12
Queuing Penalty (veh)			65	63		36	37
Storage Bay Dist (ft)	175				250		
Storage Blk Time (%)	0	1				16	
Queuing Penalty (veh)	0	0				2	

Intersection: 59: Industrial Way

Movement	EB	EB	WB	WB	NB
Directions Served	T	T	T	TR	R
Maximum Queue (ft)	319	322	21	23	174
Average Queue (ft)	89	95	1	1	75
95th Queue (ft)	293	297	16	20	151
Link Distance (ft)	304	304	208	208	118
Upstream Blk Time (%)	8	9			21
Queuing Penalty (veh)	36	41			0
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 61: Industrial Way

Movement	SB	SE	NW
Directions Served	LR	L	TR
Maximum Queue (ft)	87	30	6
Average Queue (ft)	41	2	0
95th Queue (ft)	73	14	6
Link Distance (ft)	1001		2678
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)		150	
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 64: Industrial Way

Movement	EB	EB	WB	WB	SB
Directions Served	T	TR	T	T	R
Maximum Queue (ft)	303	316	26	130	40
Average Queue (ft)	84	89	1	6	11
95th Queue (ft)	289	301	12	96	36
Link Distance (ft)	295	295	843	843	88
Upstream Blk Time (%)	9	10			
Queuing Penalty (veh)	51	54			
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 69: Dike Road & Spur Line

Movement	SE	NW	NE	SW
Directions Served	T	T	T	T
Maximum Queue (ft)	602	597	188	232
Average Queue (ft)	242	254	17	23
95th Queue (ft)	584	576	98	128
Link Distance (ft)	2167	1049	673	625
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 2702

Intersection: 1: Weyerhaeuser & Industrial Way

Movement	SE	NW	NW	NE
Directions Served	TR	L	T	LR
Maximum Queue (ft)	11	42	547	174
Average Queue (ft)	0	10	38	66
95th Queue (ft)	7	34	269	132
Link Distance (ft)	116	745	745	484
Upstream Blk Time (%)			0	
Queuing Penalty (veh)			1	
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: Oregon Way & Industrial Way

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	NB
Directions Served	L	T	T	R	L	L	T	R	L	T	T	R
Maximum Queue (ft)	204	229	234	245	337	1285	1283	80	366	514	975	250
Average Queue (ft)	101	114	109	16	185	1044	1206	56	199	240	274	177
95th Queue (ft)	176	202	201	110	302	1604	1440	102	344	408	644	294
Link Distance (ft)		745				1239	1239				2473	
Upstream Blk Time (%)						16	42					
Queuing Penalty (veh)						81	217					
Storage Bay Dist (ft)	140		400	400	310			25	235	235		120
Storage Blk Time (%)	5	6			0	1	64	19	9	8	32	12
Queuing Penalty (veh)	24	28			1	3	145	76	77	67	331	114

Intersection: 2: Oregon Way & Industrial Way

Movement	SB	SB	SB
Directions Served	L	T	TR
Maximum Queue (ft)	236	273	278
Average Queue (ft)	77	232	233
95th Queue (ft)	195	293	297
Link Distance (ft)		236	236
Upstream Blk Time (%)	0	27	29
Queuing Penalty (veh)	0	108	119
Storage Bay Dist (ft)	170		
Storage Blk Time (%)	0	43	
Queuing Penalty (veh)	2	25	

Intersection: 4: Oregon Way & Spur Line

Movement	WB	NB	NB	SB	SB
Directions Served	T	T	T	T	T
Maximum Queue (ft)	155	247	243	528	557
Average Queue (ft)	9	17	17	137	148
95th Queue (ft)	71	118	117	414	432
Link Distance (ft)	4581	236	236	702	702
Upstream Blk Time (%)		3	3		0
Queuing Penalty (veh)		14	15		0
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 5: Oregon Way & Alabama Street

Movement	EB	WB	NB	NB	NB	SB	SB	SB
Directions Served	LTR	LTR	L	T	TR	L	T	TR
Maximum Queue (ft)	167	137	84	3	8	54	6	16
Average Queue (ft)	58	51	30	0	0	16	0	1
95th Queue (ft)	128	103	64	3	4	45	6	7
Link Distance (ft)	233	852		702	702		3034	3034
Upstream Blk Time (%)	0							
Queuing Penalty (veh)	0							
Storage Bay Dist (ft)			175			165		
Storage Blk Time (%)								
Queuing Penalty (veh)								

Intersection: 9: California Way & Spur Line

Movement	WB	SE	NW
Directions Served	T	T	T
Maximum Queue (ft)	170	377	219
Average Queue (ft)	7	20	12
95th Queue (ft)	62	154	94
Link Distance (ft)	464	2581	404
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 10: Industrial Way & Spur Line

Movement	WB	SE	NW
Directions Served	T	T	T
Maximum Queue (ft)	135	704	123
Average Queue (ft)	7	52	11
95th Queue (ft)	56	346	69
Link Distance (ft)	993	2678	116
Upstream Blk Time (%)			4
Queuing Penalty (veh)			24
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 12: Industrial Way & Washington Way

Movement	EB	EB	EB	WB	WB	SE	SE	SE	NW	NW
Directions Served	L	T	R	L	T	L	T	R	L	TR
Maximum Queue (ft)	36	68	41	70	75	115	194	48	177	568
Average Queue (ft)	13	36	11	21	18	35	58	12	32	203
95th Queue (ft)	31	57	30	53	55	90	144	42	110	455
Link Distance (ft)	7	7	7		1347		1220			1630
Upstream Blk Time (%)	21	56	11							
Queuing Penalty (veh)	19	48	10							
Storage Bay Dist (ft)				90		210		25	160	
Storage Blk Time (%)				0	0	0	12	1		11
Queuing Penalty (veh)				0	0	0	14	4		4

Intersection: 16: Columbia Ave & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	270	286	144	391	392	185	150
Average Queue (ft)	109	121	18	180	192	74	55
95th Queue (ft)	209	217	88	394	403	145	113
Link Distance (ft)	420	420		379	379	398	
Upstream Blk Time (%)				8	9		
Queuing Penalty (veh)				34	39		
Storage Bay Dist (ft)			105				130
Storage Blk Time (%)			0	24		3	0
Queuing Penalty (veh)			0	3		3	1

Intersection: 20: California Way & Industrial Way

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	T	R	L	T	R
Maximum Queue (ft)	275	837	844	82	131	115	72	60	94	144	76	239
Average Queue (ft)	185	366	387	12	18	14	13	7	28	45	13	62
95th Queue (ft)	319	737	753	49	70	59	53	36	74	104	51	146
Link Distance (ft)		843	843		237	237		684			404	
Upstream Blk Time (%)		2	2									
Queuing Penalty (veh)		11	13									
Storage Bay Dist (ft)	150			150			60		60	165		300
Storage Blk Time (%)	24	28		0	0		1	0	2	0		0
Queuing Penalty (veh)	137	47		0	0		0	0	0	0		0

Intersection: 22: 3rd Avenue & Spur Line

Movement	WB	NB	NB	SB	SB
Directions Served	T	T	T	T	T
Maximum Queue (ft)	330	371	381	646	651
Average Queue (ft)	150	32	33	64	68
95th Queue (ft)	305	197	201	329	341
Link Distance (ft)	2590	370	370	2875	2875
Upstream Blk Time (%)		3	4		
Queuing Penalty (veh)		20	24		
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 24: Industrial Way & Douglas Street

Movement	SE	SW
Directions Served	L	LR
Maximum Queue (ft)	35	65
Average Queue (ft)	4	29
95th Queue (ft)	22	58
Link Distance (ft)		100
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)	195	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 25: Douglas Street & Alder Street

Movement	NW	NE
Directions Served	LT	LR
Maximum Queue (ft)	16	66
Average Queue (ft)	1	30
95th Queue (ft)	10	55
Link Distance (ft)	681	100
Upstream Blk Time (%)		0
Queuing Penalty (veh)		0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 29: Spur Line & Washington Way

Movement	EB	EB	EB	WB	WB	NW
Directions Served	T	T	T	T	T	T
Maximum Queue (ft)	169	316	120	34	27	73
Average Queue (ft)	26	87	11	2	1	4
95th Queue (ft)	116	261	56	15	14	31
Link Distance (ft)		1764	1764	7	7	1681
Upstream Blk Time (%)				4	4	
Queuing Penalty (veh)				3	2	
Storage Bay Dist (ft)	140					
Storage Blk Time (%)		16				
Queuing Penalty (veh)		14				

Intersection: 31: Weyerhaeuser Access & Spur Line

Movement	NW	NE	SW
Directions Served	T	T	T
Maximum Queue (ft)	77	73	10
Average Queue (ft)	10	14	1
95th Queue (ft)	62	50	7
Link Distance (ft)	5597	313	10
Upstream Blk Time (%)			1
Queuing Penalty (veh)			0
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 33: Weyerhaeuser Access & Industrial Way

Movement	NW	NE
Directions Served	L	LR
Maximum Queue (ft)	30	30
Average Queue (ft)	2	21
95th Queue (ft)	16	33
Link Distance (ft)		10
Upstream Blk Time (%)		12
Queuing Penalty (veh)		9
Storage Bay Dist (ft)	80	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 37: Weyerhaeuser Access 2 & Industrial Way

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 39: Industrial Way & Prudential Blvd

Movement	SE	SE	NW	NW	SW
Directions Served	L	T	T	T	L
Maximum Queue (ft)	12	97	86	74	107
Average Queue (ft)	0	30	29	19	50
95th Queue (ft)	6	76	70	55	89
Link Distance (ft)		2438	513	513	1261
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)	170				
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 41: Hoehne Avenue & Industrial Way

Movement	NE
Directions Served	R
Maximum Queue (ft)	35
Average Queue (ft)	10
95th Queue (ft)	34
Link Distance (ft)	26
Upstream Blk Time (%)	1
Queuing Penalty (veh)	0
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 45: International Way & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	345	351	112	278	284	92	138
Average Queue (ft)	131	139	22	120	130	27	70
95th Queue (ft)	264	273	76	245	259	69	118
Link Distance (ft)	746	746		304	304	973	
Upstream Blk Time (%)				1	1		
Queuing Penalty (veh)				6	6		
Storage Bay Dist (ft)			150				150
Storage Blk Time (%)				5		0	0
Queuing Penalty (veh)				1		0	0

Intersection: 47: Fiber Way & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	245	248	134	287	294	123	238
Average Queue (ft)	177	186	43	116	140	48	123
95th Queue (ft)	265	268	96	244	267	99	204
Link Distance (ft)	208	208		295	295	975	975
Upstream Blk Time (%)	10	11		0	0		
Queuing Penalty (veh)	58	67		0	1		
Storage Bay Dist (ft)			150				
Storage Blk Time (%)			0	4			
Queuing Penalty (veh)			1	2			

Intersection: 48: Industrial Way

Movement	EB	WB	WB	NB	SB
Directions Served	T	T	T	R	R
Maximum Queue (ft)	8	464	444	168	60
Average Queue (ft)	0	248	270	65	9
95th Queue (ft)	2	557	554	125	47
Link Distance (ft)	1239	420	420	236	90
Upstream Blk Time (%)		11	12	0	3
Queuing Penalty (veh)		55	59	0	0
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 49: 38th Avenue & Industrial Way

Movement	SE	SE	NW	NW	NW	NE	NE	NE	SW	SW
Directions Served	L	T	L	T	R	L	T	R	L	R
Maximum Queue (ft)	56	64	23	102	3	3	52	48	66	48
Average Queue (ft)	13	10	2	26	0	0	13	4	28	19
95th Queue (ft)	39	38	13	72	3	3	41	23	56	44
Link Distance (ft)		2365		2438	2438	3	3	3		
Upstream Blk Time (%)						0	3	0		
Queuing Penalty (veh)						0	0	0		
Storage Bay Dist (ft)	115		155						150	200
Storage Blk Time (%)		0		0						
Queuing Penalty (veh)		0		0						

Intersection: 50: Aluminum Access 1/38th Avenue & Spur Line

Movement	NW	NE	NE	SW
Directions Served	T	T	T	T
Maximum Queue (ft)	289	60	22	22
Average Queue (ft)	19	5	1	1
95th Queue (ft)	129	30	14	10
Link Distance (ft)	5784	1935		3
Upstream Blk Time (%)				3
Queuing Penalty (veh)				0
Storage Bay Dist (ft)			25	
Storage Blk Time (%)		8	2	
Queuing Penalty (veh)		1	0	

Intersection: 55: Industrial Way

Movement	WB	WB	NB	SB
Directions Served	T	T	R	R
Maximum Queue (ft)	256	271	78	46
Average Queue (ft)	59	63	22	10
95th Queue (ft)	332	339	57	37
Link Distance (ft)	746	746	99	87
Upstream Blk Time (%)	1	1	0	0
Queuing Penalty (veh)	5	6	0	0
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 56: Industrial Way & 3rd Avenue

Movement	NW	NW	NE	NE	SW	SW	SW
Directions Served	L	R	T	TR	L	T	T
Maximum Queue (ft)	84	73	247	250	188	394	394
Average Queue (ft)	27	20	101	112	21	225	234
95th Queue (ft)	71	53	205	212	97	390	392
Link Distance (ft)		2710	237	237		370	370
Upstream Blk Time (%)			3	3		4	5
Queuing Penalty (veh)			18	16		15	18
Storage Bay Dist (ft)	175				250		
Storage Blk Time (%)						10	
Queuing Penalty (veh)						1	

Intersection: 59: Industrial Way

Movement	EB	EB	WB	WB	NB
Directions Served	T	T	T	TR	R
Maximum Queue (ft)	273	285	31	39	106
Average Queue (ft)	60	70	7	7	28
95th Queue (ft)	196	215	64	64	81
Link Distance (ft)	304	304	208	208	118
Upstream Blk Time (%)	0	0	0	0	1
Queuing Penalty (veh)	1	2	1	1	0
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 61: Industrial Way

Movement	SB	SE
Directions Served	LR	L
Maximum Queue (ft)	115	31
Average Queue (ft)	47	3
95th Queue (ft)	90	16
Link Distance (ft)	1001	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		150
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 64: Industrial Way

Movement	EB	EB	WB	WB	SB
Directions Served	T	TR	T	T	R
Maximum Queue (ft)	195	197	29	81	29
Average Queue (ft)	17	18	1	4	3
95th Queue (ft)	118	124	17	36	17
Link Distance (ft)	295	295	843	843	88
Upstream Blk Time (%)	0	0			
Queuing Penalty (veh)	2	2			
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 69: Dike Road & Spur Line

Movement	SE	NW	NE	SW
Directions Served	T	T	T	T
Maximum Queue (ft)	596	582	103	176
Average Queue (ft)	268	273	8	14
95th Queue (ft)	583	633	51	89
Link Distance (ft)	2167	1051	566	491
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 2279

Intersection: 1: Weyerhaeuser & Industrial Way

Movement	SE	NW	NW	NE
Directions Served	TR	L	T	LR
Maximum Queue (ft)	15	146	631	272
Average Queue (ft)	2	18	78	80
95th Queue (ft)	24	80	385	203
Link Distance (ft)	116	745	745	484
Upstream Blk Time (%)	0		0	
Queuing Penalty (veh)	1		1	
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: Oregon Way & Industrial Way

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	NB
Directions Served	L	T	T	R	L	L	T	R	L	T	T	R
Maximum Queue (ft)	239	400	374	298	360	1289	1276	76	371	523	2511	250
Average Queue (ft)	133	146	131	31	181	1016	1163	55	212	303	633	194
95th Queue (ft)	239	352	302	161	333	1679	1519	101	387	489	1909	331
Link Distance (ft)		745				1239	1239				2473	
Upstream Blk Time (%)		0				23	46				9	
Queuing Penalty (veh)		2				119	238				0	
Storage Bay Dist (ft)	140		400	400	310			25	235	235		120
Storage Blk Time (%)	21	6	0		1	2	58	25	15	19	43	18
Queuing Penalty (veh)	100	29	0		2	4	132	98	126	153	440	169

Intersection: 2: Oregon Way & Industrial Way

Movement	SB	SB	SB
Directions Served	L	T	TR
Maximum Queue (ft)	236	275	273
Average Queue (ft)	75	220	219
95th Queue (ft)	204	351	349
Link Distance (ft)		236	236
Upstream Blk Time (%)	0	46	47
Queuing Penalty (veh)	0	187	193
Storage Bay Dist (ft)	170		
Storage Blk Time (%)	1	57	
Queuing Penalty (veh)	2	33	

Intersection: 4: Oregon Way & Spur Line

Movement	WB	NB	NB	SB	SB
Directions Served	T	T	T	T	T
Maximum Queue (ft)	108	244	245	725	731
Average Queue (ft)	9	41	41	482	489
95th Queue (ft)	62	189	190	937	937
Link Distance (ft)	4581	236	236	702	702
Upstream Blk Time (%)		12	12	29	30
Queuing Penalty (veh)		63	63	115	119
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 5: Oregon Way & Alabama Street

Movement	EB	WB	NB	NB	NB	SB	SB	SB
Directions Served	LTR	LTR	L	T	TR	L	T	TR
Maximum Queue (ft)	251	579	111	2	5	290	1018	1037
Average Queue (ft)	131	173	35	0	0	49	293	308
95th Queue (ft)	270	557	87	2	2	208	853	881
Link Distance (ft)	233	852		702	702		3073	3073
Upstream Blk Time (%)	25	2						
Queuing Penalty (veh)	0	0						
Storage Bay Dist (ft)			175			165		
Storage Blk Time (%)			0				32	
Queuing Penalty (veh)			0				10	

Intersection: 9: California Way & Spur Line

Movement	WB	SE	NW
Directions Served	T	T	T
Maximum Queue (ft)	126	1046	297
Average Queue (ft)	5	148	53
95th Queue (ft)	47	666	232
Link Distance (ft)	464	2581	404
Upstream Blk Time (%)			1
Queuing Penalty (veh)			2
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 10: Industrial Way & Spur Line

Movement	WB	SE	NW
Directions Served	T	T	T
Maximum Queue (ft)	80	1938	124
Average Queue (ft)	4	255	20
95th Queue (ft)	34	1203	94
Link Distance (ft)	993	2678	116
Upstream Blk Time (%)			13
Queuing Penalty (veh)			85
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 12: Industrial Way & Washington Way

Movement	EB	EB	EB	WB	WB	WB	SE	SE	SE	NW	NW
Directions Served	L	T	R	L	T	R	L	T	R	L	TR
Maximum Queue (ft)	41	74	44	142	337	2	214	457	49	218	481
Average Queue (ft)	12	31	11	28	59	0	52	105	12	57	210
95th Queue (ft)	31	62	31	94	233	2	153	416	39	178	471
Link Distance (ft)	7	7	7		1347	1347		1220			1630
Upstream Blk Time (%)	20	55	11					0			
Queuing Penalty (veh)	17	47	10					0			
Storage Bay Dist (ft)				90			210		25	160	
Storage Blk Time (%)				1	12		0	14	8	5	11
Queuing Penalty (veh)				0	7		0	18	34	26	4

Intersection: 16: Columbia Ave & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	330	352	204	432	421	267	198
Average Queue (ft)	140	155	24	257	261	99	57
95th Queue (ft)	284	306	112	514	510	209	129
Link Distance (ft)	420	420		379	379	398	
Upstream Blk Time (%)	1	1		26	27	0	
Queuing Penalty (veh)	4	5		116	122	0	
Storage Bay Dist (ft)			105				130
Storage Blk Time (%)			0	41		9	1
Queuing Penalty (veh)			0	5		8	1

Intersection: 20: California Way & Industrial Way

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	T	R	L	T	R
Maximum Queue (ft)	275	872	884	74	156	156	87	87	97	159	425	373
Average Queue (ft)	188	673	685	9	30	25	16	10	27	42	36	82
95th Queue (ft)	352	1080	1086	41	125	119	56	63	74	111	209	239
Link Distance (ft)		843	843		237	237		684			404	
Upstream Blk Time (%)		20	22		1	1					1	0
Queuing Penalty (veh)		132	144		2	3					2	0
Storage Bay Dist (ft)	150			150			60		60	165		300
Storage Blk Time (%)	30	51		0	3		2	0	8	0	0	2
Queuing Penalty (veh)	171	87		0	0		1	0	2	1	0	1

Intersection: 22: 3rd Avenue & Spur Line

Movement	WB	NB	NB	SB	SB
Directions Served	T	T	T	T	T
Maximum Queue (ft)	290	379	384	1915	1910
Average Queue (ft)	106	71	72	665	676
95th Queue (ft)	269	306	310	1739	1741
Link Distance (ft)	2590	370	370	3200	3200
Upstream Blk Time (%)		15	15		
Queuing Penalty (veh)		89	92		
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 24: Industrial Way & Douglas Street

Movement	SE	SW
Directions Served	L	LR
Maximum Queue (ft)	34	70
Average Queue (ft)	4	27
95th Queue (ft)	22	59
Link Distance (ft)		100
Upstream Blk Time (%)		0
Queuing Penalty (veh)		0
Storage Bay Dist (ft)	195	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 25: Douglas Street & Alder Street

Movement	NW	NE
Directions Served	LT	LR
Maximum Queue (ft)	10	61
Average Queue (ft)	1	29
95th Queue (ft)	8	56
Link Distance (ft)	681	100
Upstream Blk Time (%)		0
Queuing Penalty (veh)		0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 29: Spur Line & Washington Way

Movement	EB	EB	EB	WB	WB	NW
Directions Served	T	T	T	T	T	T
Maximum Queue (ft)	190	818	504	27	42	47
Average Queue (ft)	44	258	66	3	5	2
95th Queue (ft)	163	752	318	17	27	20
Link Distance (ft)		1752	1752	7	7	1681
Upstream Blk Time (%)				16	15	
Queuing Penalty (veh)				10	10	
Storage Bay Dist (ft)	140					
Storage Blk Time (%)	0	39				
Queuing Penalty (veh)	0	32				

Intersection: 31: Weyerhaeuser Access & Spur Line

Movement	NW	NE	SW
Directions Served	T	T	T
Maximum Queue (ft)	56	217	20
Average Queue (ft)	5	38	2
95th Queue (ft)	31	158	11
Link Distance (ft)	5597	313	10
Upstream Blk Time (%)		2	4
Queuing Penalty (veh)		0	0
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 33: Weyerhaeuser Access & Industrial Way

Movement	SE	NW	NE
Directions Served	R	L	LR
Maximum Queue (ft)	3	28	26
Average Queue (ft)	0	2	18
95th Queue (ft)	4	15	34
Link Distance (ft)			10
Upstream Blk Time (%)			12
Queuing Penalty (veh)			9
Storage Bay Dist (ft)	210	80	
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 37: Weyerhaeuser Access 2 & Industrial Way

Movement	SE
Directions Served	T
Maximum Queue (ft)	20
Average Queue (ft)	1
95th Queue (ft)	18
Link Distance (ft)	1480
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	0
Queuing Penalty (veh)	0

Intersection: 39: Industrial Way & Prudential Blvd

Movement	SE	SE	NW	NW	SW
Directions Served	L	T	T	T	L
Maximum Queue (ft)	3	104	107	85	116
Average Queue (ft)	0	35	36	25	51
95th Queue (ft)	3	80	84	63	91
Link Distance (ft)		2438	513	513	1261
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)	170				
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 41: Hoehne Avenue & Industrial Way

Movement	NE
Directions Served	R
Maximum Queue (ft)	35
Average Queue (ft)	11
95th Queue (ft)	36
Link Distance (ft)	26
Upstream Blk Time (%)	1
Queuing Penalty (veh)	0
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 45: International Way & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	780	780	225	335	346	494	263
Average Queue (ft)	442	448	28	176	180	88	105
95th Queue (ft)	934	935	124	365	371	350	220
Link Distance (ft)	746	746		304	304	973	
Upstream Blk Time (%)	15	17		13	14		
Queuing Penalty (veh)	70	80		57	63		
Storage Bay Dist (ft)			150				150
Storage Blk Time (%)			0	26		4	11
Queuing Penalty (veh)			0	4		6	3

Intersection: 47: Fiber Way & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	254	252	205	316	325	555	842
Average Queue (ft)	210	212	54	162	176	82	246
95th Queue (ft)	260	256	155	341	353	358	651
Link Distance (ft)	208	208		295	295	975	975
Upstream Blk Time (%)	38	40		10	11	1	2
Queuing Penalty (veh)	213	226		43	47	0	0
Storage Bay Dist (ft)			150				
Storage Blk Time (%)			0	19			
Queuing Penalty (veh)			0	9			

Intersection: 48: Industrial Way

Movement	EB	EB	WB	WB	NB	SB
Directions Served	T	T	T	T	R	R
Maximum Queue (ft)	27	38	470	457	167	48
Average Queue (ft)	2	3	294	303	66	6
95th Queue (ft)	36	43	608	600	126	29
Link Distance (ft)	1239	1239	420	420	236	90
Upstream Blk Time (%)			19	22	0	
Queuing Penalty (veh)			95	110	0	
Storage Bay Dist (ft)						
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 49: 38th Avenue & Industrial Way

Movement	SE	SE	SE	NW	NW	NE	NE	NE	SW	SW
Directions Served	L	T	R	L	T	L	T	R	L	R
Maximum Queue (ft)	49	97	15	200	219	38	45	81	68	45
Average Queue (ft)	13	24	1	55	37	2	9	20	27	17
95th Queue (ft)	37	71	8	156	129	18	34	58	59	43
Link Distance (ft)		2250			2438	3	3	3		
Upstream Blk Time (%)						0	4	5		
Queuing Penalty (veh)						0	1	1		
Storage Bay Dist (ft)	115		225	155					150	200
Storage Blk Time (%)		0		9	0					
Queuing Penalty (veh)		0		30	0					

Intersection: 50: Aluminum Access 1/38th Avenue & Spur Line

Movement	NW	NE	NE	NE	SW
Directions Served	T	T	T	T	T
Maximum Queue (ft)	181	25	948	76	52
Average Queue (ft)	14	2	333	29	9
95th Queue (ft)	94	15	1118	71	31
Link Distance (ft)	5783		2106		3
Upstream Blk Time (%)			2		34
Queuing Penalty (veh)			0		16
Storage Bay Dist (ft)		35		25	
Storage Blk Time (%)		4	17	49	
Queuing Penalty (veh)		2	10	29	

Intersection: 55: Industrial Way

Movement	EB	EB	WB	WB	NB	SB
Directions Served	T	T	T	T	R	R
Maximum Queue (ft)	358	369	768	777	98	55
Average Queue (ft)	95	100	294	298	25	14
95th Queue (ft)	336	346	855	862	75	45
Link Distance (ft)	379	379	746	746	99	87
Upstream Blk Time (%)	3	4	8	9	2	0
Queuing Penalty (veh)	13	21	36	38	0	0
Storage Bay Dist (ft)						
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 56: Industrial Way & 3rd Avenue

Movement	NW	NW	NE	NE	SW	SW	SW
Directions Served	L	R	T	TR	L	T	T
Maximum Queue (ft)	111	152	250	242	185	400	401
Average Queue (ft)	28	34	141	147	22	275	276
95th Queue (ft)	82	108	239	241	116	508	505
Link Distance (ft)		2710	237	237		370	370
Upstream Blk Time (%)			15	14		26	27
Queuing Penalty (veh)			90	86		100	103
Storage Bay Dist (ft)	175				250		
Storage Blk Time (%)	0	2				36	
Queuing Penalty (veh)	0	1				4	

Intersection: 59: Industrial Way

Movement	EB	EB	WB	WB	NB
Directions Served	T	T	T	TR	R
Maximum Queue (ft)	330	338	242	230	132
Average Queue (ft)	223	233	56	57	57
95th Queue (ft)	415	424	210	210	136
Link Distance (ft)	304	304	208	208	118
Upstream Blk Time (%)	15	20	7	8	19
Queuing Penalty (veh)	79	107	31	36	0
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 61: Industrial Way

Movement	SB	SE
Directions Served	LR	L
Maximum Queue (ft)	108	30
Average Queue (ft)	47	2
95th Queue (ft)	86	14
Link Distance (ft)	1001	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		150
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 64: Industrial Way

Movement	EB	EB	WB	WB	SB
Directions Served	T	TR	T	T	R
Maximum Queue (ft)	305	314	522	545	30
Average Queue (ft)	140	146	97	102	3
95th Queue (ft)	356	366	493	505	17
Link Distance (ft)	295	295	843	843	88
Upstream Blk Time (%)	12	13	2	3	
Queuing Penalty (veh)	77	89	9	12	
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 69: Dike Road & Spur Line

Movement	SE	NW	NE	SW
Directions Served	T	T	T	T
Maximum Queue (ft)	518	658	160	226
Average Queue (ft)	215	278	14	21
95th Queue (ft)	518	650	83	118
Link Distance (ft)	2167	1051	566	491
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 5750

Intersection: 1: Weyerhaeuser & Industrial Way

Movement	SE	NW	NW	NE
Directions Served	TR	L	T	LR
Maximum Queue (ft)	3	55	579	174
Average Queue (ft)	0	11	47	63
95th Queue (ft)	3	39	303	127
Link Distance (ft)	116	745	745	484
Upstream Blk Time (%)			1	
Queuing Penalty (veh)			3	
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: Oregon Way & Industrial Way

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	NB
Directions Served	L	T	T	R	L	L	T	R	L	T	T	R
Maximum Queue (ft)	231	294	277	257	361	1285	1277	75	376	534	2122	250
Average Queue (ft)	109	114	115	25	176	1082	1205	54	226	267	395	184
95th Queue (ft)	202	221	215	137	309	1613	1437	100	380	462	1215	308
Link Distance (ft)		745				1239	1239				2473	
Upstream Blk Time (%)						23	49				1	
Queuing Penalty (veh)						119	252				0	
Storage Bay Dist (ft)	140		400	400	310			25	235	235		120
Storage Blk Time (%)	9	5		0	0	1	63	19	16	10	34	15
Queuing Penalty (veh)	43	22		0	1	3	143	78	133	82	352	139

Intersection: 2: Oregon Way & Industrial Way

Movement	SB	SB	SB
Directions Served	L	T	TR
Maximum Queue (ft)	236	271	278
Average Queue (ft)	79	226	228
95th Queue (ft)	204	329	328
Link Distance (ft)		236	236
Upstream Blk Time (%)	0	37	40
Queuing Penalty (veh)	0	150	162
Storage Bay Dist (ft)	170		
Storage Blk Time (%)	0	50	
Queuing Penalty (veh)	1	29	

Intersection: 4: Oregon Way & Spur Line

Movement	WB	NB	NB	SB	SB
Directions Served	T	T	T	T	T
Maximum Queue (ft)	75	245	246	698	702
Average Queue (ft)	11	26	28	253	267
95th Queue (ft)	76	143	151	642	655
Link Distance (ft)	4581	236	236	702	702
Upstream Blk Time (%)		6	6	1	2
Queuing Penalty (veh)		29	29	5	7
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 5: Oregon Way & Alabama Street

Movement	EB	WB	NB	NB	NB	SB	SB	SB
Directions Served	LTR	LTR	L	T	TR	L	T	TR
Maximum Queue (ft)	139	109	90	4	11	63	83	130
Average Queue (ft)	54	47	29	0	0	16	7	11
95th Queue (ft)	109	87	68	3	5	47	54	72
Link Distance (ft)	233	852		702	702		3084	3084
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)			175			165		
Storage Blk Time (%)							0	
Queuing Penalty (veh)							0	

Intersection: 9: California Way & Spur Line

Movement	WB	SE	NW
Directions Served	T	T	T
Maximum Queue (ft)	30	687	290
Average Queue (ft)	1	65	33
95th Queue (ft)	15	372	179
Link Distance (ft)	464	2581	404
Upstream Blk Time (%)			1
Queuing Penalty (veh)			1
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 10: Industrial Way & Spur Line

Movement	WB	SE	NW
Directions Served	T	T	T
Maximum Queue (ft)	126	1091	122
Average Queue (ft)	44	84	12
95th Queue (ft)	163	522	72
Link Distance (ft)	993	2678	116
Upstream Blk Time (%)			6
Queuing Penalty (veh)			41
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 12: Industrial Way & Washington Way

Movement	EB	EB	EB	WB	WB	WB	SE	SE	SE	NW	NW
Directions Served	L	T	R	L	T	R	L	T	R	L	TR
Maximum Queue (ft)	41	71	48	154	288	12	216	267	49	229	413
Average Queue (ft)	14	34	11	29	50	0	56	71	9	42	210
95th Queue (ft)	32	61	32	94	188	6	144	187	35	141	367
Link Distance (ft)	7	7	7		1347	1347		1220			1630
Upstream Blk Time (%)	22	58	12								
Queuing Penalty (veh)	19	49	10								
Storage Bay Dist (ft)				90			210		25	160	
Storage Blk Time (%)				1	10		0	12	3	0	13
Queuing Penalty (veh)				1	5		1	17	14	1	5

Intersection: 16: Columbia Ave & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	268	300	179	408	412	250	154
Average Queue (ft)	112	134	22	267	272	94	52
95th Queue (ft)	217	240	103	510	507	201	110
Link Distance (ft)	420	420		379	379	398	
Upstream Blk Time (%)				26	28	0	
Queuing Penalty (veh)				118	125	0	
Storage Bay Dist (ft)			105				130
Storage Blk Time (%)			0	46		8	0
Queuing Penalty (veh)			0	5		7	0

Intersection: 20: California Way & Industrial Way

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	T	R	L	T	R
Maximum Queue (ft)	275	868	867	69	125	130	72	61	101	157	215	321
Average Queue (ft)	186	510	525	8	23	19	15	7	28	47	16	65
95th Queue (ft)	331	961	966	38	83	78	51	35	75	114	104	172
Link Distance (ft)		843	843		237	237		684			404	
Upstream Blk Time (%)		8	9								0	0
Queuing Penalty (veh)		50	55								0	0
Storage Bay Dist (ft)	150			150			60		60	165		300
Storage Blk Time (%)	27	37			0		1	0	2	0		1
Queuing Penalty (veh)	156	63			0		0	0	0	1		0

Intersection: 22: 3rd Avenue & Spur Line

Movement	WB	NB	NB	SB	SB
Directions Served	T	T	T	T	T
Maximum Queue (ft)	303	373	380	1091	1094
Average Queue (ft)	150	38	46	221	228
95th Queue (ft)	310	224	245	806	820
Link Distance (ft)	2590	370	370	3012	3012
Upstream Blk Time (%)		6	8		
Queuing Penalty (veh)		39	47		
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 24: Industrial Way & Douglas Street

Movement	SE	NW	SW
Directions Served	L	TR	LR
Maximum Queue (ft)	35	3	72
Average Queue (ft)	4	0	28
95th Queue (ft)	22	3	59
Link Distance (ft)		2660	100
Upstream Blk Time (%)			0
Queuing Penalty (veh)			0
Storage Bay Dist (ft)	195		
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 25: Douglas Street & Alder Street

Movement	NW	NE
Directions Served	LT	LR
Maximum Queue (ft)	13	66
Average Queue (ft)	1	29
95th Queue (ft)	8	56
Link Distance (ft)	681	100
Upstream Blk Time (%)		0
Queuing Penalty (veh)		0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 29: Spur Line & Washington Way

Movement	EB	EB	EB	WB	WB
Directions Served	T	T	T	T	T
Maximum Queue (ft)	190	550	303	22	45
Average Queue (ft)	49	166	39	2	4
95th Queue (ft)	170	488	192	11	22
Link Distance (ft)		1817	1817	7	7
Upstream Blk Time (%)				13	12
Queuing Penalty (veh)				8	8
Storage Bay Dist (ft)	140				
Storage Blk Time (%)	1	30			
Queuing Penalty (veh)	1	25			

Intersection: 31: Weyerhaeuser Access & Spur Line

Movement	NW	NE	SW
Directions Served	T	T	T
Maximum Queue (ft)	166	167	16
Average Queue (ft)	51	24	1
95th Queue (ft)	179	96	8
Link Distance (ft)	5597	313	10
Upstream Blk Time (%)			1
Queuing Penalty (veh)			0
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 33: Weyerhaeuser Access & Industrial Way

Movement	SE	NW	NE
Directions Served	R	L	LR
Maximum Queue (ft)	5	22	24
Average Queue (ft)	0	1	19
95th Queue (ft)	4	12	33
Link Distance (ft)			10
Upstream Blk Time (%)			12
Queuing Penalty (veh)			9
Storage Bay Dist (ft)	210	80	
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 37: Weyerhaeuser Access 2 & Industrial Way

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 39: Industrial Way & Prudential Blvd

Movement	SE	SE	NW	NW	SW
Directions Served	L	T	T	T	L
Maximum Queue (ft)	9	95	99	78	100
Average Queue (ft)	0	32	34	23	50
95th Queue (ft)	5	75	79	60	85
Link Distance (ft)		2438	513	513	1261
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)	170				
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 41: Hoehne Avenue & Industrial Way

Movement	NE
Directions Served	R
Maximum Queue (ft)	33
Average Queue (ft)	11
95th Queue (ft)	36
Link Distance (ft)	26
Upstream Blk Time (%)	1
Queuing Penalty (veh)	0
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 45: International Way & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	333	348	209	317	323	102	157
Average Queue (ft)	140	154	33	171	179	27	75
95th Queue (ft)	294	311	140	347	354	70	128
Link Distance (ft)	746	746		304	304	973	
Upstream Blk Time (%)				12	12		
Queuing Penalty (veh)				54	52		
Storage Bay Dist (ft)			150				150
Storage Blk Time (%)				23		0	0
Queuing Penalty (veh)				4		0	0

Intersection: 47: Fiber Way & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	250	256	246	322	320	131	360
Average Queue (ft)	191	200	58	158	175	48	151
95th Queue (ft)	266	267	158	322	339	102	291
Link Distance (ft)	208	208		295	295	975	975
Upstream Blk Time (%)	15	18		8	9		
Queuing Penalty (veh)	86	102		35	38		
Storage Bay Dist (ft)			150				
Storage Blk Time (%)			1	16			
Queuing Penalty (veh)			3	8			

Intersection: 48: Industrial Way

Movement	WB	WB	NB	SB
Directions Served	T	T	R	R
Maximum Queue (ft)	471	447	151	54
Average Queue (ft)	312	318	64	12
95th Queue (ft)	613	601	115	55
Link Distance (ft)	420	420	236	90
Upstream Blk Time (%)	21	24		5
Queuing Penalty (veh)	105	123		0
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 49: 38th Avenue & Industrial Way

Movement	SE	SE	SE	NW	NW	NE	NE	NE	SW	SW
Directions Served	L	T	R	L	T	L	T	R	L	R
Maximum Queue (ft)	55	97	19	265	363	42	48	67	76	47
Average Queue (ft)	13	25	2	62	58	2	9	17	30	17
95th Queue (ft)	39	68	13	185	192	18	35	51	62	43
Link Distance (ft)		2300			2438	3	3	3		
Upstream Blk Time (%)						1	3	5		
Queuing Penalty (veh)						0	1	1		
Storage Bay Dist (ft)	115		225	155					150	200
Storage Blk Time (%)		0		13	0					
Queuing Penalty (veh)		0		42	0					

Intersection: 50: Aluminum Access 1/38th Avenue & Spur Line

Movement	NE	NE	NE	SW
Directions Served	T	T	T	T
Maximum Queue (ft)	17	978	77	56
Average Queue (ft)	1	381	25	9
95th Queue (ft)	14	1244	67	30
Link Distance (ft)		2045		3
Upstream Blk Time (%)		2		34
Queuing Penalty (veh)		0		15
Storage Bay Dist (ft)	35		25	
Storage Blk Time (%)	3	24	48	
Queuing Penalty (veh)	2	14	28	

Intersection: 55: Industrial Way

Movement	WB	WB	NB	SB
Directions Served	T	T	R	R
Maximum Queue (ft)	696	690	68	53
Average Queue (ft)	289	294	18	13
95th Queue (ft)	847	853	53	43
Link Distance (ft)	746	746	99	87
Upstream Blk Time (%)	9	8	0	1
Queuing Penalty (veh)	38	35	0	0
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 56: Industrial Way & 3rd Avenue

Movement	NW	NW	NE	NE	SW	SW	SW
Directions Served	L	R	T	TR	L	T	T
Maximum Queue (ft)	94	88	244	247	130	404	403
Average Queue (ft)	27	24	119	130	18	239	245
95th Queue (ft)	72	65	217	230	75	439	436
Link Distance (ft)		2710	237	237		370	370
Upstream Blk Time (%)			5	6		13	13
Queuing Penalty (veh)			31	39		48	49
Storage Bay Dist (ft)	175				250		
Storage Blk Time (%)					0	20	
Queuing Penalty (veh)					0	2	

Intersection: 59: Industrial Way

Movement	EB	EB	WB	WB	NB
Directions Served	T	T	T	TR	R
Maximum Queue (ft)	289	296	177	176	98
Average Queue (ft)	101	111	50	52	27
95th Queue (ft)	283	294	196	200	74
Link Distance (ft)	304	304	208	208	118
Upstream Blk Time (%)	2	3	6	6	0
Queuing Penalty (veh)	9	15	26	27	0
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 61: Industrial Way

Movement	SB	SE	NW
Directions Served	LR	L	TR
Maximum Queue (ft)	104	26	2
Average Queue (ft)	47	2	0
95th Queue (ft)	83	13	2
Link Distance (ft)	1001		2678
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)		150	
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 64: Industrial Way

Movement	EB	EB	WB	WB	SB
Directions Served	T	TR	T	T	R
Maximum Queue (ft)	306	309	411	414	29
Average Queue (ft)	64	68	70	72	2
95th Queue (ft)	247	255	377	383	16
Link Distance (ft)	295	295	843	843	88
Upstream Blk Time (%)	3	4	0	0	
Queuing Penalty (veh)	18	24	1	1	
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 69: Dike Road & Spur Line

Movement	SE	NW	NE	SW
Directions Served	T	T	T	T
Maximum Queue (ft)	606	636	198	258
Average Queue (ft)	252	240	19	23
95th Queue (ft)	635	583	106	137
Link Distance (ft)	2167	1051	566	491
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 3745

Intersection: 1: Weyerhaeuser & Industrial Way

Movement	SE	NW	NW	NE
Directions Served	TR	L	T	LR
Maximum Queue (ft)	21	68	608	314
Average Queue (ft)	1	13	83	83
95th Queue (ft)	10	45	403	214
Link Distance (ft)	116	745	745	484
Upstream Blk Time (%)			1	0
Queuing Penalty (veh)			4	0
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 2: Oregon Way & Industrial Way

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	NB
Directions Served	L	T	T	R	L	L	T	R	L	T	T	R
Maximum Queue (ft)	239	378	336	306	355	1281	1286	78	384	534	2511	250
Average Queue (ft)	121	140	126	39	190	1046	1156	56	215	306	667	195
95th Queue (ft)	232	299	264	190	336	1695	1557	101	377	521	1971	320
Link Distance (ft)		745				1239	1239				2473	
Upstream Blk Time (%)						26	47				5	
Queuing Penalty (veh)						131	242				0	
Storage Bay Dist (ft)	140		400	400	310			25	235	235		120
Storage Blk Time (%)	17	7	0	0	1	3	60	26	13	19	40	18
Queuing Penalty (veh)	86	32	0	0	3	6	135	108	108	158	423	168

Intersection: 2: Oregon Way & Industrial Way

Movement	SB	SB	SB
Directions Served	L	T	TR
Maximum Queue (ft)	236	271	262
Average Queue (ft)	80	229	224
95th Queue (ft)	211	344	338
Link Distance (ft)		236	236
Upstream Blk Time (%)	0	54	54
Queuing Penalty (veh)	0	222	220
Storage Bay Dist (ft)	170		
Storage Blk Time (%)	0	62	
Queuing Penalty (veh)	1	36	

Intersection: 4: Oregon Way & Spur Line

Movement	WB	NB	NB	SB	SB
Directions Served	T	T	T	T	T
Maximum Queue (ft)	98	247	259	726	734
Average Queue (ft)	19	47	50	637	644
95th Queue (ft)	60	198	207	881	883
Link Distance (ft)	4581	236	236	702	702
Upstream Blk Time (%)		11	12	26	28
Queuing Penalty (veh)		61	65	105	112
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 5: Oregon Way & Alabama Street

Movement	EB	WB	NB	NB	SB	SB	SB
Directions Served	LTR	LTR	L	TR	L	T	TR
Maximum Queue (ft)	222	373	110	9	219	621	651
Average Queue (ft)	123	144	36	0	42	182	199
95th Queue (ft)	254	467	87	4	181	562	589
Link Distance (ft)	233	852		702		3126	3126
Upstream Blk Time (%)	19	3					
Queuing Penalty (veh)	0	0					
Storage Bay Dist (ft)			175		165		
Storage Blk Time (%)						20	
Queuing Penalty (veh)						6	

Intersection: 9: California Way & Spur Line

Movement	WB	SE	NW
Directions Served	T	T	T
Maximum Queue (ft)	70	697	383
Average Queue (ft)	4	101	59
95th Queue (ft)	33	436	249
Link Distance (ft)	464	2581	404
Upstream Blk Time (%)			1
Queuing Penalty (veh)			3
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 10: Industrial Way & Spur Line

Movement	WB	SE	NW
Directions Served	T	T	T
Maximum Queue (ft)	139	1238	124
Average Queue (ft)	56	185	20
95th Queue (ft)	188	831	93
Link Distance (ft)	993	2678	116
Upstream Blk Time (%)			13
Queuing Penalty (veh)			88
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 12: Industrial Way & Washington Way

Movement	EB	EB	EB	WB	WB	WB	SE	SE	SE	NW	NW
Directions Served	L	T	R	L	T	R	L	T	R	L	TR
Maximum Queue (ft)	43	70	50	189	393	2	268	628	53	218	420
Average Queue (ft)	12	31	12	30	78	0	55	116	17	53	189
95th Queue (ft)	32	63	35	104	258	2	164	439	48	159	355
Link Distance (ft)	7	7	7		1347	1347		1220			1630
Upstream Blk Time (%)	21	58	13					0			
Queuing Penalty (veh)	18	49	11					0			
Storage Bay Dist (ft)				90			210		25	160	
Storage Blk Time (%)				1	23		0	14	14	3	9
Queuing Penalty (veh)				1	13		0	19	58	17	3

Intersection: 16: Columbia Ave & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	325	343	172	420	419	231	167
Average Queue (ft)	159	175	26	271	277	93	57
95th Queue (ft)	348	359	116	512	508	182	120
Link Distance (ft)	420	420		379	379	398	
Upstream Blk Time (%)	2	3		26	28		
Queuing Penalty (veh)	10	13		118	125		
Storage Bay Dist (ft)			105				130
Storage Blk Time (%)			0	46		7	0
Queuing Penalty (veh)			1	5		6	0

Intersection: 20: California Way & Industrial Way

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	T	R	L	T	R
Maximum Queue (ft)	275	873	893	60	135	129	73	129	115	184	246	318
Average Queue (ft)	217	791	798	11	18	14	11	10	30	49	23	74
95th Queue (ft)	361	1036	1042	42	80	73	46	57	79	124	125	208
Link Distance (ft)		843	843		237	237		684			404	
Upstream Blk Time (%)		25	27		0						0	0
Queuing Penalty (veh)		167	183		0						0	0
Storage Bay Dist (ft)	150			150			60		60	165		300
Storage Blk Time (%)	37	56			0		1	0	7	1	0	1
Queuing Penalty (veh)	216	95			0		0	0	1	2	0	1

Intersection: 22: 3rd Avenue & Spur Line

Movement	WB	NB	NB	SB	SB
Directions Served	T	T	T	T	T
Maximum Queue (ft)	220	380	386	1549	1535
Average Queue (ft)	89	77	83	875	881
95th Queue (ft)	208	326	337	1644	1639
Link Distance (ft)	2590	370	370	3128	3128
Upstream Blk Time (%)		14	15		
Queuing Penalty (veh)		86	92		
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 24: Industrial Way & Douglas Street

Movement	SE	NW	SW
Directions Served	L	TR	LR
Maximum Queue (ft)	34	3	60
Average Queue (ft)	4	0	26
95th Queue (ft)	21	3	54
Link Distance (ft)		2660	100
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)	195		
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 25: Douglas Street & Alder Street

Movement	NW	NE
Directions Served	LT	LR
Maximum Queue (ft)	19	67
Average Queue (ft)	1	28
95th Queue (ft)	10	60
Link Distance (ft)	681	100
Upstream Blk Time (%)		0
Queuing Penalty (veh)		0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 29: Spur Line & Washington Way

Movement	EB	EB	EB	WB	WB	NW
Directions Served	T	T	T	T	T	T
Maximum Queue (ft)	190	808	512	26	49	3
Average Queue (ft)	89	418	84	4	8	0
95th Queue (ft)	236	829	328	18	30	3
Link Distance (ft)		1850	1850	7	7	1681
Upstream Blk Time (%)				26	26	
Queuing Penalty (veh)				18	18	
Storage Bay Dist (ft)	140					
Storage Blk Time (%)	0	75				
Queuing Penalty (veh)	0	63				

Intersection: 31: Weyerhaeuser Access & Spur Line

Movement	NW	NE	SW
Directions Served	T	T	T
Maximum Queue (ft)	105	211	20
Average Queue (ft)	36	40	2
95th Queue (ft)	124	144	13
Link Distance (ft)	5597	313	10
Upstream Blk Time (%)			6
Queuing Penalty (veh)			1
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 33: Weyerhaeuser Access & Industrial Way

Movement	SE	NW	NE
Directions Served	R	L	LR
Maximum Queue (ft)	11	26	26
Average Queue (ft)	1	2	17
95th Queue (ft)	10	13	34
Link Distance (ft)			10
Upstream Blk Time (%)			13
Queuing Penalty (veh)			9
Storage Bay Dist (ft)	210	80	
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 37: Weyerhaeuser Access 2 & Industrial Way

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 39: Industrial Way & Prudential Blvd

Movement	SE	SE	NW	NW	SW
Directions Served	L	T	T	T	L
Maximum Queue (ft)	6	108	94	81	103
Average Queue (ft)	0	33	33	22	48
95th Queue (ft)	4	80	76	60	84
Link Distance (ft)		2438	513	513	1261
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)	170				
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 41: Hoehne Avenue & Industrial Way

Movement	NE
Directions Served	R
Maximum Queue (ft)	33
Average Queue (ft)	10
95th Queue (ft)	34
Link Distance (ft)	26
Upstream Blk Time (%)	1
Queuing Penalty (veh)	0
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 45: International Way & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	716	728	213	340	335	397	253
Average Queue (ft)	462	476	33	191	195	79	106
95th Queue (ft)	911	915	139	372	375	303	220
Link Distance (ft)	746	746		304	304	973	
Upstream Blk Time (%)	12	14		12	12		
Queuing Penalty (veh)	57	67		51	53		
Storage Bay Dist (ft)			150				150
Storage Blk Time (%)				25		3	11
Queuing Penalty (veh)				4		5	4

Intersection: 47: Fiber Way & Industrial Way

Movement	EB	EB	WB	WB	WB	NB	NB
Directions Served	T	TR	L	T	T	L	R
Maximum Queue (ft)	247	254	240	320	328	123	608
Average Queue (ft)	215	219	61	174	190	47	222
95th Queue (ft)	244	248	161	345	361	100	489
Link Distance (ft)	208	208		295	295	975	975
Upstream Blk Time (%)	44	46		7	8		
Queuing Penalty (veh)	253	269		30	34		
Storage Bay Dist (ft)			150				
Storage Blk Time (%)			0	16			
Queuing Penalty (veh)			2	8			

Intersection: 48: Industrial Way

Movement	EB	EB	WB	WB	NB	SB
Directions Served	T	T	T	T	R	R
Maximum Queue (ft)	82	96	467	461	186	54
Average Queue (ft)	10	12	316	319	72	16
95th Queue (ft)	87	97	616	614	150	58
Link Distance (ft)	1239	1239	420	420	236	90
Upstream Blk Time (%)			20	23	2	10
Queuing Penalty (veh)			99	117	0	0
Storage Bay Dist (ft)						
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 49: 38th Avenue & Industrial Way

Movement	SE	SE	SE	NW	NW	NE	NE	NE	SW	SW
Directions Served	L	T	R	L	T	L	T	R	L	R
Maximum Queue (ft)	55	95	25	273	363	31	47	74	76	46
Average Queue (ft)	16	25	3	81	58	2	8	16	28	18
95th Queue (ft)	42	68	16	212	221	17	32	53	62	44
Link Distance (ft)		2266			2438	3	3	3		
Upstream Blk Time (%)						1	3	5		
Queuing Penalty (veh)						0	1	2		
Storage Bay Dist (ft)	115		225	155					150	200
Storage Blk Time (%)		0		19	0					
Queuing Penalty (veh)		0		62	0					

Intersection: 50: Aluminum Access 1/38th Avenue & Spur Line

Movement	NW	NE	NE	NE	SW
Directions Served	T	T	T	T	T
Maximum Queue (ft)	47	18	1151	72	51
Average Queue (ft)	4	1	499	35	13
95th Queue (ft)	30	14	1310	75	36
Link Distance (ft)	5784		1907		3
Upstream Blk Time (%)			0		50
Queuing Penalty (veh)			0		23
Storage Bay Dist (ft)		35		25	
Storage Blk Time (%)		3	19	70	
Queuing Penalty (veh)		2	11	41	

Intersection: 55: Industrial Way

Movement	EB	EB	WB	WB	NB	SB
Directions Served	T	T	T	T	R	R
Maximum Queue (ft)	311	323	774	768	86	51
Average Queue (ft)	98	101	310	314	27	14
95th Queue (ft)	354	362	875	880	83	43
Link Distance (ft)	379	379	746	746	99	87
Upstream Blk Time (%)	3	5	7	7	8	0
Queuing Penalty (veh)	13	22	32	30	0	0
Storage Bay Dist (ft)						
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 56: Industrial Way & 3rd Avenue

Movement	NW	NW	NE	NE	SW	SW	SW
Directions Served	L	R	T	TR	L	T	T
Maximum Queue (ft)	90	106	252	254	269	408	404
Average Queue (ft)	26	26	150	160	26	334	332
95th Queue (ft)	68	72	243	250	134	532	526
Link Distance (ft)		2710	237	237		370	370
Upstream Blk Time (%)			13	14		40	40
Queuing Penalty (veh)			79	87		162	163
Storage Bay Dist (ft)	175				250		
Storage Blk Time (%)		0				52	
Queuing Penalty (veh)		0				6	

Intersection: 59: Industrial Way

Movement	EB	EB	WB	WB	NB
Directions Served	T	T	T	TR	R
Maximum Queue (ft)	332	338	217	215	145
Average Queue (ft)	257	266	54	54	71
95th Queue (ft)	415	418	200	200	154
Link Distance (ft)	304	304	208	208	118
Upstream Blk Time (%)	14	23	4	5	30
Queuing Penalty (veh)	78	129	20	20	0
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 61: Industrial Way

Movement	SB	SE	NW
Directions Served	LR	L	TR
Maximum Queue (ft)	114	30	6
Average Queue (ft)	45	2	0
95th Queue (ft)	85	14	6
Link Distance (ft)	1001		2678
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)		150	
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 64: Industrial Way

Movement	EB	EB	WB	WB	SB
Directions Served	T	TR	T	T	R
Maximum Queue (ft)	312	317	429	438	26
Average Queue (ft)	188	199	61	65	3
95th Queue (ft)	381	391	330	335	20
Link Distance (ft)	295	295	843	843	88
Upstream Blk Time (%)	11	14	0	0	
Queuing Penalty (veh)	74	98	0	0	
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 69: Dike Road & Spur Line

Movement	SE	NW	NE	SW
Directions Served	T	T	T	T
Maximum Queue (ft)	409	419	179	306
Average Queue (ft)	152	164	29	43
95th Queue (ft)	392	412	119	192
Link Distance (ft)	2167	1051	566	491
Upstream Blk Time (%)				0
Queuing Penalty (veh)				0
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 6148

Intersection: 3: Main Line & Cowlitz St E/Cowitz St E

Movement	EB	WB	SB
Directions Served	T	T	T
Maximum Queue (ft)	67	85	373
Average Queue (ft)	4	5	172
95th Queue (ft)	26	35	336
Link Distance (ft)	1245	741	1543
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 10: Cowitz St E & Jo Ann Dr

Movement	EB	SB
Directions Served	LT	LR
Maximum Queue (ft)	7	39
Average Queue (ft)	0	11
95th Queue (ft)	5	37
Link Distance (ft)	741	670
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 20: Main Line & Cowlitz Gardens Rd

Movement	SB	SE	NW
Directions Served	T	T	T
Maximum Queue (ft)	364	30	50
Average Queue (ft)	170	2	3
95th Queue (ft)	333	14	21
Link Distance (ft)	1043	550	636
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 26: Main Line & Riverside Dr/Mill St

Movement	EB	WB	SB
Directions Served	T	T	T
Maximum Queue (ft)	148	208	352
Average Queue (ft)	12	18	160
95th Queue (ft)	68	95	331
Link Distance (ft)	672	687	934
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 28: Main Line & River Rd

Movement	EB	WB	SB
Directions Served	T	T	T
Maximum Queue (ft)	87	142	2
Average Queue (ft)	6	10	0
95th Queue (ft)	39	60	4
Link Distance (ft)	778	931	1545
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 47: Main Line & Port Rd

Movement	EB	WB	SB
Directions Served	T	T	T
Maximum Queue (ft)	66	88	405
Average Queue (ft)	3	5	175
95th Queue (ft)	24	37	352
Link Distance (ft)	897	913	1078
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 51: Main Line & Scott Ave

Movement	EB	WB	SB
Directions Served	T	T	T
Maximum Queue (ft)	61	167	387
Average Queue (ft)	5	14	168
95th Queue (ft)	31	81	343
Link Distance (ft)	594	737	1217
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 52: Pekin Rd & Guild Rd/Scott Ave

Movement	WB	NB
Directions Served	LT	LR
Maximum Queue (ft)	54	71
Average Queue (ft)	4	32
95th Queue (ft)	29	57
Link Distance (ft)	594	781
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 53: Down River Rd/Dow River Rd & Scott Ave

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	8	8	80	78
Average Queue (ft)	0	0	38	33
95th Queue (ft)	6	5	64	58
Link Distance (ft)	737	725	1412	1143
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 54: Main Line & Pekin Rd/Davidson Rd

Movement	EB	WB	SB
Directions Served	T	T	T
Maximum Queue (ft)	115	89	340
Average Queue (ft)	11	7	150
95th Queue (ft)	61	42	381
Link Distance (ft)	1258	684	4527
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 57: Main Line & Whalen Rd

Movement	EB	WB	SB
Directions Served	T	T	T
Maximum Queue (ft)	73	110	15
Average Queue (ft)	4	9	4
95th Queue (ft)	29	51	16
Link Distance (ft)	1426	1931	4587
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 67: 5th St & Davidson Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	6	60	94	47
Average Queue (ft)	0	15	46	20
95th Queue (ft)	5	48	75	49
Link Distance (ft)	684	755	922	939
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 0

Intersection: 3: Main Line & Cowlitz St E/Cowitz St E

Movement	EB	WB	SB
Directions Served	T	T	T
Maximum Queue (ft)	67	87	630
Average Queue (ft)	6	9	282
95th Queue (ft)	33	46	576
Link Distance (ft)	1245	741	1543
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 10: Cowitz St E & Jo Ann Dr

Movement	EB	SB
Directions Served	LT	LR
Maximum Queue (ft)	14	34
Average Queue (ft)	0	11
95th Queue (ft)	7	36
Link Distance (ft)	741	670
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 20: Main Line & Cowlitz Gardens Rd

Movement	NB	SB	SE	NW
Directions Served	T	T	T	T
Maximum Queue (ft)	469	674	33	42
Average Queue (ft)	226	295	2	3
95th Queue (ft)	445	616	15	20
Link Distance (ft)	938	1043	550	636
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 26: Main Line & Riverside Dr/Mill St

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	160	236	62	632
Average Queue (ft)	20	30	10	296
95th Queue (ft)	86	122	51	605
Link Distance (ft)	672	687	1545	934
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 28: Main Line & River Rd

Movement	EB	WB	NB
Directions Served	T	T	T
Maximum Queue (ft)	140	183	549
Average Queue (ft)	17	22	250
95th Queue (ft)	75	99	505
Link Distance (ft)	778	931	926
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 47: Main Line & Port Rd

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	76	87	546	663
Average Queue (ft)	8	10	266	281
95th Queue (ft)	42	48	510	584
Link Distance (ft)	897	913	1390	1078
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 51: Main Line & Scott Ave

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	102	190	80	599
Average Queue (ft)	12	23	15	284
95th Queue (ft)	58	105	64	571
Link Distance (ft)	594	737	4527	1217
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 52: Pekin Rd & Guild Rd/Scott Ave

Movement	WB	NB
Directions Served	LT	LR
Maximum Queue (ft)	43	82
Average Queue (ft)	3	35
95th Queue (ft)	21	65
Link Distance (ft)	594	781
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 53: Down River Rd/Dow River Rd & Scott Ave

Movement	EB	NB	SB
Directions Served	LTR	LTR	LTR
Maximum Queue (ft)	13	90	79
Average Queue (ft)	1	38	33
95th Queue (ft)	7	67	61
Link Distance (ft)	737	1412	1143
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 54: Main Line & Pekin Rd/Davidson Rd

Movement	EB	WB	NB
Directions Served	T	T	T
Maximum Queue (ft)	145	92	172
Average Queue (ft)	20	11	47
95th Queue (ft)	86	51	159
Link Distance (ft)	1258	684	4587
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 57: Main Line & Whalen Rd

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	73	103	540	4
Average Queue (ft)	8	13	264	0
95th Queue (ft)	40	61	505	3
Link Distance (ft)	1426	1931	976	4587
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 67: 5th St & Davidson Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	8	62	83	49
Average Queue (ft)	0	14	44	20
95th Queue (ft)	5	46	70	49
Link Distance (ft)	684	755	922	939
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 0

Intersection: 3: Main Line & Cowlitz St E/Cowitz St E

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	73	126	532	652
Average Queue (ft)	7	16	233	293
95th Queue (ft)	38	73	485	617
Link Distance (ft)	1245	741	1167	1543
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 10: Cowitz St E & Jo Ann Dr

Movement	EB	SB
Directions Served	LT	LR
Maximum Queue (ft)	3	34
Average Queue (ft)	0	12
95th Queue (ft)	4	38
Link Distance (ft)	741	670
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 20: Main Line & Cowlitz Gardens Rd

Movement	NB	SB	SE	NW
Directions Served	T	T	T	T
Maximum Queue (ft)	538	655	40	44
Average Queue (ft)	243	292	4	4
95th Queue (ft)	486	622	22	22
Link Distance (ft)	938	1043	550	636
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 26: Main Line & Riverside Dr/Mill St

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	156	260	40	667
Average Queue (ft)	22	39	9	301
95th Queue (ft)	95	159	45	626
Link Distance (ft)	672	687	1545	934
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 28: Main Line & River Rd

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	141	184	463	2
Average Queue (ft)	18	25	210	0
95th Queue (ft)	80	109	436	3
Link Distance (ft)	778	931	926	1545
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 47: Main Line & Port Rd

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	68	102	538	601
Average Queue (ft)	8	12	249	270
95th Queue (ft)	39	54	508	566
Link Distance (ft)	897	913	1390	1078
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 51: Main Line & Scott Ave

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	109	225	75	698
Average Queue (ft)	13	27	18	311
95th Queue (ft)	61	129	68	629
Link Distance (ft)	594	737	4527	1217
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 52: Pekin Rd & Guild Rd/Scott Ave

Movement	WB	NB
Directions Served	LT	LR
Maximum Queue (ft)	63	82
Average Queue (ft)	5	37
95th Queue (ft)	31	66
Link Distance (ft)	594	781
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 53: Down River Rd/Dow River Rd & Scott Ave

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	10	13	84	71
Average Queue (ft)	0	0	38	35
95th Queue (ft)	5	6	66	58
Link Distance (ft)	737	725	1412	1143
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 54: Main Line & Pekin Rd/Davidson Rd

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	149	105	149	3
Average Queue (ft)	22	13	41	1
95th Queue (ft)	89	59	144	7
Link Distance (ft)	1258	684	4587	4527
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 57: Main Line & Whalen Rd

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	122	142	506	5
Average Queue (ft)	12	17	241	0
95th Queue (ft)	62	79	464	4
Link Distance (ft)	1426	1931	976	4587
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 67: 5th St & Davidson Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	6	86	87	35
Average Queue (ft)	0	21	47	18
95th Queue (ft)	5	61	75	45
Link Distance (ft)	684	755	922	939
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 0

Intersection: 3: Main Line & Cowlitz St E/Cowitz St E

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	106	123	588	459
Average Queue (ft)	14	19	262	174
95th Queue (ft)	63	77	536	401
Link Distance (ft)	1245	741	1167	1543
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 10: Cowitz St E & Jo Ann Dr

Movement	EB	SB
Directions Served	LT	LR
Maximum Queue (ft)	10	34
Average Queue (ft)	0	11
95th Queue (ft)	7	36
Link Distance (ft)	741	670
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 20: Main Line & Cowlitz Gardens Rd

Movement	NB	SB	SE	NW
Directions Served	T	T	T	T
Maximum Queue (ft)	506	402	63	65
Average Queue (ft)	214	153	6	7
95th Queue (ft)	471	345	36	36
Link Distance (ft)	938	1043	550	636
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 26: Main Line & Riverside Dr/Mill St

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	252	355	320	453
Average Queue (ft)	44	65	52	180
95th Queue (ft)	160	230	224	400
Link Distance (ft)	672	687	1545	934
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 28: Main Line & River Rd

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	179	273	515	18
Average Queue (ft)	27	46	209	4
95th Queue (ft)	108	171	472	19
Link Distance (ft)	778	931	926	1545
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 47: Main Line & Port Rd

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	83	129	524	421
Average Queue (ft)	13	21	205	166
95th Queue (ft)	53	84	452	377
Link Distance (ft)	897	913	1390	1078
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 51: Main Line & Scott Ave

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	144	272	79	428
Average Queue (ft)	27	60	7	165
95th Queue (ft)	96	196	39	360
Link Distance (ft)	594	737	4527	1217
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 52: Pekin Rd & Guild Rd/Scott Ave

Movement	WB	NB
Directions Served	LT	LR
Maximum Queue (ft)	65	82
Average Queue (ft)	5	37
95th Queue (ft)	33	64
Link Distance (ft)	594	781
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 53: Down River Rd/Dow River Rd & Scott Ave

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	24	7	81	73
Average Queue (ft)	1	0	38	35
95th Queue (ft)	11	4	64	60
Link Distance (ft)	737	725	1412	1143
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 54: Main Line & Pekin Rd/Davidson Rd

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	187	120	179	70
Average Queue (ft)	36	21	24	15
95th Queue (ft)	123	78	119	89
Link Distance (ft)	1258	684	4587	4527
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 57: Main Line & Whalen Rd

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	106	139	580	405
Average Queue (ft)	15	22	273	149
95th Queue (ft)	64	85	559	421
Link Distance (ft)	1426	1931	976	4587
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 67: 5th St & Davidson Rd

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	24	82	83	38
Average Queue (ft)	1	20	46	18
95th Queue (ft)	10	59	72	46
Link Distance (ft)	684	755	922	939
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Network Summary

Network wide Queuing Penalty: 0

FEDERAL RAILROAD ADMINISTRATION

ĀÀ !"!"#$%"&

CORRIDOR AND CROSSING DATA

NL)71'B7+A1-8/*+).A('O/./278P

C8/(M	K01/LBK
!-7-8/7M	,2)7)-3+*-7-8/7
#'(()*'(+,!	+><

#'(()*'(+%-./	<=>?+%'+ 07)'2+@+9AB(				Avg. No. Trains Per Day	Train Time-of-Day Distribution
				Passenger	+=$=	C2)D'(.
&/012'3'45+6-07'(8+	+=$E=	+=$E=	+=$E=	Freight	+<$E	C2)D'(.
9)42-3+95201('2):-7)'2;	6-38/			Switch	+=$=	C2)D'(.

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

#-30B3-7/*M+<G@9/A@<=>E+++JM=<+A.

	Fatal	Injury	PDO	Total
Base	+=$==>EF?	+=$=<>=?G	+=$=HIJ?E	+=$=FJIJH
Alternate	+=$===E>?	+=$==J??>	+=$=<GEJ<	+=$=I>FJ>

CROSSING DATA FOR THE 2018 NO ACTION - SPUR CORRIDOR

Q)3/A'87+=$JF #('88)24+,!+>=>?><b

!/80()A7)'2+U%96+@+V"W"ÄX C9"Ä+&UÄ

S-O/*;+&(B/+ C(R-2;+&(B/
Ā#T+U-8/+&5A/ S-88)O/
+9-D/75+9BA$+&5A/ %'2/
Ā#T+ 37+&5A/ [)4178
+9-D/75+9BA$+75A/ %'2/

%'$+ÄÄ+&(-0K8 +>

&(-)2+9A//*8+N.A1P

Q-_+&)./7-R3/	+>=$=
S-88/24/(	+>=$=
6(/)417	+E$=
9L)701	+I$=

00)*/278+)2+E+W/-(8 +=

X)41L-5+&(-DD)0+#1-(-07/()87)08

	Base	Alternate
XZL-5+[-2/8	+<	+<$=
!)87+D('.+1L-5	+=$>=	+=$>
!&	+<==	+<==
B7'+&Y!+!)87	C2)D'(.	C2)D'(.
S/(0/27+&(B0K8	+E$=	+E$=
++YD+71)8`+a+7(-)3/(8	+=$=	+=$=
&(B0K+&Y!+!)87	C2)D'(.	C2)D'(.
S/(0/27+UB8	+=$=	+=$=
UB8+&Y!+!)87	C2)D'(.	C2)D'(.

#'878+)2+Z===+]+'D+XL-5+,.A('O/./27 +=$=

S(/*)07/*+ 22B-3+ 00)*/278

	Base	Alternate
6-7-3	+=$===>G	+=$====I
,2\B(5	+=$==>?G	+=$===GJ
S!Y	+=$==J=F	+=$==>E<
&'7-3	+=$==?=H	+=$==<=<

#'878+)2+Z===+]

	Base	Alternate
Ā(-*/+#('88)24+!/O)0/8		
Y^Q	+=$<	+>$?
Y71$+[0503/	+=$=	+=$=
#-A)7-3		+HG$?
9BAA3/./27-(5+9-D/75		
Y^Q	+=$=	+=$=
Y71$+[0503/	+=$=	+=$=
#-A)7-3		+=$=

Q)3/A'87+<$J? #('88)24+,!+>=>?<J&

!/80()A7)'2+U%96+@+IÀ!+ c"

S-O/*;+&(B/+ C(R-2;+&(B/
Ā#T+U-8/+&5A/ Ā-7/8
+9-D/75+9BA$+&5A/ %'2/
Ā#T+ 37+&5A/ %/L+&/012'3'45+>
+9-D/75+9BA$+75A/ %'2/

%'$+ÄÄ+&(-0K8 +<

&(-)2+9A//*8+N.A1P

Q-_+&)./7-R3/	+?$=
S-88/24/(	+?$=
6(/)417	+?$=
9L)701	+I$=

00)*/278+)2+E+W/-(8 +=

X)41L-5+&(-DD)0+#1-(-07/()87)08

	Base	Alternate
XZL-5+[-2/8	+G	+G$=
!)87+D('.+1L-5	+=$>=	+=$>
!&	+>J`?E=	+>J`?E=
B7'+&Y!+!)87	C2)D'(.	C2)D'(.
S/(0/27+&(B0K8	+>E$=	+>E$=
++YD+71)8`+a+7(-)3/(8	+=$=	+=$=
&(B0K+&Y!+!)87	C2)D'(.	C2)D'(.
S/(0/27+UB8	+=$=	+=$=
UB8+&Y!+!)87	C2)D'(.	C2)D'(.

#'878+)2+Z===+]+'D+XL-5+,.A('O/./27 +=$=

S(/*)07/*+ 22B-3+ 00)*/278

	Base	Alternate
6-7-3	+=$===<F	+=$===>G
,2\B(5	+=$==G>>	+=$==<=J
S!Y	+=$=>JIJ	+=$==?>?
&'7-3	+=$=<=HJ	+=$=>=I?

#'878+)2+Z===+]

	Base	Alternate
Ā(-*/+#('88)24+!/O)0/8		
Y^Q	+<$E	+E$=
Y71$+[0503/	+=$=	+=$=
#-A)7-3		+<?=$=
9BAA3/./27-(5+9-D/75		
Y^Q	+=$=	+=$=
Y71$+[0503/	+=$=	+=$=
#-A)7-3		+=$=

CROSSING DATA FOR THE 2018 NO ACTION - SPUR CORRIDOR

Milepost 2.79 Crossing ID 101821J

Description BNSF - CALIFORNIA WAY

Paved? True	Urban? True
GCX Base Type	Lights
Safety Sup. Type	None
GCX Alt Type	Gates
Safety Sup. type	None
No. RR Tracks	1

Train Speeds (mph)	
Max Timetable	10.0
Passenger	10.0
Freight	8.0
Switch	3.0

Accidents in 5 Years 0

Highway Traffic Characteristics	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	4,050	4,050
Auto TOD Dist	Uniform	Uniform
Percent Trucks	7.0	7.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00017	0.00002
Injury	0.00225	0.00025
PDO	0.00743	0.00082
Total	0.00984	0.00108

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	1.8	2.5
Oth. Lcycle	0.0	0.0
Capital		106.1
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

Milepost 3.67 Crossing ID 101805A

Description BNSF - OREGON WAY

Paved? True	Urban? True
GCX Base Type	Gates
Safety Sup. Type	None
GCX Alt Type	New Technology 1
Safety Sup. type	None
No. RR Tracks	1

Train Speeds (mph)	
Max Timetable	10.0
Passenger	10.0
Freight	10.0
Switch	3.0

Accidents in 5 Years 0

Highway Traffic Characteristics	Base	Alternate
H'way Lanes	4	4.0
Dist from hway	0.10	0.1
AADT	15,200	15,200
Auto TOD Dist	Uniform	Uniform
Percent Trucks	5.0	5.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00031	0.00016
Injury	0.00410	0.00205
PDO	0.01354	0.00677
Total	0.01795	0.00898

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	2.5	5.0
Oth. Lcycle	0.0	0.0
Capital		280.0
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

Milepost 3.88 Crossing ID 101806G

Description BNSF - INDUSTRIAL WAY

Paved? True	Urban? True
GCX Base Type	Lights
Safety Sup. Type	None
GCX Alt Type	Gates
Safety Sup. type	None
No. RR Tracks	1

Train Speeds (mph)	
Max Timetable	10.0
Passenger	10.0
Freight	10.0
Switch	3.0

Accidents in 5 Years 0

Highway Traffic Characteristics	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	10,100	10,100
Auto TOD Dist	Uniform	Uniform
Percent Trucks	15.0	15.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00023	0.00003
Injury	0.00305	0.00034
PDO	0.01008	0.00111
Total	0.01336	0.00147

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	1.8	2.5
Oth. Lcycle	0.0	0.0
Capital		106.1
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

CROSSING DATA FOR THE 2018 NO ACTION - SPUR CORRIDOR

Milepost 5.05 Crossing ID 101809C

Description BNSF - WEYERHAUSER TBR

Paved? True	Urban? True
GCX Base Type	Passive
Safety Sup. Type	None
GCX Alt Type	Lights
Safety Sup. type	None
No. RR Tracks	1

Train Speeds (mph)	
Max Timetable	10.0
Passenger	10.0
Freight	10.0
Switch	3.0

Accidents in 5 Years 0

Highway Traffic Characteristics	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	650	650
Auto TOD Dist	Uniform	Uniform
Percent Trucks	5.0	5.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00021	0.00005
Injury	0.00273	0.00068
PDO	0.00902	0.00226
Total	0.01196	0.00299

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	0.2	1.8
Oth. Lcycle	0.0	0.0
Capital		74.8
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

Milepost 6.47 Crossing ID 101817U

Description BNSF - REYNOLDS ALUM

Paved? True	Urban? True
GCX Base Type	Lights
Safety Sup. Type	None
GCX Alt Type	Gates
Safety Sup. type	None
No. RR Tracks	2

Train Speeds (mph)	
Max Timetable	10.0
Passenger	10.0
Freight	8.0
Switch	3.0

Accidents in 5 Years 0

Highway Traffic Characteristics	Base	Alternate
H'way Lanes	4	4.0
Dist from hway	0.10	0.1
AADT	3,300	3,300
Auto TOD Dist	Uniform	Uniform
Percent Trucks	5.0	5.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00025	0.00009
Injury	0.00299	0.00105
PDO	0.01117	0.00391
Total	0.01442	0.00505

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	1.8	2.5
Oth. Lcycle	0.0	0.0
Capital		106.1
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

FEDERAL RAILROAD ADMINISTRATION

GRADEDEC.NET

CORRIDOR AND CROSSING DATA

(without phased improvements)

User:	kchewuk
Dataset:	Initial dataset
Corridor ID	13

					Avg. No. Trains Per Day	*Train Time-of-Day Distribution*
Corridor Name	2018 No Action - Dike					
				Passenger	0.0	Uniform
Technology Factors	0.50	0.50	0.50	*Freight*	7.0	Uniform
Signal Synchronization?	False			*Switch*	0.0	Uniform

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

Calculated: 24-Sep-2015 6:02 pm

	Fatal	Injury	PDO	Total
Base	0.000360	0.002870	0.010421	0.013651
Alternate	0.000360	0.002870	0.010421	0.013651

CROSSING DATA FOR THE 2018 NO ACTION - DIKE CORRIDOR

Milepost 13.43 Crossing ID 101791U

Accidents in 5 Years 0

Description BNSF - DIKE RD

Paved? True	Urban? False
GCX Base Type	Lights
Safety Sup. Type	None
GCX Alt Type	Lights
Safety Sup. type	None
No. RR Tracks	4

Train Speeds (mph)

Max Timetable	10.0
Passenger	10.0
Freight	10.0
Switch	3.0

Highway Traffic Characteristics

	Base	*Alternate*
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	950	950
Auto TOD Dist	Uniform	Uniform
Percent Trucks	12.0	12.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents

	Base	*Alternate*
Fatal	0.00036	0.00036
Injury	0.00287	0.00287
PDO	0.01042	0.01042
Total	0.01365	0.01365

Costs in '000 $

	Base	*Alternate*
Grade Crossing Devices		
O&M	1.8	1.8
Oth. Lcycle	0.0	0.0
Capital		74.8
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

FEDERAL RAILROAD ADMINISTRATION

GRADEDEC.NET

CORRIDOR AND CROSSING DATA

(witho- t Uhased imUrovements)

5 ser:	pchew- p
Dataset:	Initial dataset
Corridor ID	1f

					Avg. No. Trains Per Day	*Train Time-of-Day Distribution*
Corridor Name	2018 Constr- ction Tr- cp uSU- r			*Passenger*	0.0	5 ni9rm
Technology Factors	0.f 0	0.f 0	0.f 0	*Freight*	2.f	5 ni9rm
Signal Synchronization?	False			*Switch*	0.0	5 ni9rm

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

Calc- lated: 23uSeUu201f f :f k Um

	Fatal	Injury	PDO	Total
Base	0.001804	0.027834	0.08283f	0.1083kk
Alternate	0.000f 40	0.004f 6k	0.0268f 0	0.073k8k

CROSSING DATA FOR THE 2018 CONSTRUCTION TRUC- KSPUR CORRIDOR

MileUost 0.6k — Crossing ID 101812K — Accidents in f Years: 0

DescriUtion BNSF uWEYERHA5 SER TBR

Paved? Tr- e	5 rban? Tr- e
GCX Base TyUe	Passive
Sa9ety S- U. TyUe	None
GCX Alt TyUe	Lights
Sa9ety S- U. tyUe	None
No. RR Tracps	1

Train SUeeds (mUh)	
Max Timetable	10.0
Passenger	10.0
Freight	f .0
Switch	7.0

Highway Tra9c Characteristics	*Base*	*Alternate*
H'way Lanes	2	2.0
Dist 9rom hway	0.10	0.1
AADT	2,8f 0	2,8f 0
A- to TOD Dist	5 ni9rm	5 ni9rm
Percent Tr- cps	f .0	f .0
O9this, % trailers	0.0	0.0
Tr- cp TOD Dist	5 ni9rm	5 ni9rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni9rm	5 ni9rm

Costs in '000 $ o9Hway ImUrovement: 0.0

Predicted Ann- al Accidents	*Base*	*Alternate*
Fatal	0.00077	0.00008
Inj- ry	0.0037f	0.0010k
PDO	0.01376	0.007f k
Total	0.01k03	0.00346

Costs in '000 $	*Base*	*Alternate*
Grade Crossing Devices		
O&M	0.2	1.8
Oth. Lcycle	0.0	0.0
CaUital		43.8
S- UUlementary Sa9ety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

MileUost 2.68 — Crossing ID 101826T — Accidents in f Years: 0

DescriUtion BNSF u7RD AVE

Paved? Tr- e	5 rban? Tr- e
GCX Base TyUe	Gates
Sa9ety S- U. TyUe	None
GCX Alt TyUe	New Technology 1
Sa9ety S- U. tyUe	None
No. RR Tracps	2

Train SUeeds (mUh)	
Max Timetable	8.0
Passenger	8.0
Freight	8.0
Switch	7.0

Highway Tra9c Characteristics	*Base*	*Alternate*
H'way Lanes	3	3.0
Dist 9rom hway	0.10	0.1
AADT	14,8f 0	14,8f 0
A- to TOD Dist	5 ni9rm	5 ni9rm
Percent Tr- cps	1f .0	1f .0
O9this, % trailers	0.0	0.0
Tr- cp TOD Dist	5 ni9rm	5 ni9rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni9rm	5 ni9rm

Costs in '000 $ o9Hway ImUrovement: 0.0

Predicted Ann- al Accidents	*Base*	*Alternate*
Fatal	0.0002k	0.0001f
Inj- ry	0.00314	0.00208
PDO	0.016f 8	0.0082k
Total	0.02103	0.010f 2

Costs in '000 $	*Base*	*Alternate*
Grade Crossing Devices		
O&M	2.f	f .0
Oth. Lcycle	0.0	0.0
CaUital		280.0
S- UUlementary Sa9ety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

CROSSING DATA FOR THE 2018 CONSTRUCTION TRUC- KSPUR CORRIDOR

MileUost 2.4k — Crossing ID 101821J

DescriUtion BNSF uCALIFORNIA WAY

Paved? Tr- e	5 rban? Tr- e
GCX Base TyUe	Lights
Sa9ety S- U. TyUe	None
GCX Alt TyUe	Gates
Sa9ety S- U. tyUe	None
No. RR Tracps	1

Train SUeeds (mUh)	
Max Timetable	10.0
Passenger	10.0
Freight	8.0
Switch	7.0

Accidents in f Years: 0

Highway Tra9ic Characteristics	Base	Alternate
H'way Lanes	2	2.0
Dist 9rom hway	0.10	0.1
AADT	3,0f 0	3,0f 0
A- to TOD Dist	5 ni9orm	5 ni9orm
Percent Tr- cps	4.0	4.0
O9this, % trailers	0.0	0.0
Tr- cp TOD Dist	5 ni9orm	5 ni9orm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni9orm	5 ni9orm

Costs in '000 $ o9Hway ImUrovement: 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.00014	0.00002
Inj- ry	0.0022f	0.0002f
PDO	0.00437	0.00082
Total	0.00k83	0.00108

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	1.8	2.f
Oth. Lcycle	0.0	0.0
CaUital		106.1
S- UUlementary Sa9ety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

MileUost 7.64 — Crossing ID 10180f A

DescriUtion BNSF uOREGON WAY

Paved? Tr- e	5 rban? Tr- e
GCX Base TyUe	Gates
Sa9ety S- U. TyUe	None
GCX Alt TyUe	New Technology 1
Sa9ety S- U. tyUe	None
No. RR Tracps	1

Train SUeeds (mUh)	
Max Timetable	10.0
Passenger	10.0
Freight	10.0
Switch	7.0

Accidents in f Years: 0

Highway Tra9ic Characteristics	Base	Alternate
H'way Lanes	3	3.0
Dist 9rom hway	0.10	0.1
AADT	1f ,6f 0	1f ,6f 0
A- to TOD Dist	5 ni9orm	5 ni9orm
Percent Tr- cps	f .0	f .0
O9this, % trailers	0.0	0.0
Tr- cp TOD Dist	5 ni9orm	5 ni9orm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni9orm	5 ni9orm

Costs in '000 $ o9Hway ImUrovement: 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.00071	0.00016
Inj- ry	0.00317	0.00206
PDO	0.01767	0.00682
Total	0.01808	0.00k03

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	2.f	f .0
Oth. Lcycle	0.0	0.0
CaUital		280.0
S- UUlementary Sa9ety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

MileUost 7.88 — Crossing ID 101806G

DescriUtion BNSF uIND5 STRIAL WAY

Paved? Tr- e	5 rban? Tr- e
GCX Base TyUe	Lights
Sa9ety S- U. TyUe	None
GCX Alt TyUe	Gates
Sa9ety S- U. tyUe	None
No. RR Tracps	1

Train SUeeds (mUh)	
Max Timetable	10.0
Passenger	10.0
Freight	10.0
Switch	7.0

Accidents in f Years: 0

Highway Tra9ic Characteristics	Base	Alternate
H'way Lanes	2	2.0
Dist 9rom hway	0.10	0.1
AADT	12,000	12,000
A- to TOD Dist	5 ni9orm	5 ni9orm
Percent Tr- cps	1f .0	1f .0
O9this, % trailers	0.0	0.0
Tr- cp TOD Dist	5 ni9orm	5 ni9orm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni9orm	5 ni9orm

Costs in '000 $ o9Hway ImUrovement: 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.00023	0.00007
Inj- ry	0.00727	0.0007f
PDO	0.0106f	0.00114
Total	0.01312	0.001f f

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	1.8	2.f
Oth. Lcycle	0.0	0.0
CaUital		106.1
S- UUlementary Sa9ety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

CROSSING DATA FOR THE 2018 CONSTRUCTION TRUC- KSPUR CORRIDOR

MileUost f .0f — Crossing ID 10180kC

DescriUtion BNSF uWEYERHA5 SER TBR

Paved? Tr- e	5 rban? Tr- e
GCX Base TyUe	Passive
Sa9ety S- U. TyUe	None
GCX Alt TyUe	Lights
Sa9ety S- U. tyUe	None
No. RR Tracps	1

Train SUeeds (mUh)	
Max Timetable	10.0
Passenger	10.0
Freight	10.0
Switch	7.0

Accidents in f Years: 0

Highway Tra9ic Characteristics	Base	Alternate
H'way Lanes	2	2.0
Dist 9rom hway	0.10	0.1
AADT	6f 0	6f 0
A- to TOD Dist	5 ni9orm	5 ni9orm
Percent Tr- cps	f .0	f .0
O9this, % trailers	0.0	0.0
Tr- cp TOD Dist	5 ni9orm	5 ni9orm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni9orm	5 ni9orm

Costs in '000 $ o9Hway ImUrovement: 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.00021	0.0000f
Inj- ry	0.00247	0.00068
PDO	0.00k02	0.00226
Total	0.011k6	0.002kk

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	0.2	1.8
Oth. Lcycle	0.0	0.0
CaUital		43.8
S- UUlementary Sa9ety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

MileUost 6.34 — Crossing ID 1018145

DescriUtion BNSF uREYNOLDS AL5 M

Paved? Tr- e	5 rban? Tr- e
GCX Base TyUe	Lights
Sa9ety S- U. TyUe	None
GCX Alt TyUe	Gates
Sa9ety S- U. tyUe	None
No. RR Tracps	2

Train SUeeds (mUh)	
Max Timetable	10.0
Passenger	10.0
Freight	8.0
Switch	7.0

Accidents in f Years: 0

Highway Tra9ic Characteristics	Base	Alternate
H'way Lanes	3	3.0
Dist 9rom hway	0.10	0.1
AADT	7,700	7,700
A- to TOD Dist	5 ni9orm	5 ni9orm
Percent Tr- cps	f .0	f .0
O9this, % trailers	0.0	0.0
Tr- cp TOD Dist	5 ni9orm	5 ni9orm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni9orm	5 ni9orm

Costs in '000 $ o9Hway ImUrovement: 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.0002f	0.0000k
Inj- ry	0.002kk	0.0010f
PDO	0.01114	0.007k1
Total	0.01332	0.00f 0f

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	1.8	2.f
Oth. Lcycle	0.0	0.0
CaUital		106.1
S- UUlementary Sa9ety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

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CORRIDOR AND CROSSING DATA

(without phased improvements)

User: kchewuk
Dataset: Initial dataset
Corridor ID 16

					Avg. No. Trains Per Day	Train Time-of-Day Distribution
Corridor Name	2018 Construction Truck - Dike					
				Passenger	0.0	Uniform
Technology Factors	0.50	0.50	0.50	*Freight*	7.0	Uniform
Signal Synchronization?	False			*Switch*	0.0	Uniform

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

Calculated: 24-Sep-2015 6:00 pm

	Fatal	Injury	PDO	Total
Base	0.000360	0.002870	0.010421	0.013651
Alternate	0.000360	0.002870	0.010421	0.013651

CROSSING DATA FOR THE 2018 CONSTRUCTION TRUC- KDI- E CORRIDOR

Milepost 13.43 Crossing ID 101791U

Accidents in 5 Years 0

Description BNSF - DIKE RD

Paved? True	Urban? False
GCX Base Type	Lights
Safety Sup. Type	None
GCX Alt Type	Lights
Safety Sup. type	None
No. RR Tracks	4

Train Speeds (mph)

Max Timetable	10.0
Passenger	10.0
Freight	10.0
Switch	3.0

Highway Traffic Characteristics

	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	950	950
Auto TOD Dist	Uniform	Uniform
Percent Trucks	12.0	12.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents

	Base	Alternate
Fatal	0.00036	0.00036
Injury	0.00287	0.00287
PDO	0.01042	0.01042
Total	0.01365	0.01365

Costs in '000 $

	Base	Alternate
Grade Crossing Devices		
O&M	1.8	1.8
Oth. Lcycle	0.0	0.0
Capital		74.8
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

FEDERAL RAILROAD ADMINISTRATION

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CORRIDOR AND CROSSING DATA

(without phased improvements)

User:	kchewuk
Dataset:	Initial dataset
Corridor ID	18

					Avg. No. Trains Per Day	Train Time-of-Day Distribution
Corridor Name	2018 Construction Rail - Spur					
				Passenger	0.0	Uniform
Technology Factors	0.50	0.50	0.50	*Freight*	4.0	Uniform
Signal Synchronization?	False			*Switch*	0.0	Uniform

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

Calculated: 24-Sep-2015 5:56 pm

	Fatal	Injury	PDO	Total
Base	0.002151	0.027464	0.095672	0.125288
Alternate	0.000682	0.008765	0.031173	0.040620

CROSSING DATA FOR THE 2018 CONSTRUCTION RAIL - SPUR CORRIDOR

Milepost 0.69 Crossing ID 101812K

Accidents in 5 Years 0

Description BNSF - WEYERHAUSER TBR

Paved? True	Urban? True
GCX Base Type	Passive
Safety Sup. Type	None
GCX Alt Type	Lights
Safety Sup. type	None
No. RR Tracks	1

Train Speeds (mph)

Max Timetable	10.0
Passenger	10.0
Freight	5.0
Switch	3.0

Highway Traffic Characteristics

	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	1,800	1,800
Auto TOD Dist	Uniform	Uniform
Percent Trucks	5.0	5.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents

	Base	Alternate
Fatal	0.00036	0.00009
Injury	0.00462	0.00116
PDO	0.01530	0.00382
Total	0.02028	0.00507

Costs in '000 $

	Base	Alternate
Grade Crossing Devices		
O&M	0.2	1.8
Oth. Lcycle	0.0	0.0
Capital		74.8
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

Milepost 2.68 Crossing ID 101826T

Accidents in 5 Years 0

Description BNSF - 3RD AVE

Paved? True	Urban? True
GCX Base Type	Gates
Safety Sup. Type	None
GCX Alt Type	New Technology 1
Safety Sup. type	None
No. RR Tracks	2

Train Speeds (mph)

Max Timetable	8.0
Passenger	8.0
Freight	8.0
Switch	3.0

Highway Traffic Characteristics

	Base	Alternate
H'way Lanes	4	4.0
Dist from hway	0.10	0.1
AADT	17,200	17,200
Auto TOD Dist	Uniform	Uniform
Percent Trucks	15.0	15.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents

	Base	Alternate
Fatal	0.00035	0.00018
Injury	0.00485	0.00243
PDO	0.01934	0.00967
Total	0.02454	0.01227

Costs in '000 $

	Base	Alternate
Grade Crossing Devices		
O&M	2.5	5.0
Oth. Lcycle	0.0	0.0
Capital		280.0
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

CROSSING DATA FOR THE 2018 CONSTRUCTION RAIL - SPUR CORRIDOR

Milepost 2.79 Crossing ID 101821J

Description BNSF - CALIFORNIA WAY

Paved? True	Urban? True
GCX Base Type	Lights
Safety Sup. Type	None
GCX Alt Type	Gates
Safety Sup. type	None
No. RR Tracks	1

Train Speeds (mph)	
Max Timetable	10.0
Passenger	10.0
Freight	8.0
Switch	3.0

Accidents in 5 Years 0

Highway Traffic Characteristics	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	4,050	4,050
Auto TOD Dist	Uniform	Uniform
Percent Trucks	7.0	7.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00021	0.00002
Injury	0.00263	0.00029
PDO	0.00871	0.00096
Total	0.01155	0.00127

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	1.8	2.5
Oth. Lcycle	0.0	0.0
Capital		106.1
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

Milepost 3.67 Crossing ID 101805A

Description BNSF - OREGON WAY

Paved? True	Urban? True
GCX Base Type	Gates
Safety Sup. Type	None
GCX Alt Type	New Technology 1
Safety Sup. type	None
No. RR Tracks	1

Train Speeds (mph)	
Max Timetable	10.0
Passenger	10.0
Freight	10.0
Switch	3.0

Accidents in 5 Years 0

Highway Traffic Characteristics	Base	Alternate
H'way Lanes	4	4.0
Dist from hway	0.10	0.1
AADT	15,650	15,650
Auto TOD Dist	Uniform	Uniform
Percent Trucks	5.0	5.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00038	0.00019
Injury	0.00488	0.00244
PDO	0.01615	0.00807
Total	0.02141	0.01071

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	2.5	5.0
Oth. Lcycle	0.0	0.0
Capital		280.0
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

Milepost 3.88 Crossing ID 101806G

Description BNSF - INDUSTRIAL WAY

Paved? True	Urban? True
GCX Base Type	Lights
Safety Sup. Type	None
GCX Alt Type	Gates
Safety Sup. type	None
No. RR Tracks	1

Train Speeds (mph)	
Max Timetable	10.0
Passenger	10.0
Freight	10.0
Switch	3.0

Accidents in 5 Years 0

Highway Traffic Characteristics	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	11,200	11,200
Auto TOD Dist	Uniform	Uniform
Percent Trucks	15.0	15.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00029	0.00003
Injury	0.00365	0.00040
PDO	0.01207	0.00133
Total	0.01600	0.00176

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	1.8	2.5
Oth. Lcycle	0.0	0.0
Capital		106.1
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

CROSSING DATA FOR THE 2018 CONSTRUCTION RAIL - SPUR CORRIDOR

Milepost 5.05 Crossing ID 101809C

Description BNSF - WEYERHAUSER TBR

Paved? True	Urban? True
GCX Base Type	Passive
Safety Sup. Type	None
GCX Alt Type	Lights
Safety Sup. type	None
No. RR Tracks	1

Train Speeds (mph)	
Max Timetable	10.0
Passenger	10.0
Freight	10.0
Switch	3.0

Accidents in 5 Years 0

Highway Traffic Characteristics	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	650	650
Auto TOD Dist	Uniform	Uniform
Percent Trucks	5.0	5.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00027	0.00007
Injury	0.00338	0.00085
PDO	0.01119	0.00280
Total	0.01484	0.00371

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	0.2	1.8
Oth. Lcycle	0.0	0.0
Capital		74.8
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

Milepost 6.47 Crossing ID 101817U

Description BNSF - REYNOLDS ALUM

Paved? True	Urban? True
GCX Base Type	Lights
Safety Sup. Type	None
GCX Alt Type	Gates
Safety Sup. type	None
No. RR Tracks	2

Train Speeds (mph)	
Max Timetable	10.0
Passenger	10.0
Freight	8.0
Switch	3.0

Accidents in 5 Years 0

Highway Traffic Characteristics	Base	Alternate
H'way Lanes	4	4.0
Dist from hway	0.10	0.1
AADT	3,300	3,300
Auto TOD Dist	Uniform	Uniform
Percent Trucks	5.0	5.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00030	0.00010
Injury	0.00345	0.00121
PDO	0.01291	0.00452
Total	0.01666	0.00583

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	1.8	2.5
Oth. Lcycle	0.0	0.0
Capital		106.1
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

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CORRIDOR AND CROSSING DATA

(without phased improvements)

User: -chewu-
Dataset: Initial dataset
Corridor ID 16

					Avg. No. Trains Per Day	Train Time-of-Day Distribution
Corridor Name	2018 Construction Rail kDi- e					
				Passenger	0.0	Uniform
Technology Factors	0.50	0.50	0.50	*Freight*	8.0	Uniform
Signal Synchronization?	False			*Switch*	0.0	Uniform

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

Calculated: 24kSepk2015 5:53 pm

	Fatal	Injury	PDO	Total
Base	0.000736	0.002661	0.010834	0.014244
Alternate	0.000736	0.002661	0.010834	0.014244

CROSSING DATA FOR THE 2018 CONSTRUCTION RAIL - DIKE CORRIDOR

Milepost 17.47 Crossing ID 101361U Accidents in 5 Years 0

Description BNSF kDIKE RD

Paved? True	Urban? False
GCX Base Type	Lights
Safety Sup. Type	None
GCX Alt Type	Lights
Safety Sup. type	None
No. RR Trac- s	4

Train Speeds (mph)

Max Timetable	10.0
Passenger	10.0
Freight	10.0
Switch	7.0

Highway Traffic Characteristics

	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	650	650
Auto TOD Dist	Uniform	Uniform
Percent Truc- s	12.0	12.0
Of this, % trailers	0.0	0.0
Truc- TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents

	Base	Alternate
Fatal	0.00078	0.00078
Injury	0.00266	0.00266
PDO	0.01083	0.01083
Total	0.01424	0.01424

Costs in '000 $

	Base	Alternate
Grade Crossing Devices		
O&M	1.8	1.8
Oth. Lcycle	0.0	0.0
Capital		34.8
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

FEDERAL RAILROAD ADMINISTRATION

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CORRIDOR AND CROSSING DATA

(8 ithout Uhased imUrovements)

5 ser:	- che8 u-
Dataset:	Initial dataset
Corridor ID	2f

					Avg. No. Trains Per Day	*Train Time-of-Day Distribution*
Corridor Name	2021 No Action 8 Current Trac- pSUur			*Passenger*	0.0	5 ni4brm
Technology Factors	0.70	0.70	0.70	*Freight*	6.0	5 ni4brm
Signal Synchronization?	False			*Switch*	0.0	5 ni4brm

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

Calculated: 26pSeUp20f 7 w.0k Um

	Fatal	Injury	PDO	Total
Base	0.002079	0.023213	0.09f 9kk	0.f 20w2f
Alternate	0.000333	0.001771	0.0w07k9	0.0w9102

CROSSING DATA FOR THE 2028 NO ACTION W CURRENT TRACK - SPUR CORRIDOR

MileUost 0.39 Crossing ID f 0f 1f 2K

DescriUtion BNSF pWEYERHA5 SER TBR

Paved? True	5 rban? True
GCX Base TyUe	Passive
Sa4ety SuU. TyUe	None
GCX Alt TyUe	Lights
Sa4ety SuU. tyUe	None
No. RR Trac- s	f

Train SUeeds (mUh)	
Max Timetable	f 0.0
Passenger	f 0.0
Freight	7.0
S8 itch	w.0

Accidents in 7 Years 0

High8 ay Tra4ic Characteristics	*Base*	*Alternate*
H'8 ay Lanes	2	2.0
Dist 4om h8 ay	0.f 0	0.f
AADT	270	270
Auto TOD Dist	5 ni4brm	5 ni4brm
Percent Truc- s	7.0	7.0
O4this, % trailers	0.0	0.0
Truc- TOD Dist	5 ni4brm	5 ni4brm
Percent Bus	0.0	0.0
Bus TOD Dist	5 ni4brm	5 ni4brm

Costs in '000 $ o4H8 ay ImUrovement 0.0

Predicted Annual Accidents	*Base*	*Alternate*
Fatal	0.000f 9	0.00007
Injury	0.00261	0.00032
PDO	0.00122	0.00207
Total	0.0f 090	0.002k2

Costs in '000 $	*Base*	*Alternate*
Grade Crossing Devices		
O&M	0.2	f .1
Oth. Lcycle	0.0	0.0
CaUital		k6.1
SuUUlementary Sa4ety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

MileUost 2.31 Crossing ID f 0f 123T

DescriUtion BNSF pwRD AVE

Paved? True	5 rban? True
GCX Base TyUe	Gates
Sa4ety SuU. TyUe	None
GCX Alt TyUe	Ne8 Technology f
Sa4ety SuU. tyUe	None
No. RR Trac- s	2

Train SUeeds (mUh)	
Max Timetable	1.0
Passenger	1.0
Freight	1.0
S8 itch	w.0

Accidents in 7 Years 0

High8 ay Tra4ic Characteristics	*Base*	*Alternate*
H'8 ay Lanes	6	6.0
Dist 4om h8 ay	0.f 0	0.f
AADT	20,700	20,700
Auto TOD Dist	5 ni4brm	5 ni4brm
Percent Truc- s	f 7.0	f 7.0
O4this, % trailers	0.0	0.0
Truc- TOD Dist	5 ni4brm	5 ni4brm
Percent Bus	0.0	0.0
Bus TOD Dist	5 ni4brm	5 ni4brm

Costs in '000 $ o4H8 ay ImUrovement 0.0

Predicted Annual Accidents	*Base*	*Alternate*
Fatal	0.000wk	0.000f 1
Injury	0.00706	0.00272
PDO	0.020f 0	0.0f 007
Total	0.02770	0.0f 2k7

Costs in '000 $	*Base*	*Alternate*
Grade Crossing Devices		
O&M	2.7	7.0
Oth. Lcycle	0.0	0.0
CaUital		210.0
SuUUlementary Sa4ety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

CROSSING DATA FOR THE 2028 NO ACTION W CURRENT TRACK - SPUR CORRIDOR

MileUost 2.k9 Crossing ID f 0f 12f J

DescriUtion BNSF pCALIFORNIA WAY

Paved? True	5 rban? True
GCX Base TyUe	Lights
Sa4ety SuU. TyUe	None
GCX Alt TyUe	Gates
Sa4ety SuU. tyUe	None
No. RR Trac- s	f

Train SUeeds (mUh)	
Max Timetable	f 0.0
Passenger	f 0.0
Freight	1.0
S8 itch	w.0

Accidents in 7 Years 0

High8 ay Tra44c Characteristics	Base	Alternate
H'8 ay Lanes	2	2.0
Dist 4om h8 ay	0.f 0	0.f
AADT	6,100	6,100
Auto TOD Dist	5 ni4brm	5 ni4brm
Percent Truc- s	k.0	k.0
O4this, % trailers	0.0	0.0
Truc- TOD Dist	5 ni4brm	5 ni4brm
Percent Bus	0.0	0.0
Bus TOD Dist	5 ni4brm	5 ni4brm

Costs in '000 $ o4H8 ay ImUrovement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00022	0.00002
Injury	0.002k9	0.000wf
PDO	0.00922	0.00f 0f
Total	0.0f 222	0.00f w6

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	f .1	2.7
Oth. Lcycle	0.0	0.0
CaUital		f 03.f
SuUUlementary Sa4ety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

MileUost w.3k Crossing ID f 0f 107A

DescriUtion BNSF pOREGON WAY

Paved? True	5 rban? True
GCX Base TyUe	Gates
Sa4ety SuU. TyUe	None
GCX Alt TyUe	Ne8 Technology f
Sa4ety SuU. tyUe	None
No. RR Trac- s	f

Train SUeeds (mUh)	
Max Timetable	f 0.0
Passenger	f 0.0
Freight	f 0.0
S8 itch	w.0

Accidents in 7 Years 0

High8 ay Tra44c Characteristics	Base	Alternate
H'8 ay Lanes	6	6.0
Dist 4om h8 ay	0.f 0	0.f
AADT	f 1,700	f 1,700
Auto TOD Dist	5 ni4brm	5 ni4brm
Percent Truc- s	7.0	7.0
O4this, % trailers	0.0	0.0
Truc- TOD Dist	5 ni4brm	5 ni4brm
Percent Bus	0.0	0.0
Bus TOD Dist	5 ni4brm	5 ni4brm

Costs in '000 $ o4H8 ay ImUrovement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00060	0.00020
Injury	0.0070k	0.0027w
PDO	0.0f 3k1	0.001w9
Total	0.02226	0.0f f f 2

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	2.7	7.0
Oth. Lcycle	0.0	0.0
CaUital		210.0
SuUUlementary Sa4ety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

MileUost w.11 Crossing ID f 0f 103G

DescriUtion BNSF pIND5 STRIAL WAY

Paved? True	5 rban? True
GCX Base TyUe	Lights
Sa4ety SuU. TyUe	None
GCX Alt TyUe	Gates
Sa4ety SuU. tyUe	None
No. RR Trac- s	f

Train SUeeds (mUh)	
Max Timetable	f 0.0
Passenger	f 0.0
Freight	f 0.0
S8 itch	w.0

Accidents in 7 Years 0

High8 ay Tra44c Characteristics	Base	Alternate
H'8 ay Lanes	2	2.0
Dist 4om h8 ay	0.f 0	0.f
AADT	f f ,670	f f ,670
Auto TOD Dist	5 ni4brm	5 ni4brm
Percent Truc- s	f 7.0	f 7.0
O4this, % trailers	0.0	0.0
Truc- TOD Dist	5 ni4brm	5 ni4brm
Percent Bus	0.0	0.0
Bus TOD Dist	5 ni4brm	5 ni4brm

Costs in '000 $ o4H8 ay ImUrovement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00029	0.0000w
Injury	0.00w3k	0.00060
PDO	0.0f 2f 7	0.00f w6
Total	0.0f 3f 0	0.00f kk

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	f .1	2.7
Oth. Lcycle	0.0	0.0
CaUital		f 03.f
SuUUlementary Sa4ety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

CROSSING DATA FOR THE 2028 NO ACTION W CURRENT TRACK - SPUR CORRIDOR

MileUost 7.07 Crossing ID f 0f 109C

DescriUtion BNSF pWEYERHA5 SER TBR

Paved? True	5 rban? True
GCX Base TyUe	Passive
Sa4ety SuU. TyUe	None
GCX Alt TyUe	Lights
Sa4ety SuU. tyUe	None
No. RR Trac- s	f

Train SUeeds (mUh)	
Max Timetable	f 0.0
Passenger	f 0.0
Freight	f 0.0
S8 itch	w.0

Accidents in 7 Years 0

High8 ay Tra44c Characteristics	Base	Alternate
H'8 ay Lanes	2	2.0
Dist 4om h8 ay	0.f 0	0.f
AADT	100	100
Auto TOD Dist	5 ni4brm	5 ni4brm
Percent Truc- s	7.0	7.0
O4this, % trailers	0.0	0.0
Truc- TOD Dist	5 ni4brm	5 ni4brm
Percent Bus	0.0	0.0
Bus TOD Dist	5 ni4brm	5 ni4brm

Costs in '000 $ o4H8 ay ImUrovement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00021	0.0000k
Injury	0.00w3f	0.00090
PDO	0.0f f 97	0.00299
Total	0.0f 716	0.00w93

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	0.2	f .1
Oth. Lcycle	0.0	0.0
CaUital		k6.1
SuUUlementary Sa4ety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

MileUost 3.6k Crossing ID f 0f 1f k5

DescriUtion BNSF pREYNOLDS AL5 M

Paved? True	5 rban? True
GCX Base TyUe	Lights
Sa4ety SuU. TyUe	None
GCX Alt TyUe	Gates
Sa4ety SuU. tyUe	None
No. RR Trac- s	2

Train SUeeds (mUh)	
Max Timetable	f 0.0
Passenger	f 0.0
Freight	1.0
S8 itch	w.0

Accidents in 7 Years 0

High8 ay Tra44c Characteristics	Base	Alternate
H'8 ay Lanes	6	6.0
Dist 4om h8 ay	0.f 0	0.f
AADT	w,900	w,900
Auto TOD Dist	5 ni4brm	5 ni4brm
Percent Truc- s	7.0	7.0
O4this, % trailers	0.0	0.0
Truc- TOD Dist	5 ni4brm	5 ni4brm
Percent Bus	0.0	0.0
Bus TOD Dist	5 ni4brm	5 ni4brm

Costs in '000 $ o4H8 ay ImUrovement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.000wf	0.000f f
Injury	0.00w3w	0.00f 2k
PDO	0.0f w7k	0.006k7
Total	0.0f k7f	0.003f w

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	f .1	2.7
Oth. Lcycle	0.0	0.0
CaUital		f 03.f
SuUUlementary Sa4ety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

FEDERAL RAILROAD ADMINISTRATION

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CORRIDOR AND CROSSING DATA

(without phased improvements)

User:	kchewuk
Dataset:	Initial dataset
Corridor ID	22

					Avg. No. Trains Per Day	Train Time-of-Day Distribution
Corridor Name	2028 No Action w Current Track - Dike					
				Passenger	0.0	Uniform
Technology Factors	0.50	0.50	0.50	*Freight*	7.0	Uniform
Signal Synchronization?	False			*Switch*	0.0	Uniform

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

Calculated: 24-Sep-2015 3:10 pm

	Fatal	Injury	PDO	Total
Base	0.000377	0.003008	0.010919	0.014303
Alternate	0.000377	0.003008	0.010919	0.014303

CROSSING DATA FOR THE 2028 NO ACTION W CURRENT TRACK - DIKE CORRIDOR

Milepost 13.43 Crossing ID 101791U

Accidents in 5 Years 0

Description BNSF - DIKE RD

Paved? True	Urban? False
GCX Base Type	Lights
Safety Sup. Type	None
GCX Alt Type	Lights
Safety Sup. type	None
No. RR Tracks	4

Train Speeds (mph)

Max Timetable	10.0
Passenger	10.0
Freight	10.0
Switch	3.0

Highway Traffic Characteristics

	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	1,100	1,100
Auto TOD Dist	Uniform	Uniform
Percent Trucks	12.0	12.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents

	Base	Alternate
Fatal	0.00038	0.00038
Injury	0.00301	0.00301
PDO	0.01092	0.01092
Total	0.01430	0.01430

Costs in '000 $

	Base	Alternate
Grade Crossing Devices		
O&M	1.8	1.8
Oth. Lcycle	0.0	0.0
Capital		74.8
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

FEDERAL RAILROAD ADMINISTRATION

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CORRIDOR AND CROSSING DATA

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4 ser(	- che8 f -
Dataset(	Initial dataset
Corridor ID	25

					Avg. No. Trains Per Day	Train Time-of-Day Distribution
Corridor Name	2021 No Action 8 ulanned Trac- pSUf r			Passenger	0.0	4 ni7orm
Technology Factors	0.50	0.50	0.50	Freight	6.0	4 ni7orm
Signal Synchronization?	False			Switch	0.0	4 ni7orm

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

Calcf lated(26pSeUp20k5 5(23 Um

	Fatal	Injury	PDO	Total
Base	0.002059	0.023213	0.09k9ww	0.k20: 2k
Alternate	0.000333	0.001551	0.0: 05w9	0.0: 9102

CROSSING DATA FOR THE 2028 NO ACTION W PLANNED TRACK - SPUR CORRIDOR

b ileUost 0.39 Crossing ID k0k1k2K Accidents in 5 Years 0

DescriUtion BNSF pWEYERHA4 SER TBR

ua) ed? Trf e	4 rPan? Trf e
GCX Base TyUe	uassi) e
Sa7ety Sf U. TyUe	None
GCX Alt TyUe	Lights
Sa7ety Sf U. tyUe	None
No. RR Trac- s	k

Train SUeeds vmUhM	
b ax TimetaPle	k0.0
uassenger	k0.0
Freight	5.0
S8 itch	: .0

High8 ay Tra7fc Characteristics	Base	Alternate
H'8 ay Lanes	2	2.0
Dist 7rom h8 ay	0.k0	0.k
AADT	250	250
Af to TOD Dist	4 ni7orm	4 ni7orm
uercent Trf c- s	5.0	5.0
O7this, % trailers	0.0	0.0
Trf c- TOD Dist	4 ni7orm	4 ni7orm
uercent Bf s	0.0	0.0
Bf s TOD Dist	4 ni7orm	4 ni7orm

Costs in '000 $ o7H8 ay ImUro) ement 0.0

uredicted Annf al Accidents	Base	Alternate
Fatal	0.000k9	0.00005
Injf ry	0.00261	0.00032
uDO	0.00122	0.00205
Total	0.0k090	0.002w2

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
O&b	0.2	k.1
Oth. Lcycle	0.0	0.0
CaUital		w6.1
Sf UUlementary Sa7ety		
O&b	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

b ileUost 2.31 Crossing ID k0k123T Accidents in 5 Years 0

DescriUtion BNSF p: RD AVE

ua) ed? Trf e	4 rPan? Trf e
GCX Base TyUe	Gates
Sa7ety Sf U. TyUe	None
GCX Alt TyUe	Ne8 Technology k
Sa7ety Sf U. tyUe	None
No. RR Trac- s	2

Train SUeeds vmUhM	
b ax TimetaPle	1.0
uassenger	1.0
Freight	k5.0
S8 itch	: .0

High8 ay Tra7fc Characteristics	Base	Alternate
H'8 ay Lanes	6	6.0
Dist 7rom h8 ay	0.k0	0.k
AADT	20,500	20,500
Af to TOD Dist	4 ni7orm	4 ni7orm
uercent Trf c- s	k5.0	k5.0
O7this, % trailers	0.0	0.0
Trf c- TOD Dist	4 ni7orm	4 ni7orm
uercent Bf s	0.0	0.0
Bf s TOD Dist	4 ni7orm	4 ni7orm

Costs in '000 $ o7H8 ay ImUro) ement 0.0

uredicted Annf al Accidents	Base	Alternate
Fatal	0.000: w	0.000k1
Injf ry	0.00506	0.00252
uDO	0.020k0	0.0k005
Total	0.02550	0.0k2w5

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
O&b	2.5	5.0
Oth. Lcycle	0.0	0.0
CaUital		210.0
Sf UUlementary Sa7ety		
O&b	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

CROSSING DATA FOR THE 2028 NO ACTION W PLANNED TRACK - SPUR CORRIDOR

b ileUost 2.w9 Crossing ID k0k12kJ

DescriUtion BNSF pCALIFORNIA WAY

ua)ed? Trf e	4 rPan? Trf e
GCX Base TyUe	Lights
Sa7ety Sf U. TyUe	None
GCX Alt TyUe	Gates
Sa7ety Sf U. tyUe	None
No. RR Trac-s	k

Train SUeeds vmUhM	
b ax TimetaPle	k0.0
uassenger	k0.0
Freight	k5.0
S8itch	: .0

Accidents in 5 Years 0

High8ay Tra77ic Characteristics	Base	Alternate
H'8ay Lanes	2	2.0
Dist 7rom h8ay	0.k0	0.k
AADT	6,100	6,100
Af to TOD Dist	4 ni7orm	4 ni7orm
uercent Trf c-s	w.0	w.0
O7this, % trailers	0.0	0.0
Trf c- TOD Dist	4 ni7orm	4 ni7orm
uercent Bf s	0.0	0.0
Bf s TOD Dist	4 ni7orm	4 ni7orm

Costs in '000 $ o7H8ay ImUro)ement 0.0

uredicted Annf al Accidents	Base	Alternate
Fatal	0.00022	0.00002
Injf ry	0.002w9	0.000: k
uDO	0.00922	0.00k0k
Total	0.0k222	0.00k: 6

Costs in '000 $	Base	Alternate
Grade Crossing De)ices		
O&b	k.1	2.5
Oth. Lcycle	0.0	0.0
CaUital		k03.k
Sf UUlementary Sa7ety		
O&b	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

b ileUost : .3w Crossing ID k0k105A

DescriUtion BNSF pOREGON WAY

ua)ed? Trf e	4 rPan? Trf e
GCX Base TyUe	Gates
Sa7ety Sf U. TyUe	None
GCX Alt TyUe	Ne8 Technology k
Sa7ety Sf U. tyUe	None
No. RR Trac-s	k

Train SUeeds vmUhM	
b ax TimetaPle	k0.0
uassenger	k0.0
Freight	20.0
S8itch	: .0

Accidents in 5 Years 0

High8ay Tra77ic Characteristics	Base	Alternate
H'8ay Lanes	6	6.0
Dist 7rom h8ay	0.k0	0.k
AADT	k1,500	k1,500
Af to TOD Dist	4 ni7orm	4 ni7orm
uercent Trf c-s	5.0	5.0
O7this, % trailers	0.0	0.0
Trf c- TOD Dist	4 ni7orm	4 ni7orm
uercent Bf s	0.0	0.0
Bf s TOD Dist	4 ni7orm	4 ni7orm

Costs in '000 $ o7H8ay ImUro)ement 0.0

uredicted Annf al Accidents	Base	Alternate
Fatal	0.00060	0.00020
Injf ry	0.0050w	0.0025:
uDO	0.0k3w1	0.001: 9
Total	0.02226	0.0kkk2

Costs in '000 $	Base	Alternate
Grade Crossing De)ices		
O&b	2.5	5.0
Oth. Lcycle	0.0	0.0
CaUital		210.0
Sf UUlementary Sa7ety		
O&b	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

b ileUost : .11 Crossing ID k0k103G

DescriUtion BNSF pIND4STRIAL WAY

ua)ed? Trf e	4 rPan? Trf e
GCX Base TyUe	Lights
Sa7ety Sf U. TyUe	None
GCX Alt TyUe	Gates
Sa7ety Sf U. tyUe	None
No. RR Trac-s	k

Train SUeeds vmUhM	
b ax TimetaPle	k0.0
uassenger	k0.0
Freight	20.0
S8itch	: .0

Accidents in 5 Years 0

High8ay Tra77ic Characteristics	Base	Alternate
H'8ay Lanes	2	2.0
Dist 7rom h8ay	0.k0	0.k
AADT	kk,650	kk,650
Af to TOD Dist	4 ni7orm	4 ni7orm
uercent Trf c-s	k5.0	k5.0
O7this, % trailers	0.0	0.0
Trf c- TOD Dist	4 ni7orm	4 ni7orm
uercent Bf s	0.0	0.0
Bf s TOD Dist	4 ni7orm	4 ni7orm

Costs in '000 $ o7H8ay ImUro)ement 0.0

uredicted Annf al Accidents	Base	Alternate
Fatal	0.00029	0.0000:
Injf ry	0.00: 3w	0.00060
uDO	0.0k2k5	0.00k: 6
Total	0.0k3k0	0.00kww

Costs in '000 $	Base	Alternate
Grade Crossing De)ices		
O&b	k.1	2.5
Oth. Lcycle	0.0	0.0
CaUital		k03.k
Sf UUlementary Sa7ety		
O&b	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

CROSSING DATA FOR THE 2028 NO ACTION W PLANNED TRACK - SPUR CORRIDOR

b ileUost 5.05 Crossing ID k0k109C

DescriUtion BNSF pWEYERHA4 SER TBR

ua)ed? Trf e	4 rPan? Trf e
GCX Base TyUe	uassi)e
Sa7ety Sf U. TyUe	None
GCX Alt TyUe	Lights
Sa7ety Sf U. tyUe	None
No. RR Trac-s	k

Train SUeeds vmUhM	
b ax TimetaPle	k0.0
uassenger	k0.0
Freight	k5.0
S8itch	:.0

Accidents in 5 Years 0

High8ay Tra77ic Characteristics	Base	Alternate
H'8ay Lanes	2	2.0
Dist 7rom h8ay	0.k0	0.k
AADT	100	100
Af to TOD Dist	4 ni7orm	4 ni7orm
uercent Trf c-s	5.0	5.0
O7this, % trailers	0.0	0.0
Trf c- TOD Dist	4 ni7orm	4 ni7orm
uercent Bf s	0.0	0.0
Bf s TOD Dist	4 ni7orm	4 ni7orm

Costs in '000 $ o7H8ay ImUro)ement 0.0

uredicted Annf al Accidents	Base	Alternate
Fatal	0.00021	0.0000w
Injf ry	0.00:3k	0.00090
uDO	0.0kk95	0.00299
Total	0.0k516	0.00:93

Costs in '000 $	Base	Alternate
Grade Crossing De)ices		
O&b	0.2	k.1
Oth. Lcycle	0.0	0.0
CaUital		w6.1
Sf UUlementary Sa7ety		
O&b	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

b ileUost 3.6w Crossing ID k0k1kw4

DescriUtion BNSF pREYNOLDS AL4 b

ua)ed? Trf e	4 rPan? Trf e
GCX Base TyUe	Lights
Sa7ety Sf U. TyUe	None
GCX Alt TyUe	Gates
Sa7ety Sf U. tyUe	None
No. RR Trac-s	2

Train SUeeds vmUhM	
b ax TimetaPle	k0.0
uassenger	k0.0
Freight	k0.0
S8itch	:.0

Accidents in 5 Years 0

High8ay Tra77ic Characteristics	Base	Alternate
H'8ay Lanes	6	6.0
Dist 7rom h8ay	0.k0	0.k
AADT	:,900	:,900
Af to TOD Dist	4 ni7orm	4 ni7orm
uercent Trf c-s	5.0	5.0
O7this, % trailers	0.0	0.0
Trf c- TOD Dist	4 ni7orm	4 ni7orm
uercent Bf s	0.0	0.0
Bf s TOD Dist	4 ni7orm	4 ni7orm

Costs in '000 $ o7H8ay ImUro)ement 0.0

uredicted Annf al Accidents	Base	Alternate
Fatal	0.000:k	0.000kk
Injf ry	0.00:3:	0.00k2w
uDO	0.0k:5w	0.006w5
Total	0.0kw5k	0.003k:

Costs in '000 $	Base	Alternate
Grade Crossing De)ices		
O&b	k.1	2.5
Oth. Lcycle	0.0	0.0
CaUital		k03.k
Sf UUlementary Sa7ety		
O&b	0.0	0.0
Oth. Lcycle	0.0	0.0
CaUital		0.0

FEDERAL RAILROAD ADMINISTRATION

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CORRIDOR AND CROSSING DATA

)8 ithopt vhased imvroMementsb

User(	kche8 pk
Dataset(	Initial dataset
Corridor ID	26

					Avg. No. Trains Per Day	Train Time-of-Day Distribution
Corridor Name	2021 No Action 8 ulanned Track - Dike					
				Passenger	0.0	Uniform
Technology Factors	0.50	0.50	0.50	*Freight*	7.0	Uniform
Signal Synchronization?	False			*Switch*	0.0	Uniform

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

Calcplated(2: -Sev-2045 3(40 vm

	Fatal	Injury	PDO	Total
Base	0.000377	0.003001	0.040w4w	0.04: 303
Alternate	0.000377	0.003001	0.040w4w	0.04: 303

CROSSING DATA FOR THE 2028 NO ACTION W PLANNED TRACK - DIKE CORRIDOR

P ilevost 43.: 3 Crossing ID 4047w4U Accidents in 5 j ears 0

Descrivtion KNSF - DIOE RD

uaMed? Trpe	UrXan? False
GCB Kase Tyve	Yights
Safety Spv. Tyve	None
GCB Alt Tyve	Yights
Safety Spv. tyve	None
No. RR Tracks	:

Train Sveeds)mvhb

P a, TimetaXle	40.0
uassenger	40.0
Freight	40.0
S8 itch	3.0

' igh8 ay Traffic Characteristics

	Base	Alternate
' l8 ay Yanes	2	2.0
Dist from h8 ay	0.40	0.4
AADT	4%400	4%400
Apto THD Dist	Uniform	Uniform
uercent Trpcks	42.0	42.0
Hf this%9 trailers	0.0	0.0
Trpck THD Dist	Uniform	Uniform
uercent Kps	0.0	0.0
Kps THD Dist	Uniform	Uniform

Costs in l000 & of ' 8 ay ImvroMement 0.0

uredicted Annpal Accidents

	Base	Alternate
Fatal	0.00031	0.00031
In$pry	0.00304	0.00304
uDH	0.040w2	0.040w2
Total	0.04: 30	0.04: 30

Costs in l000 &

	Base	Alternate
Grade Crossing DeMces		
HxP	4.1	4.1
Hth. Ycycle	0.0	0.0
Cavital		7: .1
Spvvlementary Safety		
HxP	0.0	0.0
Hth. Ycycle	0.0	0.0
Cavital		0.0

FEDERAL RAILROAD ADMINISTRATION

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CORRIDOR AND CROSSING DATA

vu itho- t f hased imf ro) ementsM

4 ser(	pcheu - p
Dataset(	Initial dataset
Corridor ID	25

					Avg. No. Trains Per Day	Train Time-of-Day Distribution
Corridor Name	2021 8 n Site Alt u C- rrent Tracp USf - r					
				Passenger	0.0	4 ni7orm
Technology Factors	0.60	0.60	0.60	*Freight*	20.0	4 ni7orm
Signal Synchronization?	False			*Switch*	0.0	4 ni7orm

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

Calc- lated(29USef U20w6 6(9: f m

	Fatal	Injury	PDO	Total
Base	0.009233	0.09k399	0.w. : 259	0.2wk1k0
Alternate	0.00wk29	0.0w53: 3	0.0: 192:	0.0156w9

CROSSING DATA FOR THE 2028 ON SITE ALT W CURRENT TRACK - SPUR CORRIDOR

b ilef ost 0.: 5 Crossing ID w0w1w2K Accidents in 6 Hears 0

Descrif tion WNSF UY EHEROA4 SER TWR

Xa) ed? Tr- e	4 rPan? Tr- e
GCB Wase Tyf e	Xassi) e
Sa7ety S- f . Tyf e	None
GCB Alt Tyf e	Lights
Sa7ety S- f . tyf e	None
No. RR Tracps	w

Train Sf eeds vmf hM	
b ax TimetaPle	w0.0
Xassenger	w0.0
Freight	6.0
Su itch	3.0

Oighu ay Tra7fc Characteristics	Base	Alternate
O'u ay Lanes	2	2.0
Dist 7rom hu ay	0.w0	0.w
AADT	w,390	w,390
A- to T8 D Dist	4 ni7orm	4 ni7orm
Xercent Tr- cps	6.0	6.0
8 7this, % trailers	0.0	0.0
Tr- cp T8 D Dist	4 ni7orm	4 ni7orm
Xercent W- s	0.0	0.0
W- s T8 D Dist	4 ni7orm	4 ni7orm

Costs in '000 $ o7Ou ay Imf ro) ement 0.0

Xredicted Ann- al Accidents	Base	Alternate
Fatal	0.000kw	0.00021
Inj- ry	0.00k5k	0.003ww
XD8	0.02: : 6	0.0w035
Total	0.03633	0.0w3k1

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
8 &b	0.2	w.1
8 th. Lcycle	0.0	0.0
Caf ital		k9.1
S- f f lementary Sa7ety		
8 &b	0.0	0.0
8 th. Lcycle	0.0	0.0
Caf ital		0.0

b ilef ost 2.: 1 Crossing ID w0w12: T Accidents in 6 Hears 0

Descrif tion WNSF U3RD AVE

Xa) ed? Tr- e	4 rPan? Tr- e
GCB Wase Tyf e	Gates
Sa7ety S- f . Tyf e	None
GCB Alt Tyf e	Neu Technology w
Sa7ety S- f . tyf e	None
No. RR Tracps	2

Train Sf eeds vmf hM	
b ax TimetaPle	1.0
Xassenger	1.0
Freight	1.0
Su itch	3.0

Oighu ay Tra7fc Characteristics	Base	Alternate
O'u ay Lanes	9	9.0
Dist 7rom hu ay	0.w0	0.w
AADT	20,k20	20,k20
A- to T8 D Dist	4 ni7orm	4 ni7orm
Xercent Tr- cps	w6.0	w6.0
8 7this, % trailers	0.0	0.0
Tr- cp T8 D Dist	4 ni7orm	4 ni7orm
Xercent W- s	0.0	0.0
W- s T8 D Dist	4 ni7orm	4 ni7orm

Costs in '000 $ o7Ou ay Imf ro) ement 0.0

Xredicted Ann- al Accidents	Base	Alternate
Fatal	0.000: 1	0.00039
Inj- ry	0.001wk	0.00901
XD8	0.03211	0.0w: 99
Total	0.09wk2	0.0201:

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
8 &b	2.6	6.0
8 th. Lcycle	0.0	0.0
Caf ital		210.0
S- f f lementary Sa7ety		
8 &b	0.0	0.0
8 th. Lcycle	0.0	0.0
Caf ital		0.0

CROSSING DATA FOR THE 2028 ON SITE ALT W CURRENT TRACK - SPUR CORRIDOR

b ilef ost 2.k5 Crossing ID w0w12wJ

Accidents in 6 Hears 0

Descrif tion WNSF UCALIF8 RNIA Y AH

Xa) ed? Tr- e	4 rPan? Tr- e
GCB Wase Tyf e	Lights
Sa7ety S- f . Tyf e	None
GCB Alt Tyf e	Gates
Sa7ety S- f . tyf e	None
No. RR Tracps	w

Train Sf eeds vmf hM	
b ax TimetaPle	w0.0
Xassenger	w0.0
Freight	1.0
Su itch	3.0

Oighu ay Tra77ic Characteristics	Base	Alternate
O'u ay Lanes	2	2.0
Dist 7rom hu ay	0.w0	0.w
AADT	9,100	9,100
A- to T8 D Dist	4 ni7orm	4 ni7orm
Xercent Tr- cps	k.0	k.0
8 7this, % trailers	0.0	0.0
Tr- cp T8 D Dist	4 ni7orm	4 ni7orm
Xercent W- s	0.0	0.0
W- s T8 D Dist	4 ni7orm	4 ni7orm

Costs in '000 $ o7Ou ay Imf ro) ement 0.0

Xredicted Ann- al Accidents	Base	Alternate
Fatal	0.00090	0.000w3
Inj- ry	0.0096w	0.00w90
XD8	0.0w60k	0.009: k
Total	0.0w551	0.00: w5

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
8 &b	w.1	2.6
8 th. Lcycle	0.0	0.0
Caf ital		w0: .w
S- f f lementary Sa7ety		
8 &b	0.0	0.0
8 th. Lcycle	0.0	0.0
Caf ital		0.0

b ilef ost 3.: k Crossing ID w0w106A

Accidents in 6 Hears 0

Descrif tion WNSF U8 REG8 N Y AH

Xa) ed? Tr- e	4 rPan? Tr- e
GCB Wase Tyf e	Gates
Sa7ety S- f . Tyf e	None
GCB Alt Tyf e	Neu Technology w
Sa7ety S- f . tyf e	None
No. RR Tracps	w

Train Sf eeds vmf hM	
b ax TimetaPle	w0.0
Xassenger	w0.0
Freight	w0.0
Su itch	3.0

Oighu ay Tra77ic Characteristics	Base	Alternate
O'u ay Lanes	9	9.0
Dist 7rom hu ay	0.w0	0.w
AADT	w1,kk0	w1,kk0
A- to T8 D Dist	4 ni7orm	4 ni7orm
Xercent Tr- cps	6.0	6.0
8 7this, % trailers	0.0	0.0
Tr- cp T8 D Dist	4 ni7orm	4 ni7orm
Xercent W- s	0.0	0.0
W- s T8 D Dist	4 ni7orm	4 ni7orm

Costs in '000 $ o7Ou ay Imf ro) ement 0.0

Xredicted Ann- al Accidents	Base	Alternate
Fatal	0.000k:	0.00031
Inj- ry	0.0019:	0.00923
XD8	0.02125	0.0w9w9
Total	0.03k60	0.0w1k6

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
8 &b	2.6	6.0
8 th. Lcycle	0.0	0.0
Caf ital		210.0
S- f f lementary Sa7ety		
8 &b	0.0	0.0
8 th. Lcycle	0.0	0.0
Caf ital		0.0

b ilef ost 3.11 Crossing ID w0w10: G

Accidents in 6 Hears 0

Descrif tion WNSF UIND4 STRIAL Y AH

Xa) ed? Tr- e	4 rPan? Tr- e
GCB Wase Tyf e	Lights
Sa7ety S- f . Tyf e	None
GCB Alt Tyf e	Gates
Sa7ety S- f . tyf e	None
No. RR Tracps	w

Train Sf eeds vmf hM	
b ax TimetaPle	w0.0
Xassenger	w0.0
Freight	w0.0
Su itch	3.0

Oighu ay Tra77ic Characteristics	Base	Alternate
O'u ay Lanes	2	2.0
Dist 7rom hu ay	0.w0	0.w
AADT	w2,w00	w2,w00
A- to T8 D Dist	4 ni7orm	4 ni7orm
Xercent Tr- cps	w6.0	w6.0
8 7this, % trailers	0.0	0.0
Tr- cp T8 D Dist	4 ni7orm	4 ni7orm
Xercent W- s	0.0	0.0
W- s T8 D Dist	4 ni7orm	4 ni7orm

Costs in '000 $ o7Ou ay Imf ro) ement 0.0

Xredicted Ann- al Accidents	Base	Alternate
Fatal	0.0006w	0.000w:
Inj- ry	0.006k9	0.00wk1
XD8	0.0w5w1	0.00656
Total	0.02693	0.00k11

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
8 &b	w.1	2.6
8 th. Lcycle	0.0	0.0
Caf ital		w0: .w
S- f f lementary Sa7ety		
8 &b	0.0	0.0
8 th. Lcycle	0.0	0.0
Caf ital		0.0

CROSSING DATA FOR THE 2028 ON SITE ALT W CURRENT TRACK - SPUR CORRIDOR

b ilef ost 6.06 Crossing ID w0w105C

Accidents in 6 Hears 0

Descrif tion WNSF UY EHEROA4 SER TWR

Xa) ed? Tr- e	4 rPan? Tr- e
GCB Wase Tyf e	Xassi) e
Sa7ety S- f . Tyf e	None
GCB Alt Tyf e	Lights
Sa7ety S- f . tyf e	None
No. RR Tracps	w

Train Sf eeds vmf hM	
b ax TimetaPle	w0.0
Xassenger	w0.0
Freight	w0.0
Su itch	3.0

Oighu ay Tra77ic Characteristics	Base	Alternate
O'u ay Lanes	2	2.0
Dist 7rom hu ay	0.w0	0.w
AADT	100	100
A- to T8 D Dist	4 ni7orm	4 ni7orm
Xercent Tr- cps	6.0	6.0
8 7this, % trailers	0.0	0.0
Tr- cp T8 D Dist	4 ni7orm	4 ni7orm
Xercent W- s	0.0	0.0
W- s T8 D Dist	4 ni7orm	4 ni7orm

Costs in '000 $ o7Ou ay Imf ro) ement 0.0

Xredicted Ann- al Accidents	Base	Alternate
Fatal	0.000: 3	0.00029
Inj- ry	0.00k0w	0.002k3
XD8	0.02393	0.005w9
Total	0.03w0k	0.0w2w2

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
8 &b	0.2	w.1
8 th. Lcycle	0.0	0.0
Caf ital		k9.1
S- f f lementary Sa7ety		
8 &b	0.0	0.0
8 th. Lcycle	0.0	0.0
Caf ital		0.0

b ilef ost : .9k Crossing ID w0w1wk4

Accidents in 6 Hears 0

Descrif tion WNSF UREHN8 LDS AL4 b

Xa) ed? Tr- e	4 rPan? Tr- e
GCB Wase Tyf e	Lights
Sa7ety S- f . Tyf e	None
GCB Alt Tyf e	Gates
Sa7ety S- f . tyf e	None
No. RR Tracps	2

Train Sf eeds vmf hM	
b ax TimetaPle	w0.0
Xassenger	w0.0
Freight	1.0
Su itch	3.0

Oighu ay Tra77ic Characteristics	Base	Alternate
O'u ay Lanes	9	9.0
Dist 7rom hu ay	0.w0	0.w
AADT	3,500	3,500
A- to T8 D Dist	4 ni7orm	4 ni7orm
Xercent Tr- cps	6.0	6.0
8 7this, % trailers	0.0	0.0
Tr- cp T8 D Dist	4 ni7orm	4 ni7orm
Xercent W- s	0.0	0.0
W- s T8 D Dist	4 ni7orm	4 ni7orm

Costs in '000 $ o7Ou ay Imf ro) ement 0.0

Xredicted Ann- al Accidents	Base	Alternate
Fatal	0.00069	0.00020
Inj- ry	0.00695	0.00203
XD8	0.020k5	0.00k: 5
Total	0.02: 13	0.00553

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
8 &b	w.1	2.6
8 th. Lcycle	0.0	0.0
Caf ital		w0: .w
S- f f lementary Sa7ety		
8 &b	0.0	0.0
8 th. Lcycle	0.0	0.0
Caf ital		0.0

FEDERAL RAILROAD ADMINISTRATION

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CORRIDOR AND CROSSING DATA

(u ithokt phased improvements)

User: - cheu k-
Dataset: Initial dataset
Corridor ID 21

					Avg. No. Trains Per Day	Train Time-of-Day Distribution
Corridor Name	2021 8 n Site Alt u Ckrrent Trac- 6Di- e					
				Passenger	0.0	Uniform
Technology Factors	0.50	0.50	0.50	*Freight*	27.0	Uniform
Signal Synchronization?	False			*Switch*	0.0	Uniform

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

Calcklated: 246Sep620w5 5:44 pm

	Fatal	Injury	PDO	Total
Base	0.000513	0.004223	0.0w5542	0.020753
Alternate	0.000513	0.004223	0.0w5542	0.020753

CROSSING DATA FOR THE 2028 ON SITE ALT W CURRENT TRACK - DIKE CORRIDOR

Milepost w7.47 Crossing ID w0w%3wU Accidents in 5 L ears 0

Description BNSF 6DIKE RD

Paved? Trke	Urban? False
GCX Base Type	' ights
Safety Skp. Type	None
GCX Alt Type	' ights
Safety Skp. type	None
No. RR Trac- s	4

Train Speeds (mph)

Ma& Timetable	w0.0
Passenger	w0.0
Freight	w0.0
Su itch	7.0

Oighu ay Traffic Characteristics

	Base	Alternate
Old ay ' anes	2	2.0
Dist from hu ay	0.w0	0.w
AADT	wxw00	wxw00
Akto T8 D Dist	Uniform	Uniform
Percent Trkc- s	w2.0	w2.0
8 f thisx, trailers	0.0	0.0
Trkc- T8 D Dist	Uniform	Uniform
Percent Bks	0.0	0.0
Bks T8 D Dist	Uniform	Uniform

Costs in l000 j of Ou ay Improvement 0.0

Predicted Annkal Accidents

	Base	Alternate
Fatal	0.00053	0.00053
In¥ry	0.00427	0.00427
PD8	0.0w554	0.0w554
Total	0.02079	0.02079

Costs in l000 j

	Base	Alternate
Grade Crossing Devices		
8 $M	w.1	w.1
8 th. ' cycle	0.0	0.0
Capital		%4.1
Skpplementary Safety		
8 $M	0.0	0.0
8 th. ' cycle	0.0	0.0
Capital		0.0

FEDERAL RAILROAD ADMINISTRATION

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CORRIDOR AND CROSSING DATA

Mitho4t 5hased im5robementsP

6ser)	Ucheu 4U
Dataset)	Initial dataset
Corridor ID	70

					Avg. No. Trains Per Day	Train Time-of-Day Distribution
Corridor Name	2021 8 n Site Alt u - planned TracUf S54r			Passenger	0.0	6 ni9orm
Technology Factors	0.30	0.30	0.30	Freight	20.0	6 ni9orm
Signal Synchronization?	False			Switch	0.0	6 ni9orm

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

Calc4lated) 2kfSe5f20: 3 3)33 5m

	Fatal	Injury	PDO	Total
Base	0.00k277	0.0kw7kk	0.: ((2vk	0.2: w1w0
Alternate	0.00: w2k	0.0: v7(7	0.0(1k2(	0.01v3: k

CROSSING DATA FOR THE 2028 ON SITE ALT W/ PLANNED TRACK - SPUR CORRIDOR

X ile5ost 0.(v — Crossing ID : 0: 1: 2V

Descri5tion YNSF f H EOER' A6 SER TYR

pabed? Tr4e	6 rBan? Tr4e
GCWYase Ty5e	passibe
Sa9ety S45. Ty5e	None
GCWAlt Ty5e	j ights
Sa9ety S45. ty5e	None
No. RR TracUs	:

Train S5eeds Mn5hP	
X a, TimetaBle	: 0.0
passenger	: 0.0
Freight	3.0
Su itch	7.0

Accidents in 3 Oears 0

' ighu ay Tra9ic Characteristics	Base	Alternate
' lu ay j anes	2	2.0
Dist 9rom hu ay	0.: 0	0.:
AADT	: %k0	: %k0
A4to T8 D Dist	6 ni9orm	6 ni9orm
percent Tr4cUs	3.0	3.0
8 9this%K trailers	0.0	0.0
Tr4cUT8 D Dist	6 ni9orm	6 ni9orm
percent Y4s	0.0	0.0
Y4s T8 D Dist	6 ni9orm	6 ni9orm

Costs in l000 & o9' u ay Im5robement 0.0

predicted Ann4al Accidents	Base	Alternate
Fatal	0.000w.	0.00021
In$ry	0.00ww	0.007: :
pD8	0.02((3	0.0: 07v
Total	0.07377	0.0: 7w1

Costs in l000 &	Base	Alternate
Grade Crossing Debices		
8 x X	0.2	: .1
8 th. j cycle	0.0	0.0
Ca5ital		wk.1
S455lementary Sa9ety		
8 x X	0.0	0.0
8 th. j cycle	0.0	0.0
Ca5ital		0.0

X ile5ost 2.(1 — Crossing ID : 0: 12(T

Descri5tion YNSF f 7RD A/ E

pabed? Tr4e	6 rBan? Tr4e
GCWYase Ty5e	Gates
Sa9ety S45. Ty5e	None
GCWAlt Ty5e	Neu Technology :
Sa9ety S45. ty5e	None
No. RR TracUs	2

Train S5eeds Mn5hP	
X a, TimetaBle	1.0
passenger	1.0
Freight	: 3.0
Su itch	7.0

Accidents in 3 Oears 0

' ighu ay Tra9ic Characteristics	Base	Alternate
' lu ay j anes	k	k.0
Dist 9rom hu ay	0.: 0	0.:
AADT	20%k20	20%k20
A4to T8 D Dist	6 ni9orm	6 ni9orm
percent Tr4cUs	: 3.0	: 3.0
8 9this%K trailers	0.0	0.0
Tr4cUT8 D Dist	6 ni9orm	6 ni9orm
percent Y4s	0.0	0.0
Y4s T8 D Dist	6 ni9orm	6 ni9orm

Costs in l000 & o9' u ay Im5robement 0.0

predicted Ann4al Accidents	Base	Alternate
Fatal	0.000(1	0.0007k
In$ry	0.001: w	0.00k01
pD8	0.07211	0.0: (kk
Total	0.0k: w2	0.0201(

Costs in l000 &	Base	Alternate
Grade Crossing Debices		
8 x X	2.3	3.0
8 th. j cycle	0.0	0.0
Ca5ital		210.0
S455lementary Sa9ety		
8 x X	0.0	0.0
8 th. j cycle	0.0	0.0
Ca5ital		0.0

CROSSING DATA FOR THE 2028 ON SITE ALT W/ PLANNED TRACK - SPUR CORRIDOR

X ile5ost 2.ww Crossing ID : 0: 12: J

Descri5tion YNSF f CAj IF8 RNIA H AO

pabed? Tr4e	6 rBan? Tr4e
GCWYase Ty5e	j ights
Sa9ety S45. Ty5e	None
GCWAlt Ty5e	Gates
Sa9ety S45. ty5e	None
No. RR TracUs	:

Train S5eeds Mh5hP	
X a, TimetaBle	: 0.0
passenger	: 0.0
Freight	: 3.0
Su itch	7.0

Accidents in 3 Oears 0

' ighu ay Tra9ic Characteristics	Base	Alternate
' lu ay j anes	2	2.0
Dist 9rom hu ay	0.: 0	0.:
AADT	k%00	k%00
A4to T8 D Dist	6 ni9orm	6 ni9orm
percent Tr4cUs	w.0	w.0
8 9this%K trailers	0.0	0.0
Tr4cUT8 D Dist	6 ni9orm	6 ni9orm
percent Y4s	0.0	0.0
Y4s T8 D Dist	6 ni9orm	6 ni9orm

Costs in l000 & o9' u ay Im5robement 0.0

predicted Ann4al Accidents	Base	Alternate
Fatal	0.000k0	0.000: 7
In$ry	0.00k3:	0.00: k0
pD8	0.0: 30w	0.00k(w
Total	0.0: vv1	0.00(: v

Costs in l000 &	Base	Alternate
Grade Crossing Debices		
8 x X	: .1	2.3
8 th. j cycle	0.0	0.0
Ca5ital		: 0(.:
S455lementary Sa9ety		
8 x X	0.0	0.0
8 th. j cycle	0.0	0.0
Ca5ital		0.0

X ile5ost 7.(w Crossing ID : 0: 103A

Descri5tion YNSF f 8 REG8 N H AO

pabed? Tr4e	6 rBan? Tr4e
GCWYase Ty5e	Gates
Sa9ety S45. Ty5e	None
GCWAlt Ty5e	Neu Technology :
Sa9ety S45. ty5e	None
No. RR TracUs	:

Train S5eeds Mh5hP	
X a, TimetaBle	: 0.0
passenger	: 0.0
Freight	20.0
Su itch	7.0

Accidents in 3 Oears 0

' ighu ay Tra9ic Characteristics	Base	Alternate
' lu ay j anes	k	k.0
Dist 9rom hu ay	0.: 0	0.:
AADT	: 1%w0	: 1%w0
A4to T8 D Dist	6 ni9orm	6 ni9orm
percent Tr4cUs	3.0	3.0
8 9this%K trailers	0.0	0.0
Tr4cUT8 D Dist	6 ni9orm	6 ni9orm
percent Y4s	0.0	0.0
Y4s T8 D Dist	6 ni9orm	6 ni9orm

Costs in l000 & o9' u ay Im5robement 0.0

predicted Ann4al Accidents	Base	Alternate
Fatal	0.000w(	0.00071
In$ry	0.001k(	0.00k27
pD8	0.0212v	0.0: k: k
Total	0.07w30	0.0: 1w3

Costs in l000 &	Base	Alternate
Grade Crossing Debices		
8 x X	2.3	3.0
8 th. j cycle	0.0	0.0
Ca5ital		210.0
S455lementary Sa9ety		
8 x X	0.0	0.0
8 th. j cycle	0.0	0.0
Ca5ital		0.0

X ile5ost 7.11 Crossing ID : 0: 10(G

Descri5tion YNSF f IND6 STRIAj H AO

pabed? Tr4e	6 rBan? Tr4e
GCWYase Ty5e	j ights
Sa9ety S45. Ty5e	None
GCWAlt Ty5e	Gates
Sa9ety S45. ty5e	None
No. RR TracUs	:

Train S5eeds Mh5hP	
X a, TimetaBle	: 0.0
passenger	: 0.0
Freight	20.0
Su itch	7.0

Accidents in 3 Oears 0

' ighu ay Tra9ic Characteristics	Base	Alternate
' lu ay j anes	2	2.0
Dist 9rom hu ay	0.: 0	0.:
AADT	: 2%00	: 2%00
A4to T8 D Dist	6 ni9orm	6 ni9orm
percent Tr4cUs	: 3.0	: 3.0
8 9this%K trailers	0.0	0.0
Tr4cUT8 D Dist	6 ni9orm	6 ni9orm
percent Y4s	0.0	0.0
Y4s T8 D Dist	6 ni9orm	6 ni9orm

Costs in l000 & o9' u ay Im5robement 0.0

predicted Ann4al Accidents	Base	Alternate
Fatal	0.0003:	0.000: (
In$ry	0.003wk	0.00: w1
pD8	0.0: v: 1	0.003v3
Total	0.023k7	0.00w11

Costs in l000 &	Base	Alternate
Grade Crossing Debices		
8 x X	: .1	2.3
8 th. j cycle	0.0	0.0
Ca5ital		: 0(.:
S455lementary Sa9ety		
8 x X	0.0	0.0
8 th. j cycle	0.0	0.0
Ca5ital		0.0

CROSSING DATA FOR THE 2028 ON SITE ALT W/ PLANNED TRACK - SPUR CORRIDOR

X ile5ost 3.03 Crossing ID : 0: 10vC

Descri5tion YNSF f H EOER' A6 SER TYR

pabed? Tr4e	6 rBan? Tr4e
GCWYase Ty5e	passibe
Sa9ety S45. Ty5e	None
GCWAlt Ty5e	j ights
Sa9ety S45. ty5e	None
No. RR TracUs	:

Train S5eeds Mh5hP	
X a, TimetaBle	: 0.0
passenger	: 0.0
Freight	: 3.0
Su itch	7.0

Accidents in 3 Oears 0

' ighu ay Tra9c Characteristics	Base	Alternate
' lu ay j anes	2	2.0
Dist 9rom hu ay	0.: 0	0.:
AADT	100	100
A4to T8 D Dist	6 ni9orm	6 ni9orm
percent Tr4cUs	3.0	3.0
8 9this%K trailers	0.0	0.0
Tr4cUT8 D Dist	6 ni9orm	6 ni9orm
percent Y4s	0.0	0.0
Y4s T8 D Dist	6 ni9orm	6 ni9orm

Costs in l000 & o9' u ay Im5robement 0.0

predicted Ann4al Accidents	Base	Alternate
Fatal	0.000(7	0.0002k
In$4ry	0.00w0:	0.002w7
pD8	0.027k7	0.00v: k
Total	0.07: 0w	0.0: 2: 2

Costs in l000 &	Base	Alternate
Grade Crossing Debices		
8 x X	0.2	: .1
8 th. j cycle	0.0	0.0
Ca5ital		wk.1
S455lementary Sa9ety		
8 x X	0.0	0.0
8 th. j cycle	0.0	0.0
Ca5ital		0.0

X ile5ost (.kw Crossing ID : 0: 1: w6

Descri5tion YNSF f REON8 j DS Aj 6 X

pabed? Tr4e	6 rBan? Tr4e
GCWYase Ty5e	j ights
Sa9ety S45. Ty5e	None
GCWAlt Ty5e	Gates
Sa9ety S45. ty5e	None
No. RR TracUs	2

Train S5eeds Mh5hP	
X a, TimetaBle	: 0.0
passenger	: 0.0
Freight	: 0.0
Su itch	7.0

Accidents in 3 Oears 0

' ighu ay Tra9c Characteristics	Base	Alternate
' lu ay j anes	k	k.0
Dist 9rom hu ay	0.: 0	0.:
AADT	7%00	7%00
A4to T8 D Dist	6 ni9orm	6 ni9orm
percent Tr4cUs	3.0	3.0
8 9this%K trailers	0.0	0.0
Tr4cUT8 D Dist	6 ni9orm	6 ni9orm
percent Y4s	0.0	0.0
Y4s T8 D Dist	6 ni9orm	6 ni9orm

Costs in l000 & o9' u ay Im5robement 0.0

predicted Ann4al Accidents	Base	Alternate
Fatal	0.0003k	0.00020
In$4ry	0.003kv	0.00207
pD8	0.020ww	0.00w(v
Total	0.02(17	0.00vv7

Costs in l000 &	Base	Alternate
Grade Crossing Debices		
8 x X	: .1	2.3
8 th. j cycle	0.0	0.0
Ca5ital		: 0(.:
S455lementary Sa9ety		
8 x X	0.0	0.0
8 th. j cycle	0.0	0.0
Ca5ital		0.0

FEDERAL RAILROAD ADMINISTRATION

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CORRIDOR AND CROSSING DATA

)u ithopt vhased imvroMementsb

7 ser(	6cheu p6
Dataset(	Initial dataset
Corridor ID	f 5

					Avg. No. Trains Per Day	Train Time-of-Day Distribution
Corridor Name	2021 8 n Site Alt u k- lanned Trac6 UDi6e			Passenger	0.0	7 ni3rm
Technology Factors	0.40	0.40	0.40	Freight	2f .0	7 ni3rm
Signal Synchronization?	False			Switch	0.0	7 ni3rm

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

Calcplated(2: USevU2054 4(42 vm

	Fatal	Injury	PDO	Total
Base	0.00041w	0.00: 22w	0.0544: 2	0.020f 4w
Alternate	0.00041w	0.00: 22w	0.0544: 2	0.020f 4w

CROSSING DATA FOR THE 2028 ON SITE ALT W/ PLANNED TRACK - DIKE CORRIDOR

P ilevost 5f .: f Crossing ID 5059w57 Accidents in 4 Years 0

Descrivtion KNSF UDIOE RD

- aMed? Trpe	7 rXan? False
GCB Kase Tyve	Lights
Sa3ety Spv. Tyve	None
GCB Alt Tyve	Lights
Sa3ety Spv. tyve	None
No. RR Trac6s	:

Train Sveeds)mvhb

P ax TimetaXle	50.0
- assenger	50.0
Freight	50.0
Su itch	f .0

Highu ay Tra3ic Characteristics

	Base	Alternate
H'u ay Lanes	2	2.0
Dist 3om hu ay	0.50	0.5
AADT	5,500	5,500
Apto T8 D Dist	7 ni3rm	7 ni3rm
- ercent Trpc6s	52.0	52.0
8 3this, % trailers	0.0	0.0
Trpc6 T8 D Dist	7 ni3rm	7 ni3rm
- ercent Kps	0.0	0.0
Kps T8 D Dist	7 ni3rm	7 ni3rm

Costs in '000 $ o3Hu ay ImvroMement 0.0

- redicted Annpal Accidents

	Base	Alternate
Fatal	0.0004w	0.0004w
Injpry	0.00: 2f	0.00: 2f
- D8	0.0544:	0.0544:
Total	0.020f V	0.020f V

Costs in '000 $

	Base	Alternate
Grade Crossing DeMices		
8 &P	5.1	5.1
8 th. Lcycle	0.0	0.0
Cavital		9: .1
Spvvlementary Sa3ety		
8 &P	0.0	0.0
8 th. Lcycle	0.0	0.0
Cavital		0.0

FEDERAL RAILROAD ADMINISTRATION

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CORRIDOR AND CROSSING DATA

(without phased improvements)

User:	kchewuk
Dataset:	Initial dataset
Corridor ID	14

					Avg. No. Trains Per Day	Train Time-of-Day Distribution
Corridor Name	2018 No Action - Mainline					
				Passenger	10.0	Uniform
Technology Factors	0.50	0.50	0.50	*Freight*	45.0	Uniform
Signal Synchronization?	False			*Switch*	0.0	Uniform

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

Calculated: 28-Sep-2015 1:09 pm

	Fatal	Injury	PDO	Total
Base	0.039044	0.060936	0.160175	0.260155
Alternate	0.039044	0.060936	0.160175	0.260155

CROSSING DATA FOR THE 2018 NO ACTION - MAINLINE CORRIDOR

Milepost 82.72 Crossing ID 092481X

Accidents in 5 Years 0

Description BNSF - TAYLOR CRANE RD

Paved? False	Urban? False
GCX Base Type	Passive
Safety Sup. Type	None
GCX Alt Type	Passive
Safety Sup. type	None
No. RR Tracks	2

Train Speeds (mph)

Max Timetable	50.0
Passenger	50.0
Freight	50.0
Switch	21.0

Highway Traffic Characteristics

	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	50	50
Auto TOD Dist	Uniform	Uniform
Percent Trucks	5.0	5.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents

	Base	Alternate
Fatal	0.00239	0.00239
Injury	0.00461	0.00461
PDO	0.01032	0.01032
Total	0.01732	0.01732

Costs in '000 $

	Base	Alternate
Grade Crossing Devices		
O&M	0.2	0.2
Oth. Lcycle	0.0	0.0
Capital		1.6
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

Milepost 87.43 Crossing ID 092476B

Accidents in 5 Years 0

Description BNSF - COWLITZ AVE

Paved? True	Urban? False
GCX Base Type	Gates
Safety Sup. Type	None
GCX Alt Type	Gates
Safety Sup. type	None
No. RR Tracks	2

Train Speeds (mph)

Max Timetable	50.0
Passenger	50.0
Freight	50.0
Switch	23.7

Highway Traffic Characteristics

	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	1,200	1,200
Auto TOD Dist	Uniform	Uniform
Percent Trucks	2.0	2.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents

	Base	Alternate
Fatal	0.00379	0.00379
Injury	0.00732	0.00732
PDO	0.01638	0.01638
Total	0.02749	0.02749

Costs in '000 $

	Base	Alternate
Grade Crossing Devices		
O&M	2.5	2.5
Oth. Lcycle	0.0	0.0
Capital		106.1
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

CROSSING DATA FOR THE 2018 NO ACTION - MAINLINE CORRIDOR

Milepost 95.56 Crossing ID 092466V

Description BNSF - COWLITZ GARDEN RD

Paved? True	Urban? True
GCX Base Type	Gates
Safety Sup. Type	None
GCX Alt Type	Gates
Safety Sup. type	None
No. RR Tracks	3

Train Speeds (mph)	
Max Timetable	75.0
Passenger	75.0
Freight	60.0
Switch	15.6

Accidents in 5 Years 0

Highway Traffic Characteristics	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	700	700
Auto TOD Dist	Uniform	Uniform
Percent Trucks	10.0	10.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00393	0.00393
Injury	0.00539	0.00539
PDO	0.01803	0.01803
Total	0.02735	0.02735

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	2.5	2.5
Oth. Lcycle	0.0	0.0
Capital		106.1
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

Milepost 97.67 Crossing ID 092458D

Description BNSF - MILL STREET

Paved? True	Urban? True
GCX Base Type	Gates
Safety Sup. Type	None
GCX Alt Type	Gates
Safety Sup. type	None
No. RR Tracks	3

Train Speeds (mph)	
Max Timetable	40.0
Passenger	40.0
Freight	40.0
Switch	22.5

Accidents in 5 Years 0

Highway Traffic Characteristics	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	2,550	2,550
Auto TOD Dist	Uniform	Uniform
Percent Trucks	5.0	5.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00291	0.00291
Injury	0.00749	0.00749
PDO	0.02498	0.02498
Total	0.03538	0.03538

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	2.5	2.5
Oth. Lcycle	0.0	0.0
Capital		106.1
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

Milepost 97.98 Crossing ID 092457W

Description BNSF - YEW ST.(S RIVER)

Paved? True	Urban? True
GCX Base Type	Gates
Safety Sup. Type	None
GCX Alt Type	Gates
Safety Sup. type	None
No. RR Tracks	3

Train Speeds (mph)	
Max Timetable	40.0
Passenger	40.0
Freight	40.0
Switch	22.5

Accidents in 5 Years 0

Highway Traffic Characteristics	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	1,850	1,850
Auto TOD Dist	Uniform	Uniform
Percent Trucks	50.0	50.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00274	0.00274
Injury	0.00705	0.00705
PDO	0.02350	0.02350
Total	0.03329	0.03329

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	2.5	2.5
Oth. Lcycle	0.0	0.0
Capital		106.1
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

CROSSING DATA FOR THE 2018 NO ACTION - MAINLINE CORRIDOR

Milepost 109.60 Crossing ID 092446J

Description BNSF - TOTEFF ROAD

Paved? True	Urban? False
GCX Base Type	Gates
Safety Sup. Type	None
GCX Alt Type	Gates
Safety Sup. type	None
No. RR Tracks	2

Train Speeds (mph)	
Max Timetable	79.0
Passenger	79.0
Freight	60.0
Switch	23.7

Accidents in 5 Years 0

Highway Traffic Characteristics	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	1,200	1,200
Auto TOD Dist	Uniform	Uniform
Percent Trucks	50.0	50.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00554	0.00554
Injury	0.00662	0.00662
PDO	0.01533	0.01533
Total	0.02749	0.02749

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	2.5	2.5
Oth. Lcycle	0.0	0.0
Capital		106.1
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

Milepost 115.75 Crossing ID 092437K

Description BNSF - SCOTT AVE WEST

Paved? True	Urban? False
GCX Base Type	Gates
Safety Sup. Type	None
GCX Alt Type	Gates
Safety Sup. type	None
No. RR Tracks	2

Train Speeds (mph)	
Max Timetable	75.0
Passenger	75.0
Freight	60.0
Switch	23.7

Accidents in 5 Years 0

Highway Traffic Characteristics	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	2,650	2,650
Auto TOD Dist	Uniform	Uniform
Percent Trucks	2.0	2.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00624	0.00624
Injury	0.00790	0.00790
PDO	0.01816	0.01816
Total	0.03230	0.03230

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	2.5	2.5
Oth. Lcycle	0.0	0.0
Capital		106.1
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

Milepost 116.62 Crossing ID 092435W

Description BNSF - DAVIDSON AVE

Paved? True	Urban? False
GCX Base Type	Gates
Safety Sup. Type	None
GCX Alt Type	Gates
Safety Sup. type	None
No. RR Tracks	2

Train Speeds (mph)	
Max Timetable	75.0
Passenger	75.0
Freight	60.0
Switch	23.7

Accidents in 5 Years 0

Highway Traffic Characteristics	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	2,000	2,000
Auto TOD Dist	Uniform	Uniform
Percent Trucks	35.0	35.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00590	0.00590
Injury	0.00747	0.00747
PDO	0.01717	0.01717
Total	0.03054	0.03054

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	2.5	2.5
Oth. Lcycle	0.0	0.0
Capital		106.1
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

CROSSING DATA FOR THE 2018 NO ACTION - MAINLINE CORRIDOR

Milepost 117.50 Crossing ID 092434P

Description BNSF - WHALEN RD.

Paved? True	Urban? False
GCX Base Type	Gates
Safety Sup. Type	None
GCX Alt Type	Gates
Safety Sup. type	None
No. RR Tracks	2

Train Speeds (mph)	
Max Timetable	75.0
Passenger	75.0
Freight	60.0
Switch	23.7

Accidents in 5 Years 0

Highway Traffic Characteristics	Base	Alternate
H'way Lanes	2	2.0
Dist from hway	0.10	0.1
AADT	1,550	1,550
Auto TOD Dist	Uniform	Uniform
Percent Trucks	25.0	25.0
Of this, % trailers	0.0	0.0
Truck TOD Dist	Uniform	Uniform
Percent Bus	0.0	0.0
Bus TOD Dist	Uniform	Uniform

Costs in '000 $ of Hway Improvement 0.0

Predicted Annual Accidents	Base	Alternate
Fatal	0.00561	0.00561
Injury	0.00709	0.00709
PDO	0.01630	0.01630
Total	0.02900	0.02900

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&M	2.5	2.5
Oth. Lcycle	0.0	0.0
Capital		106.1
Supplementary Safety		
O&M	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

FEDERAL RAILROAD ADMINISTRATION

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CORRIDOR AND CROSSING DATA

(u itho- t phased improvements)

5 ser:	Mtheu - M
Dataset:	Initial dataset
Corridor ID	1f

					Avg. No. Trains Per Day	Train Time-of-Day Distribution
Corridor Name	2018 Constr- ction Tr- cM4U ainline					
				Passenger	10.0	5 ni3rm
Technology Factors	0.90	0.90	0.90	*Freight*	69.0	5 ni3rm
Signal Synchronization?	False			*Switch*	0.0	5 ni3rm

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

Calc- lated: 284Sep42019 1:2f pm

	Fatal	Injury	PDO	Total
Base	0.07k066	0.0w0k7w	0.1w01f 9	0.2w0199
Alternate	0.07k066	0.0w0k7w	0.1w01f 9	0.2w0199

CROSSING DATA FOR THE 2018 CONSTRUCTION TRUC- KMAINLINE CORRIDOR

U ilepost 82.f 2 — Crossing ID 0k2681X — Accidents in 9 Years: 0

Description BNSF 4TAYLOR CRANE RD

Paved? False	5 rban? False
GCX Base Type	Passive
Sa3ety S- p. Type	None
GCX Alt Type	Passive
Sa3ety S- p. type	None
No. RR TracMs	2

Train Speeds (mph)	
U ax Timetable	90.0
Passenger	90.0
Freight	90.0
Su itch	21.0

Highu ay Tra33c Characteristics	Base	Alternate
H'u ay Lanes	2	2.0
Dist 3om hu ay	0.10	0.1
AADT	90	90
A- to TOD Dist	5 ni3rm	5 ni3rm
Percent Tr- cMs	9.0	9.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3rm	5 ni3rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3rm	5 ni3rm

Costs in '000 $ o3Hu ay Improvement: 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.0027k	0.0027k
Inj- ry	0.006w1	0.006w1
PDO	0.01072	0.01072
Total	0.01f 72	0.01f 72

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&U	0.2	0.2
Oth. Lcycle	0.0	0.0
Capital		1.w
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

U ilepost 8f .67 — Crossing ID 0k26f wB — Accidents in 9 Years: 0

Description BNSF 4COWLITZ AVE

Paved? Tr- e	5 rban? False
GCX Base Type	Gates
Sa3ety S- p. Type	None
GCX Alt Type	Gates
Sa3ety S- p. type	None
No. RR TracMs	2

Train Speeds (mph)	
U ax Timetable	90.0
Passenger	90.0
Freight	90.0
Su itch	27.f

Highu ay Tra33c Characteristics	Base	Alternate
H'u ay Lanes	2	2.0
Dist 3om hu ay	0.10	0.1
AADT	1,200	1,200
A- to TOD Dist	5 ni3rm	5 ni3rm
Percent Tr- cMs	2.0	2.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3rm	5 ni3rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3rm	5 ni3rm

Costs in '000 $ o3Hu ay Improvement: 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.007f k	0.007f k
Inj- ry	0.00f 72	0.00f 72
PDO	0.01w78	0.01w78
Total	0.02f 6k	0.02f 6k

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&U	2.9	2.9
Oth. Lcycle	0.0	0.0
Capital		10w.1
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

CROSSING DATA FOR THE 2018 CONSTRUCTION TRUC- KMAINLINE CORRIDOR

U ilepost k9.9w — Crossing ID 0k26wwV

Description BNSF 4COWLITZ GARDEN RD

Paved? Tr- e	5 rban? Tr- e
GCX Base Type	Gates
Sa3ety S- p. Type	None
GCX Alt Type	Gates
Sa3ety S- p. type	None
No. RR TracMs	7

Train Speeds (mph)	
U ax Timetable	f 9.0
Passenger	f 9.0
Freight	w0.0
Su itch	19.w

Accidents in 9 Years 0

Highu ay Tra33c Characteristics	Base	Alternate
H'u ay Lanes	2	2.0
Dist 3om hu ay	0.10	0.1
AADT	f 00	f 00
A- to TOD Dist	5 ni3rm	5 ni3rm
Percent Tr- cMs	10.0	10.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3rm	5 ni3rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3rm	5 ni3rm

Costs in '000 $ o3Hu ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.007k7	0.007k7
Inj- ry	0.0097k	0.0097k
PDO	0.01807	0.01807
Total	0.02f 79	0.02f 79

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&U	2.9	2.9
Oth. Lcycle	0.0	0.0
Capital		10w.1
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

U ilepost kf .wf — Crossing ID 0k2698D

Description BNSF 4U ILL STREET

Paved? Tr- e	5 rban? Tr- e
GCX Base Type	Gates
Sa3ety S- p. Type	None
GCX Alt Type	Gates
Sa3ety S- p. type	None
No. RR TracMs	7

Train Speeds (mph)	
U ax Timetable	60.0
Passenger	60.0
Freight	60.0
Su itch	22.9

Accidents in 9 Years 0

Highu ay Tra33c Characteristics	Base	Alternate
H'u ay Lanes	2	2.0
Dist 3om hu ay	0.10	0.1
AADT	2,990	2,990
A- to TOD Dist	5 ni3rm	5 ni3rm
Percent Tr- cMs	9.0	9.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3rm	5 ni3rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3rm	5 ni3rm

Costs in '000 $ o3Hu ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.002k1	0.002k1
Inj- ry	0.00f 6k	0.00f 6k
PDO	0.026k8	0.026k8
Total	0.07978	0.07978

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&U	2.9	2.9
Oth. Lcycle	0.0	0.0
Capital		10w.1
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

U ilepost kf .k8 — Crossing ID 0k269f W

Description BNSF 4YEW ST.(S RIVER)

Paved? Tr- e	5 rban? Tr- e
GCX Base Type	Gates
Sa3ety S- p. Type	None
GCX Alt Type	Gates
Sa3ety S- p. type	None
No. RR TracMs	7

Train Speeds (mph)	
U ax Timetable	60.0
Passenger	60.0
Freight	60.0
Su itch	22.9

Accidents in 9 Years 0

Highu ay Tra33c Characteristics	Base	Alternate
H'u ay Lanes	2	2.0
Dist 3om hu ay	0.10	0.1
AADT	1,890	1,890
A- to TOD Dist	5 ni3rm	5 ni3rm
Percent Tr- cMs	90.0	90.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3rm	5 ni3rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3rm	5 ni3rm

Costs in '000 $ o3Hu ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.002f 6	0.002f 6
Inj- ry	0.00f 09	0.00f 09
PDO	0.02790	0.02790
Total	0.0772k	0.0772k

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&U	2.9	2.9
Oth. Lcycle	0.0	0.0
Capital		10w.1
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

CROSSING DATA FOR THE 2018 CONSTRUCTION TRUC- KMAINLINE CORRIDOR

U ilepost 10k.w0 Crossing ID 0k266wJ

Description BNSF 4TOTEFF ROAD

Paved? Tr- e	5 rban? False
GCX Base Type	Gates
Sa3ety S- p. Type	None
GCX Alt Type	Gates
Sa3ety S- p. type	None
No. RR TracMs	2

Train Speeds (mph)	
U ax Timetable	f k.0
Passenger	f k.0
Freight	w0.0
Su itch	27.f

Accidents in 9 Years 0

Highu ay Tra33c Characteristics	Base	Alternate
H'u ay Lanes	2	2.0
Dist 3om hu ay	0.10	0.1
AADT	1,200	1,200
A- to TOD Dist	5 ni3rm	5 ni3rm
Percent Tr- cMs	90.0	90.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3rm	5 ni3rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3rm	5 ni3rm

Costs in '000 $ o3Hu ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.00996	0.00996
Inj- ry	0.00ww2	0.00ww2
PDO	0.01977	0.01977
Total	0.02f 6k	0.02f 6k

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&U	2.9	2.9
Oth. Lcycle	0.0	0.0
Capital		10w.1
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

U ilepost 119.f 9 Crossing ID 0k267f K

Description BNSF 4SCOTT AVE WEST

Paved? Tr- e	5 rban? False
GCX Base Type	Gates
Sa3ety S- p. Type	None
GCX Alt Type	Gates
Sa3ety S- p. type	None
No. RR TracMs	2

Train Speeds (mph)	
U ax Timetable	f 9.0
Passenger	f 9.0
Freight	w0.0
Su itch	27.f

Accidents in 9 Years 0

Highu ay Tra33c Characteristics	Base	Alternate
H'u ay Lanes	2	2.0
Dist 3om hu ay	0.10	0.1
AADT	2,w90	2,w90
A- to TOD Dist	5 ni3rm	5 ni3rm
Percent Tr- cMs	2.0	2.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3rm	5 ni3rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3rm	5 ni3rm

Costs in '000 $ o3Hu ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.00w26	0.00w26
Inj- ry	0.00f k0	0.00f k0
PDO	0.0181w	0.0181w
Total	0.07270	0.07270

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&U	2.9	2.9
Oth. Lcycle	0.0	0.0
Capital		10w.1
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

U ilepost 11w.w2 Crossing ID 0k2679W

Description BNSF 4DAVIDSON AVE

Paved? Tr- e	5 rban? False
GCX Base Type	Gates
Sa3ety S- p. Type	None
GCX Alt Type	Gates
Sa3ety S- p. type	None
No. RR TracMs	2

Train Speeds (mph)	
U ax Timetable	f 9.0
Passenger	f 9.0
Freight	w0.0
Su itch	27.f

Accidents in 9 Years 0

Highu ay Tra33c Characteristics	Base	Alternate
H'u ay Lanes	2	2.0
Dist 3om hu ay	0.10	0.1
AADT	2,000	2,000
A- to TOD Dist	5 ni3rm	5 ni3rm
Percent Tr- cMs	79.0	79.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3rm	5 ni3rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3rm	5 ni3rm

Costs in '000 $ o3Hu ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.009k0	0.009k0
Inj- ry	0.00f 6f	0.00f 6f
PDO	0.01f 1f	0.01f 1f
Total	0.07096	0.07096

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&U	2.9	2.9
Oth. Lcycle	0.0	0.0
Capital		10w.1
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

CROSSING DATA FOR THE 2018 CONSTRUCTION TRUC- KMAINLINE CORRIDOR

U ilepost 11f .90 Crossing ID 0k2676P

Accidents in 9 Years 0

Description BNSF 4WHALEN RD.

Paved? Tr- e	5 rban? False
GCX Base Type	Gates
Sa3ety S- p. Type	None
GCX Alt Type	Gates
Sa3ety S- p. type	None
No. RR TracMs	2

Train Speeds (mph)

U ax Timetable	f 9.0
Passenger	f 9.0
Freight	w0.0
Su itch	27.f

Highu ay Tra3ic Characteristics

	Base	Alternate
H'u ay Lanes	2	2.0
Dist 3om hu ay	0.10	0.1
AADT	1,990	1,990
A- to TOD Dist	5 ni3orm	5 ni3orm
Percent Tr- cMs	29.0	29.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3orm	5 ni3orm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3orm	5 ni3orm

Costs in '000 $ o3Hu ay Improvement 0.0

Predicted Ann- al Accidents

	Base	Alternate
Fatal	0.009w1	0.009w1
Inj- ry	0.00f 0k	0.00f 0k
PDO	0.01w70	0.01w70
Total	0.02k00	0.02k00

Costs in '000 $

	Base	Alternate
Grade Crossing Devices		
O&U	2.9	2.9
Oth. Lcycle	0.0	0.0
Capital		10w.1
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

FEDERAL RAILROAD ADMINISTRATION

GRADEDEC.NET

CORRIDOR AND CROSSING DATA

(u itho- t phased improvements)

User:	wcheu - w
Dataset:	Initial dataset
Corridor ID	20

					Avg. No. Trains Per Day	Train Time-of-Day Distribution
Corridor Name	2018 Constr- ction Rail M4 ainline					
				Passenger	10.0	Uniform
Technology Factors	0.50	0.50	0.50	*Freight*	39.0	Uniform
Signal Synchronization?	False			*Switch*	0.0	Uniform

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

Calc- lated: 28 Sep 2015 1:62 pm

	Fatal	Injury	PDO	Total
Base	0.067627	0.091252	0.191128	0.291k07
Alternate	0.067627	0.091252	0.191128	0.291k07

CROSSING DATA FOR THE 2018 CONSTRUCTION RAIL - MAINLINE CORRIDOR

4 ilepost 82.k2 — Crossing ID 072381X

Description BNSF MTAYLOR CRANE RD

Paved? False	Urban? False
GCX Base Type	Passive
Safety S- p. Type	None
GCX Alt Type	Passive
Safety S- p. type	None
No. RR Tracws	2

Train Speeds (mph)	
4 ax Timetable	50.0
Passenger	50.0
Freight	50.0
Su itch	21.0

Accidents in 5 Years: 0

Highu ay Traffic Characteristics	Base	Alternate
H'u ay Lanes	2	2.0
Dist from hu ay	0.10	0.1
AADT	50	50
A- to TOD Dist	Uniform	Uniform
Percent Tr- cws	5.0	5.0
Of this, % trailers	0.0	0.0
Tr- cw TOD Dist	Uniform	Uniform
Percent B- s	0.0	0.0
B- s TOD Dist	Uniform	Uniform

Costs in '000 $ of Hu ay Improvement: 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.00231	0.00231
Inj- ry	0.00393	0.00393
PDO	0.01031	0.01031
Total	0.01k39	0.01k39

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&4	0.2	0.2
Oth. Lcycle	0.0	0.0
Capital		1.9
S- pplementary Safety		
O&4	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

4 ilepost 8k.36 — Crossing ID 0723k9B

Description BNSF MCOWLITZ AVE

Paved? Tr- e	Urban? False
GCX Base Type	Gates
Safety S- p. Type	None
GCX Alt Type	Gates
Safety S- p. type	None
No. RR Tracws	2

Train Speeds (mph)	
4 ax Timetable	50.0
Passenger	50.0
Freight	50.0
Su itch	26.k

Accidents in 5 Years: 0

Highu ay Traffic Characteristics	Base	Alternate
H'u ay Lanes	2	2.0
Dist from hu ay	0.10	0.1
AADT	1,200	1,200
A- to TOD Dist	Uniform	Uniform
Percent Tr- cws	2.0	2.0
Of this, % trailers	0.0	0.0
Tr- cw TOD Dist	Uniform	Uniform
Percent B- s	0.0	0.0
B- s TOD Dist	Uniform	Uniform

Costs in '000 $ of Hu ay Improvement: 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.00682	0.00682
Inj- ry	0.00k69	0.00k69
PDO	0.01938	0.01938
Total	0.02k99	0.02k99

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&4	2.5	2.5
Oth. Lcycle	0.0	0.0
Capital		109.1
S- pplementary Safety		
O&4	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

CROSSING DATA FOR THE 2018 CONSTRUCTION RAIL - MAINLINE CORRIDOR

4 ilepost 75.59 Crossing ID 072399V

Description BNSF MCOWLITZ GARDEN RD

Paved? Tr- e	Urban? Tr- e
GCX Base Type	Gates
Safety S- p. Type	None
GCX Alt Type	Gates
Safety S- p. type	None
No. RR Tracws	6

Train Speeds (mph)	
4 ax Timetable	k5.0
Passenger	k5.0
Freight	90.0
Su itch	15.9

Accidents in 5 Years 0

Highu ay Traffic Characteristics	Base	Alternate
H'u ay Lanes	2	2.0
Dist from hu ay	0.10	0.1
AADT	k00	k00
A- to TOD Dist	Uniform	Uniform
Percent Tr- cws	10.0	10.0
Of this, % trailers	0.0	0.0
Tr- cw TOD Dist	Uniform	Uniform
Percent B- s	0.0	0.0
B- s TOD Dist	Uniform	Uniform

Costs in '000 $ of Hu ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.00679	0.00679
Inj- ry	0.00531	0.00531
PDO	0.01813	0.01813
Total	0.02k51	0.02k51

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&4	2.5	2.5
Oth. Lcycle	0.0	0.0
Capital		109.1
S- pplementary Safety		
O&4	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

4 ilepost 7k.9k Crossing ID 072358D

Description BNSF M4 ILL STREET

Paved? Tr- e	Urban? Tr- e
GCX Base Type	Gates
Safety S- p. Type	None
GCX Alt Type	Gates
Safety S- p. type	None
No. RR Tracws	6

Train Speeds (mph)	
4 ax Timetable	30.0
Passenger	30.0
Freight	30.0
Su itch	22.5

Accidents in 5 Years 0

Highu ay Traffic Characteristics	Base	Alternate
H'u ay Lanes	2	2.0
Dist from hu ay	0.10	0.1
AADT	2,550	2,550
A- to TOD Dist	Uniform	Uniform
Percent Tr- cws	5.0	5.0
Of this, % trailers	0.0	0.0
Tr- cw TOD Dist	Uniform	Uniform
Percent B- s	0.0	0.0
B- s TOD Dist	Uniform	Uniform

Costs in '000 $ of Hu ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.00276	0.00276
Inj- ry	0.00k56	0.00k56
PDO	0.02512	0.02512
Total	0.0655k	0.0655k

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&4	2.5	2.5
Oth. Lcycle	0.0	0.0
Capital		109.1
S- pplementary Safety		
O&4	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

4 ilepost 7k.78 Crossing ID 07235kW

Description BNSF MYEW ST.(S RIVER)

Paved? Tr- e	Urban? Tr- e
GCX Base Type	Gates
Safety S- p. Type	None
GCX Alt Type	Gates
Safety S- p. type	None
No. RR Tracws	6

Train Speeds (mph)	
4 ax Timetable	30.0
Passenger	30.0
Freight	30.0
Su itch	22.5

Accidents in 5 Years 0

Highu ay Traffic Characteristics	Base	Alternate
H'u ay Lanes	2	2.0
Dist from hu ay	0.10	0.1
AADT	1,850	1,850
A- to TOD Dist	Uniform	Uniform
Percent Tr- cws	50.0	50.0
Of this, % trailers	0.0	0.0
Tr- cw TOD Dist	Uniform	Uniform
Percent B- s	0.0	0.0
B- s TOD Dist	Uniform	Uniform

Costs in '000 $ of Hu ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.002k5	0.002k5
Inj- ry	0.00k08	0.00k08
PDO	0.02693	0.02693
Total	0.0663k	0.0663k

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&4	2.5	2.5
Oth. Lcycle	0.0	0.0
Capital		109.1
S- pplementary Safety		
O&4	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

CROSSING DATA FOR THE 2018 CONSTRUCTION RAIL - MAINLINE CORRIDOR

4 ilepost 107.90 Crossing ID 072339J

Description BNSF MTOTEFF ROAD

Paved? Tr- e	Urban? False
GCX Base Type	Gates
Safety S- p. Type	None
GCX Alt Type	Gates
Safety S- p. type	None
No. RR Tracws	2

Train Speeds (mph)	
4 ax Timetable	k7.0
Passenger	k7.0
Freight	90.0
Su itch	26.k

Accidents in 5 Years 0

Highu ay Traffic Characteristics	Base	Alternate
H'u ay Lanes	2	2.0
Dist from hu ay	0.10	0.1
AADT	1,200	1,200
A- to TOD Dist	Uniform	Uniform
Percent Tr- cws	50.0	50.0
Of this, % trailers	0.0	0.0
Tr- cw TOD Dist	Uniform	Uniform
Percent B- s	0.0	0.0
B- s TOD Dist	Uniform	Uniform

Costs in '000 $ of Hu ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.00558	0.00558
Inj- ry	0.00995	0.00995
PDO	0.01532	0.01532
Total	0.02k99	0.02k99

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&4	2.5	2.5
Oth. Lcycle	0.0	0.0
Capital		109.1
S- pplementary Safety		
O&4	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

4 ilepost 115.k5 Crossing ID 07236kK

Description BNSF MSCOTT AVE WEST

Paved? Tr- e	Urban? False
GCX Base Type	Gates
Safety S- p. Type	None
GCX Alt Type	Gates
Safety S- p. type	None
No. RR Tracws	2

Train Speeds (mph)	
4 ax Timetable	k5.0
Passenger	k5.0
Freight	90.0
Su itch	26.k

Accidents in 5 Years 0

Highu ay Traffic Characteristics	Base	Alternate
H'u ay Lanes	2	2.0
Dist from hu ay	0.10	0.1
AADT	2,950	2,950
A- to TOD Dist	Uniform	Uniform
Percent Tr- cws	2.0	2.0
Of this, % trailers	0.0	0.0
Tr- cw TOD Dist	Uniform	Uniform
Percent B- s	0.0	0.0
B- s TOD Dist	Uniform	Uniform

Costs in '000 $ of Hu ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.00927	0.00927
Inj- ry	0.00k73	0.00k73
PDO	0.01829	0.01829
Total	0.06238	0.06238

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&4	2.5	2.5
Oth. Lcycle	0.0	0.0
Capital		109.1
S- pplementary Safety		
O&4	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

4 ilepost 119.92 Crossing ID 072365W

Description BNSF MDAVIDSON AVE

Paved? Tr- e	Urban? False
GCX Base Type	Gates
Safety S- p. Type	None
GCX Alt Type	Gates
Safety S- p. type	None
No. RR Tracws	2

Train Speeds (mph)	
4 ax Timetable	k5.0
Passenger	k5.0
Freight	90.0
Su itch	26.k

Accidents in 5 Years 0

Highu ay Traffic Characteristics	Base	Alternate
H'u ay Lanes	2	2.0
Dist from hu ay	0.10	0.1
AADT	2,000	2,000
A- to TOD Dist	Uniform	Uniform
Percent Tr- cws	65.0	65.0
Of this, % trailers	0.0	0.0
Tr- cw TOD Dist	Uniform	Uniform
Percent B- s	0.0	0.0
B- s TOD Dist	Uniform	Uniform

Costs in '000 $ of Hu ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.00575	0.00575
Inj- ry	0.00k51	0.00k51
PDO	0.01k2k	0.01k2k
Total	0.060k2	0.060k2

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&4	2.5	2.5
Oth. Lcycle	0.0	0.0
Capital		109.1
S- pplementary Safety		
O&4	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

CROSSING DATA FOR THE 2018 CONSTRUCTION RAIL - MAINLINE CORRIDOR

4 ilepost 11k.50 Crossing ID 072363P

Description BNSF MWHALEN RD.

Paved? Tr- e	Urban? False
GCX Base Type	Gates
Safety S- p. Type	None
GCX Alt Type	Gates
Safety S- p. type	None
No. RR Tracws	2

Train Speeds (mph)

4 ax Timetable	k5.0
Passenger	k5.0
Freight	90.0
Su itch	26.k

Accidents in 5 Years 0

Highu ay Traffic Characteristics

	Base	Alternate
H'u ay Lanes	2	2.0
Dist from hu ay	0.10	0.1
AADT	1,550	1,550
A- to TOD Dist	Uniform	Uniform
Percent Tr- cws	25.0	25.0
Of this, % trailers	0.0	0.0
Tr- cw TOD Dist	Uniform	Uniform
Percent B- s	0.0	0.0
B- s TOD Dist	Uniform	Uniform

Costs in '000 $ of Hu ay Improvement 0.0

Predicted Ann- al Accidents

	Base	Alternate
Fatal	0.00595	0.00595
Inj- ry	0.00k16	0.00k16
PDO	0.01930	0.01930
Total	0.0271k	0.0271k

Costs in '000 $

	Base	Alternate
Grade Crossing Devices		
O&4	2.5	2.5
Oth. Lcycle	0.0	0.0
Capital		109.1
S- pplementary Safety		
O&4	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

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CORRIDOR AND CROSSING DATA

(8 itho- t phased improvements)

5 ser:	Mthe8 - M
Dataset:	Initial dataset
Corridor ID	2f

					Avg. No. Trains Per Day	*Train Time-of-Day Distribution*
Corridor Name	2021 No Action 8 C- rrent TracM4U ainline			*Passenger*	60.0	5 ni3rm
Technology Factors	0.90	0.90	0.90	*Freight*	7f .0	5 ni3rm
Signal Synchronization?	False			*Switch*	0.0	5 ni3rm

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

Calc- lated: 214Sep42069 f :6u pm

	Fatal	Injury	PDO	Total
Base	0.0kkw7f	0.07uu6u	0.610600	0.2w2u16
Alternate	0.0kkw7f	0.07uu6u	0.610600	0.2w2u16

CROSSING DATA FOR THE 2028 NO ACTION W CURRENT TRACK - MAINLINE CORRIDOR

U ilepost 12.u2 — Crossing ID 0w2k16X — Accidents in 9 Years: 0

Description BNSF 4TAYLOR CRANE RD

Paved? False	5 rban? False
GCX Base Type	Passive
Sa3ety S- p. Type	None
GCX Alt Type	Passive
Sa3ety S- p. type	None
No. RR TracMs	2

Train Speeds (mph)	
U ax Timetable	90.0
Passenger	90.0
Freight	90.0
S8 itch	26.0

High8 ay Tra33c Characteristics	*Base*	*Alternate*
H'8 ay Lanes	2	2.0
Dist 3om h8 ay	0.60	0.6
AADT	90	90
A- to TOD Dist	5 ni3rm	5 ni3rm
Percent Tr- cMs	9.0	9.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3rm	5 ni3rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3rm	5 ni3rm

Costs in '000 $ o3H8 ay Improvement: 0.0

Predicted Ann- al Accidents	*Base*	*Alternate*
Fatal	0.002uu	0.002uu
Inj- ry	0.00961	0.00961
PDO	0.066u2	0.066u2
Total	0.06w77	0.06w77

Costs in '000 $	*Base*	*Alternate*
Grade Crossing Devices		
O&U	0.2	0.2
Oth. Lcycle	0.0	0.0
Capital		6.7
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

U ilepost 1u.kf — Crossing ID 0w2ku7B — Accidents in 9 Years: 0

Description BNSF 4COWLITZ AVE

Paved? Tr- e	5 rban? False
GCX Base Type	Gates
Sa3ety S- p. Type	None
GCX Alt Type	Gates
Sa3ety S- p. type	None
No. RR TracMs	2

Train Speeds (mph)	
U ax Timetable	90.0
Passenger	90.0
Freight	90.0
S8 itch	2f .u

High8 ay Tra33c Characteristics	*Base*	*Alternate*
H'8 ay Lanes	2	2.0
Dist 3om h8 ay	0.60	0.6
AADT	6,k90	6,k90
A- to TOD Dist	5 ni3rm	5 ni3rm
Percent Tr- cMs	2.0	2.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3rm	5 ni3rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3rm	5 ni3rm

Costs in '000 $ o3H8 ay Improvement: 0.0

Predicted Ann- al Accidents	*Base*	*Alternate*
Fatal	0.00kk6	0.00kk6
Inj- ry	0.00127	0.00127
PDO	0.0617w	0.0617w
Total	0.0f 6f 7	0.0f 6f 7

Costs in '000 $	*Base*	*Alternate*
Grade Crossing Devices		
O&U	2.9	2.9
Oth. Lcycle	0.0	0.0
Capital		607.6
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

CROSSING DATA FOR THE 2028 NO ACTION W CURRENT TRACK - MAINLINE CORRIDOR

U ilepost w9.97 Crossing ID 0w2k77V

Description BNSF 4COWLITZ GARDEN RD

Paved? Tr- e	5 rban? Tr- e
GCX Base Type	Gates
Sa3ety S- p. Type	None
GCX Alt Type	Gates
Sa3ety S- p. type	None
No. RR TracMs	f

Train Speeds (mph)	
U ax Timetable	u9.0
Passenger	u9.0
Freight	70.0
S8 itch	69.7

Accidents in 9 Years 0

High8 ay Tra33c Characteristics	Base	Alternate
H'8 ay Lanes	2	2.0
Dist 3om h8 ay	0.60	0.6
AADT	190	190
A- to TOD Dist	5 ni3rm	5 ni3rm
Percent Tr- cMs	60.0	60.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3rm	5 ni3rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3rm	5 ni3rm

Costs in '000 $ o3H8 ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.00k91	0.00k91
Inj- ry	0.00707	0.00707
PDO	0.02070	0.02070
Total	0.0f 62k	0.0f 62k

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&U	2.9	2.9
Oth. Lcycle	0.0	0.0
Capital		607.6
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

U ilepost wu.7u Crossing ID 0w2k91D

Description BNSF 4U ILL STREET

Paved? Tr- e	5 rban? Tr- e
GCX Base Type	Gates
Sa3ety S- p. Type	None
GCX Alt Type	Gates
Sa3ety S- p. type	None
No. RR TracMs	f

Train Speeds (mph)	
U ax Timetable	k0.0
Passenger	k0.0
Freight	k0.0
S8 itch	22.9

Accidents in 9 Years 0

High8 ay Tra33c Characteristics	Base	Alternate
H'8 ay Lanes	2	2.0
Dist 3om h8 ay	0.60	0.6
AADT	2,900	2,900
A- to TOD Dist	5 ni3rm	5 ni3rm
Percent Tr- cMs	9.0	9.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3rm	5 ni3rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3rm	5 ni3rm

Costs in '000 $ o3H8 ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.00f 22	0.00f 22
Inj- ry	0.0010k	0.0010k
PDO	0.02u0k	0.02u0k
Total	0.0f 12w	0.0f 12w

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&U	2.9	2.9
Oth. Lcycle	0.0	0.0
Capital		607.6
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

U ilepost wu.w1 Crossing ID 0w2k9uW

Description BNSF 4YEW ST.(S RIVER)

Paved? Tr- e	5 rban? Tr- e
GCX Base Type	Gates
Sa3ety S- p. Type	None
GCX Alt Type	Gates
Sa3ety S- p. type	None
No. RR TracMs	f

Train Speeds (mph)	
U ax Timetable	k0.0
Passenger	k0.0
Freight	k0.0
S8 itch	22.9

Accidents in 9 Years 0

High8 ay Tra33c Characteristics	Base	Alternate
H'8 ay Lanes	2	2.0
Dist 3om h8 ay	0.60	0.6
AADT	2,200	2,200
A- to TOD Dist	5 ni3rm	5 ni3rm
Percent Tr- cMs	90.0	90.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3rm	5 ni3rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3rm	5 ni3rm

Costs in '000 $ o3H8 ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.00f 69	0.00f 69
Inj- ry	0.00u19	0.00u19
PDO	0.027kf	0.027kf
Total	0.0f uk2	0.0f uk2

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&U	2.9	2.9
Oth. Lcycle	0.0	0.0
Capital		607.6
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

CROSSING DATA FOR THE 2028 NO ACTION W CURRENT TRACK - MAINLINE CORRIDOR

Uilepost 60w.70 Crossing ID 0w2kk7J

Description BNSF 4TOTEFF ROAD

Paved? Tr- e	5 rban? False
GCX Base Type	Gates
Sa3ety S- p. Type	None
GCX Alt Type	Gates
Sa3ety S- p. type	None
No. RR TracMs	2

Train Speeds (mph)	
Uax Timetable	uw.0
Passenger	uw.0
Freight	70.0
S8 itch	2f .u

Accidents in 9 Years 0

High8 ay Tra33c Characteristics	Base	Alternate
H'8 ay Lanes	2	2.0
Dist 3om h8 ay	0.60	0.6
AADT	6,k90	6,k90
A- to TOD Dist	5 ni3rm	5 ni3rm
Percent Tr- cMs	90.0	90.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3rm	5 ni3rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3rm	5 ni3rm

Costs in '000 $ o3H8 ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.007kk	0.007kk
Inj- ry	0.00ukf	0.00ukf
PDO	0.06ukw	0.06ukw
Total	0.0f 6f 7	0.0f 6f 7

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&U	2.9	2.9
Oth. Lcycle	0.0	0.0
Capital		607.6
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

Uilepost 669.u9 Crossing ID 0w2kf uK

Description BNSF 4SCOTT AVE WEST

Paved? Tr- e	5 rban? False
GCX Base Type	Gates
Sa3ety S- p. Type	None
GCX Alt Type	Gates
Sa3ety S- p. type	None
No. RR TracMs	2

Train Speeds (mph)	
Uax Timetable	u9.0
Passenger	u9.0
Freight	70.0
S8 itch	2f .u

Accidents in 9 Years 0

High8 ay Tra33c Characteristics	Base	Alternate
H'8 ay Lanes	2	2.0
Dist 3om h8 ay	0.60	0.6
AADT	f ,600	f ,600
A- to TOD Dist	5 ni3rm	5 ni3rm
Percent Tr- cMs	2.0	2.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3rm	5 ni3rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3rm	5 ni3rm

Costs in '000 $ o3H8 ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.00u69	0.00u69
Inj- ry	0.001uf	0.001uf
PDO	0.020f w	0.020f w
Total	0.0f 721	0.0f 721

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&U	2.9	2.9
Oth. Lcycle	0.0	0.0
Capital		607.6
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

Uilepost 667.72 Crossing ID 0w2kf 9W

Description BNSF 4DAVIDSON AVE

Paved? Tr- e	5 rban? False
GCX Base Type	Gates
Sa3ety S- p. Type	None
GCX Alt Type	Gates
Sa3ety S- p. type	None
No. RR TracMs	2

Train Speeds (mph)	
Uax Timetable	u9.0
Passenger	u9.0
Freight	70.0
S8 itch	2f .u

Accidents in 9 Years 0

High8 ay Tra33c Characteristics	Base	Alternate
H'8 ay Lanes	2	2.0
Dist 3om h8 ay	0.60	0.6
AADT	2,f 90	2,f 90
A- to TOD Dist	5 ni3rm	5 ni3rm
Percent Tr- cMs	f 9.0	f 9.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3rm	5 ni3rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3rm	5 ni3rm

Costs in '000 $ o3H8 ay Improvement 0.0

Predicted Ann- al Accidents	Base	Alternate
Fatal	0.007uw	0.007uw
Inj- ry	0.0012w	0.0012w
PDO	0.06wf 7	0.06wf 7
Total	0.0f kk9	0.0f kk9

Costs in '000 $	Base	Alternate
Grade Crossing Devices		
O&U	2.9	2.9
Oth. Lcycle	0.0	0.0
Capital		607.6
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

CROSSING DATA FOR THE 2028 NO ACTION W CURRENT TRACK - MAINLINE CORRIDOR

Uilepost 66u.90 Crossing ID 0w2kf kP

Accidents in 9 Years 0

Description BNSF 4WHALEN RD.

Paved? Tr- e	5 rban? False
GCX Base Type	Gates
Sa3ety S- p. Type	None
GCX Alt Type	Gates
Sa3ety S- p. type	None
No. RR TracMs	2

Train Speeds (mph)

U ax Timetable	u9.0
Passenger	u9.0
Freight	70.0
S8 itch	2f .u

High8 ay Tra3c Characteristics

	Base	Alternate
H'8 ay Lanes	2	2.0
Dist 3om h8 ay	0.60	0.6
AADT	6,100	6,100
A- to TOD Dist	5 ni3rm	5 ni3rm
Percent Tr- cMs	29.0	29.0
O3this, % trailers	0.0	0.0
Tr- cMTOD Dist	5 ni3rm	5 ni3rm
Percent B- s	0.0	0.0
B- s TOD Dist	5 ni3rm	5 ni3rm

Costs in '000 $ o3H8 ay Improvement 0.0

Predicted Ann- al Accidents

	Base	Alternate
Fatal	0.007k9	0.007k9
Inj- ry	0.00u11	0.00u11
PDO	0.061f w	0.061f w
Total	0.0f 2u2	0.0f 2u2

Costs in '000 $

	Base	Alternate
Grade Crossing Devices		
O&U	2.9	2.9
Oth. Lcycle	0.0	0.0
Capital		607.6
S- pplementary Sa3ety		
O&U	0.0	0.0
Oth. Lcycle	0.0	0.0
Capital		0.0

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CORRIDOR AND CROSSING DATA

v- ithoM (hased im(ro) ementsb

3 serp	4che- M4
Datasetp	Initial dataset
Corridor ID	25

					Avg. No. Trains Per Day	Train Time-of-Day Distribution
Corridor Name	2021 8 n Site Alt - CMrrent Trac4 Uf ainline					
				Passenger	70.0	3 ni9orm
Technology Factors	0.60	0.60	0.60	*Freight*	57.0	3 ni9orm
Signal Synchronization?	False			*Switch*	0.0	3 ni9orm

CORRIDOR SUMMARY OF PREDICTED ANNUAL ACCIDENTS

CalcMatedp21USe(U2076 : p05 (m

	Fatal	Injury	PDO	Total
Base	0.0kw5u6	0.0wuw01	0.716uuu	0.: 02k02
Alternate	0.0kw5u6	0.0wuw01	0.716uuu	0.: 02k02

CROSSING DATA FOR THE 2028 ON SITE ALT W CURRENT TRACK - MAINLINE CORRIDOR

f ile(ost 12.52 Crossing ID 0u2k17B

Accidents in 6 L ears 0

Descri(tion YNSF UTAL C8 R CRANE RD

Xa) ed? False	3 rPan? False
GCB Yase Ty(e	Xassi) e
Sa9ety SM(. Ty(e	None
GCB Alt Ty(e	Xassi) e
Sa9ety SM(. ty(e	None
No. RR Trac4s	2

Train S(eeds vm(hb	
f ax TimetaPle	60.0
Xassenger	60.0
Freight	60.0
S- itch	27.0

High- ay Tra9c Characteristics	Base	Alternate
H'- ay Oanes	2	2.0
Dist 9rom h- ay	0.70	0.7
AADT	60	60
AMo T8 D Dist	3 ni9orm	3 ni9orm
Xercent TrMc4s	6.0	6.0
8 9this, % trailers	0.0	0.0
TrMc4 T8 D Dist	3 ni9orm	3 ni9orm
Xercent YMs	0.0	0.0
YMs T8 D Dist	3 ni9orm	3 ni9orm

Costs in '000 $ o9H- ay Im(ro) ement 0.0

Xredicted AnnMal Accidents	Base	Alternate
Fatal	0.002u2	0.002u2
InjMry	0.006k0	0.006k0
XD8	0.0722w	0.0722w
Total	0.02061	0.02061

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
8 &f	0.2	0.2
8 th. Ocycle	0.0	0.0
Ca(ital		7.w
SM((lementary Sa9ety		
8 &f	0.0	0.0
8 th. Ocycle	0.0	0.0
Ca(ital		0.0

f ile(ost 15.k: Crossing ID 0u2k5wY

Accidents in 6 L ears 0

Descri(tion YNSF UC8 WOTZ AVE

Xa) ed? TrMe	3 rPan? False
GCB Yase Ty(e	Gates
Sa9ety SM(. Ty(e	None
GCB Alt Ty(e	Gates
Sa9ety SM(. ty(e	None
No. RR Trac4s	2

Train S(eeds vm(hb	
f ax TimetaPle	60.0
Xassenger	60.0
Freight	60.0
S- itch	2: .5

High- ay Tra9c Characteristics	Base	Alternate
H'- ay Oanes	2	2.0
Dist 9rom h- ay	0.70	0.7
AADT	7,k60	7,k60
AMo T8 D Dist	3 ni9orm	3 ni9orm
Xercent TrMc4s	2.0	2.0
8 9this, % trailers	0.0	0.0
TrMc4 T8 D Dist	3 ni9orm	3 ni9orm
Xercent YMs	0.0	0.0
YMs T8 D Dist	3 ni9orm	3 ni9orm

Costs in '000 $ o9H- ay Im(ro) ement 0.0

Xredicted AnnMal Accidents	Base	Alternate
Fatal	0.00kw0	0.00kw0
InjMry	0.00160	0.00160
XD8	0.07u: 7	0.07u: 7
Total	0.0: 2k7	0.0: 2k7

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
8 &f	2.6	2.6
8 th. Ocycle	0.0	0.0
Ca(ital		70w.7
SM((lementary Sa9ety		
8 &f	0.0	0.0
8 th. Ocycle	0.0	0.0
Ca(ital		0.0

CROSSING DATA FOR THE 2028 ON SITE ALT W CURRENT TRACK - MAINLINE CORRIDOR

f ile(ost u6.6w Crossing ID 0u2kwwV

Descri(tion YNSF UC8 WCITZ GARDEN RD

Xa) ed? TrMe	3 rPan? TrMe
GCB Yase Ty(e	Gates
Sa9ety SM(. Ty(e	None
GCB Alt Ty(e	Gates
Sa9ety SM(. ty(e	None
No. RR Trac4s	:

Train S(eeds vm(hb	
f ax TimetaPle	56.0
Xassenger	56.0
Freight	w0.0
S- itch	76.w

Accidents in 6 L ears 0

High- ay Tra9c Characteristics	Base	Alternate
H'- ay Oanes	2	2.0
Dist 9rom h- ay	0.70	0.7
AADT	160	160
AMo T8 D Dist	3 ni9orm	3 ni9orm
Xercent TrMc4s	70.0	70.0
8 9this, % trailers	0.0	0.0
TrMc4 T8 D Dist	3 ni9orm	3 ni9orm
Xercent YMs	0.0	0.0
YMs T8 D Dist	3 ni9orm	3 ni9orm

Costs in '000 $ o9H- ay Im(ro) ement 0.0

Xredicted AnnMal Accidents	Base	Alternate
Fatal	0.00k55	0.00k55
InjMry	0.00w22	0.00w22
XD8	0.0272u	0.0272u
Total	0.0: 221	0.0: 221

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
8 &f	2.6	2.6
8 th. Ocycle	0.0	0.0
Ca(ital		70w.7
SM((lementary Sa9ety		
8 &f	0.0	0.0
8 th. Ocycle	0.0	0.0
Ca(ital		0.0

f ile(ost u5.w5 Crossing ID 0u2k61D

Descri(tion YNSF Uf ICO STREET

Xa) ed? TrMe	3 rPan? TrMe
GCB Yase Ty(e	Gates
Sa9ety SM(. Ty(e	None
GCB Alt Ty(e	Gates
Sa9ety SM(. ty(e	None
No. RR Trac4s	:

Train S(eeds vm(hb	
f ax TimetaPle	k0.0
Xassenger	k0.0
Freight	k0.0
S- itch	22.6

Accidents in 6 L ears 0

High- ay Tra9c Characteristics	Base	Alternate
H'- ay Oanes	2	2.0
Dist 9rom h- ay	0.70	0.7
AADT	2,600	2,600
AMo T8 D Dist	3 ni9orm	3 ni9orm
Xercent TrMc4s	6.0	6.0
8 9this, % trailers	0.0	0.0
TrMc4 T8 D Dist	3 ni9orm	3 ni9orm
Xercent YMs	0.0	0.0
YMs T8 D Dist	3 ni9orm	3 ni9orm

Costs in '000 $ o9H- ay Im(ro) ement 0.0

Xredicted AnnMal Accidents	Base	Alternate
Fatal	0.00: : k	0.00: : k
InjMry	0.00126	0.00126
XD8	0.0251k	0.0251k
Total	0.0: uk:	0.0: uk:

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
8 &f	2.6	2.6
8 th. Ocycle	0.0	0.0
Ca(ital		70w.7
SM((lementary Sa9ety		
8 &f	0.0	0.0
8 th. Ocycle	0.0	0.0
Ca(ital		0.0

f ile(ost u5.u1 Crossing ID 0u2k65W

Descri(tion YNSF UL EW ST.vS RIVERb

Xa) ed? TrMe	3 rPan? TrMe
GCB Yase Ty(e	Gates
Sa9ety SM(. Ty(e	None
GCB Alt Ty(e	Gates
Sa9ety SM(. ty(e	None
No. RR Trac4s	:

Train S(eeds vm(hb	
f ax TimetaPle	k0.0
Xassenger	k0.0
Freight	k0.0
S- itch	22.6

Accidents in 6 L ears 0

High- ay Tra9c Characteristics	Base	Alternate
H'- ay Oanes	2	2.0
Dist 9rom h- ay	0.70	0.7
AADT	2,200	2,200
AMo T8 D Dist	3 ni9orm	3 ni9orm
Xercent TrMc4s	60.0	60.0
8 9this, % trailers	0.0	0.0
TrMc4 T8 D Dist	3 ni9orm	3 ni9orm
Xercent YMs	0.0	0.0
YMs T8 D Dist	3 ni9orm	3 ni9orm

Costs in '000 $ o9H- ay Im(ro) ement 0.0

Xredicted AnnMal Accidents	Base	Alternate
Fatal	0.00: 25	0.00: 25
InjMry	0.00105	0.00105
XD8	0.02522	0.02522
Total	0.0: 16w	0.0: 16w

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
8 &f	2.6	2.6
8 th. Ocycle	0.0	0.0
Ca(ital		70w.7
SM((lementary Sa9ety		
8 &f	0.0	0.0
8 th. Ocycle	0.0	0.0
Ca(ital		0.0

CROSSING DATA FOR THE 2028 ON SITE ALT W CURRENT TRACK - MAINLINE CORRIDOR

f ile(ost 70u.w0 Crossing ID 0u2kkwJ

Descri(tion YNSF UT8 TEFF R8 AD

Xa) ed? TrMe	3 rPan? False
GCB Yase Ty(e	Gates
Sa9ety SM(. Ty(e	None
GCB Alt Ty(e	Gates
Sa9ety SM(. ty(e	None
No. RR Trac4s	2

Train S(eeds vm(hb	
f ax TimetaPle	5u.0
Xassenger	5u.0
Freight	w0.0
S- itch	2: .5

Accidents in 6 L ears 0

High- ay Tra9c Characteristics	Base	Alternate
H'- ay Oanes	2	2.0
Dist 9rom h- ay	0.70	0.7
AADT	7,k60	7,k60
AMo T8 D Dist	3 ni9orm	3 ni9orm
Xercent TrMc4s	60.0	60.0
8 9this, % trailers	0.0	0.0
TrMc4 T8 D Dist	3 ni9orm	3 ni9orm
Xercent YMs	0.0	0.0
YMs T8 D Dist	3 ni9orm	3 ni9orm

Costs in '000 $ o9H- ay Im(ro) ement 0.0

Xredicted AnnMal Accidents	Base	Alternate
Fatal	0.00w57	0.00w57
InjMry	0.005w:	0.005w:
XD8	0.07105	0.07105
Total	0.0: 2k7	0.0: 2k7

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
8 &f	2.6	2.6
8 th. Ocycle	0.0	0.0
Ca(ital		70w.7
SM((lementary Sa9ety		
8 &f	0.0	0.0
8 th. Ocycle	0.0	0.0
Ca(ital		0.0

f ile(ost 776.56 Crossing ID 0u2k: 5K

Descri(tion YNSF USC8 TT AVE WEST

Xa) ed? TrMe	3 rPan? False
GCB Yase Ty(e	Gates
Sa9ety SM(. Ty(e	None
GCB Alt Ty(e	Gates
Sa9ety SM(. ty(e	None
No. RR Trac4s	2

Train S(eeds vm(hb	
f ax TimetaPle	56.0
Xassenger	56.0
Freight	w0.0
S- itch	2: .5

Accidents in 6 L ears 0

High- ay Tra9c Characteristics	Base	Alternate
H'- ay Oanes	2	2.0
Dist 9rom h- ay	0.70	0.7
AADT	: ,700	: ,700
AMo T8 D Dist	3 ni9orm	3 ni9orm
Xercent TrMc4s	2.0	2.0
8 9this, % trailers	0.0	0.0
TrMc4 T8 D Dist	3 ni9orm	3 ni9orm
Xercent YMs	0.0	0.0
YMs T8 D Dist	3 ni9orm	3 ni9orm

Costs in '000 $ o9H- ay Im(ro) ement 0.0

Xredicted AnnMal Accidents	Base	Alternate
Fatal	0.005k:	0.005k:
InjMry	0.001u6	0.001u6
XD8	0.02702	0.02702
Total	0.0: 5k0	0.0: 5k0

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
8 &f	2.6	2.6
8 th. Ocycle	0.0	0.0
Ca(ital		70w.7
SM((lementary Sa9ety		
8 &f	0.0	0.0
8 th. Ocycle	0.0	0.0
Ca(ital		0.0

f ile(ost 77w.w2 Crossing ID 0u2k: 6W

Descri(tion YNSF UDAVIDS8 N AVE

Xa) ed? TrMe	3 rPan? False
GCB Yase Ty(e	Gates
Sa9ety SM(. Ty(e	None
GCB Alt Ty(e	Gates
Sa9ety SM(. ty(e	None
No. RR Trac4s	2

Train S(eeds vm(hb	
f ax TimetaPle	56.0
Xassenger	56.0
Freight	w0.0
S- itch	2: .5

Accidents in 6 L ears 0

High- ay Tra9c Characteristics	Base	Alternate
H'- ay Oanes	2	2.0
Dist 9rom h- ay	0.70	0.7
AADT	2,: 60	2,: 60
AMo T8 D Dist	3 ni9orm	3 ni9orm
Xercent TrMc4s	: 6.0	: 6.0
8 9this, % trailers	0.0	0.0
TrMc4 T8 D Dist	3 ni9orm	3 ni9orm
Xercent YMs	0.0	0.0
YMs T8 D Dist	3 ni9orm	3 ni9orm

Costs in '000 $ o9H- ay Im(ro) ement 0.0

Xredicted AnnMal Accidents	Base	Alternate
Fatal	0.0050w	0.0050w
InjMry	0.00167	0.00167
XD8	0.07uu1	0.07uu1
Total	0.0: 66k	0.0: 66k

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
8 &f	2.6	2.6
8 th. Ocycle	0.0	0.0
Ca(ital		70w.7
SM((lementary Sa9ety		
8 &f	0.0	0.0
8 th. Ocycle	0.0	0.0
Ca(ital		0.0

CROSSING DATA FOR THE 2028 ON SITE ALT W CURRENT TRACK - MAINLINE CORRIDOR

f ile(ost 775.60 Crossing ID 0u2k: kX

Descri(tion YNSF UWHACEN RD.

Xa) ed? TrMe	3 rPan? False
GCB Yase Ty(e	Gates
Sa9ety SM(. Ty(e	None
GCB Alt Ty(e	Gates
Sa9ety SM(. ty(e	None
No. RR Trac4s	2

Train S(eeds vm(hb	
f ax TimetaPle	56.0
Xassenger	56.0
Freight	w0.0
S- itch	2: .5

Accidents in 6 L ears 0

High- ay Tra9c Characteristics	Base	Alternate
H'- ay Oanes	2	2.0
Dist 9rom h- ay	0.70	0.7
AADT	7,100	7,100
AMo T8 D Dist	3 ni9orm	3 ni9orm
Xercent TrMc4s	26.0	26.0
8 9this, % trailers	0.0	0.0
TrMc4 T8 D Dist	3 ni9orm	3 ni9orm
Xercent YMs	0.0	0.0
YMs T8 D Dist	3 ni9orm	3 ni9orm

Costs in '000 $ o9H- ay Im(ro) ement 0.0

Xredicted AnnMal Accidents	Base	Alternate
Fatal	0.00w57	0.00w57
InjMry	0.0010u	0.0010u
XD8	0.07u00	0.07u00
Total	0.0: : 10	0.0: : 10

Costs in '000 $	Base	Alternate
Grade Crossing De) ices		
8 &f	2.6	2.6
8 th. Ocycle	0.0	0.0
Ca(ital		70w.7
SM(lementary Sa9ety		
8 &f	0.0	0.0
8 th. Ocycle	0.0	0.0
Ca(ital		0.0

Appendix B

Data for Selected Crossings Outside of Cowlitz County

Data for Selected Crossings Outside of Cowlitz County

ID #	USDOT/FRA Crossing ID	Milepost	Study Crossing	County	Passenger Train Speed (mph) (UTC Data)	Freight Train Speed (mph) (UTC Data)	AADT (FRA Source 1)	AADT Year (FRA Source 1)	AADT 2015 (FRA Source 1)	AADT (UTC Data)	AADT Year (UTC Data)	AADT 2015 (UTC Data)	Existing Daily Train Traffic (FRA Source 1)	Existing Daily Train Traffic Year (FRA Source 1)	Existing Daily Train Traffic (FRA Source 2)	Existing Daily Train Traffic Year (FRA Source 2)	Existing Plus Proposed Action Daily Train Traffic	Existing Daily Train Traffic (WSDOT Rail Plan)	2028 Basline Daily Traffic (WSDOT Rail Plan)	2028 Basline Plus Proposed Action Daily Traffic	Percent Increase in Daily Train Traffic 2028
Kootenai Subdivision																					
1	066236B	53.37	Idaho Rd	Spokane	79	60	000201	0	0	2041	2000	2653	50	0	55	2015	71	70	106	122	13%
2	066239W	56.16	McKinzey Rd	Spokane	79	60	000127	1988	203	2041	2001	2612	50	1998	55	2015	71	70	106	122	13%
3	066240R	56.81	Harvard Rd	Spokane	79	60	000540	1988	862	6561	2001	8398	50	1998	55	2015	71	70	106	122	13%
4	066244T	58.93	Barker Rd	Spokane	79	60	001258	1988	2009	10694	2000	13902	50	1993	55	2013	71	70	106	122	13%
5	066245A	59.9	Flora Rd	Spokane	79	60	000362	1988	578	5061	2000	6579	50	1993	55	2013	71	70	106	122	13%
6	066367E	62.95	Pines Rd-SR27	Spokane	79	60	011000	1995	15180	28000	2012	29680	50	1989	55	2015	71	70	106	122	13%
7	066371U	64.04	University Rd	Spokane	79	60	002662	2005	3194	2210	2010	2431	50	0	56	2014	72	70	106	122	13%
8	066377K	66.12	Park Road	Spokane	79	60	006682	1989	10464	12612	2000	16396	50	1989	56	2015	72	70	106	122	13%
Lakeside Subdivision																					
9	066315M	15.8	Pine St	Spokane	35	35	000480	1988	767	250	0	0	37	1998	39	2014	55	39	56	72	22%
10	065970L	16.4	"F" St/Cheney-Spangle	Spokane	35	35	002300	1988	3673	1906	0	0	37	1998	39	2015	55	39	56	72	22%
11	065971T	16.83	Cheney-Plaza Rd	Spokane	35	35	000670	1988	1070	1400	0	0	37	1998	39	2014	55	39	56	72	22%
12	089665U	74.22	Paha Packard Rd	Adams	79	60	000076	1987	124	128	0	0	35	1991	38	2013	54	39	56	72	22%
13	089670R	80.59	Kahlotus Rd	Adams	79	60	000190	1986	315	93	0	0	35	1991	38	2013	54	39	56	72	22%
14	089672E	81.85	1st St	Adams	60	50	000300	1987	488	140	0	0	35	1991	38	2015	54	39	56	72	22%
15	089673L	82.1	Wilbur/City Rd	Adams	60	50	000344	1987	560	344	0	0	35	1991	38	2014	54	39	56	72	22%
16	089699N	129.1	Eltopia Rd W	Franklin	79	60	000220	1987	358	582	0	0	37	1991	39	2014	55	39	56	72	22%
17	089700F	134.16	Sagemoor Rd	Franklin	79	60	000260	1986	431	410	0	0	36	1991	38	2013	54	39	56	72	22%
Fallbridge Subdivision																					
18	090031U	229.21	E 3rd Ave	Benton	35	35	001735	1987	2825	2041	0	0	32	1991	37	2014	45	34	48	56	14%
19	090035W	227.47	Dague Rd-E 25th Avenue	Benton	60	60	000487	1987	793	833	0	0	32	1991	37	2014	45	34	48	56	14%
20	090036D	226.41	Perkins Rd 7572	Benton	60	60	000440	1987	716	849	0	0	32	1991	37	2014	45	34	48	56	14%
21	090038S	225.75	Bowles Rd 9713	Benton	60	60	001515	1987	2466	650	0	0	32	1991	37	2014	45	34	48	56	14%
22	090039Y	225.04	Cochran Rd 7810	Benton	60	60	000073	1987	119	347	0	0	32	1991	37	2014	45	34	48	56	14%
23	090040T	224.52	Finley Rd 9721	Benton	60	60	001943	1988	3103	1030	0	0	32	1991	37	2014	45	34	48	56	14%
24	090061L	171.9	Whitcomb Island	Benton	60	60	000035	1987	57	35	1987	57	34	1991	36	2014	44	34	48	56	14%
25	090169V	75.76	Maple St	Klickitat	45	45	000330	1988	527	750	2009	840	43	0	48	2014	56	34	48	56	14%
26	090168N	75.5	Walnut St	Klickitat	45	45	000850	1987	1384	850	1987	1384	43	1991	48	2014	56	34	48	56	14%
27	090164L	74.2	South Dock Grade Rd	Klickitat	60	55	000080	2011	86	377	0	0	21	0	41	2014	49	34	48	56	14%
28	090159P	65.9	Indian Crossing	Skamania	60	55	000070	1988	112	70	1988	112	37	1991	41	2014	49	34	48	56	14%
29	090155M	59.6	Home Valley Pk	Skamania	60	55	000050	1992	74	100	0	0	37	1991	41	2013	49	34	48	56	14%
30	090151K	54.75	Cemetery Xing	Skamania	0	0	000010	1987	16	0	0	0	37	1991	41	2013	49	34	48	56	14%
31	090148C	53.89	Russell Ave	Skamania	20	20	000500	1988	799	361	2015	361	36	1991	40	2013	48	34	48	56	14%
32	090135B	43.3	Skamania Landing/Butler Rd	Skamania	60	60	000100	1987	163	100	2011	108	36	1991	40	2015	48	34	48	56	14%
33	090134U	42.6	Walker/Skam Landing	Skamania	60	60	000100	1987	163	120	0	0	36	1991	40	2013	48	34	48	56	14%
34	090133M	39.72	St Cloud Rd	Skamania	0	0	000050	0	0	0	0	0	20	0	40	2014	48	34	48	56	14%
Seattle Subdivision																					
35	092484T	77.83	SR 506-7th St	Lewis	75	50	002200	1988	3513	1300	2012	1378	40	1990	52	2014	60	50	73	81	10%
36	092493S	71.6	Walnut St - SR505/603	Lewis	50	50	004500	1995	6210	2700	2012	2862	40	1990	52	2013	60	50	73	81	10%
37	092519S	54.2	E Locust St	Lewis	40	40	001937	1993	2793	2000	0	0	40	1990	52	2013	60	50	73	81	10%
38	092520L	54.1	Main St	Lewis	40	40	001850	1993	2668	5000	0	0	40	1990	52	2013	60	50	73	81	10%
39	092521T	53.8	Maple St	Lewis	40	40	002442	1993	3521	2500	0	0	40	1987	51	2013	59	50	73	81	10%
40	092524N	51.8	Big Hanaford Rd	Lewis	0	10	001550	1986	2571	2760	0	0	0	1995	0	2015	8	50	73	81	10%
Yakima Valley Subdivision																					
41	099178A	79.4	Jones Rd E	Yakima	0	40	000950	1986	1576	2440	0	0	10	1986	10	2013	18	7	11	19	42%
42	104523U	63.8	Indian Church	Yakima	0	40	001519	1987	2473	613	0	0	10	1987	10	2013	18	7	11	19	42%
43	104534G	52.21	SR241/Reservation	Yakima	0	40	002200	1995	3036	2700	2012	2862	10	1986	7	2014	15	7	11	19	42%
44	104536V	51.12	Gulden Rd	Yakima	0	40	000170	1986	282	500	0	0	8	1986	7	2013	15	7	11	19	42%

0 No Data

UTC Data = Washington Utilities and Transportation Commission crossing data sent by request to ICF International on September 18, 2015.
FRA Source 1 = http://safetydata.fra.dot.gov/OfficeofSafety/publicsite/Downloaddbf.aspx. Accessed September 25, 2015.
FRA Source 2 = FRA Office of Safety Analysis data. Available at: http://safetydata.fra.dot.gov/OfficeofSafety/publicsite/crossing/crossing.aspx. Accessed September 25, 2015.
WSDOT Rail Plan = Washington State Rail Plan, 2014. Available: http://www.wsdot.wa.gov/NR/rdonlyres/F67D73E5-2F2D-40F2-9795-736131D98106/0/StateRailPlanFinal201403.pdf

MILLENNIUM BULK TERMINALS—LONGVIEW SEPA ENVIRONMENTAL IMPACT STATEMENT

SEPA VESSEL TRANSPORTATION TECHNICAL REPORT

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Acronyms and Abbreviations

°F	degrees Fahrenheit
ACP	Northwest Area Contingency Plan
AIS	Automatic Identification System
ANT	Aids to Navigation Team
Applicant	Millennium Bulk Terminals—Longview, LLC
ATB	articulated tug-barge
Bar	Columbia River Bar
Bar Pilots	Columbia River Bar Pilots
BNSF	BNSF Railway Company
BWM	ballast water management
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
City	City of Longview
River Pilots	Columbia River Pilot
Corps	U.S. Army Corps of Engineers
COTP	Captain of the Port
County	Cowlitz County
DNR	Washington Department of Natural Resources
dwt	deadweight tonnage
Ecology	Washington State Department of Ecology
ERTS	Environmental Report Tracking System
FOSC	Federal On-Scene Coordinator
fps	feet per second
Groundfish FMP	Pacific Coast Groundfish Fishery Management Plan
GRP	geographic response plan
HSP	Harbor Safety Plan
MARPOL	International Convention for the Prevention of Pollution from Ships
MFSA	Maritime Fire & Safety Association
MISLE	Marine Information for Safety and Law Enforcement
mph	miles per hour
MSU	Marine Safety Unit
NANPCA	Nonindigenous Aquatic Nuisance Prevention and Control Act
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NISA	National Invasive Species Act
NOA	Notice of Arrival
NOAA	National Oceanic and Atmospheric Administration
OAR	Oregon Administrative Rules
ODEQ	Oregon Department of Environmental Quality
OPA 90	Oil and Pollution Act of 1990
ORS	Oregon Revised Standards

PDXMEX	Merchants Exchange of Portland, Oregon
PORTS	Physical Oceanographic Real-Time System
PTSA	Port and Tanker Safety Act
PWSA	Ports and Waterways Safety Act
RCW	Revised Code of Washington
River Pilots	Columbia River Pilots
RM	river mile
SEPA	Washington State Environmental Policy Act
SOLAS	Safety of Life at Sea
SOSC	State On-Scene Coordinator
SPIIS	Spills Program Incident Information
TV32	Transview 32
UP	Union Pacific Railroad
USC	United States Code
USCG	U.S. Coast Guard
VEAT	Vessel Entries And Transits
VTIS	Vessel Traffic Information System
WAC	Washington Administrative Code

Chapter 1
Introduction

This technical report assesses the potential vessel transportation impacts of the proposed Millennium Bulk Terminals—Longview project (Proposed Action) and No-Action Alternative. For the purposes of this assessment, vessel transportation refers to the movement of vessels within the Columbia River, including capacity of the river, historical and projected traffic levels, and vessel traffic management, safety, and emergency response. This report describes the regulatory setting, establishes the method for assessing potential vessel transportation impacts, presents the historical and current vessel transportation conditions in the study area, and assesses potential impacts.

1.1 Project Description

Millennium Bulk Terminals—Longview, LLC (Applicant) proposes to construct and operate a coal export terminal in Cowlitz County, Washington, along the Columbia River (Figure 1). The coal export terminal would receive coal from the Powder River Basin in Montana and Wyoming and the Uinta Basin in Utah and Colorado via rail, then load and transport the coal by ocean-going ships via the Columbia River and Pacific Ocean to overseas markets in Asia. The coal export terminal would be capable of receiving, stockpiling, blending, and loading coal by conveyor onto ships for export. Construction of the coal export terminal would begin in 2018. For the purpose of this analysis, it is assumed the coal export terminal would operate at full capacity in 2028.

The following subsections present a summary of the Proposed Action and No-Action Alternative. For detailed information on these alternatives, see the Washington State Environmental Policy Act (SEPA) Alternatives Technical Report (ICF International 2016a).

1.1.1 Proposed Action

The Proposed Action would develop a coal export terminal on 190 acres (project area). The project area is located within an existing 540-acre area currently leased by the Applicant at the former Reynolds Metals Company facility, and land currently owned by Bonneville Power Administration. The project area is adjacent to the Columbia River in unincorporated Cowlitz County, Washington near Longview city limits (Figure 2).

The Applicant currently and separately operates, and would continue to separately operate, a bulk product terminal on land leased by the Applicant. Industrial Way (State Route 432) provides vehicular access to the Applicant's leased land. The Reynolds Lead and the BNSF Spur, both operated by Longview Switching Company,[1] provide rail access to the Applicant's leased area from a point on the BNSF Railway Company (BNSF) main line (Longview Junction, Washington) located to the east in Kelso, Washington. Ships access the Applicant's leased area via the Columbia River and berth at an existing dock (Dock 1) operated by the Applicant in the Columbia River.

[1] Longview Switching Company is jointly owned by BNSF Railway Company (BNSF) and Union Pacific Railroad.

Figure 1. Project Vicinity

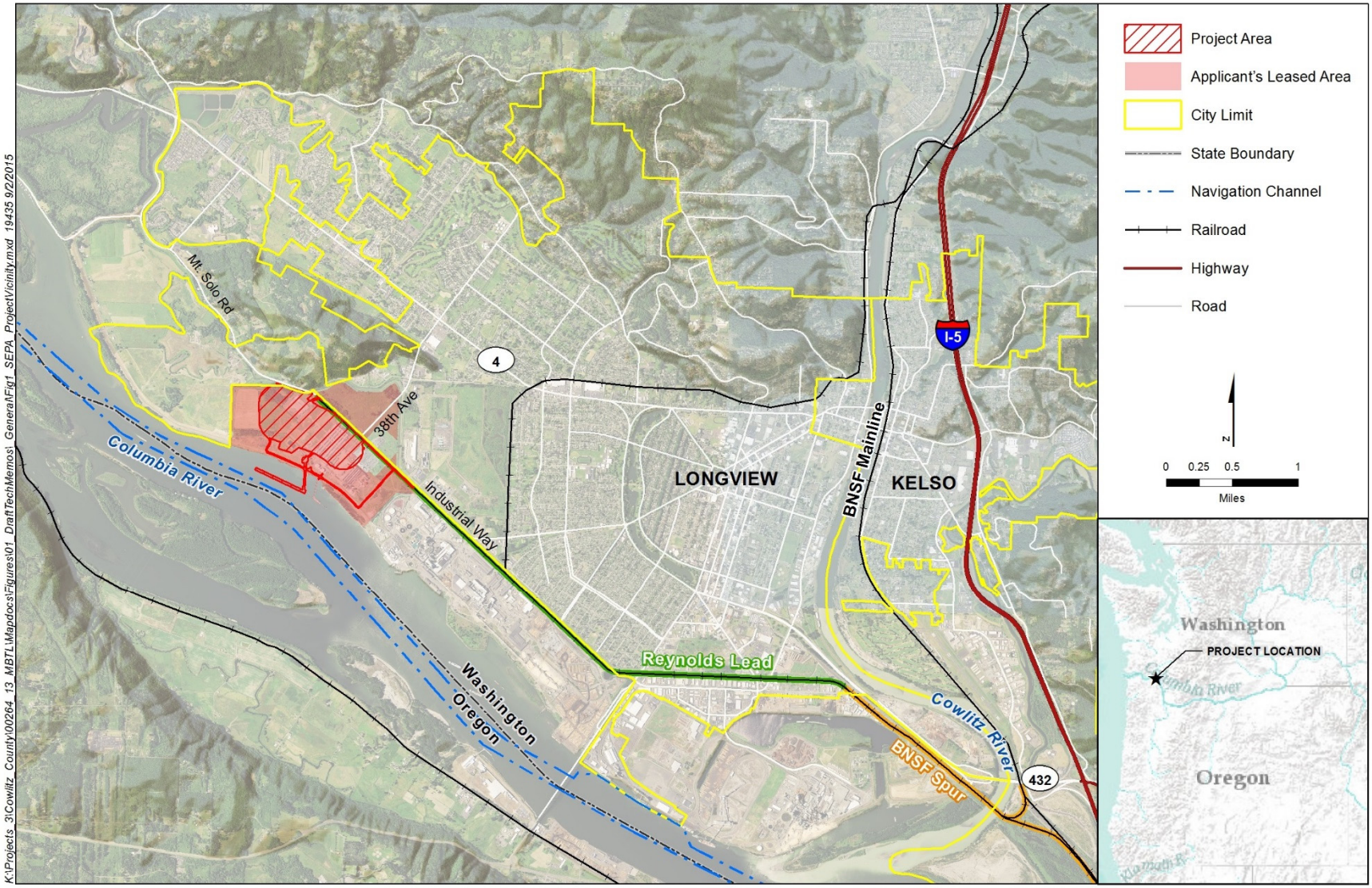
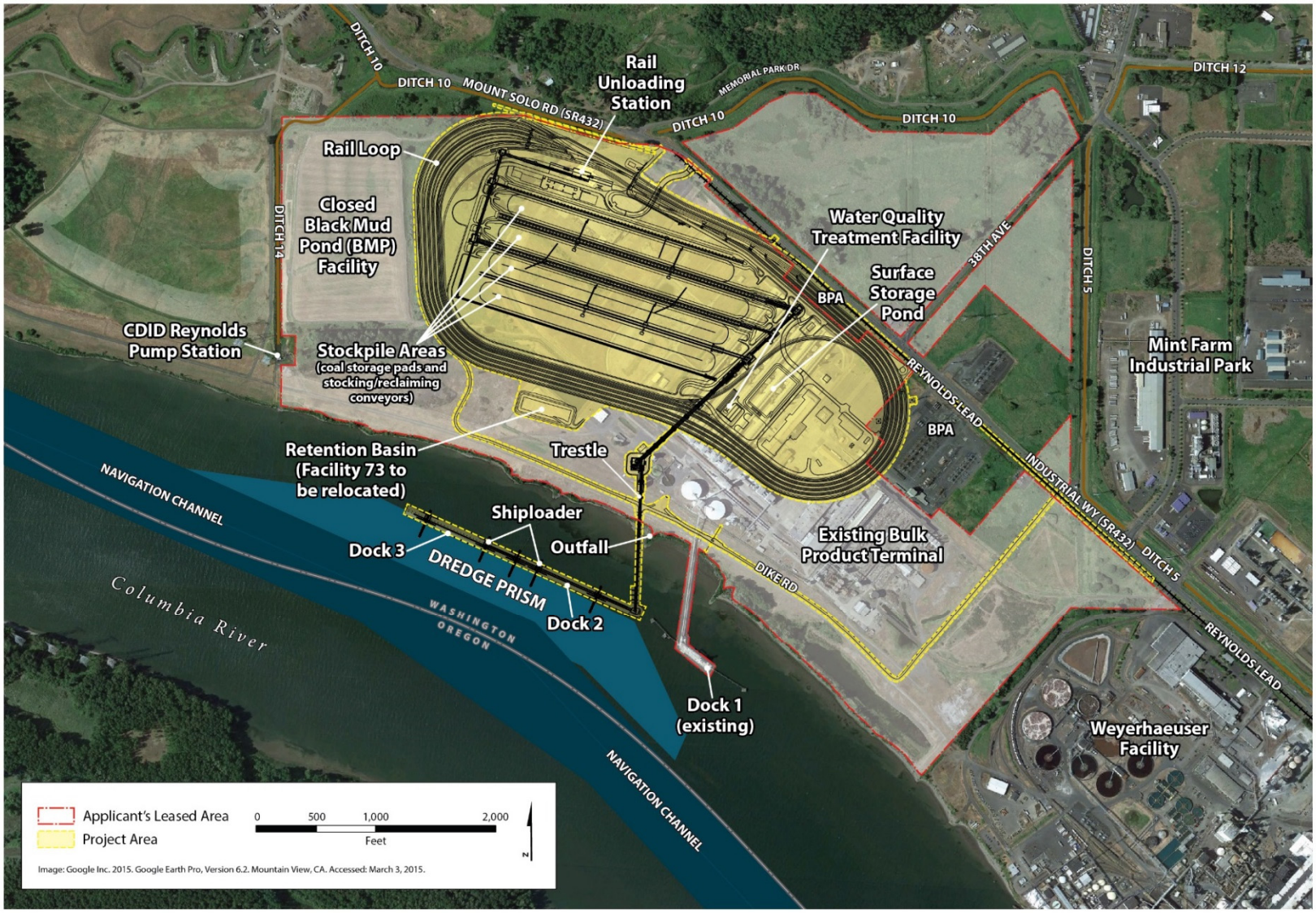


Figure 2. Proposed Action



Under the Proposed Action, BNSF or Union Pacific Railroad trains would transport coal in rail cars from the BNSF main line at Longview Junction, Washington, to the project area via the BNSF Spur and Reynolds Lead. Coal would be unloaded from rail cars, stockpiled and blended, and loaded by conveyor onto ocean-going ships at two new docks (Docks 2 and 3) on the Columbia River for export.

Once construction is complete, the Proposed Action would have an annual throughput capacity of up to 44 million metric tons.[2] The coal export terminal would consist of one operating rail track, eight rail tracks for the storage of rail cars, rail car unloading facilities, stockpile areas for coal storage, conveyor and reclaiming facilities, two new docks in the Columbia River (Docks 2 and 3), and ship-loading facilities on the two docks. Dredging of the Columbia River would be required to provide access to and from the Columbia River navigation channel and for berthing at the two new docks.

Vehicles would access the project area from Industrial Way (State Route 432). Ships would access the project area via the Columbia River and berth at one of the two new docks. Terminal operations would occur 24 hours per day, 7 days per week. The coal export terminal would be designed for a minimum 30-year period of operation.

1.1.2 No-Action Alternative

Under the No-Action Alternative, the proposed export terminal would not be constructed. Current operations of the bulk product terminal, which include the storage and transport of alumina and up to 150,000 metric tons per year of coal. Importing of alumina would continue and increase in the project area using Dock 1. The Applicant could expand the existing bulk product terminal onto the 190-acre project area, developing storage and shipment facilities to bulk product terminal operations. Coal and alumina would continue to be stored, transferred, and shipped. Additional bulk product transfers activities involving products such as calcine pet coke, coal tar pitch, cement, fly ash, and sand or gravel could also be pursued, and new or revised permits could be required. These operations would involve storage and upland transfer of bulk products, which would use existing or new buildings. Construction of new buildings could involve demolition and replacement of existing buildings and new or modified permits. Any new construction would be limited to uses allowed under existing Cowlitz County development regulations and federal and state permits.

1.2 Regulatory Setting

Different jurisdictions are responsible for the regulation of vessel transportation. These jurisdictions and their regulations, statutes, and guidance that apply to vessel transportation are summarized in Table 1.

[2] A metric ton is the U.S. equivalent to a tonne per the International System of Units, or 1,000 kilograms or approximately 2,204.6 pounds.

Table 1. Conventions, Regulations, Statutes, and Guidelines for Vessel Transportation

Convention, Regulation, Statute, Guideline	Description
International	
International Convention for the Safety of Life at Seas (SOLAS)	Maintains global safety standards for international maritime shipping. In addition to the construction, navigation, life-saving, communications, and fire equipment requirements inherent to Chapters I through V of the Convention, SOLAS Chapter XII, Additional Safety Measures for Bulk Carriers, adopted by Conference in November 1997 and entered into force on 1 July 1999 covers specific, mandatory requirements for bulk carriers. The regulations provide structural and detection and alarm equipment requirements to prevent the catastrophic flooding of bulk carriers if a cargo hold is damaged.
International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) Annex I: Prevention of Pollution by Oil Annex II: Control of Pollution by Noxious Liquid Substances Annex IV: Prevention of Pollution by Sewage from Ships Annex V: Prevention of Pollution by Garbage from Ships Annex VI Prevention of Air Pollution from Ships	International convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 respectively and updated by amendments through the years. Includes six technical annexes of which five apply to this project. Annexes I and II are implemented within U.S. legislation and require covered ships to carry a shipboard oil pollution emergency plan or SOPEP. Annexes III through VI are optional. The U.S. has accepted Annex V, which came into force on 31 December 1988, and Annex VI which was adopted by the U.S. on October 8, 2008.
International Ship and Port Facility Security (ISPS) Code	Adopted under SOLAS in 2002; entered into force in 2004. Contains detailed security-related requirements for Governments, port authorities, and shipping companies.
International Maritime Solid Bulk Cargoes Code (IMSBC Code)	Adopted under SOLAS in 2008; entered into force in 2011. The aim of the mandatory IMSBC Code is to facilitate the safe stowage and shipment of solid bulk cargoes by providing information on the dangers associated with the shipment of certain types of cargo and instructions on the appropriate procedures to be adopted.
International Regulations for Preventing Collisions at Sea, 1972 (known as 72 COLREGS)	COLREGS are regulations which aid mariners in safe navigation in International Waters or waters outside the COLREGS demarcation line which, for the Columbia River entrance, is a line drawn from the seaward extremity of the Columbia River North Jetty to the seaward extremity of the Columbia River South jetty.
Standards of Training, Certification, and Watchkeeping (STCW) 1978 revised in 1995 and 2010	STCW standardizes the training, certification, and watchkeeping requirements for seafarers worldwide.

Convention, Regulation, Statute, Guideline	Description
Federal	
National Environmental Policy Act (42 USC 4321 et seq.)	Requires the consideration of potential environmental effects. NEPA implementation procedures are set forth in the President's Council on Environmental Quality's Regulations for Implementing NEPA (49 CFR 1105).
46 USC (Shipping) Chapter 33 (Inspection)	Consolidates the laws governing the inspection and certification of vessels by USCG.
Ports and Waterways Safety Act of 1972 (33 USC 1221 et seq.)	Provides for the protection and "safe use" of a U.S. port (includes the marine environment, the navigation channel, and structures in, on, or immediately adjacent to the navigable waters) and for the protection against the degradation of the marine environment.
Port and Tanker Safety Act of 1978 (amended the PWSA). Relevant regulations are 33 CFR 161 and 164.	Addresses improvements in the supervision and control over all types of vessels, foreign and domestic, operating in the U.S. navigable waters. Additionally, the PTSA addresses improvements in the control and monitoring of vessels operating in offshore waters near U.S. coastline, and vessel manning and piloting standards.
Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 as amended by the National Invasive Species Act of 1996 (16 USC 4711(c)(2)) Relevant regulations are 33 CFR 151 and 46 CFR 162.	Requires the Secretary of Homeland Security to ensure to the maximum extent practicable that aquatic nuisance species are not discharged into waters of the U.S. from vessels. Also allows the Secretary to approve the use of certain alternative BWM methods.
Maritime Transportation Security Act of 2002 (46 USC 701). Relevant regulations are 33 CFR 101 and 105.	Requires a comprehensive maritime security framework that includes planning, personnel security, and monitoring of port facilities, and cargo. Aligned, where appropriate, the requirements of domestic maritime security regulations with the international maritime security standards in the International Convention for the Safety of Life at Sea, 1974, and the International Code for the Security of Ships and of Port Facilities to ensure security arrangements in the U.S. are as compatible as possible for vessels trading internationally.
Federal Water Pollution Control Act, as amended by Section 4202 of the Oil and Pollution Act of 1990 (33 USC 1321). Relevant regulations are the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 300) and 33 CFR 155.5010–5075.	Requires owners or operators of tank and nontank vessels to prepare and submit oil or hazardous substance discharge response plans for certain vessels operating on the navigable waters of the United States.
The Act to Prevent Pollution from Ships (33 U.S.C. 1901 et. seq.)	Implementing U.S. legislation for MARPOL and Annexes I and II.
Maritime Transportation Security Act (MTSA) 2002	Implements ISPS for U.S. vessels and foreign vessels visiting U.S. waters and ports.
33 CFR 80-82	International Navigation Rules.
33 CFR 83-90	Inland Navigation Rules

Convention, Regulation, Statute, Guideline	Description
33 CFR, 46 CFR, and 49 CFR	These regulations incorporate international laws to which the U.S. is signatory as well as various classification society and industry technical standards governing the inspection, control, and pollution prevention requirements for vessels. For example, MTSA 2002 requirements for vessels are regulated in accordance with 33 CFR Part 104.
Washington State	
Washington State Environmental Policy Act (WAC 197-11, RCW 43.21C)	Requires state and local agencies in Washington to identify potential environmental impacts that could result from governmental decisions.
Washington State Ballast Water Management Rules (WAC 220-150) (Statutory Authority: RCW 77.120).	Requires the owner/operator in charge of a vessel 300 gross tons or more, U.S. and foreign, carrying or capable of carrying ballast water into the waters of the State to file a ballast water reporting form at least 24 hours prior to arrival into waters of the State and to ensure that the vessel does not discharge ballast water into the waters of the State except as authorized by the law.
Washington State Bunkering Operations (WAC 317-40) (Statutory Authority: RCW 88.46.170)	Establishes minimum standards for safe bunkering (transfer of fuel to a vessel) operations to reduce the likelihood of an oil spill.
Washington State Oil Spill Contingency Plan Requirements (WAC 173-182) (Statutory Authority: RCW 88.46, 90.56, and 90.48)	Requires that cargo vessels (self-propelled ships in commerce) 300 or more gross tons (other than a passenger vessel or tank vessel) submit a contingency plan for the containment and cleanup of oil spills from the covered vessel into the waters of the State and for the protection of fisheries and wildlife, shellfish beds, natural resources, and public and private property from such spills. Alternatively, the contingency plan for a cargo vessel may be submitted by the agent for the vessel or by a nonprofit corporation established for the purpose of oil spill response and contingency plan coverage and of which the owner/operator is a member.
Washington State Vessel Oil Transfer Advance Notice and Containment Requirements (WAC 173-184)	Requires facility or vessel operators who transfer oil to provide the state with a 24-hour advance notice of transfer.
Washington State Cargo Vessel Boarding and Inspection (WAC 317-31)	Cargo vessels 300 or more gross tons shall submit a notice of entry at least 24 hours before the vessel enters state waters and be subject to boarding and inspection by state inspectors to ensure compliance with accepted industry standards.
Oregon State	
OAR (Division 143, Sections 340-143-0001 through 340-143-0060) (Statutory Authority: ORS 468.020, 783.620-640)	Oregon Department of Environmental Quality enforces ballast water management requirements that are essentially the same as federal regulations (administered by the USCG).

Convention, Regulation, Statute, Guideline	Description
OAR 856-010-0003 through 0060 and 856-030-0000 through 0045 (Statutory Authority: ORS Title 58 Chapter 776).	Oregon State Board of Maritime Pilots Rules cover the organization, governance of, training, licensing, accident reporting, and other requirements concerning the pilotage of vessels in Oregon state waters, including the Columbia River.
OAR Division 141, Sections 340-141-0001 through 340-141-0240 (Statutory Authority ORS Chapter 468.020, 468B.345-468B.390)	Oregon Department of Environmental Quality State Oil Spill Contingency Plan requirements for cargo vessels (self-propelled ships in commerce) 300 or more gross tons (other than a tank vessel or a passenger vessel).
Local	
Cowlitz County SEPA Regulations (CCC 19.11)	Provide for the implementation of SEPA in Cowlitz County.

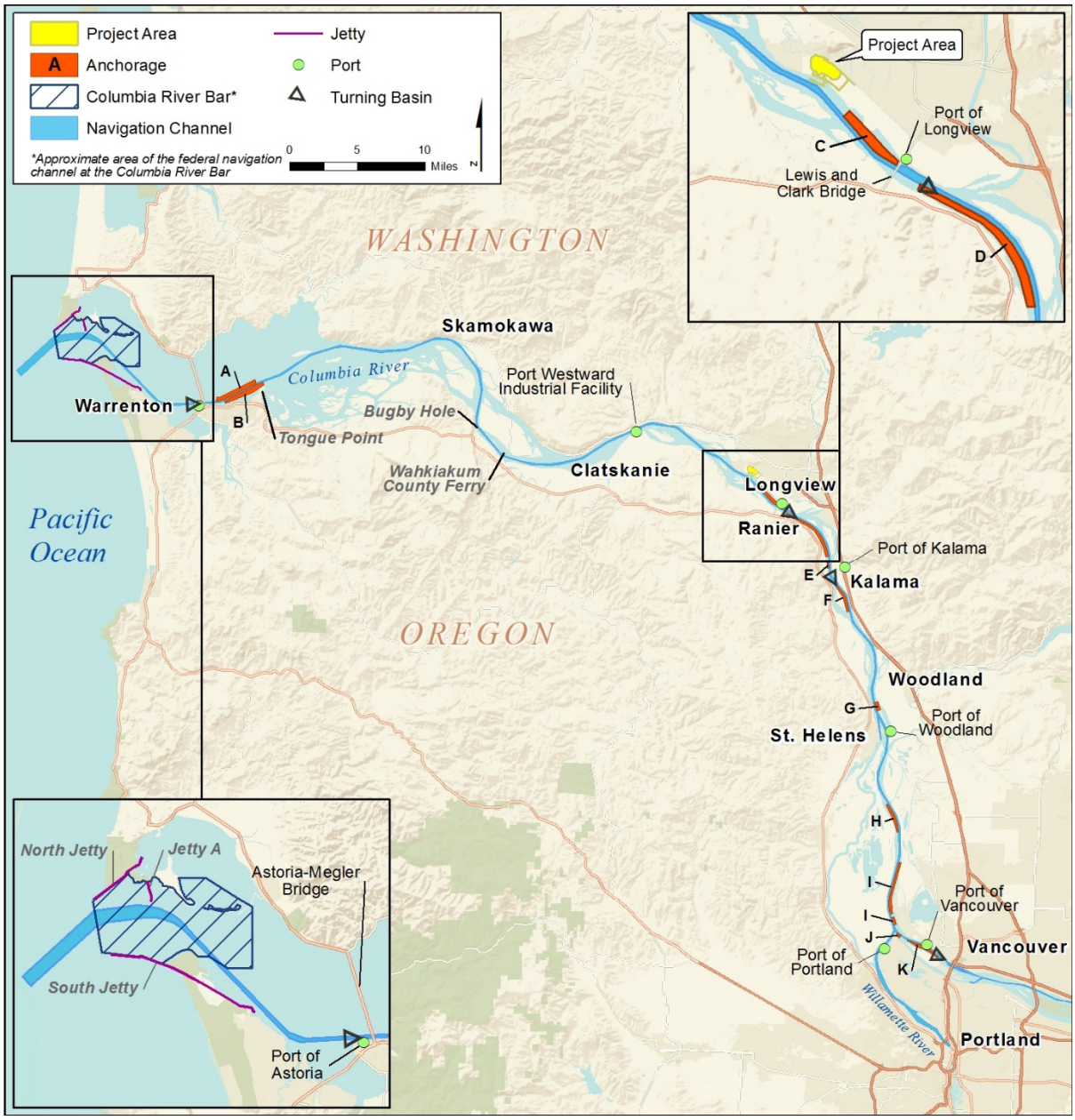
Notes:
USC = United States Code; NEPA = National Environmental Policy Act; CFR = Code of Federal Regulations; CEQ = Council on Environmental Quality; PWSA = Ports and Waterways Safety Act; PTSA = Port and Tanker Safety Act; NANPCA = Nonindigenous Aquatic Nuisance Prevention and Control Act; NISA = National Invasive Species Act; BWM = ballast water management; OPA 90 = Oil and Pollution Act of 1990; WAC = Washington Administrative Code; RCW = Revised Code of Washington; ORS = Oregon Revised Standards; USCG = U.S. Coast Guard; SEPA = Washington State Environmental Policy Act; City = City of Longview; County = Cowlitz County; OAR = Oregon State Administrative Rules; MARPOL = International Convention for the Prevention of Pollution from Ships

1.3 Study Area

The study area for vessel transportation includes the waterways that would be used by or could be affected by vessels calling at the project area. It includes the waters out to 3 nautical miles seaward of the mouth of the Columbia River, the Columbia River Bar (Bar), the Columbia River upstream to Vancouver, Washington[3], and the Willamette River upstream to the Port of Portland (Figure 3).

[3] The Port of Vancouver is the furthest upstream port receiving large commercial vessels.

Figure 3. Study Area for Vessel Transportation



Chapter 2
Existing Conditions

This chapter explains the methods for assessing the existing conditions and determining impacts and describes the existing conditions in the study area as they pertain to vessel transportation.

2.1 Methods

This section describes the sources of information and methods used to characterize existing conditions and assess the potential impacts of the Proposed Action and No-Action Alternative on vessel transportation.

2.1.1 Data Sources

Data for the vessel transportation analysis were obtained from stakeholder interviews and the following sources of information.

- Detailed vessel transportation data from the Columbia River Bar Pilots (Bar Pilots) included in the *Traffic and Transportation Resource Report* prepared for the Applicant (URS Corporation 2014) was validated during a meeting with the Bar Pilots. That report and other data obtained from the pilots are the basis for historical vessel transportation type and volumes. In addition, Washington State Department of Ecology (Ecology)] Vessel Entries And Transits (VEAT) data were used for comparison with the Bar Pilot data.
- The Columbia River Pilots (River Pilots) representatives provided information on vessel traffic management within the Columbia River and vessel docking issues at the existing dock at the project area.
- Merchants Exchange of Portland, Oregon (PDXMEX), representatives provided a synopsis of its operations, which consist of vessel tracking (through the Automatic Identification System [AIS]), data collection, and information exchange (via telephone, radio, and website). AIS data from 2014 were also provided and served as the basis for characterizing current vessel traffic mix and densities, as described further in Section 2.1.2, *Impact Analysis*.
- AIS data from 2014 were used to characterize existing (2014) vessel distribution and density.
- *Coast Pilot 7 (Pacific Coast: California, Oregon, Washington, Hawaii, and Pacific Islands)* (National Oceanic and Atmospheric Administration 2014) and the *Lower Columbia Region Harbor Safety Plan* (Lower Columbia Region Harbor Safety Committee 2013) provided information on the vessel transportation characteristics of the study area.
- The following sources were used as part of the risk analysis.
    - AIS data to establish baseline (2014) vessel types, sizes, routes, and transit frequencies between the Columbia River mouth and Longview.
    - Historical vessel incidents and severity, based on the U.S. Coast Guard (USCG) Marine Information for Safety and Law Enforcement (MISLE) database from 2001 to 2014.

  - Data on reported oil spills in the Columbia and Willamette Rivers from the following three databases for the period between January 1, 2004, and December 31, 2014:[4] USCG MISLE database, Ecology's Environmental Report Tracking System (ERTS) database, which records all incidents reported to the state, and Ecology's Spills Program Incident Information (SPIIS) database, which records spills reported to the state.
- Information also was collected during visits to the project area on October 14, 2014.

2.1.2 Impact Analysis

For the purposes of this analysis, construction impacts are based on the peak construction period, and operations impacts are based on maximum coal export terminal throughput capacity (up to 44 million metric tons per year). The following methods were used to evaluate the potential impacts of the Proposed Action and No-Action Alternative on vessel transportation.

- The vessel transportation route, navigational considerations, historical and current vessel traffic patterns, and the systems in place to monitor and control vessel traffic along that route were described based on information gathered through the sources described in Section 2.1.1, *Data Sources*.
- Construction-related impacts were qualitatively assessed based on the relative increase in activity in and around the project area and the potential to disturb ongoing vessel transportation.
- Operations-related impacts at the project area (direct impacts) were qualitatively evaluated in terms of the increased potential for vessel-related incidents to occur.
- Operations-related impacts during vessel transit (indirect impacts) were evaluated both qualitatively and quantitatively to determine the potential for increased risks. Historical vessel incident data were evaluated to characterize the nature and magnitude of vessel incidents that have occurred on the Columbia River in the project area.
- The potential for increased incidents (i.e., allisions[5] at the project area, collisions, groundings, and fire/explosions by project-related vessels during transit) were modeled for existing conditions, the Proposed Action, and No-Action Alternative. The potential for allisions during transit was qualitatively assessed.
  - The incident frequencies were estimated using the Marine Accident Risk Calculation System model and were limited to the area evaluated in the study (Appendix A).
  - The number of trips for non-Proposed Action-related vessels were derived from 2014 AIS data for all vessel types. An increase of 1% per year was applied to the 2014 AIS data through 2028 for the No-Action Alternative. The number of vessels under the Proposed Action was added to this total to determine the incremental increase in the likelihood of the modeled incidents occurring.
- To provide context for understanding the relative consequences of a collision, grounding or allision incident, a survey of USCG MISLE database was conducted for years 2001 to 2014. This

[4] When the information from these three datasets were combined, all duplicate entries were removed and only incidents with actual reported spills of petroleum or petroleum products were considered in the development of the baseline oil spill frequency for the study area.

[5] An allision occurs when a vessel strikes a fixed structure, such as a dock or a vessel at berth.

period was chosen because it covers over 99% of all reported collision, grounding, and allision incidents in the dataset. Data surveys were conducted for the national dataset and for the study area separately to test for the differences in the distribution of incident severity between the two.

- Increased risks of bunker oil spills were addressed both quantitatively and qualitatively.
  - The potential for a bunker oil spill to occur as the result of an incident was modeled using the NAPA model (DNV GL 2016). Using Monte Carlo simulations, in accordance with International Maritime Organization Resolution MEPC.110(49)[6] - Probabilistic Methodology for Calculating Oil Outflow, the model estimates oil outflow volumes based on the number of damaged cargo tanks and interaction with tidal influences. Monte Carlo simulations were run for 50,000 damage cases to estimate the potential variability in impact and oil outflow volumes.
  - The potential for releases to occur during bunkering was qualitatively assessed based on the relative increase in vessel transportation.

2.2 Existing Conditions

This section addresses the existing conditions related to vessel transportation in the study area, including the marine environment, navigation channel and other features; vessel traffic, vessel traffic management, vessel casualty and spill surveys; and incident management.

2.2.1 Marine Environment

Conditions of the marine environment in the study area that can affect vessel transportation include winds, longshore and tidal currents, river flows, swells and waves, and extreme weather. These elements are described below by portion of the study area

2.2.1.1 Pacific Ocean—Offshore of the Columbia River

Conditions in the Pacific Ocean approaching the Columbia River can vary greatly depending upon the time of year. Prevailing winds and seasonal patterns have the greatest effect on offshore conditions. *Coast Pilot 7* (National Oceanic and Atmospheric Administration 2014: 261–265) provides a thorough discussion of weather in the Pacific Ocean off the West Coast and a brief synopsis of what vessel captains transiting along the U.S. coastline can expect:

> The route along the California-Oregon-Washington coast frequently must be navigated in thick weather. Most of the courses are long, and the effect of currents is uncertain (p. 265).

Closer to the river system, longshore currents that generally flow to the north in winter and to the south in summer are a factor for vessel navigators, although not as much as tidal current and river flows near the river system. Offshore swells can vary more than several feet with the current flow and can result in breaking waves.

[6] The Marine Environment Protection Committee (MEPC) is a subsidiary body of the International Maritime Organization Council.

Average winter daytime temperatures vary from the upper forties (48 to 49) of degrees Fahrenheit (°F) near the mouth to the upper thirties (39°F) at Vancouver, Washington, and Portland, Oregon. At night, the coastal temperatures range within the mid- to high-thirties (35 to 37°F) compared to the low- to mid-thirties (32 to 37°F) further inland near Vancouver and Portland. Snowfall is not common west of Vancouver. Average annual snowfall in Vancouver is 2 inches and occurs in higher elevations of the city.

Although winds are strongest in late fall and winter, they seldom reach gale force along the Columbia River. The strongest winds are usually out of the south or southwest. Wind flow is generally from the east through southeast in winter, and wind speeds reach 17 knots or more about 5 to 10% of the time.

Spring temperatures rise slowly near the Columbia River mouth, compared to the rate of temperature rise further upriver. By April, daytime temperatures in Vancouver average in the low-60s (°F) versus the mid-50s in the towns closer to the Columbia River mouth. Spring and summer typically have northwest and west wind patterns that often clash with river outflows. The volume of water flowing from the Columbia River and the force of impact with ocean conditions can combine to create daunting sea conditions. Nevertheless. Summer winds generally remain light and have a cooling effect keeping average daytime temperatures below 70°F at Astoria and below 80°F at Portland. Toward late summer, fog becomes a hazard near the river mouth and visibilities fall below 0.5 mile on about 4 days in August. Fog spreads upstream to Portland by September. During the fall, fog reduces visibility to less than 0.5 mile on 4 to 8 days per month.

River current always flows out, but with wide variations in flow rate and volume. The outflow from the Columbia River is a combination of tidal currents with river discharge. At times, currents reach a velocity of over 5 knots on the ebb; on the flood they seldom exceed a velocity of 4 knots.

2.2.1.2 Columbia River Bar

The Bar is a system of bars and shoals just seaward of the mouth of the Columbia River (Figure 3). The bar is about 3 miles wide and 6 miles long, and is where the energy of the river's current dissipates into the Pacific Ocean, often as large standing waves (one meter/3.28 feet or more) (Jordan pers. comm. B). The waves result from the bottom contours of the bar area, the mixing of fresh and saltwater, and environmental conditions.

Tide, current, swell, and wind—direction and velocity—all affect bar conditions. Current velocity typically ranges from 4 to 7 knots westward into the predominantly westerly winds and ocean swells, creating significant disturbances of the water column and waves. There are two full tidal current ebb and flood cycles each day, and conditions at the bar can change unpredictably in a short time period with the tidal flow. Worst-case conditions typically occur when onshore winds and tidal ebb combine with the river flow; when this happens, the effects can change unpredictably in a very short time as the tidal flow cycles.

2.2.1.3 Columbia River

The tidal range at the mouth of the Columbia River is approximately 5.6 feet with mean higher high water measured at 7.5 feet in 2013 (National Oceanic and Atmospheric Administration 2014). At Portland and Vancouver the tidal range is approximately 2.3 feet with mean higher high water measured at 8.7 feet in 2013 (National Oceanic and Atmospheric Administration [NOAA] tides and water levels station 9440083). The Columbia River experiences a mixed semidiurnal tide cycle. This

means that there are two high and two low high tides of different size every lunar day. Moreover, the river flow combines with the tides to influence tidal heights. For example, during the spring when the river flow peaks, tidal height is increased by additional water flowing through the river. This phenomena is referred to as *freshet* (National Oceanic and Atmospheric Administration 2009).

Annual freshets have little effect on the tide range at the mouth of the Columbia River; however, at Portland and Vancouver they average about 12 feet with the highest-known level of 33 feet at Portland. Typically, tidal influence reaches as far as the Portland/Vancouver area. However, tidal effects can be felt to as much as 140 miles upriver under low-flow conditions.

The average annual flow for the Columbia River at Beaver Army Terminal near Quincy, Oregon,[7] is approximately 236,600 cubic feet per second (cfs) (1 cfs = 448.8 gallons per minute). The river's annual discharge rate fluctuates with precipitation and ranges from 63,600 cfs in a low water year to 864,000 cfs in a high water year (U.S. Geological Survey 2014). The flow is driven primarily by the outflow from the dams on the upper portion of the river, which varies with both snowmelt and rainfall.

2.2.2 Columbia River Navigation Channel

The Washington-Oregon border follows the Columbia River (Figure 3). The portion of the channel at the mouth of the Columbia River referred to as the Bar, is 6 miles long, extending 3 nautical miles[8] into the Pacific Ocean from the mouth of the river to 3 miles up the river. From this point at 3 miles upstream, the channel continues along the Columbia River upstream to river mile (RM) 106.5, at the Port of Vancouver, and 11.6 miles along the Willamette River from its confluence with the Columbia River to Broadway Bridge in Portland. These portions of the channel are described in more detail below.

Although some areas of the channel are dredged through rock, the banks consist primarily of loose, unconsolidated soils. However, there may be areas of submerged objects or rocky bottom. The River Pilots describe the banks of the river and the edges of the channel as generally soft with no major risks to vessels from a potential grounding (Amos pers. comm.).

The channel is shown on NOAA charts beginning with Chart No. 18521 at the mouth of the river, progressing to Chart No. 18524 at Longview and to Chart Numbers 18526 and 18527 at Portland and Vancouver (National Oceanic and Atmospheric Administration 2014).

2.2.2.1 Columbia River Bar

Descriptions on the U.S. Army Corps of Engineers (Corps), Portland District website note that "the Columbia River bar is the second-most treacherous in the world and the most treacherous in the United States" (U.S. Army Corps of Engineers 2015a). The Corps also notes that maintaining the channel to its authorized depth ensures safe passage for commercial and recreational vessels. The channel varies from 2,000 feet wide and 55 feet deep to 640 feet wide and 48 feet deep. Dredging is possible only during the calmer weather period from June to early November. Up to 5 feet of over-depth dredging may be approved to ensure authorized project depth in between dredging cycles. In some locations an additional 1 to 2 feet of depth may be authorized.

[7] Approximately 12 river miles downstream of the project area.

[8] Offshore distances are recorded in terms of nautical miles and inshore distances and river distances are given in terms of statute miles.

The Corps maintains three jetties at the mouth of the Columbia River (Figure 3). The north jetty (2.5 miles long) and Jetty "A" (0.3 mile long) are on the Washington side of the mouth. The south jetty (6.6 miles long) is on the Oregon side. The jetties do not block waves but are aligned to focus the river flow to help keep the channel at the mouth of the river clear.

2.2.2.2 Columbia River

The Rivers and Harbors Act of 1878, authorized the original channel, and subsequent acts increased the authorized dimensions. The Water Resources Development Act of 1999 authorized deepening the channel to its present 43 feet from 40 feet. Depths are referenced to the Columbia River Datum, which is 2.32 feet above the North American Vertical Datum of 1988 at RM 61.7.

The deepening of the channel was undertaken to "accommodate the current fleet of international bulk cargo and container ships" and was completed in 2010 (U.S. Army Corps of Engineers 2015a). Detailed information is available on the Corps' Portland District website, including the *Columbia River Federal Navigation Channel Operations and Maintenance Dredging and Dredged Material Placement Network Update, River Miles 3 to 106.5, Washington and Oregon* (U.S. Army Corps of Engineers 2014).

The Columbia River navigation channel is maintained to the following dimensions (U.S. Army Corps of Engineers 2015b).

- From the Columbia River entrance at RM 3.0 to Vancouver, at RM 101.4: 43 feet deep and 600 feet wide.
- From RM 101.4 to RM 105.5 at Vancouver: 43 feet deep and 400 feet wide.
- From RM 105.5 to RM 106.5 at Vancouver: 35 feet deep and 500 feet wide.

The navigation channel also includes anchorages and turning basins, discussed below in Section 2.2.3.2, *Anchorages and Turning Basins.*

2.2.2.3 Willamette River

The portion of the navigation channel in the Willamette River is 43 feet deep and runs along the lower 11.6 miles of the Willamette River from its confluence with the Columbia River to the Broadway Bridge in Portland, at Willamette RM 11.6.[9]

2.2.3 Ports, Anchorages, and Other Features

This section describes ports, anchorages, and other physical features along the navigation channel.

2.2.3.1 Ports

Table 2 lists the ports in the study area with berthing for large vessels along with their locations and facilities. Figure 3 shows the locations of these ports.

[9] Unless specifically referred to as Willamette RM, all references to river mile (RM) in this report apply to the Columbia River.

Table 2. Ports in the Study Area

Port	Location	Facilities
Port of Astoria, Oregon	RM 12	Three deep-draft berths; additional berths for small commercial fishing vessels and research vessels; two marinas and a boatyard; two anchorages
Port Westward Industrial Facility, near Clatskanie, OR	RM 53	One dock and one deep-water berth
Port of Longview, WA	RM 65	Eight marine terminals containing a total of eight berths
Port of Kalama, WA	RM 75	Seven marine terminals: two grain elevators, one general cargo dock, one barge dock, one liquid bulk facility, one lumber barge berth, and one deep-draft wharf
Port of Portland, OR	RM 100	Four marine terminals containing a total of 18 berths
Port of Vancouver, WA	RM 106.5	Four marine terminals containing a total of 13 berths

Notes:
RM = river mile

2.2.3.2 Anchorages and Turning Basins

This section describes anchorages and turning basins in the study area.

Vessels anchor within the Columbia River system for a variety of reasons, planned (e.g., to take on fuel, to wait for a berth) or unplanned (e.g., mechanical repairs, to wait for better weather conditions). In anticipation of this need, USCG has designated 11 locations for vessels to anchor. Each location has specific characteristics with which vessel masters, crews, and pilots must be familiar. Designated anchorages, as identified by USCG and described in 33 Code of Federal Regulations (CFR) 110.228 (Columbia River, Oregon and Washington), are listed in Table 3 and depicted in Figure 3.

The Corps' regulations establish the operational rules for the anchorages, including a requirement that vessels desiring to anchor must contact the pilot office that manages the anchorage to request a position assignment. The Bar Pilots manage Astoria North and Astoria South anchorages. The River Pilots manage the anchorages upriver from Astoria. The rules also specify that no vessel may occupy a designated anchorage for more than 30 consecutive days without permission from the USCG Captain of the Port (COTP).

The Lower Vancouver and Upper Vancouver anchorages are the only anchorage areas maintained by the Corps as part of the Columbia River navigation channel. The other designated anchorages are at sites identified as naturally deep locations, although shoaling does occur to some extent and dredging is occasionally necessary.

Although the anchorages downstream of the project area (Astoria North and South) can accommodate deep-draft vessels, use by vessels with drafts of more than 28 feet (at the Astoria North Anchorage) are not recommended due to the probability of dragging anchor. However, a deep anchorage position at Astoria North, referred to as The Hole, is normally kept vacant for deep-draft vessels in unusual situations or emergencies or for short-term anchoring (Lower Columbia Region

Harbor Safety Committee 2013: 9). The Prescott and Upper Vancouver anchorages have stern mooring buoys that help prevent larger vessels using the anchorage from swinging into the navigation channel while at anchorage.

Table 3. Anchorages in the Study Area

ID[a]	Anchorage Name	River Miles	Range of Depth(s) (feet)	Maximum Vessel Size	Vessel Capacity	Stern Buoy?[b]
A	Astoria North[c]	14–17.8	24–45+	Panamax	6	No
B	Astoria South	15–18.2	20–45+	Handymax	4	No
C	Longview	64–66	29–40+	Handymax	5	No
D	Cottonwood Island	66.7–71.2	19–40+	Handymax	13	No
E	Prescott	72.1–72.5	52–65+	Panamaxe	1	Yes (1)
F	Kalama	73.2–76.2	26–40+	Panamax	7	No
G	Woodland[d]	83.6–84.3	8–40+	<600 feet LOA	3	No
H	Henrici Bard	91.6–93.9	22–33+	<600 feet LOA	8	No
I	Lower Vancouver	96.2–101.0	Minimum of 50	<600 feet LOA	14	No
J	Kelly Point	101.6–102.0	25–40+	Panamax	1	No
K	Upper Vancouver	102.6–105.2	35–50+	Panamax or larger	7	Yes (2)

Notes:
[a] Identification letter corresponds to letters in Figure 3.
[b] Number in parentheses reflects the number of stern buoys maintained at the anchorage.
[c] This anchorage is generally reserved for large and deeply laden vessels as determined by Columbia River Pilots.
[d] Remote and not currently in use.
Source: Lower Columbia Region Harbor Safety Committee 2013; U.S. Army Corps of Engineers 2015b
LOA = length overall

Four turning basins are in the study area (Figure 3). Turning basins are generally wider areas along a channel dredged to the same depth as the channel, where vessel masters and pilots have maneuvering room to turn vessels for the purposes of pointing the bow of the vessel in the direction of transit.

2.2.3.3 Bridges

Two bridges cross the navigation channel at and downstream of the Longview area: the Astoria-Megler Bridge and Lewis and Clark Bridge.

- Astoria-Megler Bridge crosses the Columbia River between Astoria, Oregon, just inland of the Port of Astoria, and Point Ellice, near Megler, Washington. It has a vertical clearance of 205 feet and a horizontal clearance of 1,070 feet.
- Lewis and Clark Bridge crosses the Columbia River between Longview, Washington, and Rainier, Oregon. It has a vertical clearance of 187 feet and a horizontal clearance of 1,120 feet. This bridge is upstream from the project area, and project-related vessels would not pass through this bridge under normal operations.

2.2.3.4 Ferries

One ferry, the Wahkiakum County, Washington, Ferry, crosses the river between Puget Island, Washington, and Westport, Oregon, at RM 37.4. It is the only ferry crossing downstream of the project area.

2.2.4 Large Commercial Vessel Traffic

This section focuses on commercial vessels—excluding fishing vessels and smaller commercial passenger vessels[10]—calling at ports in the study area. For the purposes of this report, these vessels are referred to as *large commercial vessels*. They are primarily cargo vessels, ships and barges carrying various cargo (i.e., dry bulk, automobiles, containers, bulk liquids, and other general cargo). These vessels comprise most, if not all, of the deep-draft vessels, which are restricted to movement in the navigation channel, as well as other commercial vessels with shallower drafts that are able to navigate outside of the channel. Commercial fishing vessels and smaller commercial passenger vessels, as well as recreational vessels and service vessels, are discussed in Section 2.2.5, *Other Vessel Traffic*.

The following sections describe types and amounts of cargo transported, vessel types, and traffic volumes for commercial vessels in the study area.

2.2.4.1 Cargo Types and Amounts

Table 4 presents the types and amounts of cargo transported along the Columbia River. The amounts and percentages in the table reflect average annual gross tonnage for the period 2004 to 2014, based on Bar Pilots data (Jordan pers. comm. A).

The following types of cargo are transported along the Columbia River.

- Dry bulk, primarily grain (wheat and corn) and oilseeds (soybeans), as well as wood (logs and chips), potash, coal, and alumina
- Automobiles
- Containers
- General cargo, primarily iron and steel, machinery, and other general cargo that is not containerized or bulk
- Bulk liquids, primarily petroleum products

The primary growth areas in recent years have been in the dry bulk and automobile traffic.

[10] Includes passenger car ferry and overnight and daytime vessels.

Table 4. Cargo Types and Corresponding Average Annual Gross Tonnage (2004–2014)

Cargo Type	Gross Tonnage	Percentage[a] of Total Cargo Moved
Dry bulk	44,551,063	47.3
Automobiles	20,986,525	22.3
Containers	11,187,455	11.9
General cargo	7,447,913	7.9
Bulk liquid	4,127,333	4.4
Other[b]	5,912,903	6.3
Total	**94,213,193**	**100**

Notes:
[a] Percentages refer to gross tonnage to better represent the approximate quantities of various commodities moved along the Columbia River.
[b] Miscellaneous gross tonnage accounting for vessel movements from one berth to another, passenger vessels, tugs, and empty barge movements.
[c] Numbers are rounded up.
Source: Jordan pers. comm. A.

2.2.4.2 Types of Large Commercial Vessels

The types of large commercial vessels in the study area are listed below by four broad categories.

- Cargo ships
  - Tankers carrying bulk liquids
  - Container ships carrying containerized cargo
  - Dry bulk carriers carrying forest products and steel, ore, grain, potash, and other dry bulk cargoes
  - General cargo ships carrying steel, machinery, and other general cargo that is not containerized or bulk.
  - Automobile carriers
- Barges
  - Tank barges (including articulated tug barges [ATBs][11]) carrying bulk liquids
  - Other cargo barges carrying dry bulk, containerized and other cargo
- Passenger cruise ships
- Other[12]

Table 5 presents typical specifications for these vessels and example images.

[11] An articulated tug barge, or ATB, is a tank barge that is propelled and maneuvered by a high-powered tug positioned in a notch in its stern.
[12] Includes bunkers and other vessel types that occur only occasionally (e.g., military, research, and industrial/marine construction vessels).

Table 5. Types of Large Commercial Vessels in the Study Area

Vessel Category	Vessel Types	Typical Vessel Specifications	Example Photos
Cargo ships	Dry bulk cargo ships (bulkers), container ships, general cargo ships, automobile carriers	**Dry bulk, container, and general cargo ships:** DWT: 50,000–80,000, Length: 650–965 feet Beam: 100- 106 feet Draft: 33–39.5 feet	 Bulk cargo ship (bulk carrier)
		Automobile Carriers: DWT: 18,638 Length 650 feet Bean: 105 feet Draft: 27 feet	 Automobile Carrier
		Container ships: DWT: 57,088 Length: 260 feet Beam: 33 feet Draft: 12.5 feet	 Container Ship

Vessel Category	Vessel Types	Typical Vessel Specifications	Example Photos
		Tankers DWT: 65,000–80,000 Length: 965 feet Beam: 106 feet Draft: 41 feet	 Tanker
Barges	Cargo barges including tank barges, dry cargo barges and container barges	Length: 132–286 feet Beam: 40–55 feet Draft: 8–17 feet DWT: N/A (Gross tons: 559–2,700)	 Dry cargo barge
Passenger cruise ships		Length: 560–965 feet Beam: 78–125 feet Draft: 18–29 feet DWT: 2,700–13,290	 Cruise ship

Notes:
DWT = deadweight tons; ATB = articulated tug barge
Photo sources: MarineTraffic.com except for tanker, worldmaritimenews.com; and dry cargo barge, Tidewater.com.

The vessels discussed in this section come in various sizes, as reflected by the ranges (e.g., width, draft) shown in Table 6. Cargo ships are categorized[13] by their capacity and dimensions. The vessel classes that can be accommodated in the study area are listed in Table 6 with their typical dimensions and cargo capacities.

[13] These category names often reflect the canal through which the vessels are designed to travel.

Table 6. Vessel Classes in Use on the Columbia River Navigation Channel

Vessel Class	Deadweight (tons)	Length (feet)	Beam (feet)	Design Draft (feet)
Handymax	10,000–49,999	490–655	75–105	36–39
Panamax	50,000–79,999	965	106	39.5
Post-Panamax[a]	Over 80,000	965 or greater	106 or greater	39.5 or greater

Notes:
[a] The Post-Panamax class, also referred to as New Panamax, is a new vessel class that reflects the expanded Panama Canal dimensions.
Source: INTERCARGO 2015

2.2.4.3 Tug Assistance

Cargo and cruise ships require tugs (generally a minimum of two) to provide assistance during docking and undocking, because these vessels lack adequate maneuverability at slower speeds. These vessels also may rely on tugs in emergency situations to assist, escort and in some cases provide fire suppression. Tug escorts on the Columbia River are generally engaged only in unusual conditions (e.g., electronic equipment issue that would prevent safe navigation or inoperable vessel propulsion system at normal power levels) that can be mitigated by the tug escort. Most likely an unusual condition that requires a tug escort would be in effect for all portions of the transit (from crossing the bar to the final destination).

Tugs are assigned, primarily for docking assistance, based on the minimum bollard pull required for a particular vessel type or operation. Shaver Transportation Company and Olympic Tug and Barge, both based in Portland, provide tugs suitable for ship assists in the study area. Based on the River Pilots' Vessel Movement Guidelines, at least eight of Shaver's 12 study area tugs are suitable for assisting Panamax and Handymax ships; one or two of Olympic's four study area tugs are suitable (Columbia River Pilots 2014).

Tugs also are used to tow and push barges between destinations in the study area for bunkering, fuel transport, and hauling cargo. The following companies provide barge towing in the study area: Bernert Barge Lines, Brusco, and Tidewater.

2.2.4.4 Vessel Speed and Travel Times

The vessels discussed in this section are primarily restricted to the navigation channel where traffic moves in two lanes: one lane inbound and one lane outbound. Vessel speeds generally range between 9 and 15 knots in the study area, with the slower speeds in that range occurring while passing port areas; still slower speeds of between 6 and 9 knots occur while passing through anchorages (Appendix A).

Travel time across the bar, between the offshore Pilot Station and Tongue Point, takes approximately 2 hours in either direction. River transits depend on the study area terminal origination or destination. As an example, the travel time from Tongue Point to Longview is approximately 5 hours inbound (generally vessels in ballast[14]) and about 6 hours outbound

[14] Vessels *in ballast* are not loaded with cargo, but have had their tanks loaded with seawater to increase vessel stability; these vessels have less of a draft than when loaded.

(generally loaded vessels). Outbound transits generally take longer than inbound transits for two reasons: the majority of outbound vessels are loaded and, therefore, travel at reduced speeds; outbound transits are scheduled during high-tide conditions to maximize underkeel clearance [15] and, thus, are usually running against the force of a flood (incoming) tide.

2.2.4.5 Existing and Historical Traffic

This section describes existing (2014) vessel activity and distribution in the study area. It also describes the existing and historical traffic volumes over the past 11 years in the context of historical peak volumes prior to this period.

Existing Commercial Vessel Traffic

This section describes the volume and distribution of existing vessel traffic throughout most of the study area,[16] based on 2014 AIS data (Appendix A). Figure 4 depicts activity by vessel type at eight cross sections (shown in Figure 5) of the study area based on 2014 AIS data. The categories shown in Figure 4 that apply to large commercial vessels are Cargo Ships, Passenger (cruise ships and other large commercial passenger vessels), and, Tug/Tug with Barge.[17] As shown in the figure, vessel activity is greatest near the mouth of the Columbia River. Much of this increased activity at these cross sections (Ilwaco West, Ilwaco East, and Astoria) is related to service and fishing vessel activity, discussed in Section 2.2.5, *Other Vessel Traffic*, below. Cargo ship activity remained fairly consistent across the eight cross sections.

[15] *Under-keel clearance* is the amount of space between the hull of the vessel and the bottom of the channel.

[16] The 2014 AIS data were analyzed as part of the risk study (Appendix A). The upstream extent of the study area for risk is Longview. Therefore, this discussion does not include vessel activity in the study area upstream of Longview.

[17] Because barges do not have AIS receivers, barge numbers are captured as part of the tug data. The tug numbers include tugs traveling independently and tugs towing or pushing barges. Only the latter are considered large commercial vessels. The number of tug and barge units (cargo barges), including ATBs, entering and exiting the river are best represented by transits recorded for the Ilwaco locations; the increased tug activity in the upstream portions of the study area, especially near Longview and Wauna, likely represents tugs traveling independently to provide docking services and tugs shifting cargo barges between ports.

Figure 4. Number of Transits per Location by Vessel Type (based on 2014 AIS Data)

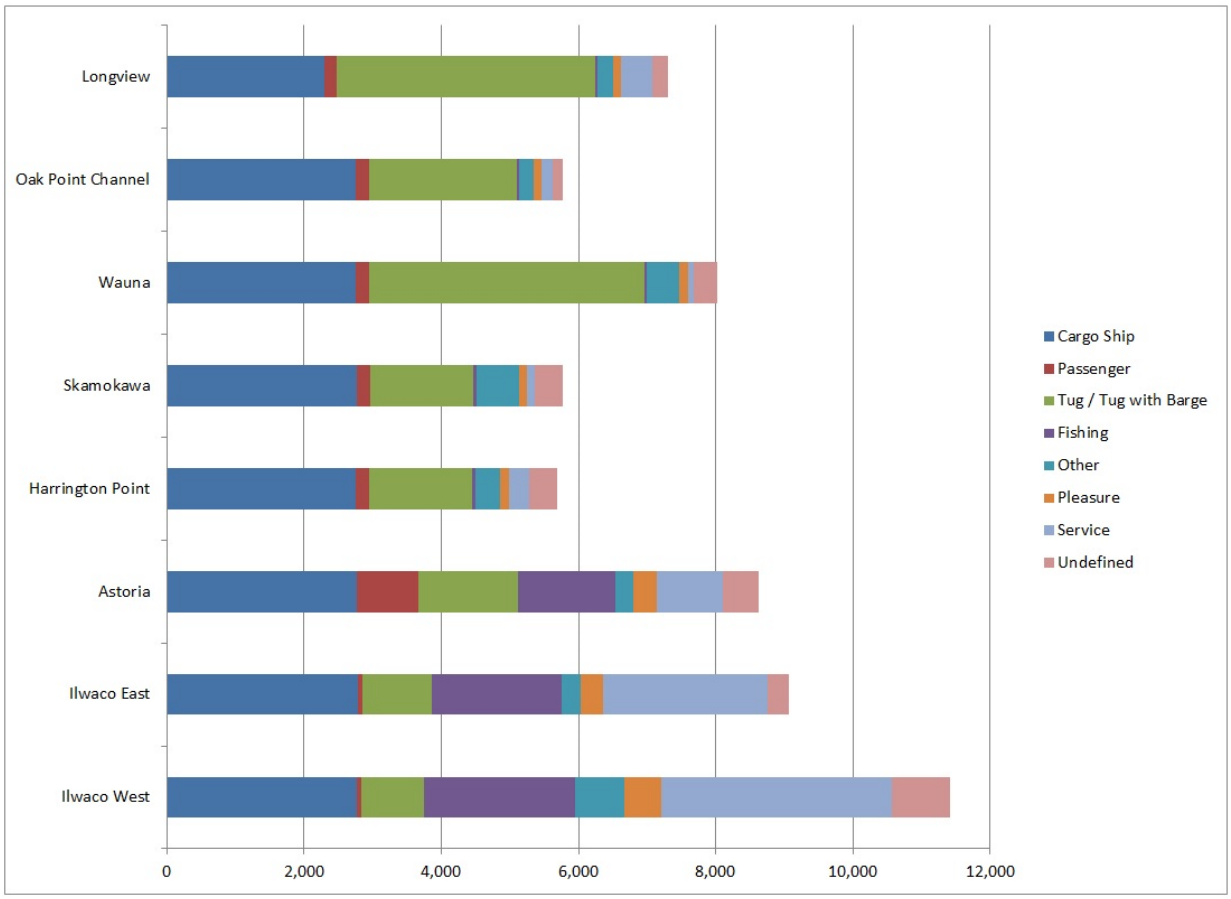
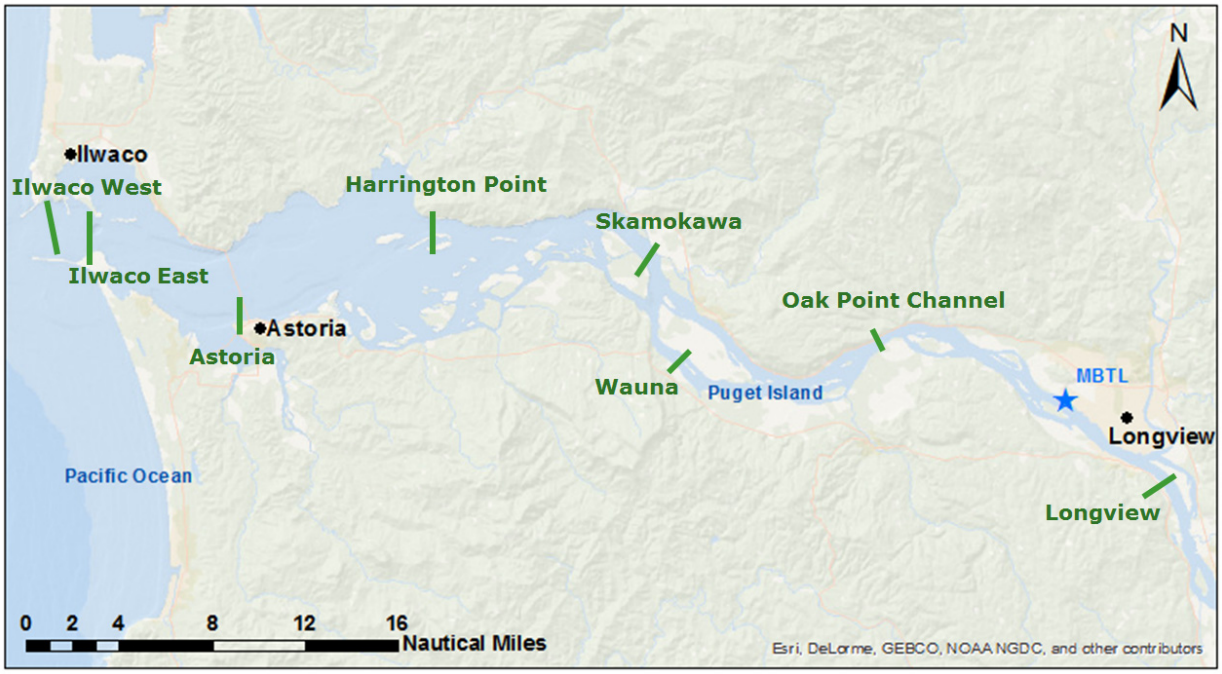


Figure 5. Vessel Data Location Points



Characterizing existing port activity is another way to understand large commercial vessel activity. Types and uses of vessels calling at ports in the study area (Figure 3) are described below.

- Port of Astoria primarily receives cruise ships, loggers and other cargo vessels, and other types of vessels (e.g., USCG, pollution control, commercial fishing, and recreational vessels). The Port reports approximately 230 vessel calls [18] at the Waterfront and Tongue Point berths in 2015 (McGrath pers. comm.).
- Port Westward Industrial Facility receives tankers and tank barges.
- Port of Longview receives cargo ships and barges transporting various types of general and bulk cargo, including steel, lumber, logs, grain, minerals, alumina, fertilizers, pulp, paper, wind energy components, and heavy-lift cargo. The port reported 222 vessel calls in 2015, with a 5-year average of 205 vessel calls per year (Hendriksen pers. comm.).
- Port of Kalama receives cargo ships and barges primarily transporting grain, but also bulk liquid chemicals and general cargo. The port reported 205 vessel calls in 2014 (Port of Kalama 2015).
- Port of Portland receives cargo ships (mostly Handymax and Panamax) and barges, cruise ships, and other vessel types (e.g., other commercial passenger vessels, dredges, pollution control vessels). The cargo vessels transport all types of cargo. The port reported 513 and 352 vessel calls in 2014 and 2015, respectively (Myer pers. comm.).
- Port of Vancouver receives cargo ships (Handymax and Panamax) and barges transporting grain, scrap, steel, automobiles, petroleum products, other dry and liquid bulk cargo, and other products. The port also receives commercial passenger vessels (not cruise ships) and dredges. The port reported 450 vessel calls per year in 2014 and 2015 (Ulgum pers. comm.).

Historical Traffic Volumes

This section describes historical commercial vessel traffic volumes in the study area. Table 7 shows annual vessel traffic volumes in the study area over an 11-year period (2004 to 2014), based on VEAT data and Bar Pilots' records. The VEAT numbers reflect vessels entering the Columbia River, which is equivalent to vessel calls. The Bar Pilots record bar crossings, or entries to and exits from the Columbia River, which are equivalent to transits. A call typically results in two transits—an inbound transit and an outbound transit; therefore, the Bar Pilot transits were divided by two for ease of comparison with the VEAT calls in Table 7. As shown in the table, the calls based on Bar Pilots data are slightly higher than those based on VEAT data; this difference reflects that the Bar Pilots record some vessels that are not reported in the VEAT database and vice versa.[19] As shown in Figure 6, despite these relatively minor differences, the two datasets produce very similar traffic volume curves over the 11-year period.

[18] A call represents a visit to a port terminal. A vessel call typically results in two vessel transits: one inbound and one outbound.

[19] The Bar Pilots record several vessel types not recorded in the VEAT data: military vessels, research vessels, industrial/marine construction vessels, and dredges. The VEAT database records some passenger vessels not recorded by the Bar Pilots; while both record cruise ships, the VEAT data also include passenger ferries and inland passenger vessels used for such purposes as day trips and dinner cruises.

Table 7. Columbia River Vessel Traffic[a] Levels

	Calls[b]	
Year	**Bar Pilots Data**	**VEAT Database**
2004	1,777	1,669
2005	1,718	1,654
2006	1,809	1,720
2007	1,929	1,872
2008	1,891	1,806
2009	1,463	1,397
2010	1,683	1,583
2011	1,581	1,466
2012	1,589	1,431
2013	1,724	1,457
2014	1,819	1,662

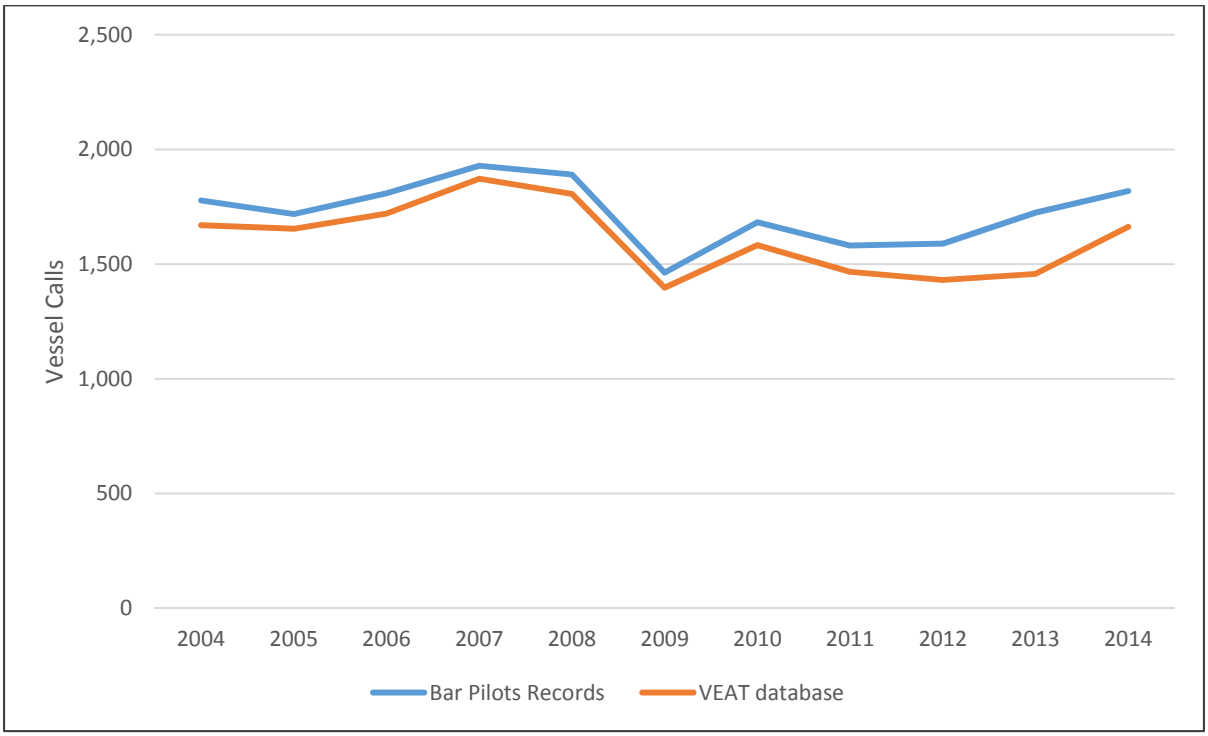
Notes:

[a] Tows consisting of tug and barge traffic, mostly for grain and wood products are not included in the data evaluated. For the most part, that traffic stops upriver from the project area and is not monitored as closely as the deep-draft vessel traffic.

[b] A vessel call represents a vessel's entry to the river or its visit to a port.

Sources: Jordan pers. comm. A; VEAT (Washington State Department of Ecology 2015).

Figure 6. Comparison of Vessel Calls Based on Bar Pilot and VEAT Data (2004–2014)



As shown in Table 7 and Figure 6, traffic volumes were similar in 2004 and 2014, but fluctuated within that time period. For comparison, the historical peak vessel traffic year for the Columbia River is 1999 with 2,269 calls based on VEAT data (Washington State Department of Ecology 2014), and 1979 with 2,376 calls, based on the Bar Pilots data (Jordan pers. comm. A). Although vessel traffic volumes have been considerably lower over the past 11 years compared to these peak years, vessel sizes and total cargo tonnages have increased in recent years.

The overall decrease in vessel traffic levels has been attributed to several factors. General economic conditions that affected industry levels nationally and worldwide have had commensurate impacts on regional activity and thus vessel traffic. On the other hand, the deepening of the Columbia River channel from 40 feet to 43 feet has allowed larger vessels with greater drafts to call at river ports, and vessels that previously had to be light-loaded to now be loaded to deeper drafts, which resulted in the need for fewer vessels to move a given volume of cargo. This is especially the case for the dry bulk cargo vessels that make up a high percentage of the river traffic (Krug pers. comm.; Myer pers. comm.; Amos pers. comm.; Jordan pers. comm. B). The changing nature of vessel design and the likely partial impact on vessel volumes in the study area is illustrative of the multiple factors that can affect vessel traffic volumes over time.

Figure 7 shows annual vessel transits[20] over the past 11 years by the four vessel categories: cargo ships, barges, passenger ships, and other (based on the Bar Pilots data [Jordan pers. comm. A). As shown in the figure, cargo ships[21] (including tankers) constitute the largest percentage of vessel traffic in the study area (around 90% annually on average) over the 11-year period, while barges represent 3 to 10% and cruise ships less than 1%. The remainder, approximately 3%, consists of a mixture of other vessel types.[22]

This cargo ship traffic can be broken down further into specific vessel types, based on the Bar Pilots records. Figure 8 shows transits of the cargo ship category shown in Figure 7 by cargo ship type. Dry cargo ship transits represent over half (between 50 and 60%) of the cargo ship traffic annually in the study area. The remainder (in descending order of magnitude) were automobile carriers, general cargo ships, container ships, and tankers.

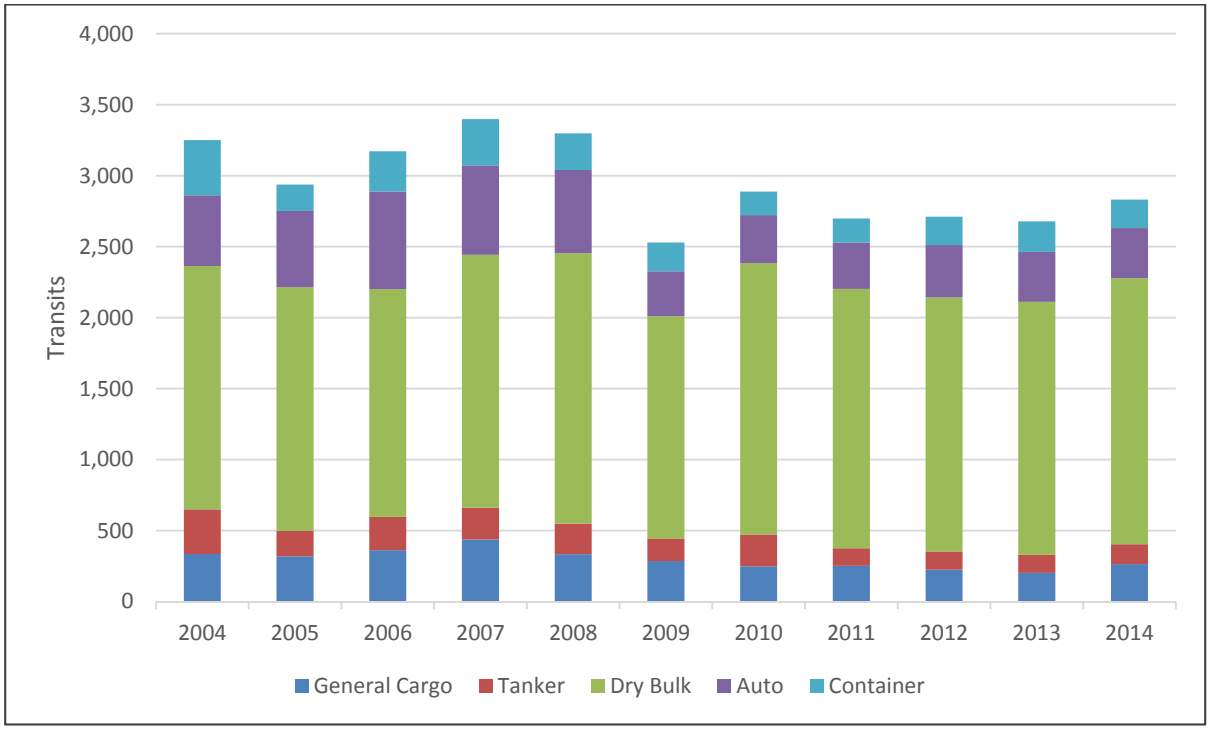
[20] These numbers only account for transits across the bar in either direction. They do not include any in-river transits from one terminal or port to another. Moreover, transit lengths vary: one transit may stop at Astoria while another may extend the length of the study area.

[21] Vessels categorized as *cargo ships* include vessels recorded in Bar Pilot data as general cargo ships, tankers, bulkers, loggers, auto carriers, chippers, and container ships.

[22] Vessels categorized as *other* include vessels recorded in Bar Pilot data as miscellaneous (occasional military vessel, research vessels, industrial/marine construction, dredges), bunkers, shipyard, and shifts.

Figure 7. Vessel Traffic Volumes by Major Vessel Category (2004–2014)

Figure 8. Percentage of Annual Cargo Ships by Vessel/Cargo Type (2004–2014)



2.2.5 Other Vessel Traffic

The vessels discussed in this section include commercial fishing, recreational, smaller commercial passenger, and service vessels. These vessels are generally much smaller than the vessels discussed in the previous section and have different activity and transit patterns. Most can move about the river without being restricted to the navigation channel. Table 8 presents typical specifications for these vessels and example images.

Table 8. Other Vessel Types in the Study Area

Vessel Type	Typical Specifications	Example Image
Fishing vessels	Length: 20–180 feet Beam: 8–45 feet Draft:: 3–15 feet	 Fishing (gillnetter) vessel
Other commercial passenger vessels: car ferries, inland passenger ships, passenger ferries	**Car ferry:** Length: 109.2 feet Breadth: 47.5 feet Draft: 6 feet **Other commercial passenger vessel:** Gross Tons: < 100 Length: 80–150 feet Beam: 30–40 feet Draft: 6–12 feet	 Car ferry “Oscar B” River cruise vessel

Vessel Type	Typical Specifications	Example Image
Recreational vessels, including pleasure boats, yachts, sailing vessels	Length: 20–150 feet Beam: 8–40 feet Draft: 3–15 feet	 Pleasure craft
Service vessels Military (USCG), law enforcement, pilot, and Aids to Navigation vessels	U.S. Coast Guard vessels range in length from 22 feet to over 300 feet. **Vessel shown:** Length: 47 feet Beam: 14 feet	 U.S. Coast Guard search and rescue vessel
	Pilot vessel (shown): Length: 72 feet Beam: 20 feet	 Pilot vessel COLUMBIA
	Pollution control vessels: Length: 20–40 feet Beam: 6–20 feet	

Vessel Type	Typical Specifications	Example Image
Tugs	Length: 50–150 feet Beam: 26–35 feet Draft: 9–16 feet	 General tug
Dredge vessels	**Vessel shown:** Length: 200 feet Beam: 58 feet Draft: 16 feet	 Dredge vessel YAQUINA

Notes:
Photo sources: MarineTraffic.com, except fishing (gillnetter) vessel, WDFW Image Gallery; car ferry "Oscar B," Daily Astorian; search and rescue vessel, News Lincoln County.

2.2.5.1 Commercial Fishing

Columbia River

The Columbia River is divided into six commercial fishery management zones; of these, Zones 1 through 3, and a portion of Zone 4 occur in the study area (NOAA Fisheries 2016). The commercial fisheries in these zones are managed by the states of Oregon and Washington.

Within the study area, the Columbia River supports important commercial shad, anchovy, herring, smelt, and salmon fisheries. Commercial fishers deploy gillnets, tangle-nets, or seins depending on species, season, and zone. Anchovies and herring may be taken for commercial purposes at any time in the Columbia River seaward of the Astoria-Megler Bridge (Figure 3). Commercial salmon seasons and authorized fishing gear are shown in Table 9. Shad typically can be taken for commercial purposes from the study area zones during commercial salmon seasons with the same fishing gear authorized for the taking of salmon. The retention of green sturgeon and white sturgeon was prohibited in the Columbia River downstream of Bonneville Dam beginning in 2006 and 2014, respectively.

Table 9. Major Columbia River Salmon Commercial Fishery Seasons in the Study Area

Season[a]	Primary Species	Areas	Authorized Method/Gear
Winter (February–March)	Spring Chinook	Select Area Fisheries[b]	Gillnets and tangle-nets
Spring (April–June)	Spring Chinook	Select Area Fisheries[b] and Columbia River mainstem[c]	Gillnets and tangle-nets
Summer (June–July)[c]	Sockeye and Summer Chinook	Columbia mainstem and Select Area Fisheries[b]	Gillnets
Early Fall (August–mid-September)	Summer and Fall Chinook	Columbia River mainstem and Select Area Fisheries[b]	Gillnets
Late Fall (mid-September–mid-November)	Fall Chinook and Coho	Columbia River mainstem and Select Area Fisheries[b]	Gillnets, tangle nets, and experimental seines

Notes:
[a] Dates and areas subject to stock abundance and management decisions.
[b] Select Area Fisheries include Youngs Bay, Blind Slough/Knappa Slough, Tongue Point/South Channel, and Deep River.
[c] Columbia River mainstem areas include Zones 1 (Columbia River mouth) to 5 (Beacon Rock at RM 142).
Source: Washington Department of Fish and Wildlife and Oregon Department of Fish and Wildlife 2015a (winter, spring and summer) and 2015b (fall fisheries).

Approximately 2,046,747 pounds of shad and salmon (Chinook, coho, pink, and sockeye) were harvested (160,821 landings) on the Columbia River in 2015; the late-fall salmon season accounted for approximately 85% of this total harvest, making the late-fall salmon season the busiest time of year for commercial fishing on the Lower Columbia River (Oregon Department of Fish and Wildlife 2015b).

Coastal, Nearshore, and Ocean Commercial Fishing

Several coastal, nearshore, and offshore open-ocean fisheries, including groundfish, halibut, salmon, albacore, pacific whiting, sardines, and shellfish (primarily Dungeness crab and pink shrimp) are present within or adjacent to the study area. However, activities in the study area range from harvesting to landing/processing, depending on the fishery. Commercial fleets come and go from ports near the mouth of the Columbia River, making the river mouth the busiest part of the study area for commercial fishing vessel traffic, though numbers of operating vessels fluctuate by season and license by fishery. The Port of Astoria is home to three seafood processors (Port of Astoria 2016). Fisheries with the greatest likelihood of vessels operating within the study area are discussed below.

Commercial coastal and nearshore fishing in the study area include vessels operating within 3 nautical miles and reporting to the Ports of Astoria, Chinook and Ilwaco. The U.S. West Coast nearshore groundfish commercial fleet operates in the study area and consists of vessels from 10 to 50 feet long, with an average length of 25 feet (NOAA Fisheries 2016). Fixed gear includes hand-lines, cable gear, fishing poles, and pots (traps). Gear is set to retrieve catch multiple times a day and catch is generally landed on a daily basis.

Regulations for nearshore fisheries are set by both the Pacific Management Council and the states; each state manages its nearshore fleet independently by issuing regulations on the cumulative trip limits of nearshore species in their state waters (NOAA Fisheries 2016). The State of Washington

does not allow commercial fishing within its territorial waters (0 to 3 mile from the coastline); therefore, a commercial fixed-gear fleet does not operate in Washington nearshore waters of the study area (NOAA Fisheries 2016). The nearshore commercial fixed-gear fleet in Oregon typically fishes shallow water and targets cabezon, greenlings, and several species of rockfish (NOAA Fisheries 2016).

The Pacific Coast Groundfish Fishery Management Plan (Groundfish FMP) was implemented in 1982 and has since been amended 20 times by the Pacific Fishery Management Council in response to changes in the fishery, reauthorizations of the Magnuson-Stevens Act, and litigation that invalidated provisions of earlier amendments (Pacific Fishery Management Council 2008). The Groundfish FMP guides the management of groundfish fisheries in federal waters, 3 to 200 nautical miles offshore.

The Pacific Coast Salmon Fishery Management Plan guides the management of salmon fisheries in federal waters. Oregon and Washington's commercial ocean salmon fisheries are hook-and-line troll fisheries. This fishery largely targets Chinook salmon, with minor coho salmon seasons in some years (Oregon Department of Fish and Wildlife 2015c). In odd-numbered years, catches of pink salmon can also be significant off Washington and Oregon coastlines (Pacific Fishery Management Council 2014). This is a limited-entry fishery in both states, meaning that a permit is required to actively participate in the fishery each year.

Commercial fishing for Dungeness crab occurs in the study area along the Washington and Oregon coastlines. The ocean crab season begins December 1 and continues through August 14, with peak harvest occurring during the first 8 weeks of the season. Dungeness crabs are caught using circular steel traps with a length of line and a buoy attached to mark its location. The average commercial Dungeness crab fishing vessel fishes 300 to 500 pots in depths of 30 to 600 feet (Oregon Dungeness Crab Commission 2014).

Oregon and Washington have a limited entry system in-place on the Dungeness crab fishery, with more than 350 vessels in Oregon and 200 vessels in Washington operating the fishery (Oregon Dungeness Crab Commission 2014; Washington Department of Fish and Wildlife 2016a). Vessels range from small wooden trollers to large steel combination vessels. The Columbia River estuary is an important location for commercial Dungeness crab fishing with three main landing locations located in the study area: the Port of Astoria, Port of Ilwaco, and Port of Chinook,

Commercial pink shrimp fishing occurs adjacent to the study area in offshore waters of Oregon and Washington (3 to 200 miles offshore) with processing facilities located at the Port of Ilwaco and the Port of Astoria. A limited entry system for the pink shrimp fishery is in place for Oregon and Washington, with 83 active licenses in Washington.

The pink shrimp season begins April 1 and continues through October 31. Fishing occurs during daylight hours using trawl gear, most commonly utilizing double-rigged, semipelagic, fine-meshed shrimp nets (Washington Department of Fish and Wildlife 2016b). Pink shrimp trawl vessels range in size from 38 to 105 feet long, with an average length of 65 feet.

2.2.5.2 Tribal Fishing

The treaties of 1855 between the United States and individual tribal governments reserved tribal rights to fish, hunt, and gather traditional foods and medicines throughout ceded lands identified in the treaties.

The Columbia River and its tributaries support a variety of tribal resources, including six species of salmon and Pacific lamprey, which have been a reliable and important source of food and trade items to Columbia River. The Columbia River tribes are: The Confederated Tribes and Bands of the Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of Warm Springs, and the Nez Perce Tribe. These four tribes in the Columbia River Basin have reserved rights to anadromous fish in treaties with the United States (Columbia River Inter-Tribal Fish Commission 2016). Zone 6, upstream of the study area from Bonneville Dam to McNary Dam, is managed as an exclusive treaty commercial fishing zone. The Draft Environmental Impact Statement assesses the potential impacts of the Proposed Action on tribal resources.

2.2.5.3 Recreational Fishing and Boating

The Columbia and Willamette Rivers are popular areas for recreational boating (motorized and nonmotorized), fishing, and other recreational activities (Port of Portland 2010). Over 30 water access and boat launch sites along the Columbia and Willamette Rivers in the study area provide public and private river access for recreational boating and fishing (Table 10).

Table 10. Water Access Sites in the Study Area[a]

Boating Facility Name	Owner	Waterbody	County (State)
17th Street Transient Dock	City of Astoria	Columbia River	Clatsop (OR)
Courthouse Docks	City of St. Helens	Columbia River	Columbia (OR)
East Mooring Basin	Port of Astoria	Columbia River	Clatsop (OR)
Hammond Marina	City of Warrenton	Columbia River	Clatsop (OR)
Pier 39	Private	Columbia River	Clatsop (OR)
Rainier City Marina	City of Rainier	Columbia River	Columbia (OR)
Riverfront Park	City of Rainier	Columbia River	Columbia (OR)
Sand Island Marine Park	City of St. Helens	Columbia River	Columbia (OR)
Sand Island Marine Park North	City of St. Helens	Columbia River	Columbia (OR)
Scipio's Goble Landing	Private	Columbia River	Columbia (OR)
St. Helens Marina	Private	Columbia River	Columbia (OR)
West Mooring Basin	Port of Astoria	Columbia River	Clatsop (OR)
Westport Ramp	Clatsop County	Columbia River	Clatsop (OR)
Sportsman Club	WDFW	Columbia River	Cowlitz (WA)
Woodland Bottoms	WDFW	Columbia River	Cowlitz (WA)
Knappton	WDFW	Columbia River	Pacific (WA)
Puget Island	WDFW	Columbia River	Wahkiakum (WA)
Port of Ilwaco Marina	Port of Ilwaco	Columbia River	Pacific (WA)
Port of Chinook	Pacific County	Columbia River	Pacific (WA)
Port of Wahkiakum County No. 1	Wahkiakum County	Columbia River	Wahkiakum (WA)
Port of Wahkiakum County No. 2	Wahkiakum County	Columbia River	Wahkiakum (WA)
Elochoman Slough Marina	Wahkiakum Port District 1	Columbia River	Wahkiakum (WA)
Port of Kalama Marina	Port of Kalama	Columbia River	Cowlitz (WA)
McCuddy's Ridgefield Marina	Private	Columbia River	Cowlitz (WA)
Port of Longview Marinas	Port of Longview	Columbia River	Cowlitz (WA)

Boating Facility Name	Owner	Waterbody	County (State)
Port of Woodland Marina	Port of Woodland	Columbia River	Cowlitz (WA)
Riverplace Marina	Private	Willamette River	Multnomah (OR)
Cathedral Park	City of Portland	Willamette River	Multnomah (OR)
Willamette Park	City of Portland	Willamette River	Multnomah (OR)
Kelley Point Park	City of Portland	Willamette/Columbia Rivers	Multnomah (OR)
Hayden Island Marinas (numerous)	Private and Public	Columbia River	Multnomah (OR)

Notes:

[a] This table does not represent an all-inclusive list of water access points in the study area; additional private, municipal, county, and state facilities may be operational in the study area.

Sources: State of Oregon 2016; Washington Public Ports Association 2016; Washington Department of Fish and Wildlife 2016c; Port of Portland 2010

WDFW = Washington Department of Fish and Wildlife; WA = Washington; OR = Oregon

The Columbia River is the most boated waterbody in the State of Oregon with 524,091 boat use days, followed by the Willamette River with 281,176 boat use days. Hayden Island—which is located on the Columbia River, between Vancouver, Washington, and Portland, Oregon—serves as a key location for recreational boaters traveling to different sections of the Columbia and Willamette Rivers. Marinas in the vicinity report that recreational boating is highest during summer months and that 100% of 3,600 boat slips on Hayden Island are leased between April and October (Port of Portland 2010). The Columbia River Water Trail is a designated area for canoes and kayaks that travels through the study area to the mouth of the river.

The Columbia and Willamette Rivers support numerous aquatic species including salmon, steelhead, small mouth bass, shad, and sturgeon fisheries. Greenling, rockfish, lingcod and perch are caught from the jetties, and flounder are common on sandy flats. Recreational fishing seasons vary by target species, but fishing occurs year-round for many species. Recreational catch-and-release fishing for green and white sturgeon is currently allowed year-round (Oregon Department of Fish and Wildlife 2015c). Warm-water game fish species season is also year-round in the study area (Oregon Department of Fish and Wildlife 2015c). The spring Chinook and steelhead fishery for the Columbia River is open from January to March depending on fishery management decisions, and Chinook and coho salmon fishing season runs from August to December.

The spring Chinook fishery in the Hayden Island area of the Columbia River is extremely popular and fishing participation rates have increased over recent years. During the spring Chinook season, between 135,000 and 145,000 angler days are documented on this section of the Columbia River between March 1 and June 1 (Port of Portland 2010). Also, the area between the mouth of the river and Tongue Point, which includes Youngs Bay, is a popular area for recreational fishing year-round (Oregon Department of Fish and Wildlife 2016:25). This area is popular, especially during the fall Chinook and coho salmon season, which generally peaks in the last 2 weeks of August (Washington Department of Fish and Wildlife 2016d).

Dungeness crabs are caught in the estuary and in nearshore and offshore areas beyond the mouth of the river, and razor clams are harvested along the ocean beaches north and south of the mouth of the river.

2.2.5.4 Commercial Passenger Vessels (Non-Cruise Ships)

Commercial passenger (noncruise ship) vessels transit from one port to another within the Columbia River; they include a range of vessels up to 100 gross tons carrying from six to over 150 passengers. Examples of these vessels include the Portland Spirit and Columbia Gorge Sternwheeler, which provide dinner cruises and day trips, respectively, and the Waikiakum County ferry, the only ferry on the Lower Columbia River, which shuttles passengers and up to 12 cars back and forth between Puget Island, Washington, and Westport, Oregon.[23]

2.2.5.5 Service Vessels

Service vessels, including USCG, law enforcement, pilot, spill response, tugs, and dredges operate throughout the study area and could be found anywhere on the lower Columbia River at any time. The vessel types and activities are summarized below.

U.S. Coast Guard Vessels

USCG vessels in the study area are stationed primarily at the Port of Astoria, Cape Disappointment, and Portland, Oregon. These vessels are used for search and rescue, maritime law enforcement, boating safety, Aids to Navigation, and homeland security. The area of responsibility for the Coast Guard Aids to Navigation Team (ANT) in Astoria, Oregon, includes the Columbia River up to Portland, Oregon. The ANT stations two medium endurance cutters (USCG Cutter ALERT and USCG Cutter STEADFAST), which operate offshore and near the mouth of the Columbia River providing search and rescue, and illegal drug and immigrant interdictions. The ANT also stations the USCGC Fir, which is a seagoing buoy tender that maintains 150 aids to navigation along the Washington and Oregon coasts, as well as the Columbia River.

USCG Station Cape Disappointment is situated at the mouth of the Columbia River at Ilwaco, Washington, and is the largest search and rescue station on the Northwest Coast. The station has five search and rescue boats, including the 52-foot moto lifeboat Triumph II, two 47-foot motor lifeboats, and two 29-foot second generation Defender-class response boats. These vessels operate primarily offshore and within the Bar.

Operational responsibilities of the USCG Marine Safety Unit (MSU) in Portland include ship inspections, commercial fishing vessel safety, investigations, waterway management, shoreline facility inspections, and aids to navigation. MSU Portland is homeport to the 100-foot inland buoy tender (USCG Bluebell) responsible for serving aids to navigation throughout the Columbia River and nearby waterways.

Each of the USCG stations described above also have access to a mixture of response and trailerable boats and skiffs.

Local Law Enforcement Vessels

In addition to the USCG law enforcement vessels, Oregon State Police and Washington State Police also operated law enforcement vessels on the Columbia River to coordinate the enforcement of commercial fishery and sport angling regulations and for special investigations. County governments along the Columbia River also staff full-time deputies assigned to patrol the waters of

[23] The Wahkiakum County Ferry is currently closed for repairs for an unspecified period of time.

the Columbia River and conduct boat inspections. These local law enforcement vessels can be found operating within their respective jurisdictions of the Columbia River and its adjacent waterways.

Pilot Vessels

Pilot vessels are used to transport Bar Pilots and River Pilots to large vessels for pilotage duties described above in *Large Commercial Vessels, Vessel Traffic Management*. The Bar Pilots use one of two pilot boats, the Astoria or the Columbia, both 72-feet long, for offshore transfers.[24] For transfers within the Columbia River, the River Pilots and the Bar Pilots use the Connor Foss, a 63-foot-by-17-foot aluminum vessel designed specifically for pilot transfers. The Bar Pilots make approximately 3,600 vessel crossings of the bar each year with vessels ranging from 100-foot tugs to 1,100-foot cargo ships. River Pilots pilot vessels upriver from Astoria including along 13 miles of the Willamette River from its confluence with the Columbia River to the seawall in downtown Portland (Columbia River Pilots 2014).

Spill Response Vessels

Three marine spill response vessels are prestaged in the study area at the Port of Astoria. These vessels belong to Marine Spill Response Corporation – Northwest, which is a cooperative that member companies rely on for oil spill response equipment and support.

Tugs

Tugs operating in the study area include those towing or pushing barges from or to destinations beyond the study area and those from tug companies located along the Columbia River. The latter tug companies provide cargo barge movement services between ports along the river; move bunkers (fuel oil barges) to vessels requiring fuel; and provide docking, escort, and other assistance, as described above under *Large Commercial Vessels, Tug Assistance*. Figure 4 shows tug traffic levels (with and without barges) at eight cross sections in the study area. Tug activity is much higher in the upstream portions of the study area, especially near Longview and Wauna. This activity likely represents tugs transits to and from terminals to provide docking services and tugs shifting cargo barges between ports.

Dredges

Dredging vessels are used to maintain the navigation channel by removing excess sand, silt, and mud that naturally settles to the bottom and on the sides of the channel over time. Maintenance dredging or channel improvement projects, whereby channel dimensions are altered to accommodate larger sizes and/or more loaded commercial vessels, are accomplished by the Corps. In the past, the Corps has used mechanical dredges in the Columbia River (U.S. Army Corps of Engineers 2003:6-6). These types of dredges remove material by scooping it from the bottom and then placing it into a waiting barge or directly into the disposal area, depending upon the location of the dredging. Dredging operations are always advertised to mariners transiting in the Columbia River and are conducted in such a manner as to generally not impede vessel traffic.

[24] Embarking and disembarking of Columbia River Bar Pilots offshore can be by boat or helicopter. It is the individual pilot's choice whether to use the boat or helicopter for transfers offshore, with the helicopter being used about 70% of the time (Jordan pers. comm. B).

2.2.6 Vessel Traffic Management

Management of vessel traffic in the study area is primarily a real-time activity between the Bar Pilots and River Pilots, the vessel master, and the PDXMEX. Deep-draft vessel traffic along the navigation channel moves in a two-way pattern: one lane inbound and one lane outbound. This simplistic layout constitutes the foundation of the traffic management system.

Oversight and active participation in the vessel traffic management process involves coordination between all stakeholders in the Lower Columbia River Harbor Safety Committee comprising representatives from the following.

- USCG
- The Corps
- Ecology
- Oregon Department of Environmental Quality (ODEQ)
- River Pilots
- Bar Pilots
- Shipping agents
- Terminal operators
- Vessel operators (tug and barge companies)
- Associations (such as PDXMEX, the Columbia River Yachting Association, and the Maritime Fire & Safety Association [MFSA])
- Port and vessel services (such as Clean Rivers Cooperative)

The Lower Columbia River Harbor Safety Committee is an open forum that allows for the discussion of the membership's vital interests in assuring safe navigation and maritime practices to protect the public, mariners, the environment, and property. The committee meets approximately every 2 months to review old and new information on the agenda and to hear reports from the active committees (bridges, harbor safety plan, navigation, outreach, and executive steering). The committee publishes and maintains a *Lower Columbia Region Harbor Safety Plan* (last edition published January 2013) which provides users of the Columbia River guidelines to the aids to navigation, anchorages, bunkering, dam lockage, incident management and other navigation practices.

2.2.6.1 Pretransit Planning and Scheduling

Large commercial vessels are required to provide an advance Notice of Arrival (NOA) to USCG at least 96 hours before arrival at the bar in most cases, or upon departure from the last port of call for shorter voyages. This information is provided electronically and shared almost instantaneously with the PDXMEX and the Pilots.[25]

[25] In addition to serving as an arrival notification the NOA includes vital information about the vessel, voyage information (specifics about the five ports visited, name and telephone number of a 24-hour point of contact, etc.),

Upon receipt of the NOA a coordination process is initiated between the pilots and the shipping agent representing the vessel interests. The Bar Pilots and River Pilots work closely with each other and PDXMEX[26] during the pretransit scheduling. The pilots use information provided in the NOA, as well as weather conditions, pilot availability, tidal and river conditions, and anchorage and berth availability to determine scheduling. Federal (USCG, U.S. Immigration and Customs Enforcement) and state agencies (Ecology, ODEQ) will schedule visits to the vessel once it is docked as required for vessel and crew documentation and cargo checks.

For inbound vessels, tracking and coordination begins when the vessel is approximately 2 to 3 hours away from the pilot boarding station (Jordan pers. comm. B). Traffic management for vessels crossing the bar is the responsibility of the Bar Pilots. Decisions on vessel movements are made by the Bar Pilots alone although other considerations by or affecting the Columbia River Pilots could result in delaying a vessel's transit. Bar Pilots typically start their transits approximately 2 hours before high tide.

The Bar Pilots coordinate closely with the USCG on navigation conditions and safety. While only the USCG COTP can close the bar to vessel traffic, the Bar Pilots can suspend traffic movements when the overall circumstances dictate. In assessing navigation conditions, the pilots use these decision criteria. (Jordan pers. comm.)

- Is it safe for the vessel to cross? Factors considered include the expected underkeel clearance, the vessel's maneuverability and horsepower rating, and other aspects of the vessel's condition.
- Can the pilot get on or off the vessel safely?
- Once the pilot is on board, can the pilot boat or helicopter return to base safely?

Some of the factors that could influence a decision are swell and sea height, swell period, current flow direction, wind speed and direction, coastal jet winds in certain circumstances, and timing relative to storm conditions. Low river flow combined with ebb current creates the worst conditions. Movements of larger ships with deeper drafts are influenced more by the tide and current conditions than smaller vessels with a commensurate effect on vessel speed.

The Bar Pilots give the River Pilots a "window of opportunity" for getting an outbound vessel over the bar (Amos pers. comm.). The River Pilots then develop their transit plans to match that window. Transit planning for draft-constrained vessels varies with river flows. For example, during the low-water season, pilots can only count on having sufficient water under keel during one of the daily high tides. Outbound transit plans are developed at least 8 hours and as much as 24 hours in advance.

The decision to sail outbound is more critical than the decision to bring a vessel in. For outbound traffic, once the vessel starts downriver there is no place to stop or turn around unless the vessel is in extremis and requests to anchor; inbound vessels can stop before approaching the bar (Jordan pers. comm. B). Nevertheless, there is a point at which a vessel approaching the bar from sea or from the river is fully committed to the crossing. This is why the pre-transit planning is key to safe passage across the bar in either direction. As discussed in Section 2.2.4.5, tug escorts for vessel transits in the study area are rare (Rich pers. comm.).

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cargo information, information about each crewmember and other people onboard, operational condition of equipment, and documentation specifics.

[26] An information and communication center for ports and stakeholders along the Columbia River.

The Bar Pilot–River Pilot exchange location is at Tongue Point near Astoria with the vessel underway. Vessel size is a significant factor in transit planning. The River Pilots typically place just one pilot on each vessel, but in some circumstances, including vessels with a beam greater than 140 feet, two pilots are assigned.

2.2.6.2 Methods for Managing River Traffic

Marine pilots are highly trained mariners who are experts in vessel navigation and the characteristics of a particular waterway. They are responsible for safely maneuvering vessels on the Columbia River. Their expertise is supported by the vessel master's knowledge of their own vessel and how it maneuvers; the use of electronic navigation tools and information provided through the use of those tools; tug assistance, if required; and the existence of inland rules of the road, regulations, and coordination principles specific to the Columbia River.

Pilotage

The Bar Pilots board inbound vessels outside the bar, at a predetermined site suitable for safe boarding, and are responsible for piloting the vessel to Tongue Point, near Astoria. At Tongue Point, the Bar Pilot disembarks and the River Pilot boards. The River Pilot guides the vessel to the terminal until it is safely moored. For departing vessels, the process is reversed.

Upon boarding, each pilot will conduct an initial safety briefing with the vessel's master, exchanging information prior to assuming pilotage duties (Master-Pilot Exchange). This information typically includes the following.

- Any vessel deficiencies
- Drafts fore and aft
- Air draft corrected for trim.
- Location of navigation equipment
- Type of propulsion
- Propeller type and rotation
- Engine notice requirements
- Thruster status/horsepower, if equipped
- Maneuvering speeds of vessel
- Known errors in the gyrocompass
- Any deficiencies or unusual characteristics of the navigation or ship control systems

The Master/Pilot Exchange will also confirm the following.

- The Captain is immediately available at all times.
- An officer fluent in English is to be on the bridge at all times.
- The helm is manned with a qualified helmsman.
- A proper lookout is posted and direct communications are available.
- Anchors stations are sufficiently manned, ready for immediate and controlled release.

- The intended Passage Plan including:
  - Anticipated traffic.
  - Anticipated tides, currents and weather.
  - Speed restrictions.
  - Minimum underkeel/airdraft clearances.
  - Berthing/unberthing plan.

If, at any time during the transit, it becomes necessary to anchor a commercial vessel for an unexpected reason the USCG COTP will be contacted (contact could be by the vessel master, the shipping agent, or the Pilot) to be informed about the specific reason for anchoring. The USCG COTP will direct the anchoring of the vessel upon consultation with the individual master and pilot, the circumstances, and the weather. The Columbia River Harbor Safety Plan Anchorage Guidelines provide details about the anchorages and raises awareness about potential hazards (local weather patterns, vessel traffic, recreational river usage, etc.) that could impact the decision where to anchor a vessel and how to maintain the vessel safely at anchorage.

The River Pilots work with the tug companies providing tug-assist services in the study area to ensure that appropriate tugs are available upon request. As discussed in Section 2.2.4.3, *Tug Assistance*, tugs are assigned primarily for docking assistance, based on the minimum bollard pull required for a particular vessel type or operation. Pilots requesting tug support also take into account other tug features such as type of propulsion, deck machinery, or number of propellers. Section 2.2.4.3, provides information on companies providing tug services in the study area.

Pilotage Tools

Pilots use a variety of tools to manage traffic on the river and rely mostly on Transview 32 (TV32) Vessel Traffic Information System (VTIS) software, LOADMAX software, and back-up AIS towers.

Bar Pilots and River Pilots carry Portable Pilot Units that they use along with installed navigation equipment on vessels to monitor real-time vessel traffic and data on current weather and tidal conditions. To prevent potential groundings of vessels, they also run underkeel clearance programs that have been customized for each class of vessel; the pilots picked the most critical vessel types for the modeling (Jordan pers. comm. B). Input includes the Corps bottom survey data for the navigation channel and vessel maneuvering information, including squat.[27] Other data are received from tide gages and wave buoys located strategically near the bar and mouth of the river.

There are four NOAA data buoys in the area located as much as 287 nautical miles offshore that provide wave forecasts for periods from 1 to 19 hours before the waves reach the mouth of the river. There are also a number of wave buoys managed by the Scripps Institute; the latter measure waves differently than the NOAA data buoys. They generally show greater wave heights than the NOAA data buoys (as much as twice the height), and the Bar Pilots consider them a better indicator of actual conditions. The Bar Pilots generally consider suspending movement when the buoys show significant wave heights of 20 feet. Data are also received from the NOAA Northwest River Forecast Center.

[27] The squat effect is the hydrodynamic phenomenon by which a vessel moving quickly through shallow water creates an area of lowered pressure that causes the ship to be closer to the seabed than would otherwise be expected.

The computer program includes a Columbia River Estuary Operational Forecast System model, which uses the input data to determine current velocity and also estimates ship motion in response to environmental conditions. It collects real time data from monitoring stations on the waterway and provides forecast guidance for water levels, currents, water temperature, and salinity.

The computer program shows the expected underkeel clearance from the bar to Tongue Point at Astoria, which is where the Bar Pilots and River Pilots exchange duties. The Bar Pilots use the output to forecast the conditions that the vessel will encounter. The vessel's installed AIS system provides continuous information on the vessel's speed over the ground, speed through the water, and position in the channel. The pilot can compare that information to the forecast underkeel conditions. Bar Pilots prefer that the clearance be equal to 2 feet plus the expected squat (Jordan pers. comm. B). If the results show that underkeel clearance will be insufficient for a particular transit, then the pilot can adjust start time or transit speed to ensure that there is adequate clearance at each critical point along the route.

Pilot dispatchers and individual pilots continuously monitor waterway traffic and communications, especially AIS data and TV32 data. Pilots can observe and compare predicted conditions and real-time data at any point in the transit, and historically, those predicted and actual conditions match very closely. The pilot dispatchers also monitor anchorage status and availability. The tug company dispatch offices also have AIS- and communications-monitoring capabilities; however, individual tugs do not.

While operating, every pilot has access to Corps survey data that include channel depths, the 43-foot contour, and cross sections, along with NOAA Physical Oceanographic Real-Time System (PORTS[28]) and LOADMAX data, as well as the vessel's own navigation system information displays. Using this information, pilots can predict vessel meeting points and display those locations when two ships are as much as 70 miles apart. The pilots can then adjust vessel speeds to ensure that the meetings take place in suitable locations and avoid the few places on the river where meeting situations must be avoided (Jordan pers. comm.). The River Pilots also monitor shoaling developments and assess how those might affect transit plans.

The River Pilots note that the well-defined edges of the channel create a bank effect for virtually the entire transit that aids navigation and helps keep vessels away from the sides of the channel (Amos pers. comm.).

Washington and Oregon have separate vessel-tracking requirements that they obtain through a shared Columbia River Plan with PDXMEX. Membership in PDXMEX is a requirement for all commercial vessels of more than 300 gross tons and all vessels carrying oil. Individual vessels may also enroll for spill and incident response services through MFSA.

Merchants Exchange of Portland, Oregon

PDXMEX serves as an information and communication center for all of the ports and various stakeholders along Columbia River. By way of a subscription service, PDXMEX provides a monitoring system that allows users to locate vessels on the Columbia and Willamette Rivers. PDMEX also operates a dispatch center that assists in vessel traffic management by coordinating with the River Pilots and Bar Pilots dispatch centers to ensure proper vessel traffic management.

[28] PORTS measures surface current speeds, water depth, wind direction, and wind speed. Data are transmitted and displayed on the TV32 interface every 6 minutes.

PDXMEX is also a central point of contact for vessel agents, who provide necessary shore-side services for vessels.

Transview 32

TV32 is real-time, vessel traffic information and management system software that portrays vessel movements and interactions on the river, along with water depth, current flow information, and updated bathymetry charts. It combines the following systems to provide extremely high spatial resolution accuracy: AIS, ENC and ECDIS, NOAA nautical charts, NOAA PORTS, and differential global positioning system. TV32 allows pilots to accurately determine vessel meeting points to facilitate informed decision making regarding navigation, anchorage, and traffic coordination.

TV32 is considered a VTIS. In a VTIS, vessel location, course, and speed data are made available directly to vessels operating in the area so that navigation decisions can be made and agreed upon between the pilots. For the most part, this is a "pull" type of system in that the user (pilots) must deliberately access information in order to have situational awareness. For comparison, the Vessel Traffic Service in Puget Sound is managed within a Vessel Traffic Center that is manned by continuously receiving and disseminating navigation safety information to those vessels asking for or requiring it via VHF-FM communications.

LOADMAX

LOADMAX is a system made up of seven computer-connected PORTS gages along the Columbia River, from RM 17 at Astoria, Oregon, to RM 106.5 at Vancouver, Washington. These gages measure water level in real time and are tied into a system that produces daily email forecasts of river stage and velocity at 1-hour intervals, with a forecast horizon of 10 days. Pilots routinely use these data to time river transits. Pilots operating draft-constrained vessels transiting the Columbia River have to adjust the time of their transit to allow for 2 feet of underkeel clearance on the river (Myers 2015).

AIS and Aids to Navigation

The River Pilots have specifically credited AIS towers and virtual aids as important to their navigation. Pilots have two relay towers that allow them to see the entire length of the route and monitor traffic using the waterway.[29] It is a requirement of the International Convention for the Safety of Life at Sea (SOLAS). SOLAS requires that AIS transmitters are active onboard all vessels of more than 300 gross tons, a requirement that River Pilots actively enforce.[30]

Aids to navigation allow vessels to identify and locate other vessels and increase situational awareness of hazards and route features that are not otherwise physically marked (or would require extra time and resources to mark).

USCG is responsible for maintaining the aids to navigation systems on the Columbia River. The aids include a series of fixed and floating aids, which are visual, aural, electronic or any combination of all three. Visual aids include buoys, beacons, day marks and lights. In the navigation system in place on the Columbia River entering from seaward, red buoys and marks are kept to starboard, and green buoys and marks are kept to port. Preferred channel markers, buoys, and markers with alternating red and green stripes may also be employed to identify junctions and obstructions and indicate the preferred route to avoid obstruction.

Aural aids (sound-producing devices) include bells, whistles, and fog signals. Bells and whistles are typically buoy-mounted and activated by wave action. Fog signals are shore-based, mounted on buoys or mounted on offshore structures.

Nautical charts depict the location and characteristics of aids to navigation, both fixed and floating. The abbreviations used to describe the aids are specified by the International Hydrography Organization.

Inland Rules and Other Applicable Regulations

The navigation of commercial vessels worldwide is subject to a set of international rules formalized in the Convention on the International Regulations for Preventing Collisions at Sea, 1972, effective July 15, 1977. The rules (commonly called 72 COLREGS) are part of the convention, and vessels that enter the study area, foreign and domestic, must adhere to the rules where applicable.[31] The rules are applicable on waters outside of established navigational lines of demarcation. The lines are called COLREGS Demarcation Lines and delineate those waters upon which mariners shall comply with the Inland and International Rules. The Demarcation Lines for U.S. ports are listed in 33 CFR 80. The Demarcation Line at the Columbia River entrance (between Oregon and Washington states) is a line drawn from the seaward extremity of the Columbia River North Jetty to the seaward extremity of the Columbia River South Jetty.

In 1980, Congress passed the Inland Navigational Rules Act. This legislation set out Rules 1 through 38 constituting the Inland Rules (Rules of the Road) which mariners follow upon passing across the Demarcation Line inland into the Columbia River. The International and Inland Rules are, for the most part, very similar in both content and format.[32]

USCG is responsible for establishing and enforcing the Rules of the Road, which are defined and described in 33 CFR E – Inland Navigation Rules. The primary objective of the Rules of the Road is to facilitate safe maritime travel. All vessels, both recreational and commercial, in the study area are required to understand and comply with the Rules of the Road.

Cooperative Coordination

Cooperative coordination between the Bar Pilots and River Pilots, primarily used in meeting situations on specific portions of the route, is a unique local practice that is an effective method of collision avoidance. As a standard practice, River Pilots avoid meeting situations in the following areas of the river.

- Miller Sands (RMs 22 through 25)
- Skamokawa/Abernathy (RMs 28 through 34)
- Bugby Hole(RMs 39 through 40)
- Bunker Hill (RMs 55.5 through 56.5).
- Longview Bridge (RMs 65 through 67)

[31] Congress adopted the 72 COLREGS as the International Navigational Rules Act of 1977 and other countries signatory to the International Convention similarly adopted the rules.

[32] Annex V to the Inland Rules, Pilot Rules, are for obvious reasons unique to the inland waters of the United States.

In general, the Bar Pilots and River Pilots avoid overtaking situations where one vessel passes another from behind. The Bar Pilots do not engage in cooperative coordination at specific locations; they coordinate with each other to ensure that deep-draft vessels do not pass each other on the bar.

2.2.6.3 Limitations and Restrictions for Vessel Traffic

Commercial vessel traffic on the Columbia River may be affected by weather patterns, river and tidal conditions, and other (smaller) vessel traffic.

Environmental Conditions

Weather along the Columbia River consists of a series of microclimates that have the potential to cause operational issues. Environmental restrictions can result from fog, high winds, and tidal currents.

When coastal fog restricts visibility on the Bar and its approaches, the vessel's master and pilot (if employed) should assess all variables and determine whether it is safe for a vessel to enter the river. In some cases, it may be safer to wait offshore until visibility improves. In situations of restricted visibility, a vessel that is underway may proceed along its intended passage with caution. Vessels intending to dock in restricted visibility should be able to visually see the intended wharf for the entire length of the vessel. However, the vessel's master and pilot may assess all variables and determine that the best course of action is to proceed to the dock. Vessels at dock or anchored in a safe anchorage should not commence movement if visibility is less than 0.5 mile unless the master and pilot assess all variables and determine that the vessel can proceed safely.

In all cases, the vessel's master and pilot should evaluate the current and forecasted weather and the impact on vessel movement, and if necessary, delay movement, call for additional tugs, or take other appropriate measures to ensure safe operations. Masters and pilots should consult the coast pilot and other sources of local knowledge when transiting high risk areas, and be prepared for strong tides, currents, and weather conditions.

2.2.6.4 Recreational and Fishing Vessels

The USCG is the primary federal maritime law enforcement agency on the Columbia River. Oregon State Police and Oregon county law enforcement (Clatsop County Sheriff Marine Patrol) also patrol on the Columbia River (Oregon.gov 2016). Vessels in these state and local law enforcement units are used to regulate recreational and fishing vessel traffic on the river in accordance with state and local laws.

USCG boards commercial fishing vessels at sea to ensure compliance with safety equipment requirements required by the Commercial Fishing Industry Vessel Safety Act of 1988. The USCG auxiliary conducts dockside inspections of commercial fishing vessels to supplement the at-sea boardings and educate fishermen on safety equipment and training requirements. USCG vessels participate with state and local law enforcement in joint operations on a periodic basis to manage vessel traffic and maintain boater safety (U.S. Coast Guard 2014a). For example, during August and September each year, the Coast Guard Auxiliary, in conjunction with USCG Station Cape Disappointment, Clatsop County Sheriff's Office, and Oregon State Police, engage in a Recreational Boating Safety surge operation to educate and inform boaters participating in Columbia River recreational salmon season. USCG also hosts Operation Make Way, a yearly joint recreational boater education and enforcement campaign, to educate recreational boat users about the need to give way

and stay clear of large commercial vessels operating within the Columbia and Willamette navigation channels. The program aligns with the states' and counties' recreational boating safety missions.

2.2.7 Ship Casualty Survey

The information presented in this section is based on data obtained from the USCG (2014) MISLE database and covers all available data from 2001 through 2014 (Appendix A). The data are collected for 26 vessel incident types and are not predictive of cargo vessel casualties. Three primary incident types—collision, allision, and a combination of grounding/set adrift—are representative of the navigational incidents that could occur and compare best to the results of the incident modeling (Table 11).

The database notes the severity of each incident and describes vessel damage. Table 11 presents the outcome distribution in three categories—total loss[33], damaged, and undamaged—for marine incidents that took place between the Columbia River mouth and the Port of Portland.

The results of the data survey are very similar to those from nationwide incidents in that approximately two-thirds of incidents resulted in no damage, one-third in some damage, and slightly less than 3% in total loss.

Table 11. Incident Severity by Incident Type for Study Area (Total Incidents)

Damage Status	Total Loss (% of Total)	Damaged (% of Total)	Undamaged (% of Total)	Total
Allision	3 (5%)	24 (43%)	29 (52%)	56
Collision	1 (5%)	9 (47%)	9 (47%)	19
Grounding /Adrift	1 (1%)	16 (21%)	59 (78%)	76
Total[a]	**5 (3%)**	**49 (32%)**	**97 (64%)**	**151**

Notes:
[a] Total may not sum due to rounding.
Source: Appendix A

Groundings were the most common type of incident, followed by allisions, then collisions. Although collisions represented less than 13% of total incidents during the survey period, they resulted in the highest severity outcomes, followed closely by allisions; groundings resulted in significantly less severe outcomes (78% of grounding resulted in no vessel damage).

Table 12 presents the distribution of incident severity in the study area for all incidents by vessel type. The table shows that the higher severity events more typically involved smaller craft (e.g., fishing or recreational vessels).

[33] For the purposes of this analysis, *actual total loss*, *total constructive loss: salvaged*, and *total constructive loss: unsalvaged* were combined into a single *total loss* category.

Table 12. Outcome Distribution for All Marine Incidents in the Study Area by Vessel Type

Vessel Type	Total Loss (%)	Damaged (%)	Undamaged (%)	Total (%)
General Dry Cargo	0	1	3	4
Bulk Carrier	0	2	16	18
Ro-Ro Cargo	0	1	1	2
Tank	0	0	2	2
Barge	0	2	7	9
Military	0	1	0	1
Passenger	1	8	7	15
Recreational	1	3	0	3
Fishing	2	5	13	21
Towing	0	7	13	20
Miscellaneous	0	1	0	1
Unspecified	0	1	3	4
Total[a]	**3**	**32**	**64**	**100**

Notes:
[a] Total may not sum due to rounding.
Source: Appendix A

Tables 13 through 15 present the distribution of incident severity by vessel type and by incident type for the study area. These tables show that collisions appear to result in the highest severity outcomes, with 5% resulting in a vessel loss and 47% resulting in damage to the vessel(s) involved in the incident. Allisions have the second highest severity outcomes with 5% vessel loss and 43% damage. Groundings result in only 1% vessel loss and 21% vessel damage.

Table 13. Outcome Distribution for Allisions in the Study Area by Vessel Type

Vessel Type	Total Loss (%)	Damaged (%)	Undamaged (%)	Total (%)
General Dry Cargo	0	4	0	4
Bulk Carrier	0	4	5	9
Ro-Ro Cargo	0	2	0	2
Barge	0	2	14	16
Passenger	0	13	4	16
Towing	0	11	23	34
Recreational	0	2	0	2
Fishing	5	2	4	11
Miscellaneous	0	2	0	2
Unspecified	0	4	2	5
Total[a]	**5**	**43**	**52**	**100**

Notes:
[a] Total may not sum due to rounding.
Source: Appendix A

Table 14. Outcome Distribution for Collisions in the Study Area by Vessel Type

Vessel Type	Total Loss (%)	Damaged (%)	Undamaged (%)	Total (%)
Tank	0	0	5	5
Barge	0	0	11	11
Military	0	5	0	5
Passenger	0	5	5	11
Towing	0	5	11	16
Recreational	5	16	0	21
Fishing	0	11	11	21
Miscellaneous	0	5	0	5
Unspecified	0	0	5	5
Total[a]	**5**	**47**	**47**	**100**

Notes:
[a] Total may not sum due to rounding.
Source: Appendix A

Table 15. Outcome Distribution for Groundings in the Study Area by Vessel Type

Vessel Type	Total Loss (%)	Damaged (%)	Undamaged (%)	Total (%)
General Dry Cargo	0	0	5	5
Bulk Carrier	0	1	28	29
Ro-Ro Cargo	0	0	3	3
Tank	0	0	3	3
Barge	0	3	1	4
Passenger	1	5	9	16
Fishing	0	7	21	28
Towing	0	5	5	11
Unspecified	0	0	3	3
Total[a]	**1**	**21**	**78**	**100**

Notes:
[a] Total may not sum due to rounding.
Source: Appendix A

2.2.8 Marine Oil Spill Survey

Vessel-related oil spills that occurred in the study area from 2004 through 2014 are presented in Table 16 by spill volume and incident type, based on MISLE, SPIIS, and ERTS data. Spill volumes per incident ranged from 0.1 gallon to 1,603 gallons. An average 15.6 oil spills per year occurred during the study period; of these, 84% had a volume of less than 10 gallons. As reflected in Table 16, most of the spills were not related to a vessel incident. Spills greater than 100 gallons occurred at a frequency of 0.4 per year or once every 2.2 years. The average size of these spills was approximately 630 gallons.

Table 16. Oil Spill Incident Count and Frequency—Lower Columbia River (2004–2014)

Incident Type	Oil Spill Incident Count by Spill Volume					Oil Spills per Year
	< 1 gal	1–10 gal	10–100 gal	> 100 gal	Total gal	
Allision	1	-	-	-	1	0.1
Capsize	1	-	-	-	1	0.1
Environmental Damage	123	57	28	6	214	15.3
Grounding	-	-	1	-	1	0.1
Sinking	-	2	-	-	2	0.1
Total	**125**	**59**	**29**	**6**	**219**	**15.6**
Spills per Year	**8.9**	**4.2**	**2.1**	**0.4**	**15.6**	

Notes:
gal = gallons

The vessel-related spill survey was largely confined to the specified time period of 2004 through 2014, to develop a baseline representative of existing risk. Additionally, this period provided the best overlap in data available from the three datasets. Larger-scale incidents involving the release of oil have occurred in previous years; however, these events predate legislation targeted at and largely successful in reducing the likelihood of oil spills from vessels or diminishing the impact of a spill should it occur, namely, the enforcement in U.S. waters of the International Convention for the Prevention of Pollution from Ships (MARPOL) and the Oil Pollution Act of 1990. The latter brought about more stringent planning and spill prevention activities than the previous U.S. legislation (the Federal Water Pollution Control Act as amended by the Clean Water Act) and improved preparedness and response capability (public and private), and established a double hull requirement for tank vessels.

2.2.9 Incident Management and Response Systems

The National Contingency Plan (NCP) codified in 40 CFR 300 establishes Federal On-Scene Coordinators (FOSCs) for oil spills and hazardous material releases within the inland zone and coastal environments. The NCP is the foundation document for state, regional, and local planning documents governing pollution response; it provides organizational focus for the related emergency situations that caused or could cause an oil spill such as vessel groundings, collisions, allisions, and fires. Under the NCP, the FOSC is designated as either USCG or U.S. Environmental Protection Agency, depending on the location of the spill. The project vessel route and site are located within the USCG FOSC and COTP zones (Sector Columbia River and MSU Portland hold these authorities). Ecology is the designated state on-the-scene coordinator for spill response (Revised Code of Washington 90.56.020). The Washington Emergency Management Division is the designated State On-Scene Coordinator (SOSC) for natural disasters. The Washington State Patrol or state fire marshal is the designated SOSC for fires. The Washington State Emergency Response system is designed to provide coordinated state agency response, in cooperation with federal agencies for effective clean-up of oil or hazardous substance spills. Within Oregon State, ODEQ is the lead agency for oil or hazardous material spills. The Oregon Office of Emergency Management coordinates support from other state agencies, when required, and the Office of the State (Oregon) Fire Marshal provides hazardous materials/fire incident response coordination and support from unaffected state jurisdictions when a situation exceeds local response capabilities.

The Northwest Area Contingency Plan (ACP) is the regional planning framework for oil and hazardous substance spill response in Washington, Idaho, and Oregon. Representatives from the federal and state agencies listed here and local governments plan for spill response emergencies together and come together to implement the ACP when an incident occurs. The plan includes but is not limited to the following elements.

- A description of the area covered by the plan, including the areas of special economic or environmental importance that might be damaged by a spill.
- Roles and responsibilities of an owner or operator and of federal, state, and local agencies in spill response and in mitigating or preventing a substantial threat of a discharge.
- A list of equipment (including firefighting equipment) and personnel available to respond to oil spills.
- Site-specific geographic response plan (GRP).

GRPs are part of the ACP. Each plan is written for a specific area, including the Lower Columbia River, and includes tactical response strategies tailored to a particular shore or waterway at risk of injury from oil. GRPs have two main objectives: to identify sensitive resources at risk of injury from oil spills and to direct response actions related to sensitive resource protection during the initial hours of a response. Strategies in the plan are deployed by a part of the response organization as soon as potential impacts (generally with real-time weather data and oil spill trajectories) are evaluated even while other parts of the response organization may still be addressing immediate concern of controlling and containing the source of a spill.

In addition to the ACP and the GRP governing spill response within the Lower Columbia River the Lower Columbia Region Harbor Safety Committee[34] meets on a regular basis to discuss waterway issues in the river, including emergency procedures in case of a vessel incident. The standards, guidelines, and protocols agreed upon by members of the committee are promulgated and maintained within the Harbor Safety Plan (HSP). The HSP complements existing regulations by advising mariners of unique conditions and requirements associated with transiting the Lower Columbia River. The HSP includes incident management guidelines, emergency communications, notification requirements in case of an oil spill, steps to take in case of a vessel grounding, vessel collision, bridge allision, and mechanical or equipment failures.

These government and agency plans all help coordinate response efforts by the responsible party (the spiller, in this case the vessel owner/operator) and federal and state agencies.

Since the proposed coal export terminal would not transfer oil to project-related vessels in bulk, the Proposed Action would not be required to submit a federal facility response plan for oil spills. The coal export terminal would likely be a designated waterfront facility under 33 CFR 126.13, which means that the coal export terminal would be designated for handling, storing, loading, and discharging a hazardous material whose transport is subject to the Dangerous Cargoes Regulations contained in 49 CFR 170–179.

Under SOLAS, coal is defined as dangerous goods in solid form when in bulk. Consequently, this designation requires that the Applicant meet certain conditions at the project area (applicable USCG regulations are contained in 33 CFR 126.15) including the following.

[34] The Lower Columbia Region Harbor Safety Committee comprises public and private stakeholders with vital interest in assuring safe navigation and maritime practices on the Columbia River.

- Fire extinguishing equipment (automatic sprinklers, hydrants, hose connections, and firefighting water supplies) must be available and maintained in adequate quantities and locations.
- The location of fire appliances such as fire hydrants, standpipes, hose stations, fire extinguishers, and fire alarm boxes must be conspicuously marked and readily accessible (according to National Fire Protection Association).
- Warning signs must be posted.
- If coal is transferred between sunset and sunrise then the Applicant must install outdoor lighting that adequately illuminates the transfer work area.
- Access restrictions whenever the cargo is transferred or stored at the terminal.
- Security measures must be in place to deter and detect unlawful entrance; to detect and report fire hazards, fires, and releases of dangerous cargo and hazardous materials.

The security measures described above could be guards or "equivalent controls" such as alarm systems, closed-circuit television cameras and monitors, or a combination of both. In case of an emergency the situation must be reported to USCG personnel as soon as they are discovered. Since the facility is not a covered facility under Washington State law for oil spill contingency planning, the Applicant is not required to have an oil spill response plan under state law.

Vessel owners/operators of the project-related vessels would be required to prepare and submit oil spill response plans under federal requirements (33 CFR 155.5010-155.5075) and state requirements (Washington Administrative Code 173-182 and Oregon State Administrative Rules 340-141) to ensure that resources, including equipment, are in place for a spill of the vessel's fuel oil and of any oil carried as secondary cargo. The Non-tank Vessel Response Plans would include notification procedures, shipboard spill mitigation procedures, shore-based response activities, a list of contacts, and training and exercise procedures,

The vessel owner/operator would be required to have available through contract or other approved means an oil spill removal organization and a spill management team. It is customary for owners/operators of vessels to contract with cooperative organizations that specialize in oil spill response and personnel that maintain, train, and exercise the equipment. MFSA generally serves this role in the Columbia River and has access to oil spill response equipment on the river system (through a sharing agreement with Clean Rivers Cooperative).[35]

The MFSA vessel response plan is an umbrella plan for enrolled vessels entering the Columbia River. MFSA recently updated the Master Oil Spill Contingency Plan for Covered Vessels and submitted it to Ecology for approval. Ecology has approved the update.

2.2.9.1 Oil Spill Incident Response

This section describes the incident response system in place on the Columbia River, as spelled out in the MFSA response plan.

[35] Working with federal granting agencies and local jurisdictions, Astoria Fire Department/Port of Astoria, Clark County Fire & Rescue, Scappoose Rural Fire District and Vancouver Fire Department achieved funding to acquire new Quick Response Vessels in 2014. The Quick Response Vessels provide enhanced response capabilities between Vancouver and Astoria.

USCG is the FOSC for oil and hazardous materials spills on the Lower Columbia River. Ecology and ODEQ are the SOSCs for spills and impacts on state waters. These agencies and the responsible party (as represented by the MFSA for a covered vessel) represent the Unified Command. The Unified Command coordinates responses, mitigation, and cleanup efforts for spills on the Lower Columbia River to protect public health and safety, response personnel, and the environment (Maritime Fire & Safety Association 2013).

For vessels covered under MFSA, these general steps are followed when a bunker spill occurs.

1. Ignition is shut down, personnel are warned, containment is initiated, and vessel is secured.
2. Vessel representative initiates MFSA and federal and state response plans by notifying the Merchants Exchange, USCG, and state emergency management offices.
3. Vessel representative designates MFSA as Incident Commander representing company interests.
4. MFSA representative assesses situation, makes necessary notifications for response resources, and participates in Unified Command.
5. MFSA returns control to the vessel representative for completion of clean-up, damage assessment, decontamination, disposal, and demobilization.

The contract between the vessel owner/operator and the MFSA and the incident specifics determine when steps three and five take place.

2.2.9.2 Shipboard Fire Incident Response

Under the Federal Fire Prevention and Control Act of 1974, fire prevention remains a local and state responsibility (Northwest Area Committee 2015). The local fire jurisdiction is the first responder to a shipboard fire. If the incident is beyond the local jurisdiction's capacity, mutual aid resources[36] are requested. If local and mutual aid resources are exhausted, the local fire chief requests assistance from the state emergency management office. With appropriate approvals, the state fire chief (Oregon) or state fire marshal mobilization coordinator (Washington) takes control over the response (Office of State Fire Marshal 2015; Washington State Patrol 2015).

The USCG COTP will act as the FOSC if there is a shipboard fire outside a fire agency's jurisdiction but within the Sector Columbia River COTP zone, or if a vessel fire is treated as a search-and-rescue case (Northwest Area Committee 2015).

2.2.9.3 Collision and Grounding Incident Response

For collision and grounding incidents, the vessel must immediately secure all necessary watertight closures in accordance with the ship's emergency procedures and contact the USCG COTP and Ecology. The USCG COTP may establish a communications schedule and request the vessel to periodically update its situation. If the waterway is blocked or needs to be closed, a safety marine information broadcast will be issued, including providing information of the incident, including location, vessel type and cargo, incident description, and other details.

In response to a collision, USCG response personnel and state investigators may respond to the scene for initial assessment and on-scene communications and supervision and may form a Unified Command. The Unified Command will instruct the responsible parties on standard procedures for

[36] Local and state firefighting organizations enter into reciprocal agreements to provide mutual aid when resources are overwhelmed.

separating vessels, if joined, and moving them to an available dock, anchorage, or directly to a ship yard for repairs. The USCG COTP will work with the vessel and Unified Command to initiate pollution response measures as necessary. In most cases, a surveyor will be required to inspect damage and verify repairs.

In response to a grounding, the objective is to refloat and minimize damage to the vessel and environment. Upon grounding, the responsible party must contact the USCG COTP to provide vessel and incident information and a safety marine information broadcast is issued. The responsible party must submit a salvage plan to the USCG COTP or Unified Command for approval prior to attempting to refloat. If calculations determine that the vessel cannot be refloated at the recorded draft just prior to grounding the lightering[37] of vessel cargo and/or fuel may take place to lighten the vessel. This transfer of coal or fuel would be completed only after all other options were evaluated for refloating the vessel and the salvage and lightering plan is approved by the USCG.[38] Most likely, approval of the salvage and lightering plan will include a requirement that the responsible party activate the vessel response plan to mitigate any pollution threat prior to refloating. The type of bottom (mud, sand, gravel, rock) and the speed of the vessel (underway, maneuvering with tugs, dragged anchor in high winds) prior to grounding will most often determine the severity of the incident and the precautions to be taken until the vessel refloats. In most cases, a surveyor will be required either on scene, or to inspect damage and verify repairs.

[37] Lightering is the process of transferring cargo between vessels of different sizes, usually between a barge and a bulker or oil tanker.

[38] Depending on the severity of the grounding (determined by length of time the vessel is grounded, whether or not the navigation channel is blocked, and if lightering must take place to refloat) a Unified Command may be formed. In this case the Unified Command would review and approve the salvage and lightering plan.

Chapter 3
Impacts and Mitigation

This chapter describes the impacts related to vessel transportation that would result from construction and operation of the Proposed Action or the ongoing conditions under the No-Action Alternative.

3.1 Impacts

This section describes the impacts related to vessel transportation that could result from the Proposed Action and No-Action Alternative.

3.1.1 Proposed Action

Potential impacts related to vessel transportation from the Proposed Action are described below. The Proposed Action would load 70 vessels a month or 840 vessels a year. This equates to 1,680 vessel transits in the Columbia River. Proposed Action-related cargo vessels would be required by federal and state law to meet vessel standards and plan requirements. These include structural, fire-fighting and personnel requirements as well as oil spill contingency and response plans as previously described

3.1.1.1 Construction: Direct Impacts

Construction of the Proposed Action would result in the following direct impacts.

In-water dock construction (pile-driving, dredging, and general construction above water) would occur over a 6-month to 1-year period (Grette Associates, LLC 2014:12). For this work, barges would be located near the proposed docks (Docks 2 and 3). The barges would be positioned outside of the navigation channel to not impede vessels traveling within the channel. The barges would also be placed outside of the area used by vessels accessing Dock 1, so they would not affect these activities. Additional information on dredging and pile driving is included in the SEPA Water Quality Technical Report (ICF International 2016b).

3.1.1.2 Construction: Indirect Impacts

Construction of the Proposed Action would result in the following indirect impacts.

If supplies and equipment for construction are delivered to or removed from the project area by barge, there would be a temporary increase in barge activity in the study area.

The Applicant has identified three construction-material-delivery scenarios: delivery by truck, rail, or barge. If material is delivered by barge, it is assumed that approximately 1,130 barge trips would be required over the construction period. Approximately two-thirds of the barge trips would occur during the peak construction year, assumed to be 2018. Approximately 750 barge trips in the study area would be required during the peak construction year to deliver construction materials. Because the project area does not have an existing barge dock, the material would be off-loaded at an existing dock elsewhere on the Columbia River and transported to the project area by truck.

Barges are shallower in draft and could transit the Columbia River navigation channel during periods of low water to avoid interfering with larger vessel traffic. Coordination would take place with the River Pilots prior to and during transit. Moreover, the construction barges would be transiting a portion of the navigation channel during construction in the vicinity of the project area and not the entire study area. Therefore, impacts on vessel traffic in the study area as a result of construction-related barge traffic would be low.

3.1.1.3 Operations: Direct Impacts

Operations of the Proposed Action would result in the following direct impacts. The Proposed Action would load 70 vessels a month or 840 vessels a year. This equates to 1,680 vessel transits in the Columbia River.

The Proposed Action would add two docks and eventually have the capacity to export 44 million metric tons of coal by vessel. Loading coal onto vessels for export is the only activity proposed for the new docks. Vessel loading would be performed using an electrical-powered, single-traveling shiploader installed on Docks 2 and 3. Each shiploader would have an average capacity of 6,500 metric tons per hour. At maximum throughput, an average of 70 vessels per month (an average of over two per day) would be loaded at the new docks. The berths for the new docks are expected to be occupied by project-related vessels 365 days per year.

River Pilots would pilot the incoming and outgoing vessels (from Astoria inland and vice versa) and direct docking and undocking maneuvers. At least two tugs would be used to assist with docking and undocking maneuvers for each arriving and departing project-related vessel (Gill pers. comm.). Therefore, at least two tugs would be active in the vicinity of the docks four times per day on average. The pilot determines the appropriate size and horsepower of the tugs depending on a number of factors such as the size of the vessel, weather conditions, and currents at the time of maneuvers (Gill pers. comm.).

Docks 2 and 3 would be designed to accommodate dry bulk cargo ships with maximum dimensions of 830 feet long and 130 feet wide. They would, therefore, accommodate standard Panamax vessels and the somewhat smaller Handymax vessels. The berths at Docks 2 and 3 would have a depth of 43 feet, which is the depth at which the Columbia River navigation channel is maintained (U.S. Army Corps of Engineers 2015b).

The expected fleet mix is 80% Panamax and 20% Handymax vessels. Table 17 contains the size and dimensions of these types of vessels assumed for the risk analysis (Appendix A).

Table 17. Sizes and Dimensions for Panamax- and Handymax-Class Vessels Assumed in the Risk Analysis

Vessel Class[a]	Deadweight (tons)	Length Overall (meters)	Beam (meters)	Draft (meters)
Handymax	46,101	183	32.3	11.0
Panamax	68,541	225	32.2	13.3

Notes:
[a] These specifications chosen to represent the size and dimensions for Panamax and Handymax class vessels are representative of an "average-sized" Panamax class vessel and an "average-sized" Handymax class vessel.
Source: Appendix A

Operational impacts related to the Proposed Action are based on the following assumptions:

- The River Pilots anticipate turning the ships in the project area in loaded condition—in preparation for departure, as opposed to turning downstream upon arrival (Gill pers. comm.).[39] Thus, inbound ships would approach Docks 2 and 3 in ballast (headed upstream), maneuver out of the navigation channel toward the dock, and align parallel to the dock, docking with the assistance of tugs. Figure 9 depicts typical maneuvering of a ship approaching the downstream berth, Dock 3, with a Panamax ship already at Dock 2.
- Pilots estimate that operations at the project area (Docks 2 and 3) would require the two assisting tugs to have bollard pull ratings of at least 30 tons operating ahead and at least 22.5 tons operating astern. Those tugs would be in the 3,000 to 4,000 horsepower range (Gill pers. comm.). Pilots will determine if tugs are needed.
- The River Pilots anticipate that they would turn vessels off the dock, as opposed to the turning basin upstream of the project area (Gill pers. comm.). If river conditions were not suitable or the vessel was too long, however, they would use the turning basin. A typical departure of a loaded vessel (Figure 10) with the assistance of the tugs, would involve moving the bow out into the channel flow while keeping the stern near the dock to give the pilot accurate positioning of the vessel during the turn, and rotating in the bend widener portion of the channel until it is aligned in the channel and moving downstream. The width of the channel at this point is approximately 1,200 feet, which provides a turning area approximately 1.6 times the length of the vessel.
- Currently, maneuvering a vessel to the existing berth (Dock 1) can be challenging upstream of the project area (Amos pers. comm.). The outflow from the bank at that dock creates the need for more tugs, vessel power, and time to dock safely. Pilots expect that conditions for Docks 2 and 3 would be the same as at Dock 1 (Gill pers. comm.). Pilots would be aware of this issue and would consider it during planning and operations.

[39] Currents in the river at the project area are typically directed downriver or ebbing due to the river flow overriding the tidal currents. It is more efficient and safer to dock the ship heading into the current using the forward power of the engines which is stronger than the vessel's backing power. When the loaded vessel leaves the dock with the bow pointing upstream, the currents assist the vessel turning in the channel by pushing the bow around and downstream.

Figure 9. Typical Approach of a Panamax Bulk Carrier in Ballast Condition to Dock 3

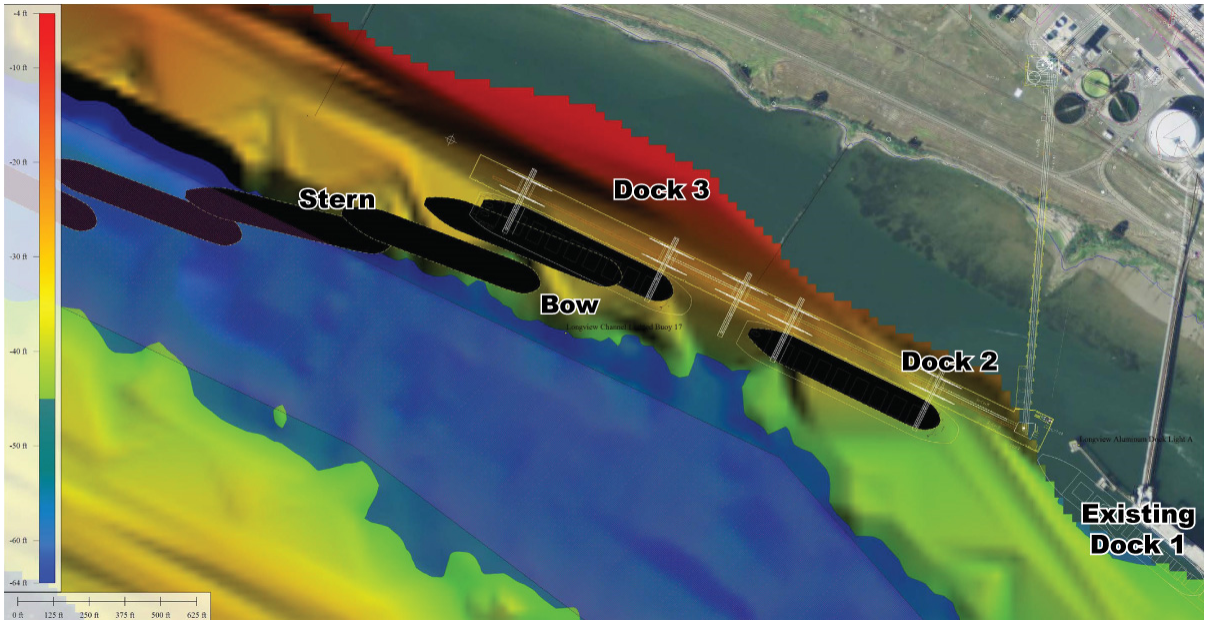


Figure 10. Typical Departure of a Panamax Bulk Carrier in Loaded Condition from Dock 3

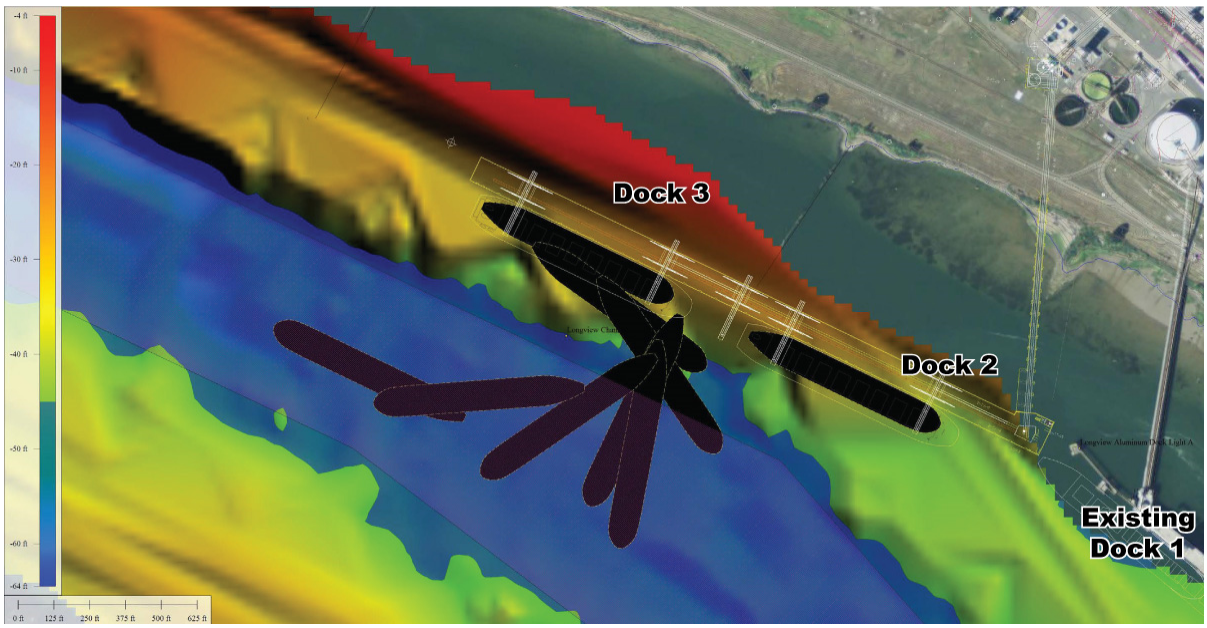
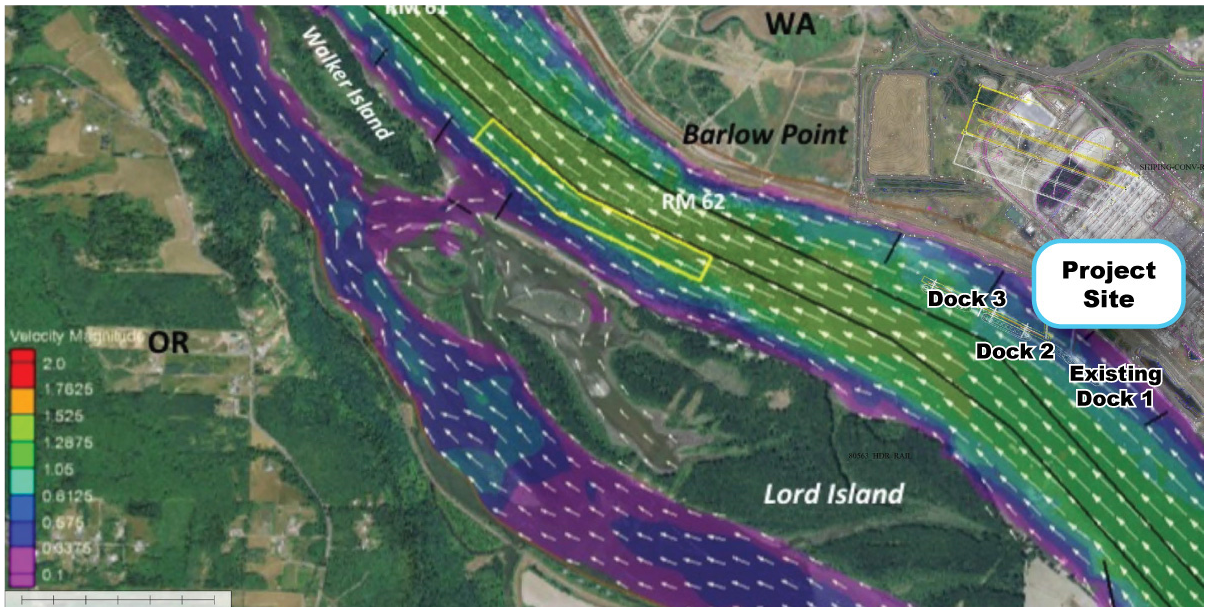


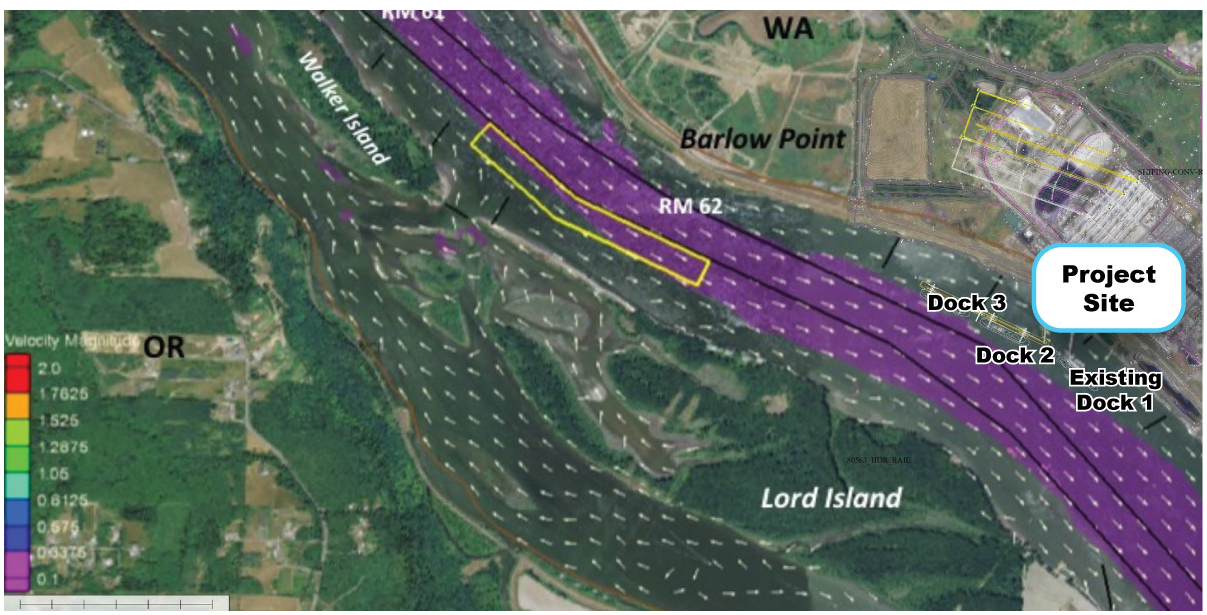
Figure 11 shows the computed current vector plot of the peak ebb period in mid-June 2009. This figure shows that the currents are relatively parallel to both the existing and proposed berths except at the upriver end of Dock 2 where the currents have a component that would push the ship onto the dock and could make moving off the dock more difficult. The magnitude of the current at Dock 1 is approximately 0.7 to 0.8 feet per second (fps), while at the down-river berth, Dock 3, the velocity magnitude would be approximately 1.5 to 1.8 fps.

Figure 11. Computed Peak Ebb Flow in Mid-June 2009



A plot of the flood currents during a low river discharge period is shown in Figure 12. The velocity vectors are aligned with all three berths with this flow, and the magnitudes of the velocities are very low, below 0.1 fps.

Figure 12. Computed Peak Flood Flow in Early October 2009



These vector plots of depth-averaged velocities do not provide any evidence showing why the pilots would have difficulty moving a ship onto the existing berth. However, the computational grid of these plots indicates that the data resolution in the area of the docks is low, and it is questionable as to whether the dikes along the shoreline in the vicinity of the docks are included in the

computational grid. These dikes could have a significant impact on the velocities along the shoreline that could cause eddies to form, as well as redirection of the currents away from the shoreline.

Should an accident occur due to the Proposed Action-related vessel operations, it would most likely be attributable to one or more of the situations described below.

Increased Risk of a Vessel Emergency while at Dock

A fire in the vessel's machinery spaces or accommodation areas is a potential emergency scenario that could occur at the dock. Vessel design standards, fire equipment requirements, and crew training would be required to prevent or to facilitate rapid response to a vessel emergency while at the dock. Therefore, an onboard emergency is unlikely to affect resources other than the vessel itself.

Coal, in any form, is a combustible material, making it susceptible to a variety of ignition scenarios. Coal fires during transfer and loading operations are typically caused by one of two sources of ignition: the coal itself (self-ignition) or the conveyor belt used in the transport of coal (e.g., over-heating due to damaged bearings, roller, belt slip). Safety requirements prohibit open flames near coal-loading operations.

A fire in the vessel's machinery spaces or accommodation areas is a potential emergency scenario that could occur at the dock. Vessel design standards, fire equipment requirements, and crew training are in place to prevent or to facilitate rapid response to a vessel emergency while at the dock. All of these standards and requirements are implemented in accordance with SOLAS in foreign and domestic cargo vessels (and codified in U.S. regulations) and enforced by USCG.

A bulk carrier such as the project-related vessels would have the following fire prevention and response features.

- Structural fire protection, including certain bulkheads constructed to prevent the passage of flame and smoke for one hour. Other bulkheads must be constructed of incombustible materials. Current regulations require that risk of fire hazards be eliminated as much as possible in other construction features of the vessel (46 CFR 92).
- Structural insulation around compartments containing the emergency source of power (such as the ship's service generators). Other approved materials capable of preventing an excessive temperature rise in the space may also be used to eliminate the spread of a fire that originates in this type of compartment (46 CFR 92).
- Fire pumps, hydrants, hoses, and nozzles for the purposes of onboard firefighting. In additional certain spaces must have approved hand portable fire extinguishers and semiportable fire extinguishing systems (46 CFR 95).
- Officers and crewmembers with a basic level of training that includes fire prevention and firefighting (U.S. Coast Guard 2014b).

Within the hold of a vessel, coal can be susceptible to ignition due primarily to self-heating and/or the creation and subsequent ignition of certain gases, including methane and hydrogen. Fire-detection systems including carbon monoxide detection and infrared scanning would be in place to monitor and minimize the potential for onboard coal fires. Additionally, manual scanning by workers would enhance built-in mechanical detection systems. Automated fire suppression systems that are activated in the early stages of fire development are critical to reducing the potential for

flame spread. These typically include water sprinklers combined with a fire extinguishing agent such as wetting agents or foam. Therefore, an onboard emergency is unlikely to affect resources other than the vessel itself.

Increased Risk of an Oil Spill while at Dock

The potential for an operational oil spill at the dock would occur primarily as the result of bunkering (i.e., a ship receiving fuel while at the dock). The Applicant has committed to not allowing vessel bunkering from barges or tanker trucks at Docks 2 and 3; therefore, there would be no increased risks of oil spills at docks associated with oil transfers. The risks that might occur during transit are addressed below under Section 3.1.1.4, *Operations: Indirect Impacts*.

Increased Risk of a Vessel Allision at the Dock

An allision occurs when a vessel strikes a fixed structure, such as a project-related vessel striking the proposed docks at the project area or another vessel striking a project-related vessel at berth.

As discussed above, pilots sometimes experience difficulties getting a ship to the berth at Dock 1, which is located just upstream of the proposed Docks 2 and 3. The reason for this cannot be determined from the examination of current vectors provided by the Corps, making it difficult to link the maneuvering challenges at Dock 1 with potential maneuvering challenges due to currents and river flow at the proposed docks. A vessel allision with the dock is a potential outcome when there are strong currents in the vicinity of the dock during vessel maneuvers. An allision may also occur if there were a loss of steering or loss of propulsion during transit or maneuvering at the dock. Despite the uncertainty associated with vessel maneuvers at the dock, the likelihood of a vessel allision is lessened due to the presence of tug power while docking and undocking.

Risk of allision could also involve another vessel striking a project-related vessel while the vessel was at berth. All large commercial vessel traffic bound for Longview or ports further upriver, including the Port of Portland and Port of Vancouver, pass the project area. Based on incident modeling (Appendix A), the likelihood of an allision under the Proposed Action is once in 39 years (2028) and once in 25 years (2038). However, as noted in Section 2.2.7, *Ship Casualty Survey*, the magnitude of an incident has been shown to vary from little to no damage to greater consequence events. To provide some historical context, between 2001 and 2014, 5% of allisions resulted in substantial consequences, such as total vessel loss, and all of these events involved fishing vessels only.[40]

3.1.1.4 Operations: Indirect Impacts

Operations of the Proposed Action would result in the following indirect impacts.

As noted above, all large commercial vessel traffic bound for ports further upriver pass the project area. Transiting project-related vessels could affect or be affected by other vessel movements in the study area. Moreover, increased vessel traffic could result in changes in wake patterns, increased propeller wake, increased underwater noise, and vessel emissions that could affect environmental resources. These impacts are addressed in the SEPA Water Quality Technical Report (ICF International 2016b), SEPA Noise and Vibration Technical Report (ICF International and Wilson

[40] The data also show that between 2001 and 2014, 4% of the allisions resulting in some damage were bulk carrier allisions.

Ihrig 2016), and SEPA Air Quality Technical Report (ICF International 2016c). Impacts on the vessel transportation system and related environmental resources along the Columbia River navigation channel due to vessel operations are considered to be indirect impacts under SEPA.

As discussed in greater detail in Appendix A, vessel traffic for existing conditions (2014) was based on AIS data. Table 18 compares large commercial vessel traffic under existing conditions (based on 2014 AIS data), the No-Action Alternative (2028), and with the Proposed Action (2028). Vessel traffic unrelated to the Proposed Action was projected using a 1% growth rate and is included for 2028, the year of full build=out.

Table 18. Existing and Projected Large Commercial Vessel Traffic in the Lower Columbia River

Condition	Vessel Transits per Year
Existing Conditions (2014)	3,862
No-Action Alternative (2028)	4,440
Proposed Action (2028)	6,120

Notes:
Source: Based on 2014 AIS data for Cargo/Carrier, Tanker, Tug, and Passenger vessel types; a projected growth rate of 1% was applied to the 2014 transits to obtain the 2028 vessel transits under the no-action alternative; and proposed vessel transits (1,680) were added to the no-action transits to obtain transits with the Proposed Action.

For the purposes of incident modeling, the baseline traffic year of 2014 was selected to represent relatively recent traffic conditions on the river. Historically, vessel traffic on the river has reached higher numbers than represented by this 2014 datum. The VTIS in operation in the study area and other risk-reduction factors were considered in the analysis of the potential for increased risks during vessel transit as discussed in greater detail in Appendix A.

The incidents evaluated in the modeling include allision, collision, grounding (powered or drift), and fire/explosion, (Section 2.2.7, *Ship Casualty Survey*). The incident modeling results presented below considered the interaction between project-related vessels and other large commercial vessels using the channel. as well as smaller vessels (e.g., recreational boats or commercial fishing vessels) not limited to the channel. The potential increases in these risks are discussed below.

Increased Risk of a Vessel Allision (with a Fixed Object) during Transit

For vessels outbound from the project area, no fixed structures or waterfront facilities are close to the edge of the navigation channel until the Port Westward dock at RM 53 (Figure 3) and after that a small barge terminal dock at RM 36. Thereafter, there are no facilities or structures until reaching the Port of Astoria, and those are well clear of the channel. The Astoria-Megler Bridge is the next structure encountered, and once past that, the remaining structures are the jetties at the entrance of the river.[41] Due to the minimal impediments to vessel traffic within the navigation channel, the likelihood of a project-related vessel alliding with a fixed structure while in transit is low and was not quantitatively evaluated in the risk assessment (Appendix A). As shown in Table 11, 56 vessel allisions occurred in the study area from 2001 to 2014. Of these, just over half (52%) resulted in no

[41] Since they are piloted, large commercial vessels have an advantage over fishing and recreational vessels as pilots are specifically trained to keep a large commercial vessel from alliding with a known object in the navigation route, including a bridge. Approximately 30 years ago, there was an allision at the Astoria-Megler Bridge that involved a piloted vessel. Since this incident, Bar Pilots have implemented risk-reduction measures to reduce the probability of allisions at the bridge: they avoid meeting other piloted vessels at the bridge, observe weather and river current conditions, and review weather forecasts before transiting under the bridge (Appendix A: 69).

damage. Of the remaining incidents, 43% resulted in some level of damage and 5% resulted in total loss (all fishing vessels). Therefore, although there would be an increase in risks compared to existing conditions, the overall risk of a project-related vessel resulting in an allision to or from the project area would be low.

Increased Risk of Vessel Other Incidents during Transit

While a collision may seem to be a more likely incident scenario in the two-lane channel, the vessel casualty data (Table 11) and incident modeling results (Table 12) show that groundings, specifically powered groundings, are more likely under all traffic scenarios.

As presented in Table 19, the Proposed Action would result in an increased potential for incidents compared to both existing condition (2014) and the No-Action Alternative (2028) due primarily to the increase in the number of vessels associated with the Proposed Action relative to the other conditions. It should be noted that the consequences of a modeled incident can vary greatly from no damage to total loss and that the increase in likelihood alone is not representative of the magnitude of the potential consequences. In other words, not all of these incidents are likely to result in notable damages. For example, of the 151 reported incidents that occurred in the study area from 2001 through 2014 (Table 11), over half (64%) resulted in no damage, 32% resulted in damage, and 3% resulted in total loss.

Additionally, it is important to note the incident frequencies predicted for existing condition are representative of a single year (2014); while this year accounts for higher vessel traffic compared to more recent years, it does not account for the wide variation in vessel traffic that has occurred prior to the recession or the historical highs for traffic on the Columbia River. Further, because the Proposed Action would ramp up over time, it is important to note that comparing the addition of 840 vessels to the existing condition is a conservative approach. Therefore, it is important to also consider how the No-Action Alternative would compare to the existing condition and how the Proposed Action would compare to the No-Action Alternative. As shown in Table 19, a relative increase in the likelihood of all incident types would occur over time unrelated to the Proposed Action.

Table 19. Predicted Incident Frequencies per Year in the Study Area

Scenario	Predicted Collision Incident Frequency	Predicted Powered Grounding Incident Frequency	Predicted Drift Grounding Incident Frequency	Predicted Fire/Explosion Incident Frequency	Total Incident Frequency
Existing Condition (2014)	1.94	11.8	2.8	0.0032	16.6
No Action (2028)	2.53	13.6	3.3	0.0037	19.4
Proposed Action (2028)	2.91	14.4	3.6	0.0040	22.2

Notes:
Source: Appendix A.

Collisions

As noted in Section 2.2.6.2, *Methods for Managing River Traffic*, the River Pilots and Bar Pilots generally avoid overtaking situations where one vessel passes another from behind. Thus, the primary potential collision scenario is an upbound vessel meeting a downbound vessel. The River Pilots have identified specific points on the river where conditions are not suitable for vessels to pass each other, and they carefully manage transits to avoid two vessels meeting in those locations. Instead, they manage the vessel transits so if they do need to pass each other, it is done in a safe area. Avoidance of these areas were taken into consideration in the calculation of incident frequencies (i.e., estimating the likelihood of a collision due to the Proposed Action) in the incident modeling.

The most likely collision scenarios are bow-to-bow and side-to-side contact involving two large commercial vessels transiting the navigation channel. Bow-to-side is a possibility, but the channel width and the sizes of the vessels would make it more of a glancing impact rather than a straight on "T" impact.

Bow-to-bow contact is generally viewed as the easiest type to avoid because the target area is small and either vessel can act independently to avoid it. Also, a vessel's bow is its strongest structural point and bow-to-bow collisions would not be expected to result in cargo hold damage or fuel oil release. In addition, the hydrodynamic interaction between ships meeting causes the bows to be pushed away from each other as they approach.

Side-to-side or a glancing bow-to-side collision could result in damage to the hull, but the likelihood of catastrophic damage is relatively low. For dry cargo vessels—including bulk carriers—it is likely that little, if any, coal cargo would be released into the water in the event of an angle of impact less than 22.5 degrees (Appendix A). For tank vessels—including ATBs carrying oil in bulk—the risk of an oil spill cannot be ruled out; however, modern tank vessel design standards, including double hull construction of tankers, significantly reduce that potential.

As noted in Section 2.2.5, *Other Vessel Traffic*, the Columbia and Willamette Rivers provide important fisheries for commercial, tribal, and recreational purposes. Although these smaller vessels are not restricted to the navigation channel, they do often cross the river to access various locations within the study area. Particularly during periods of high fishing activity, there would be an increased chance for a vessel collision to occur. However, in general, because these smaller vessels are not restricted to the channel and must by law yield to oncoming large commercial vessels, the potential for a collision between a smaller vessel and a project-related vessel would be low. Although it is not possible to predict the types of vessels that might be involved in a future incident, the incident modeling does show a very small increase in the potential for collisions involving fishing vessels (0.05 incident per year) and recreational vessels (0.01 incident per year).

Groundings

The River Pilots noted that there are few areas where waterway conditions create a substantial chance for an accidental grounding to occur. Awareness of the river conditions and timing vessel transits with tidal heights and currents allows the River Pilots to avoid hazardous conditions conducive to grounding. For example, during periods of low water (generally between the months of September and November) pilots give adequate consideration to underkeel clearance to avoid

touching bottom. Pilots also note that the nature of the river channel is such that there is a bank cushion effect that helps to keep vessels away from the channel edges.[42] (Amos pers. comm.)

Fires, Explosions, and Other Emergencies

Equipment failure affecting power or steering while the vessel is underway could lead to loss of control of a vessel. A fire in the vessel's machinery spaces or accommodation areas is also a potential emergency scenario. For any of these situations the vessel master would do what is necessary to protect the safety of his crew first, and avoid damage to the vessel second. A prudent action would be to remove the vessel from the navigation channel to a safe haven, i.e., a location where appropriate actions can be taken by the vessel crew without compounding the emergency by involving another vessel or structure.

Safe haven opportunities on the river are minimal. Marine terminals at the port areas and designated anchorages are the only places where vessels can stop to manage an emergency. Two anchorages at Astoria can accommodate five deep-draft vessels, at most, depending on their sizes. There are no other anchorage areas until reaching Longview (past the project area). Once a loaded vessel gets underway inbound to or outbound from the Longview area, it is committed to completing the planned transit.[43]

Nothing prevents a vessel's master from anchoring anywhere in the river under emergency conditions; however, there is no way to predict how successful such an action might be in stopping the vessel. Anchoring effectiveness is dependent on factors such as the nature and condition of the waterway bottom, water depth, and vessel speed at the time of the anchoring. Risks include the potential for the anchor to damage the vessel if the water is not sufficiently deep. The vessel's location in or near the channel could also hamper or endanger other vessels depending on their locations at the time. Dropping an anchor or anchors in an attempt to stop a vessel would be done only if other control measures failed. Opportunities for these emergency measures would be discussed as part of the pretransit planning between the master and the pilot.

In an emergency, a vessel could anchor in the channel at some locations; however, that presents significant risks for the vessel with respect to the narrow channel and most likely would block virtually all other traffic. The likelihood of a vessel emergency causing a collision is low. Safe haven limitations (described above) mean that vessel transit would not begin until everyone involved is satisfied that the vessel is fully capable of completing the transit.

Although a vessel emergency increases the likelihood of indirect impacts on the Columbia River navigation channel, the likelihood of such an emergency occurring is minimal. As shown in Table 19, the likelihood of fires/explosions is substantially lower than any other type of incident considered in the risk assessment. If such an emergency were to occur, the presence of a qualified vessel master and the pilot, in addition to crew training, vessel design, and equipment, help minimize the harmful impact on human safety and the environment.

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[42] When the ship is near the bank, the water is forced between the narrowing gap between the ship's bow and the bank. This water tends to create a "cushion" that pushes the ship away from the bank.

[43] A number of potential sites for additional anchorages are being discussed by the waterway stakeholders; however, they are generally shallow water sites. Reportedly, the discussions include the possibility of the Corps maintaining those areas as part of the federal channel project. Provision of additional stern buoys is also being considered.

Increased Risk of an Oil Spill during Transit or at Anchorages

Risks of oil spills involving diesel or heavy fuel oil during transit could occur as the result of an incident or during bunkering transfers at locations other than the dock. The Applicant has committed to not allowing vessel bunkering from barges or tanker trucks at Docks 2 or 3. If an incident occurred that resulted in an impact, there is a possibility that a fuel tank could be damaged and fuel spilled. Oil spills could also occur during bunkering at anchorages within the study area. In general, the risks of spills would increase under the Proposed Action due to an increase in the number of vessels calling at the project area and the resultant increase to overall vessel traffic in the study area. To provide additional information about the relative likelihood of various sized oil spills, the risk assessment also quantitatively evaluated the incremental increase in risks of a spill (in the event of a collision or grounding) due to the Proposed Action.

Tables 20 and 21 present the likelihood (in example return periods[44]) of representative spill sizes that could occur as the result of the modeled increased risk of collisions or groundings, respectively.

Table 20. Example Bunker Oil Spill Volumes and Frequencies due to Collisions Related to the Proposed Action (2028 and 2038)

Return Period (years)	Bunker Oil Spill Volume (gallons)
341	20,900 or less
581	59,300 or less
676	107,400 or less
3,748	166,500 or less

Notes:
[a] Frequency of collisions in 2038 is higher compared to 2028 due to an increase in the overall vessel traffic in the study area.
Source: Appendix A

Table 21. Example Bunker Oil Spill Volumes and Frequencies due to Groundings Related to the Proposed Action (2028 and 2038)

Return Period (years)	Bunker Oil Spill Volume (gallons)
140	5,700 or less
182	10,700 or less
403	39,700 or less
4,299	45,800 or less

Notes:
[a] Grounding frequencies do not vary from 2028 to 2038 since the number of project vessels remains at 840 in both years.
Source: DNV GL 2016

As shown in the tables, the likelihood of bunker oil spills from a vessel incident is relatively low with the most likely scenarios occurring in the range of once every 244 years for collisions (2038 traffic levels) and once every 140 years for groundings (2028 or 2038 traffic levels). As noted in Section 2.2.8, *Marine Oil Spill Survey*, spills that have historically occurred in the study area are much smaller than the quantities indicated in Tables 20 and 21 and have ranged from 0.1 gallon to 1,603 gallons.

[44] Estimated period of time between occurrences of an event.

[45] The average number of oil spills within this same timeframe (2004 to 2014) is 15.6 spills per year with 84% having a volume of less than 10 gallons. Spills of more than 100 gallons have occurred at a frequency of 0.4 per year or once every 2.2 years. The average size of these relatively larger spills is approximately 630 gallons.

The reason that the potential spill sizes modeled for the Proposed Action are larger is because the spill scenarios presented above are associated with large-scale vessel incidents: collisions or groundings. For such an incident to result in a release of bunker oil, the energy involved in the initial incident must be great enough to puncture the vessel's tanks. Increases in the types of oil spills of a scale more similar to those that have occurred over the last 10 or so years would also be expected under the Proposed Action somewhat commensurate with the relative increase in vessel traffic. Expansion of the casualty survey to a longer (beyond 11 years) timeframe, would include more unlikely events of a larger scale more in line with those addressed by the incident modeling.

An amendment to MARPOL Annex that went into force in 2007, included a new Annex I Regulation, 12A, on oil fuel tank protection. That regulation applies to any ship that has an aggregate oil fuel capacity of 785 cubic yards—3,774 barrels (158,508 gallons) of oil equivalent—or more and was contracted for on or after August 1, 2007; or had a keel laying date on or after February 1, 2008; or was delivered on or after August 1, 2010. The regulation limits an individual fuel tank to a maximum capacity limit of 3,270 cubic yards—15,725 barrels (660,450 gallons) —and also includes requirements for the protected location of the fuel tanks and performance standards for accidental oil fuel outflow. It requires consideration of general safety aspects, including maintenance and inspection needs, when approving the vessel's design and construction. These improvements are intended to reduce the extent of releases in the event of a vessel incident.

Increased vessel traffic associated with the Proposed Action also has the potential to result in an increased risk of oil spills during bunkering activities. Causes of oil spills during bunkering transfers include overflow of the tank, parting the hose due to mooring fault, operator error in connecting the hose, failure of the hose or pipework, and failure of bunker tanks (HSE 2012). Experience from insurance claims (Gard 2002) is that most bunker spills result from an overflow of the bunker tank due to carelessness or negligence, either on the part of those supplying the bunkers, or those on board the vessel receiving them.

The main safeguard against the occurrence of bunker spills are use of bunkering best practices such as attentive tank level monitoring and valve alignment, use of bunkering procedures and checklists, and the supervision of the bunkering operation by a qualified person in charge.[46] Standard/ABS (2012) lists the main features of such procedures.

The consequences of a spill of heavy fuel oil into the marine environment are, in general, considered to be more severe than for other fuels, although this may depend on the sensitivity of the local environment to acute toxicity (DNV GL 2011). Undoubtedly, spills of heavy fuel oil will be more persistent, taking longer to weather naturally and being more difficult to clean-up. The average

[45] The data presented in Section 5.4.4.4 includes all vessel-related reported spills from 2004 to 2014 not just those caused by vessel incidents such as groundings and collisions.

[46] *Bunkering Best Practices: A Reference Manual for Safe Bunkering Operations in Washington State* (Washington State Department of Ecology 2014) and Bunkering Guidelines in *Lower Columbia Region Harbor Safety Plan* (January 2013). These references provide extensive guidelines related to winds, sea states, mooring equipment, tug availability, and regulatory requirements to provide for safe, spill-free bunkering operations.

clean-up costs per metric ton of oil spilled have been estimated as more than 7 times higher for heavy fuel oil than for diesel (Etkin 2000).

Spills of oil cargoes are better documented than spills from bunkering. Therefore, previous risk analyses (DNV GL 2011) have assumed the frequency of spills during bunkering is the same as during transfer of liquid cargoes: 1.8×10^{-4} (.00018) per bunkering operation for spills exceeding 1 metric ton (7.3 barrels or 308 gallons). The frequency of smaller spills is likely to be much greater. This implies that the annual likelihood depends on the number of bunkering operations. If the vessel bunkers 10 times per year, the likelihood of a spill of 1 metric ton or more would be 1.8×10^{-3} (.0018 or.00018*10) per year, or approximately 1 chance in 500 per year. Although it is not possible to predict the number of vessels that may bunker or where they would bunker, the risks of a spill during transfer would increase slightly due to the increase in vessel trips under the Proposed Action.

Increased Vessel Activity

Increased vessel traffic associated with the Proposed Action would also have the potential to result in other impacts from increased activity, vessel wake, propeller wash, underwater noise and vibration, and vessel emissions. The potential impacts on water quality, surface water and floodplains, vegetation, fish, and wildlife are addressed in the SEPA Water Quality Technical Report (ICF International 2016b), SEPA Surface Water and Floodplains Technical Report (ICF International 2016d), SEPA Vegetation Technical Report (ICF International 2016e), SEPA Fish Technical Report (ICF International 2016f), and SEPA Wildlife Technical Report (ICF International 2016g), respectively. These vessel-related impacts are particularly complex and depend on a variety of interrelated factors, including but not limited to, the distance of the channel from the shoreline, depth of the intervening riverbed, placement and size of dredged materials, the presence of particularly sensitive species, the speed and size of the vessels, the prevailing river and tidal currents, and otherwise natural-occurring wave action. Many of these factors are regulated by the federal government, including dredging activities, the placement of dredged spoils, and vessel traffic management within the study area. In general, the increase in deep-draft vessels associated with the Proposed Action would result in the increased potential for vessel-related impacts to occur.

3.1.2 No-Action Alternative

Under the No-Action Alternative, the Applicant would not construct Docks 2 and 3. Dock 1 would continue to be used for bulk cargo, primarily alumina, and might also be used for general cargo. The largest vessels currently calling at this facility are in the Handymax class, typically in the 35,000 deadweight tons range; however, the dock might be modified to accept somewhat larger Panamax-class vessels. The Applicant has stated that it plans to continue current activities at the site and increase commodities storage and shipment.

Table 22 describes the extent of these planned activities. When compared to the existing operations, this represents an additional eight vessels per year. Although this is an increase of 133% when compared to the six vessels per year that are currently mooring at Dock 1, the impact would be negligible in terms of dock capacity and the vessel traffic management systems/resources that are in place in the Columbia River navigation channel. Eight additional vessels per year would be negligible when compared to current vessel activity within the Columbia River navigation channel (an increase of almost 1%).

Table 22. Planned Activities and Transport Operations at the Existing Bulk Product Terminal

Commodity	Vessel Class	Facility Activity	Vessel Activity (includes existing operations)
Alumina	Handymax	Vessels deliver alumina to Dock 1. Alumina is stored on site and then shipped to Chelan County by train.	8 ships/year
Other Commodities	Not provided	Other commodities that are assumed to be delivered by vessel, stored, and shipped via truck and train to various locations.	6 ships/year

Notes:
[a] See typical dimensions of a Handymax-class vessel in Table 6.
Source: URS Corporation 2014.

Potential Future Marine Terminal Activities

In addition to current and planned activities, the Applicant is also considering the receipt and shipment of any products permitted by the terms of the Washington State Department of Natural Resources (DNR) lease,[47] including calcine pet coke, coal tar pitch, cement, fly ash, and sand (Table 23). Before the existing bulk product terminal could expand to accept additional products, it would need to obtain the necessary permit modifications or approvals. The following are estimates of the amount and method for transporting each of these commodities.

- Calcine pet coke would be imported by ship from Asia, unloaded from ships using a vacuum unloader, and stored in an existing on-site building. Approximately 600,000 tons of calcine pet coke per year could be imported.
- Coal tar pitch would arrive by ship via super-sacks, and unloaded from either vessel mounted unloading gear or new equipment. Approximately 200,000 tons of coal tar pitch per year could be imported.
- Cement would arrive by ship and distributed either by rail or truck.
- Fly ash would come in by rail and depart by truck, or come in by truck and depart by rail.
- Sand or gravel would likely come in by rail and depart by truck, or come in by truck and depart by rail.

[47] Northwest Alloys holds a 30-year aquatic lease (20-B09222) with DNR allowing the use of DNR property for three ship docks. The lease expires on January 2, 2038. Per the DNR Lease Exhibit B Plan of Development, Operations and Maintenance Docks:

- The existing dock can be used for off-loading alumina ore from ships for transfer to railcar or trucks, off-loading cement for transfer to railcars and trucks, and off-loading any product that can be moved by vacuum including any type powder or granulated product.
- Two new fixed docks can be used for products not compatible with the existing system on Dock 1. The products would include coal, silica sand, dry fertilizer, potash, coke, cement clinker and other general bulk cargo.

Table 23. Potential Future Commodities Transported to Existing Site by Vessel

Commodity	Vessel Class	Facility Activity	Vessel Activity (includes existing operations)
Calcine pet coke Coal tar pitch Cement Fly ash Sand or gravel	Not provided	Ships deliver cargo over Dock 1; the cargo is temporarily stored and then shipped out by ground transport	10 to 12 additional ships/year

Notes:
Source: URS Corporation 2014.

Total Vessel Traffic

If all planned and potential activities are implemented, combined with existing storage and transport operations at the existing site, the vessel calls listed in Table 24 are anticipated by year 2020.

Table 24. Vessel Calls for Existing, Planned, and Potential Future Activities at Existing Bulk Product Terminal

Commodity	Vessel Class	Facility Activity	Vessel Activity (includes existing operations)
Existing, Planned, and Potential Future	Not provided	Ships deliver cargo over Dock 1; the cargo is temporarily stored and then shipped out by ground transport	26 vessels/year

Notes:
Source: URS Corporation 2014.

3.2 Mitigation

Based on the findings in this technical report, the co-lead agencies (Cowlitz County and Washington State Department of Ecology) developed potential Applicant mitigation measures. The SEPA Draft Environmental Impact Statement presents these mitigation measures.

Chapter 4
Required Permits

The Proposed Action would not require permits or approvals related to vessel transportation.

Chapter 5
References

5.1 Written References

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Appendix A

Navigation Risk Study

DNV·GL

MILLENNIUM BULK TERMINALS LONGVIEW (MBTL) PROJECT

Navigation Risk Study

ICF Jones & Stokes, Inc.

Report No.: PP141993-2, Rev. 1
Document No.: PP141993-2
Date: January 19, 2016

Project name:	Millennium Bulk Terminals Longview (MBTL) Project	DNV GL Oil & Gas
Report title:	Navigation Risk Study	Risk Advisory Services
Customer:	ICF Jones & Stokes, Inc., 630 K. Street, Suite 400, Sacramento, CA 95814	1400 Ravello Drive Katy, TX
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1 EXECUTIVE SUMMARY

DNV GL was hired as subcontractor to ICF International who was tasked by Cowlitz County, the Washington State Department of Ecology, and the U.S. Army Corps of Engineers to estimate the impact of the proposed Millennium Bulk Terminals—Longview project—a coal export terminal in Cowlitz County, Washington, along the Columbia River—on navigational safety, marine incident and oil spill risk in the Lower Columbia River. There would be 840 vessel calls to the terminal per year with 80% being Panamax class bulk carriers and 20% being Handymax class bulk carriers.

The study addresses impacts incrementally over a 24-year period (Base Case in 2014, Project Impact in 2028 and Cumulative Impact in 2038) in order to understand the contribution of the proposed project to future navigation safety. The study area for this study includes the waterways that would be used by or could be affected by vessels calling at the project sites. It includes the waters out to 3 nautical miles seaward of the mouth of the Columbia River, the Columbia River Bar, and the Columbia River upstream to Vancouver, Washington.

DNV GL's proprietary model, Marine Accident Risk Calculation (MARCS) was used to estimate navigation incident frequencies and bunker spill frequencies of project vessels and other vessel traffic; and the Naval Architecture Package (NAPA) was used to estimate the conditional probabilities of bunker oil spill volumes for project vessels. A survey of marine incident data was also performed in order to establish a severity distribution for marine incident outcomes. Finally, further data analysis was performed to measure the incremental impact of the proposed project on navigational safety.

MARCS combines processed AIS data for vessel traffic (e.g., vessel types, sizes, routes, and transit frequencies), the marine environment (e.g., location of shallow water, visibility data, and wind data) and operational aspects of shipping (e.g., pilotage, escort tugs) to predict the frequency of incidents at sea, including:

- Collision
- Allision
- Drift grounding
- Powered grounding
- Fire / Explosion

Collisions generally occur in the navigable part of the channel where the traffic is most dense. Drift and powered groundings occur near the shoreline or in shallow waters.

Preliminary MARCS and NAPA results were presented in a stakeholder workshop with DNV GL, ICF International, Washington State Department of Ecology (Ecology), Cowlitz County, U.S. Environmental Protection Agency (EPA), U.S. Coast Guard (USCG), and the U.S. Army Corp of Engineers Sector Columbia River (USACE) on November 9, 2015.

1.1 Incremental Contribution to Marine Incidents

The total incremental incident frequency due to proposed project in 2028 is 1.5 incidents per year which equates to an 8% increase over the no-action scenario in 2028. Of these 1.6 incidents, 0.8 are powered groundings, 0.34 are drift groundings, 0.38 are collisions and 0.03 are allisions.

The total incremental incident frequency due to proposed project in 2038 is 1.6 incidents per year which equates to a 6% increase over the no-action scenario in 2038. Of these 1.7 incidents, 0.8 are powered groundings, 0.34 are drift groundings, 0.47 are collisions and 0.04 are allisions.

In order to provide context around the consequences of a collision, grounding or allision incident, a survey of USCG Marine Information for Safety and Law Enforcement (MISLE) database was conducted for years 2001 to 2014. For the purposes of this study, the various categories used to describe incident severity for each reported incident were aggregated into “Total Loss”, “Damage” and “No Damage”. The data coverage period of 2001 to 2014 was chosen, as it covers over 99% of all reported collision, grounding, and allision incidents in the dataset. Data surveys were conducted for the national dataset and for the study area separately in order to test for differences in the distribution of incident severity between the two. Survey findings show that for a given incident type, the severity distributions were very similar for national incident data compared to Lower Columbia River incident data.

Using the results of the data survey, we can therefore comment on the likely severity of the incremental contribution of marine incidents contributed by the project.

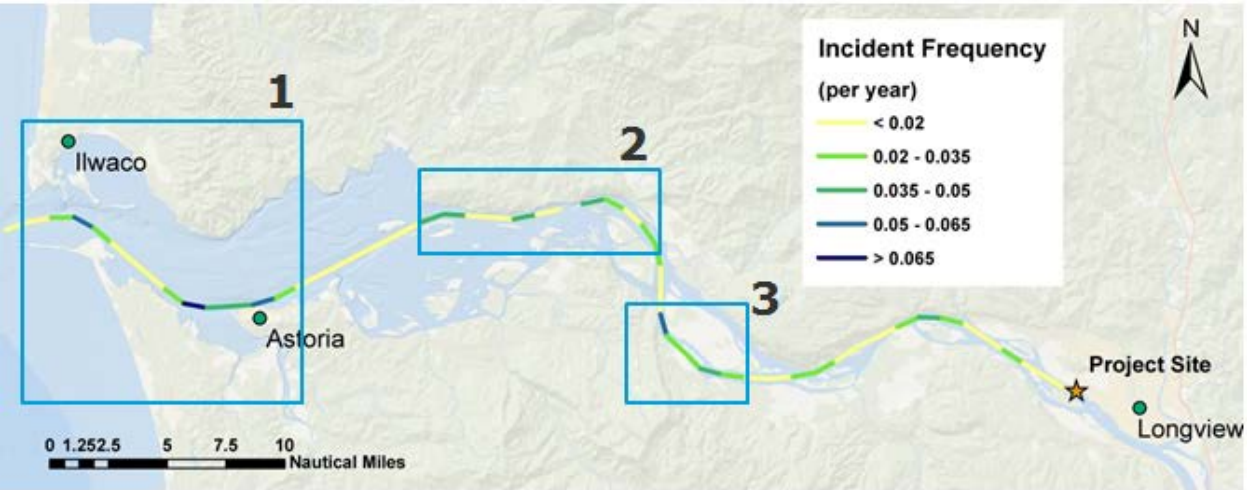
- Based on a survey of historical incident severity, 1-2% of the grounding events contributed by the project are likely to result in a total loss of the vessel, 21-24% are likely to result in damage to vessel and 74-78% are likely to result in no reported damage. Note: None of the total loss events reported due to grounding involved carriers or vessels of similar size. The only vessel categories reported as a total loss in a grounding event were passenger vessels.
- Based on a survey of historical incident severity, 3-5% of the collision events contributed by the project are likely to result in a total loss of one or more vessels, 47-53% are likely to result in damage to one more vessels and 44-47% are likely to result in no reported damage.
  Note: None of the total loss events reported due to collision involved carriers or vessels of similar size. The only vessel categories reported as a total loss in a collision event were recreational vessels.
- Based on a survey of historical incident severity, 1-5% of the allision events surveyed resulted in a total loss of the vessel, 43-45% resulted in vessel damage and 52-54% resulted in no reported damage.
  Note: None of the total loss events reported due to allision involved carriers or vessels of similar size. The only vessel categories reported as a total loss in an allision event were fishing vessels.

Assuming the distributions described above, the project would contribute to an incident resulting in the total loss of a vessel roughly once every 30 years, incidents resulting in reportable damage once every 2 years and approximately 1 incident per year resulting in no damage.

The incremental contribution appears to decrease from 2028 (8%) to 2038 (6%) because non-project vessel traffic continues to increase over this ten-year time period while the number of project vessels remains constant at 840 per year. Therefore the relative contribution in 2038 is lower because project vessels make up a smaller portion of overall vessel traffic.

Figure 1-1 below presents marine incident frequencies for project vessels in 2028 and 2038 along the proposed route. Notes explaining primary drivers are provided.

Figure 1-1 Incident Frequency – 2028 & 2038 With-Project



1) River Mile (RM) 2-14: Primary Driver of increased incident frequency is Powered Grounding but this area also contributes the highest collision frequencies of the study area.
2) RM 22-33 & 3) RM 36-40: Primary Driver of increased incident frequency is Powered Grounding. No variation was found in grounding frequency between 2028 and 2038 as number of project vessels remains constant.

1.2 Incremental Contribution to Oil Spill Risk

Less than 1% of the collision, grounding and allision incidents involving project vessels are expected to result in a bunker oil spill. As a result, the frequency of a bunker spill of any size due to a marine incident involving a project vessel is estimated to be 1.02×10^{-2} in 2028 and 1.17×10^{-2} in 2038. This equates to roughly one spill (of any size) every 98 years in 2028 and one spill (of any size) every 85 years in 2038. Based on a survey of oil spill data from 2004 to 2014, the Lower Columbia River has experienced a spill of greater than 100 gallons approximately once every 2.2 years. Therefore, the proposed project would increase the frequency of a spill greater than 100 gallons by approximately 2 to 3% to approximately once in every 2.15 years.

In the event that a collision or grounding event resulted in a bunker oil spill, the smallest estimated bunker oil spill volume from a project vessel would be roughly 20 m^3 for grounding and 80 m^3 for collisions (5,700 and 20,900 gallons, respectively). The frequency of various bunker oil spill sizes is provided in Table 1-1 for grounding scenarios. Since the number of project vessels does not change between 2028 and 2038, frequencies are the same in both years. The frequency of various bunker oil spill sizes is provided in Table 1-2 and Table 1-3 for collision scenarios. Since the number of non-project vessels increases between 2028 and 2038, collision frequencies vary across those years. It is important to note that this study did not assess the risk of small spills due to activities such as bunkering, damage to the environment and other causes unrelated to navigational incidents.

Table 1-1 Example Bunker Oil Spill Volumes & Frequencies due to Grounding (2028/2038)

Return Period (Years)	Spill Volume (gal)
140	5,700 or less
182	10,700 or less
403	39,700 or less
4,299	45,800 or less

Table 1-2 Example Bunker Oil Spill Volumes & Frequencies due to Collision (2028)

Return Period (Years)	Spill Volume (gal)
341	20,900 or less
581	59,300 or less
676	107,400 or less
3,748	166,500 or less

Table 1-3 Example Bunker Oil Spill Volumes & Frequencies due to Collision (2038)

Return Period (Years)	Spill Volume (gal)
224	20,900 or less
381	59,300 or less
444	107,400 or less
2,461	166,500 or less

2 INTRODUCTION

Millennium Bulk Terminals—Longview, LLC (Applicant) proposes to construct and operate a coal export terminal in Longview, WA along the Lower Columbia River. The terminal would receive coal via rail shipment, then load and transport the coal by ocean-going ships via the Columbia River and Pacific Ocean. There would be 840 vessel calls to the terminal per annum; 80% of vessels calling the terminal would be Panamax class bulk carriers and 20% would be Handymax class bulk carriers.

DNV GL was tasked to estimate the impact of the proposed project and associated increases in vessel calls on navigation safety on the Columbia River. DNV GL's study estimates the impact of the proposed project to other vessel traffic from the precautionary zone in the Pacific Ocean to the proposed terminal facility. The study addresses impacts incrementally over a 24-year period (Base Case in 2014, Project Impact in 2028 and Cumulative Impact in 2038) to understand future trends in navigation safety. DNV GL's findings will supplement the environmental impact statement (EIS) for the proposed project, and is expected to address public concerns regarding navigation safety.

2.1 Stated Objectives

The primary objective of this study is to quantify the incremental risk in 2028 and 2038 posed by project vessels to other vessel traffic on the river in terms of the increased likelihood of any incident. The secondary objective was to provide additional information about the potential consequences of these incidents, more specifically, qualification of the magnitude or severity of potential outcomes using 1. Comparisons to historical data and 2. Modeling likelihood for different bunker oil release volumes. To achieve these objectives the following four questions are addressed:

1. Could there be an incident?
2. If so, how severe would the incident be?
3. Could the incident result in a release of bunker oil?
4. If so, how much bunker oil would be released?

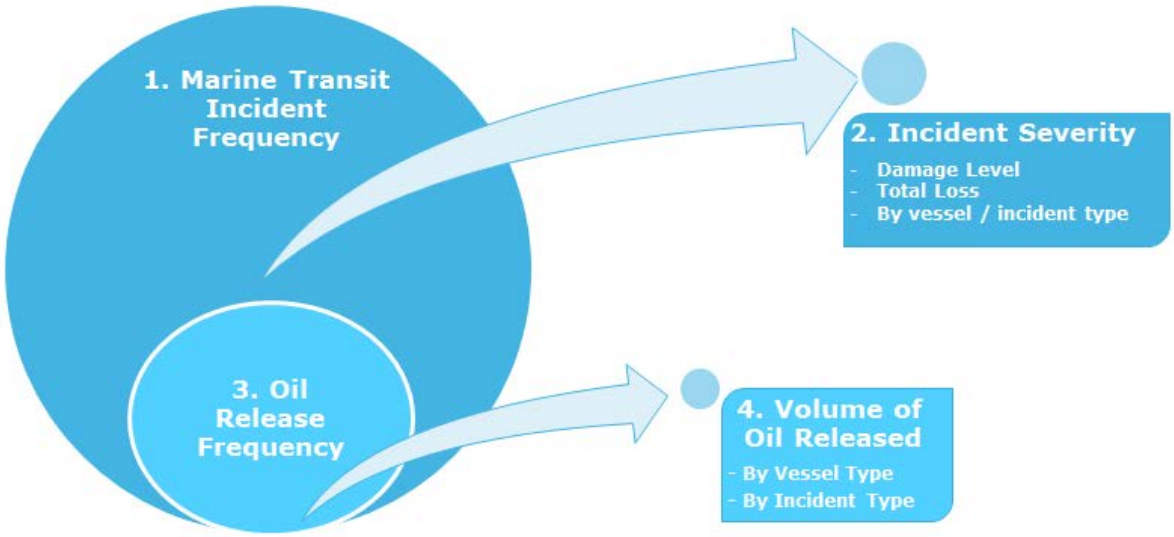


Figure 2-1 Navigational Risk Study Objectives

To achieve these goals, the following modeling outputs were obtained from this navigational risk study:

1. The incremental difference of navigation incident frequencies of project and non-project vessels in traffic conditions with and without proposed project are estimated for years 2028 and 2038.
2. A distribution of incident severity is developed based on a survey of historical marine incident data.
3. Bunker spill frequencies contributed by project vessels at full build-out in 2028 and 2038.
4. Conditional probabilities of bunker spill volumes contributed by project vessels at full build-out in 2028 and 2038.

2.2 Study Area

The study area for this study includes the waterways that would be used by or could be affected by vessels calling at the project sites. It includes the waters out to 3 nautical miles seaward of the mouth of the Columbia River, the Columbia River Bar, and the Columbia River upstream to Vancouver, Washington.

3 DESCRIPTION OF VESSEL TRAFFIC

This section describes the AIS data and assumptions related to vessels and vessel traffic that are applied in the study.

3.1 Project Vessel Specifications and Number of Transits

Two design vessels have been chosen to represent an average sized Panamax class vessel and an average sized Handymax class vessel.

The design vessels chosen to represent the Panamax class and the Handymax class are the MP Panamax 6 and the Advance II, respectively. The vessels' specifications are outlined in Table 3-1(Ref. /1/, /2/)

Table 3-1 Vessels' Specifications (Ref. /1/)

	MP Panamax 6	Advance II
Deadweight Tonnage (DWT)	68,541 tons	46,101 tons
Gross Tonnage (GT)	36,097 tons	30,032 tons
Length Overall (LOA)	225.0 meters	183.0 meters
Length Between Perpendiculars (LBP)	216.0 meters	173.9 meters
Breadth (B)	32.2 meters	32.3 meters
Draught (D)	13.3 meters	11.0 meters

It is expected that the proposed project would result in 672 Panamax vessels per year and 168 Handymax vessels per year in 2028 and 2038, for a total of 840 MBTL vessel calls a year.

Results will be presented as total incident frequencies for all project vessel calls and will not differentiate between Handymax and Panamax vessels.

3.1.1 Bunker Oil Capacity

For the purposes of estimating potential bunker spill volumes, bunker oil capacity and bunker tank locations from a typical Panamax class vessel are assumed.

Figure 3-1 shows the locations of the bunker oil / heavy fuel oil (HFO) tanks for a typical Panamax class vessel (shown in red at the stern of the vessel). Based on a review of DNV GL-classed Panamax-class carriers, the typical Bunker Oil capacity for these vessels is assumed to between 2400 and 2500 m^3.

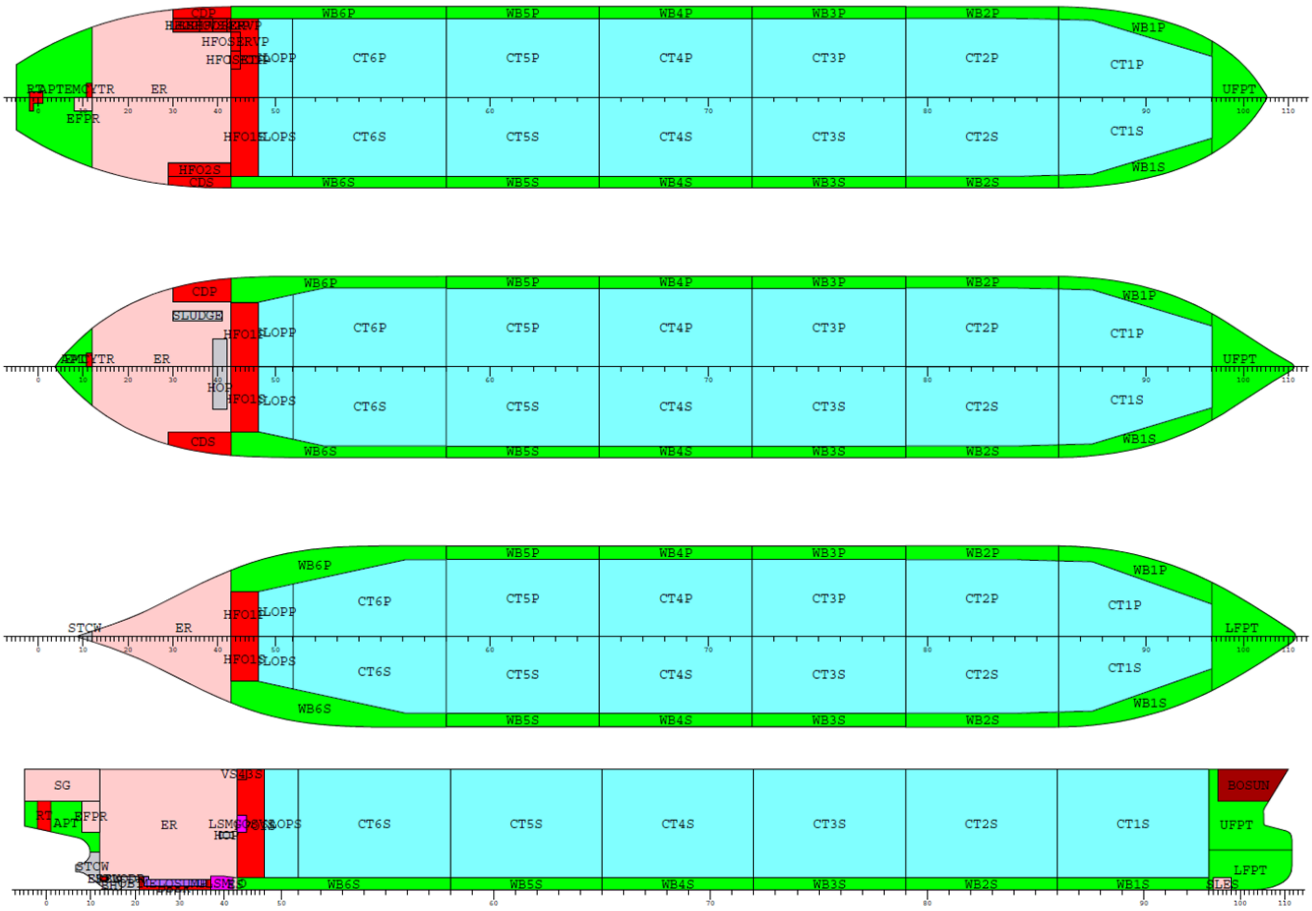


Figure 3-1 Bunker Oil / HFO tank locations for typical Panamax class carrier

3.2 Use of AIS 2014 Data

The MARCS model (described in detail in Section 4) for this study requires Automatic Identification System (AIS) data for the area around the terminal and shipping routes. Tracks are created from the AIS data points and are used to establish vessel traffic patterns and densities within the study area.

Figure 3-2 presents the general methodology used to treat the AIS dataset. Once the data for a full calendar year is received, it is then plotted geospatially in a geographic information system (GIS). The dataset was plotted as individual points for each data entry in the study area. From the plotted dataset, the vessel density, speed and traffic patterns are determined for analysis and use in the MARCS model.

To determine the traffic density, the AIS dataset was translated into the number of AIS points per grid cell (0.005 x 0.005 decimal degrees), which is interpreted as vessel density. The vessel density was not used as input into the MARCS model, but as a method of understanding vessel behavior in the study area. A vessel density 'heat' map was created for the overall traffic and each defined vessel category used in MARCS.

Speed profiles were created to determine the vessel category speeds to be used as an input to the MARCS model. The timestamp in the AIS data for a single vessel is used to determine the speed of the vessel when travelling between two given AIS data entries. An average speed for each vessel category at a given location is applied in MARCS. A map of the varying speeds along the route was created for each vessel category.

The entries of each vessel in the AIS dataset are linked throughout the study area based on the location and time stamp to create vessel tracks. The tracks present the general traffic patterns and route in the study area. To input the information into the MARCS model, it is necessary to consolidate the vessel tracks into the main traffic routes for the study area. The vessel frequency for each vessel type travelling along (co-flow and counter flow traffic) the defined main traffic route is inputted into the model. A vessel track frequency is included in the count of a given route if it is within a 27°degree angle of the defined main traffic route. The vast majority of vessel tracks are captured on one of the defined main routes. This method allows for the large amount of AIS dataset to be accurately and efficiently utilized in the MARCS model.

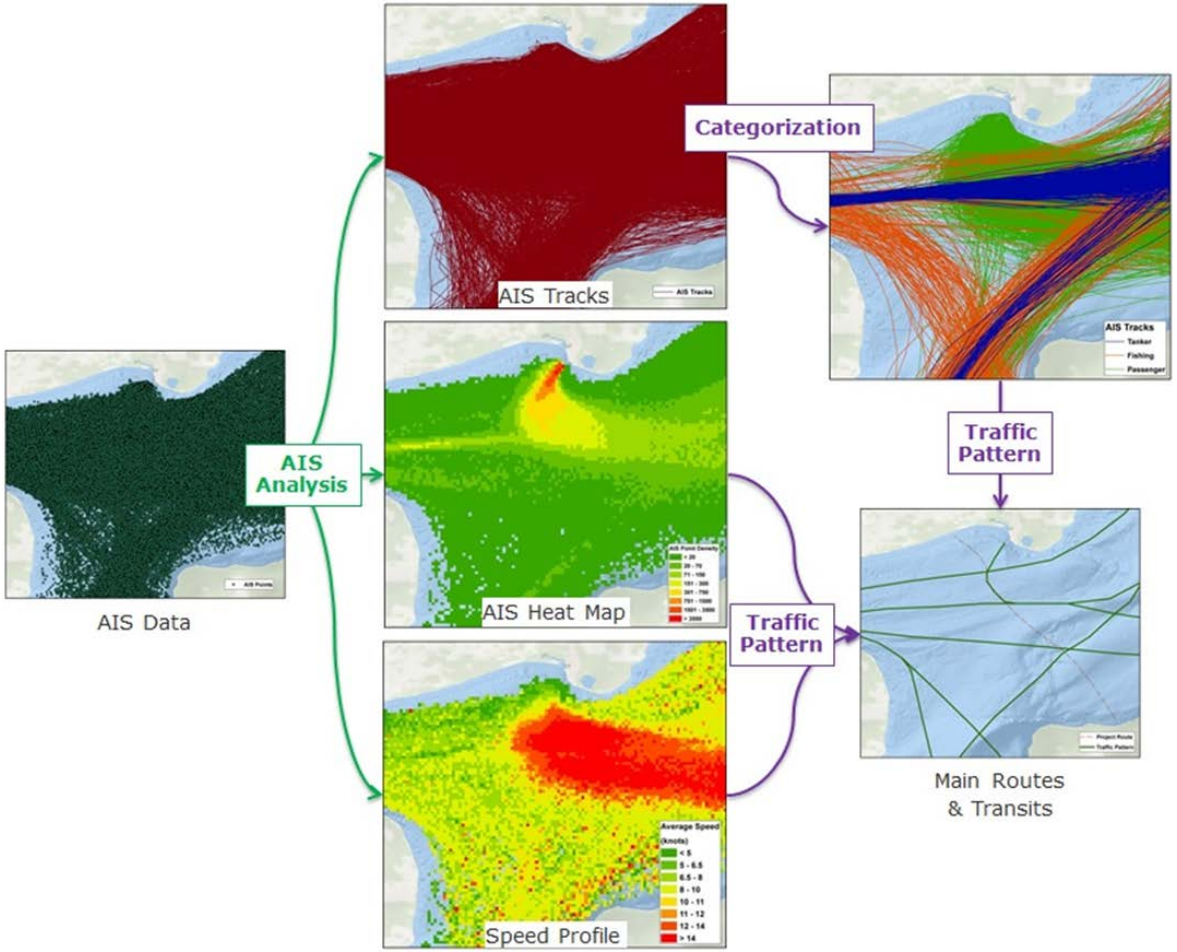


Figure 3-2 AIS Data Treatment Methodology

The AIS dataset, presented in Figure 3-3, was obtained from Merchants Exchange in Portland, OR. The period of coverage for the AIS data is from '2014-01-1 00:00' to '2014-12-31 23:59' (Ref. /3/).

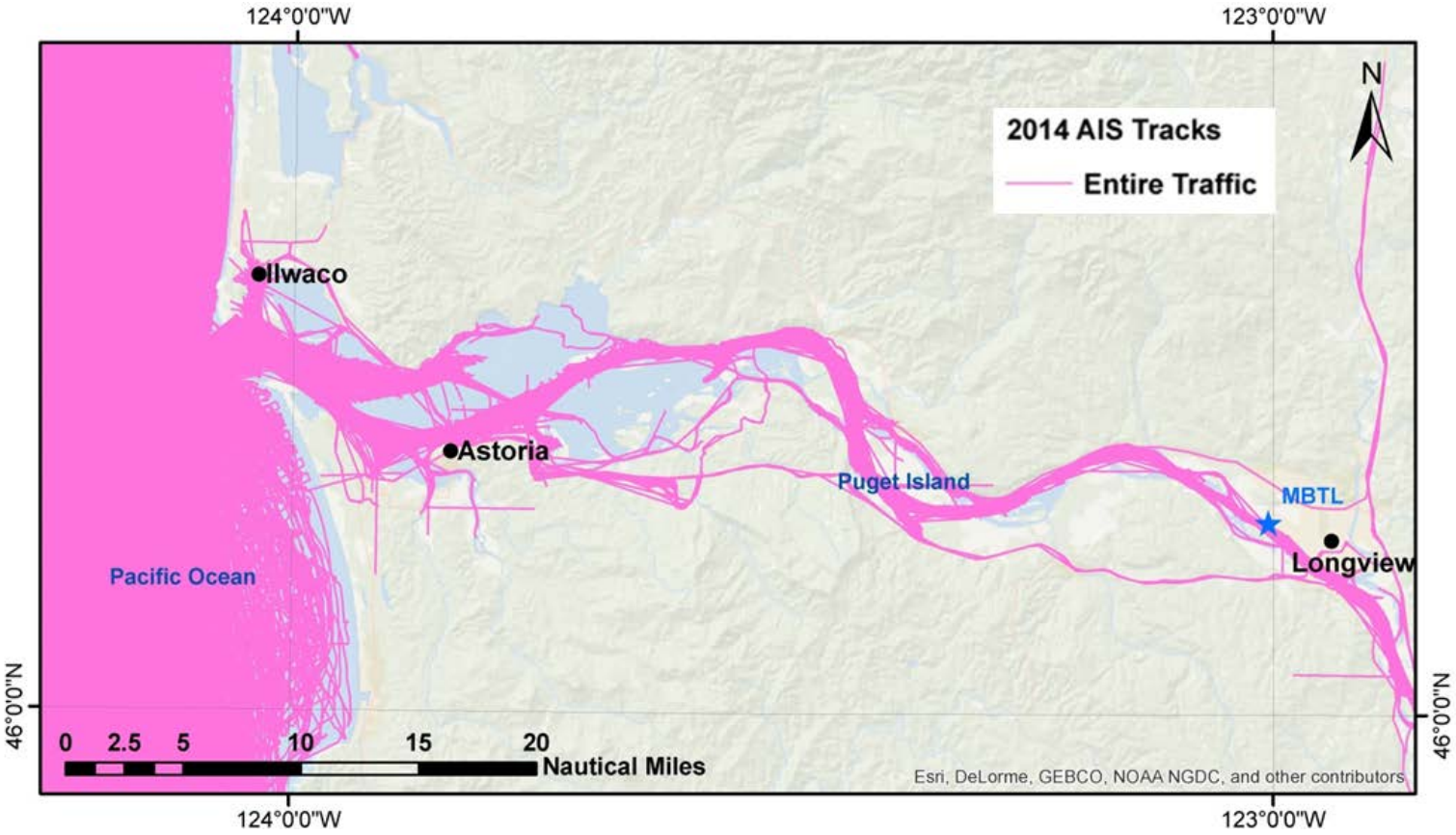


Figure 3-3 2014 AIS Tracks for All Transits

Figure 3-4 provides a close-up of the project vessel route and AIS tracks near the proposed terminal location.

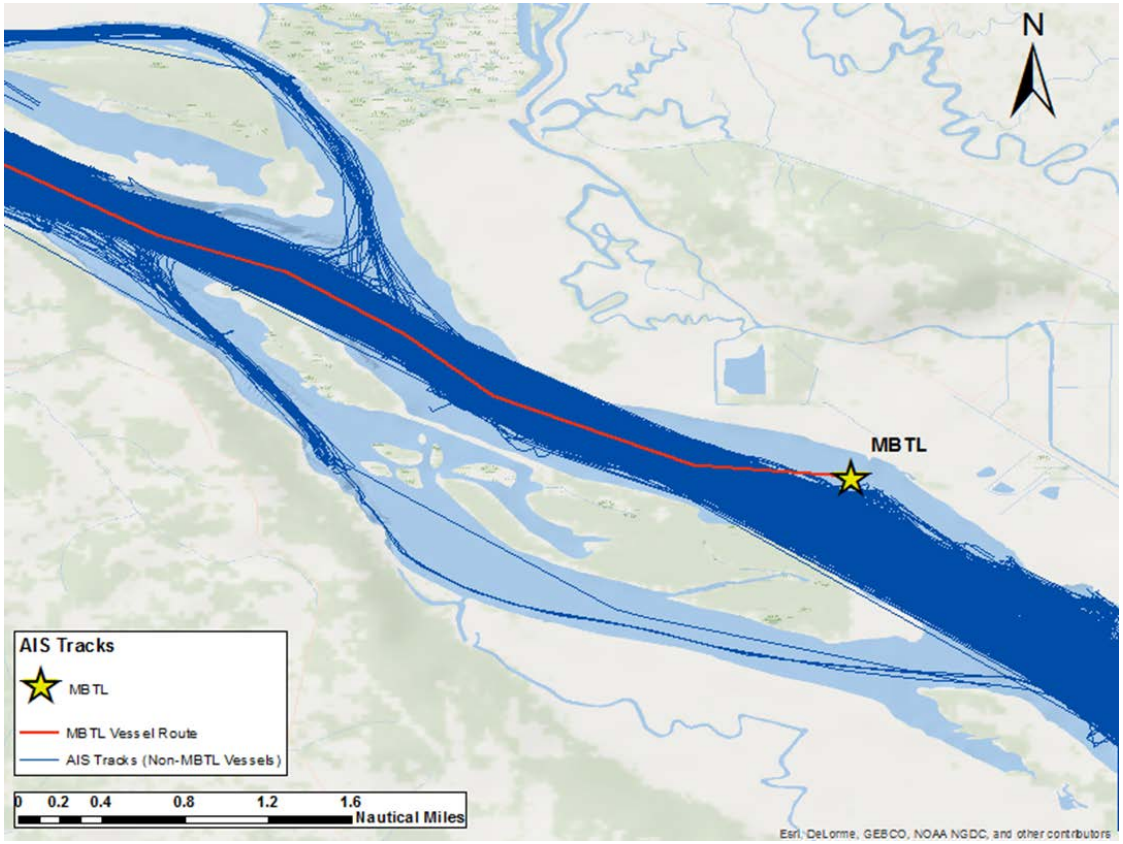


Figure 3-4 AIS Tracks near Project Location

3.3 Vessel Type Categories

The vessel categories are used to group AIS descriptors together in categories. Each category of vessels has a common specified average speed, average size (DWT, LOA, and B) and set of risk reductions that are applied to each vessel. The average speed and size of vessel categories are derived from the AIS data.

3.3.1 Vessel Type Descriptions

The marine traffic risk assessment used AIS data to characterize vessel traffic. Vessel categories used in the navigational risk model included:

- Cargo/Carrier
- Passenger
- Service
- Tug
- Fishing
- Pleasure
- Tanker
- Other
- Undefined

Table 3-2 provides a summary description of the typical vessel types operating on the Columbia River that correspond to the AIS vessel types used in the marine traffic risk assessment. A description of the information found in each column of Table 3-2 is summarized below.

- Vessel Category: Grouping of vessel types from the AIS Data. These are grouped by commonalities in function/service as well as vessel dimensions.
- AIS Vessel Types: Vessel categories extracted directly from AIS data which are then grouped into the “Vessel Category” field.
- Service Description: Functions and operations typical to each vessel category.
- Vessel Specifications: typical vessel dimensions including length, beam, draft and Dead Weight Tonnage (DWT)
- Image: Photograph of a typical vessel from each category.

Table 3-2 Typical Vessel Types Operating on the Columbia River

Vessel Category	AIS Vessel Types	Service Description	Typical Vessel Specifications	Image
Cargo/ Carrier	Bulk carriers, container ships, general cargo ships, automobile carriers, timber carriers	Cargo/carrier vessels include a wide range of vessels commonly seen on the Columbia River carrying forest products; steel, ore, grain, potash, and other dry bulk cargoes; general cargo; containerships; and automobiles.	Bulk Carriers (may include bulk, timber, general cargo): DWT: 50,000 - 80,000, Length: 650 - 965 ft Beam: 100- 106 ft Draft: 33 - 39.5 ft Car Carriers: DWT: 18,638 Length 650 ft Beam: 105 ft Draft: 27 ft	 Example of a Bulk Carrier Example of Car Carrier[1]

[1] Marine Traffic. *Photos of PASSERO (MMSI: 236111887)*. Available at: http://www.marinetraffic.com/en/photos/of/ships/shipid:204314/shipname:PASSERO/#forward

Vessel Category	AIS Vessel Types	Service Description	Typical Vessel Specifications	Image
			Container ships: DWT: 57,088 Length: 260 ft Beam: 33 ft Draft: 12.5	 Example of Containership[2]
Tanker	LPG tankers, oil tankers, chemical tankers	Carriage of bulk liquid or gas petroleum, hydrocarbon or chemical products	DWT: 65,000 – 80,000 Length: 965 ft Beam: 106 ft Draft: 41 ft	 Example of an oil tanker

[2] Marine Traffic. *Photos of HORIZON SPIRIT (MMSI: 366629000)*. Available at: http://www.marinetraffic.com/en/photos/of/ships/shipid:426112/shipname:HORIZON%20SPIRIT/mmsi:366629000

Vessel Category	AIS Vessel Types	Service Description	Typical Vessel Specifications	Image
Tug	General tugs, towing vessels, , towing long and wide	All tugs are included in this category, regardless of their service or configuration of tow (e.g., towing, pushing, ATB). This category also includes barges attached to tugs.	Tugs: Length: 50 ft – 150 ft Beam: 26 ft – 35 ft Draft: 9 ft – 16 ft	 Example of a general tug[3]
Fishing	Trawlers, all commercial and recreational fishing vessels	This category includes all commercial and fishing vessels.	Length: 100 – 180 ft Beam: 25 – 45 ft Draft:: 9 – 15 ft	 Example of a fishing vessel[4]

[3] Marine Traffic. *Photos of STACY T (MMSI: 367516730).* Available at: http://www.marinetraffic.com/en/photos/of/ships/shipid:448629/#forward

[4] Vessel Finder. *JOYCE MARIE – Fishing Vessel.* Available at : https://www.vesselfinder.com/vessels/ship-photo/0-367406690-99eacfaa3613eade55f4610e76c36c78/1

Vessel Category	AIS Vessel Types	Service Description	Typical Vessel Specifications	Image
Service	Military, law enforcement, search and rescue vessels, pilot vessels, pollution control vessels	U.S. Coast Guard vessels are captured in AIS as either Military, Law Enforcement, or SAR vessels.	Coast Guard vessels range in length from 22 ft to over 300 ft.	Example of U.S. Coast Guard Search and Rescue vessel
		Pilot vessels are vessels whose specific function is the transport of pilots to/from vessels subject to pilotage.	Length: 72 ft Beam: 20 ft	Pilot Vessel COLUMBIA[5]
		Pollution control vessels inlcude vessels specifically designated for pollution response.	Length: 20 ft - 40 ft Beam: 6 ft – 20 ft	

[5] Marine Traffic. *COLUMBIA.* Available at: http://www.marinetraffic.com/en/ais/details/ships/shipid:441374/mmsi:367331730/vessel:COLUMBIA

Vessel Category	AIS Vessel Types	Service Description	Typical Vessel Specifications	Image
Passenger	Ro-Ro/Passenger ships (i.e., car ferries), inland passenger ships, passenger ferries	The Oscar B (Waikiakum County ferry) is the only car ferry on the Lower Columbia River. Passenger vessels include cruise ships, passenger ferries, small passenger vessels (SPV) (as defined in 46 U.S.C. §2101) used for such purposes as day trips and dinner cruises..	Ro-Ro Passenger Vessel: Length: 109.2 ft Breadth: 47.5 ft Draft: 6 ft Inland Passenger Ship: GT: < 100 Length: 80-150 ft Beam: 30-40 ft Draft: 6-12 ft	 Example of a Ferry (Ro-Ro Passenger Vessel)[6] Example of an SPV, American Empress[7]

[6] Churchill, D. *Astoria Day Trips, Bridges and Ferries.* Available at: https://astoriadaytrips.wordpress.com/bridge-and-ferry/

[7] FleetMon. *Photo of AMERICAN EMPRESS.* Available at: https://www.fleetmon.com/vessels/american-empress_9263538_15186/photos/1221103/

Vessel Category	AIS Vessel Types	Service Description	Typical Vessel Specifications	Image
Pleasure	Pleasure crafts, yachts, sailing vessels	Wide range	Length: 20 ft – 150 ft Beam: 8 ft – 40 ft Draft: 3 ft – 15 ft	 Example of a pleasure craft[8]
Other	Dredgers, Cable Layers, Offshore Supply Vessels, Replenishment Vessels, Heavy Lift Vessels	Wide range.	Length: 150 - 800 ft Beam: 30 - 180 ft Draft: 13 – 30 ft	 Dredge vessel YAQUINA[9]

[8] Marine Traffic. *Photos of GEORGE EMERGY (MMSI: 367465340)*. Available at: http://www.marinetraffic.com/en/photos/of/ships/shipid:446392/#forward

[9] Marine Traffic. *YAQUINA*. Available at: http://www.marinetraffic.com/en/ais/details/ships/shipid:430981/mmsi:366971000/vessel:YAQUINA

Vessel Category	AIS Vessel Types	Service Description	Typical Vessel Specifications	Image
Undefined	Vessels where vessel type is missing from AIS data	Sometimes vessel operators fail to enter the proper Vessel Type in AIS. This results in the receipt of an AIS signal, but the signal does not include sufficient data to provide identifying characteristics about the vessel.	N/A	N/A

3.4 Vessel Traffic Cross Sections

Cross sections were placed at various locations to perform an analysis of the type of traffic transiting the Columbia River. At each cross section, the number of vessels that passed through the defined section was taken to be a transit.

Cross sections are areas where “slices” of 2014 AIS vessel traffic data were extracted to retrieve information on vessel traffic density. More specifically, cross sections were used to identify where vessels transit, classify vessel traffic trends and patterns, and understand the composition of vessel types over the study area. Findings from cross sections are then used to understand how traffic trends, patterns and composition can affect quantitative model results generated in MARCS, DNV GL’s proprietary navigation risk model (see Section 4).

Figure 3-5 presents the locations of the defined cross sections.

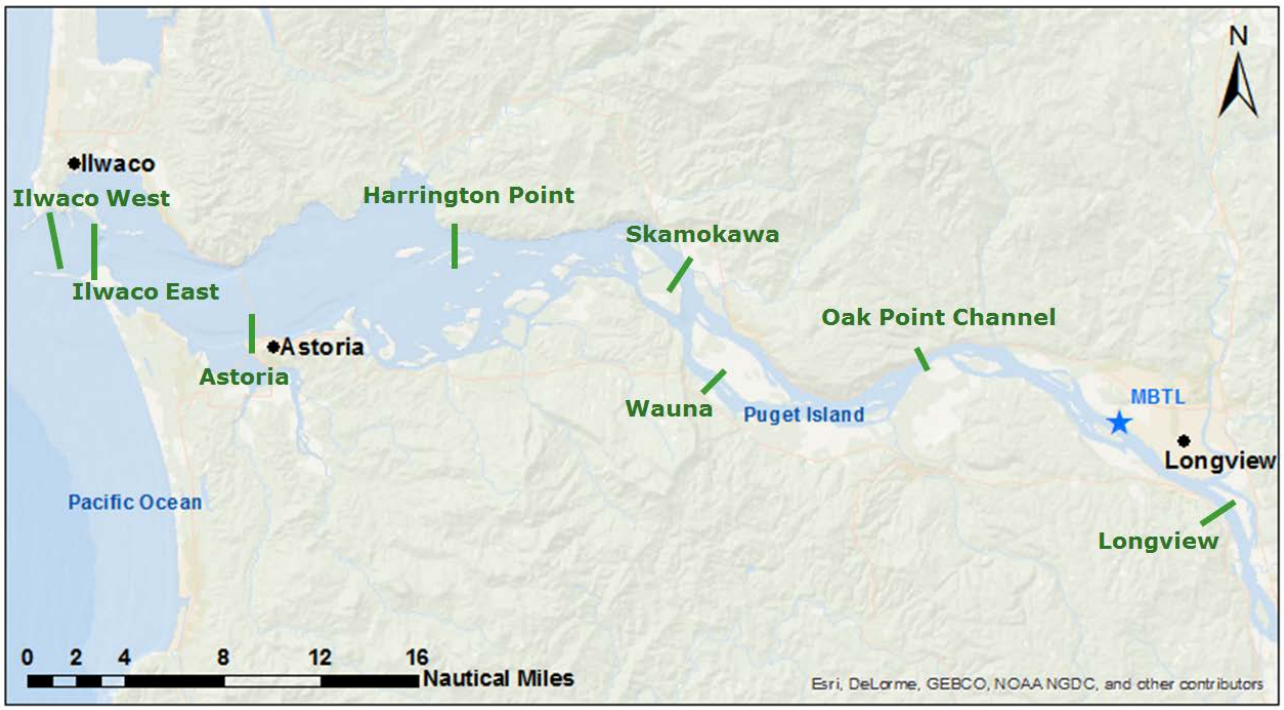


Figure 3-5 Cross Sections for Traffic Analysis

Figure 3-6 presents the distribution of vessel types that transit through each cross section.

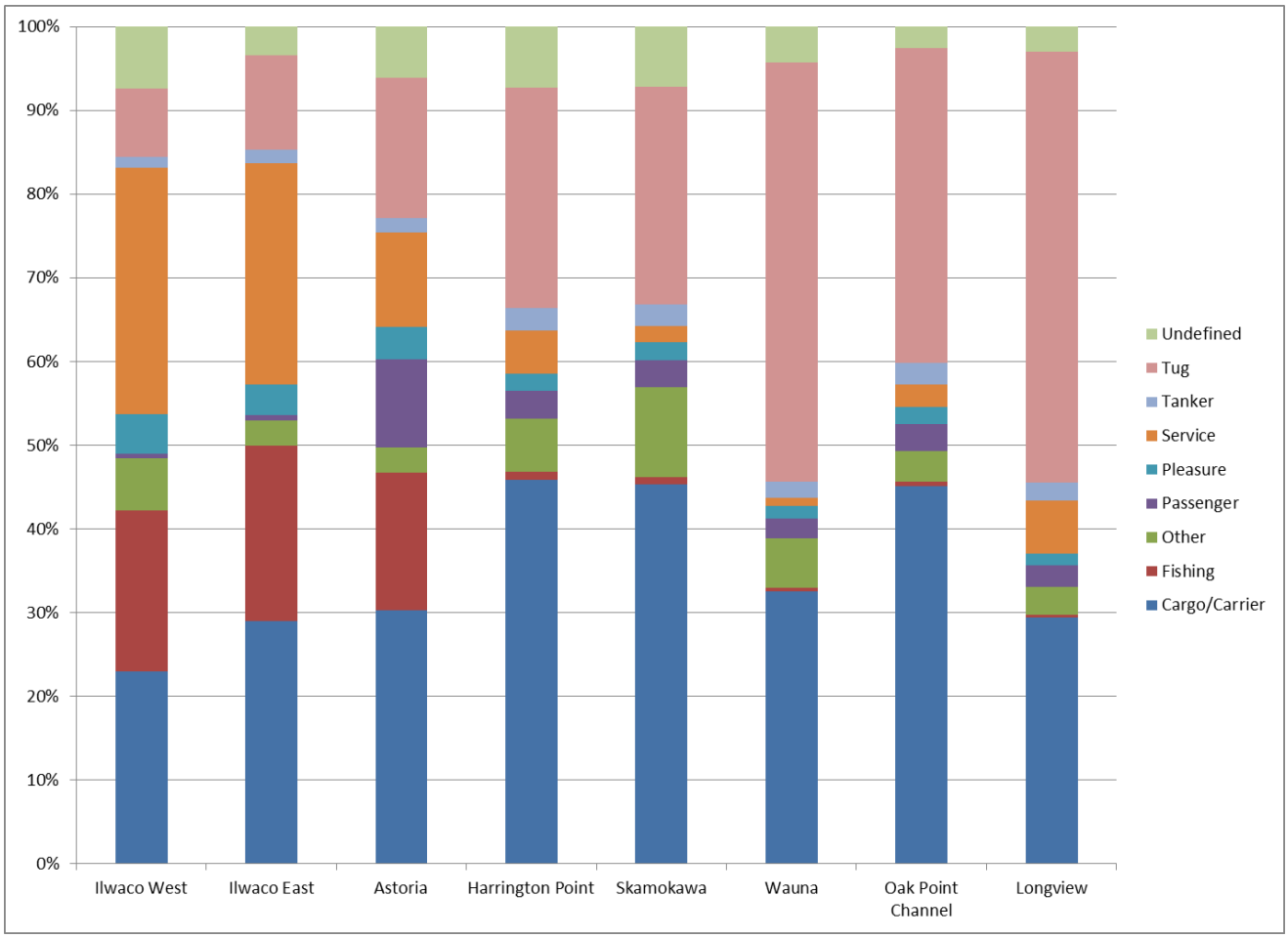


Figure 3-6 Vessel Type Distribution at Cross Sections (2014 AIS Data)

Figure 3-6 presents the number of transits through the defined cross sections, combined with the number of transits contributed by each vessel type. It can be seen that more vessels passed through the cross sections at the mouth of the Columbia River.

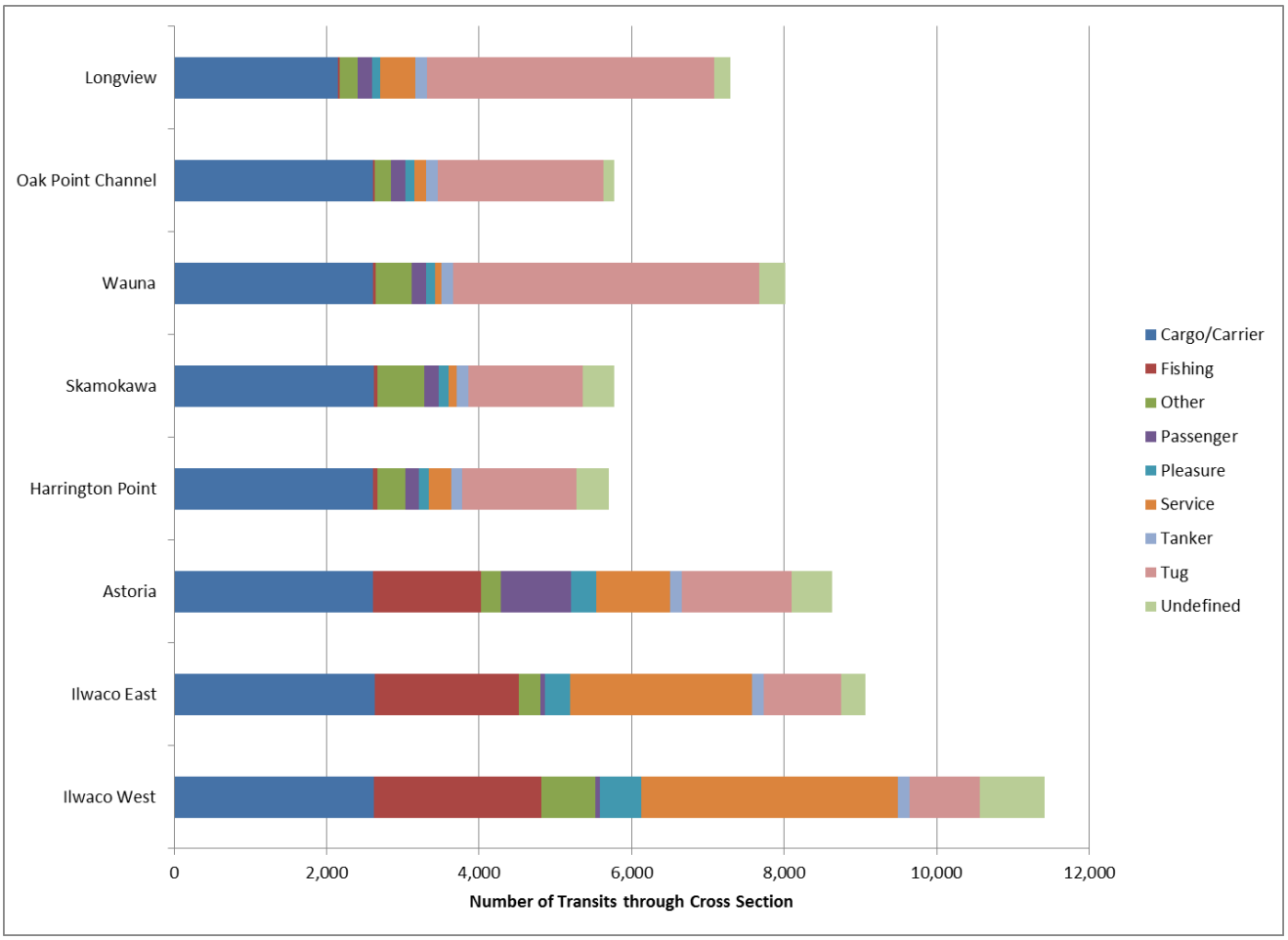


Figure 3-7 Number of Transits per Cross Section by Vessel Type (2014 AIS Data)

3.5 Vessel Traffic Density by Vessel Type

AIS data was used to map the traffic density in the study area. The AIS dataset was translated into the number of AIS points per grid cell (0.005 x 0.005 decimal degrees), which was interpreted as vessel density.

Figure 3-7 to Figure 3-16 present the density of each ship type as a 'heat map' with yellow representing the least dense areas and dark blue represent the densest areas.

It is noteworthy that areas of slower speeds, such as direction changes in the channel, are shown as higher density areas on the heat maps. This is assumed to occur because when vessels travel at a slower speed, they are transmitting more AIS data while in that area than if they were travelling at higher speeds. The figure shows that areas of relatively greater density begin to occur around the Columbia River bar and persist in the navigable channel past Longview.

Figure 3-8 2014 AIS Density Profile for All Vessels Transits

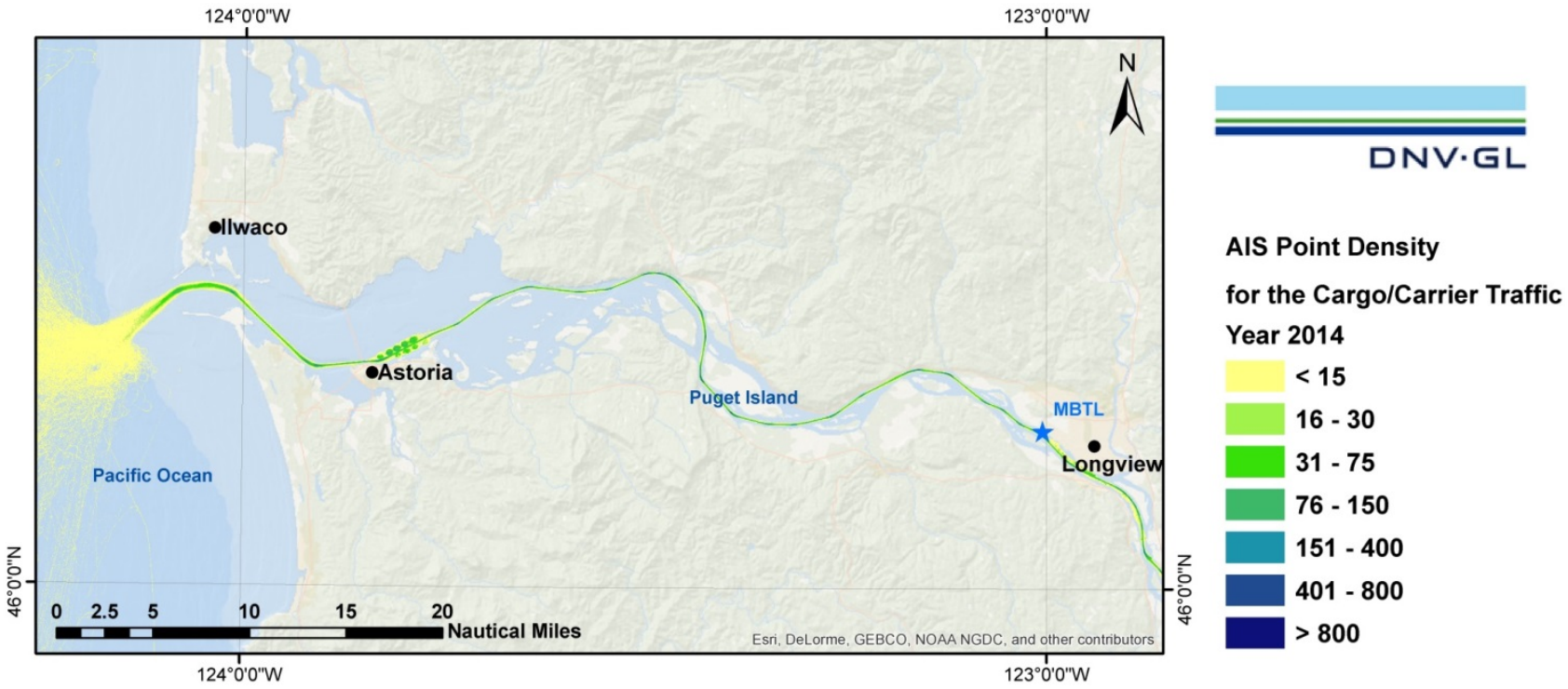


Figure 3-9 2014 AIS Density Profile for Cargo/Carrier Transits

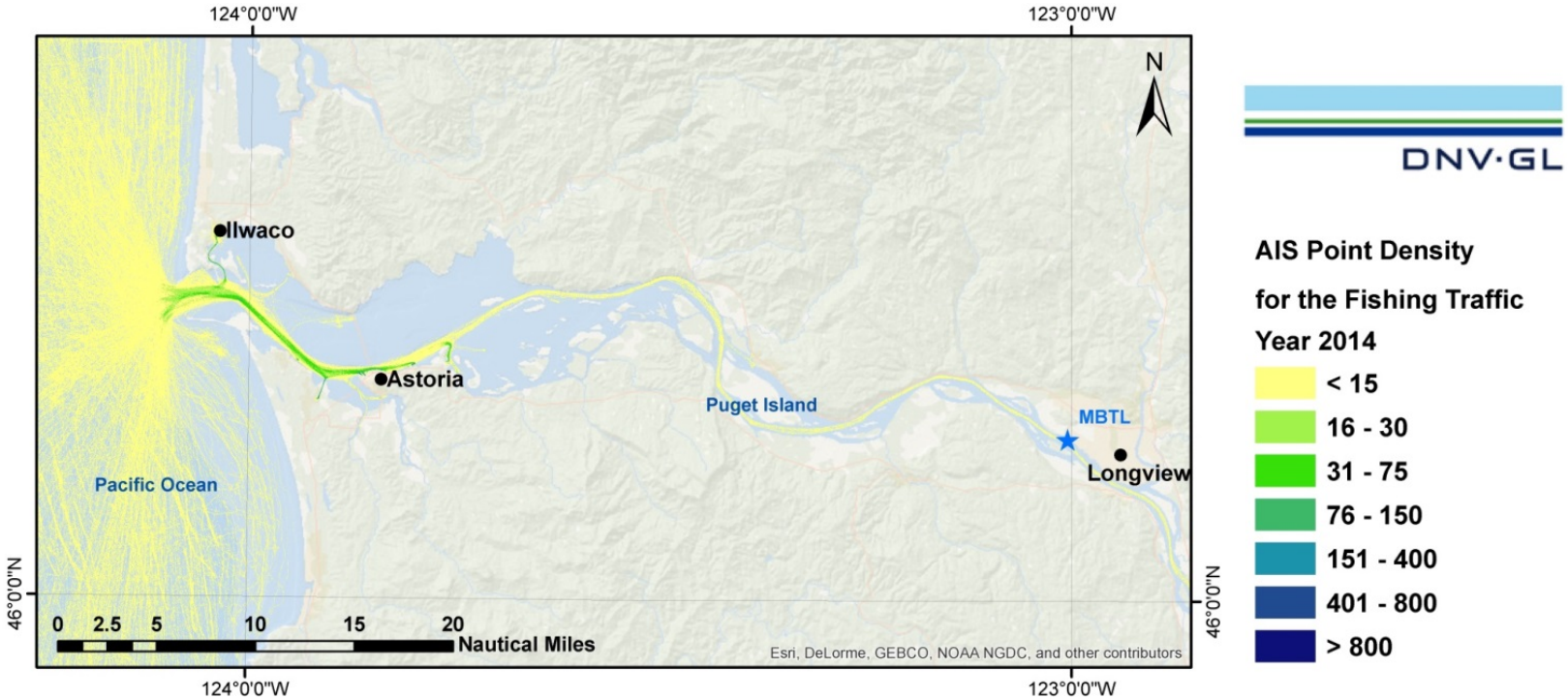


Figure 3-10 2014 AIS Density Profile for Fishing Transits

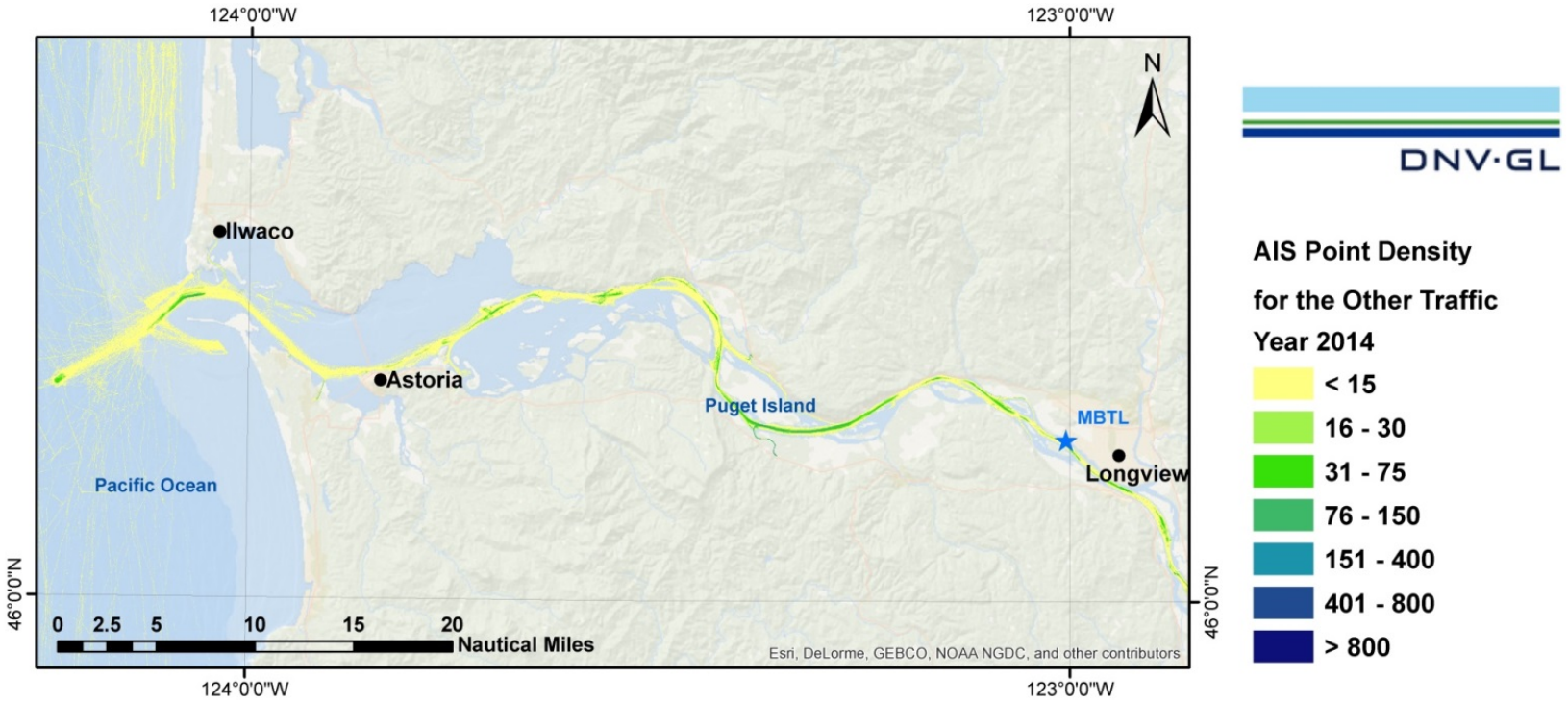


Figure 3-11 2014 AIS Density Profile for Other Transits

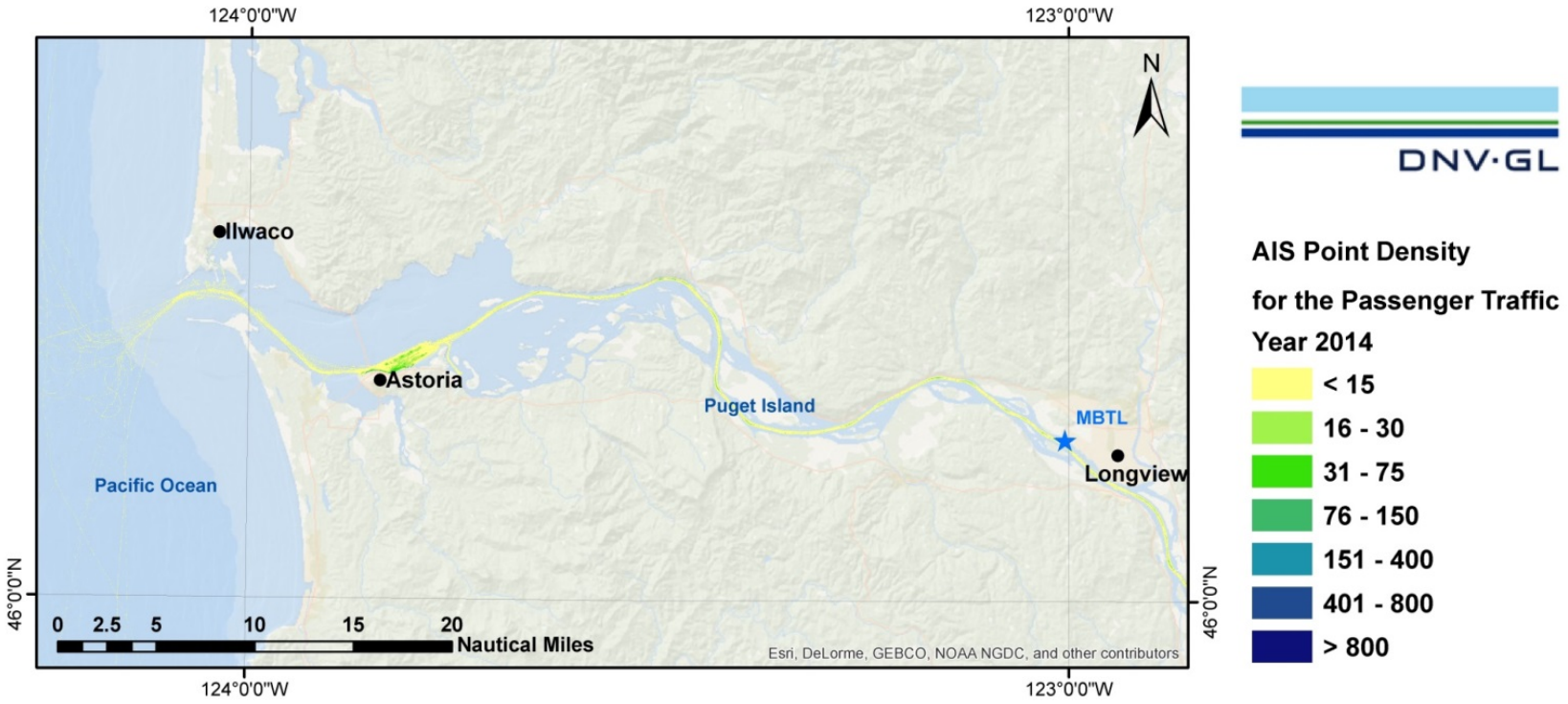


Figure 3-12 2014 AIS Density Profile for Passenger Transits

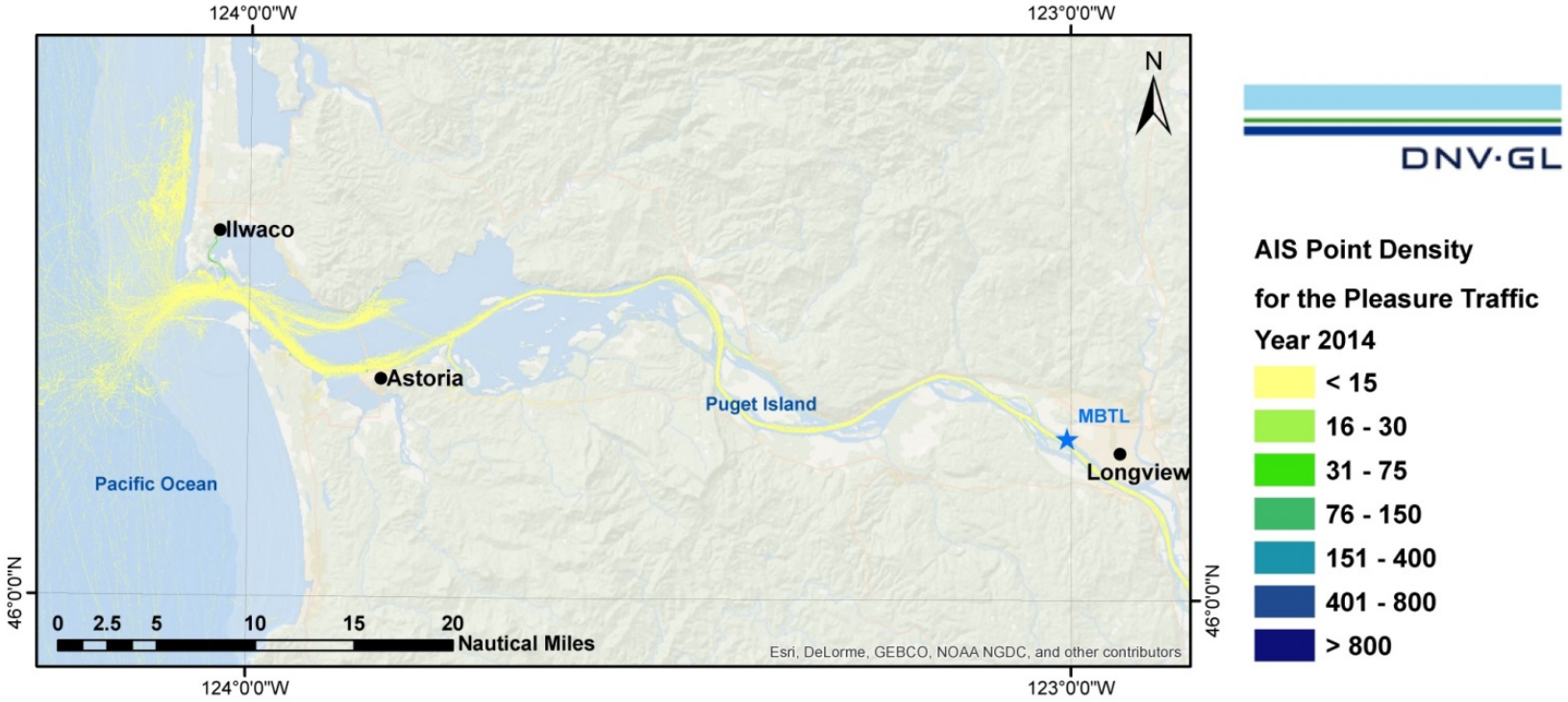


Figure 3-13 2014 AIS Density Profile for Pleasure Transits

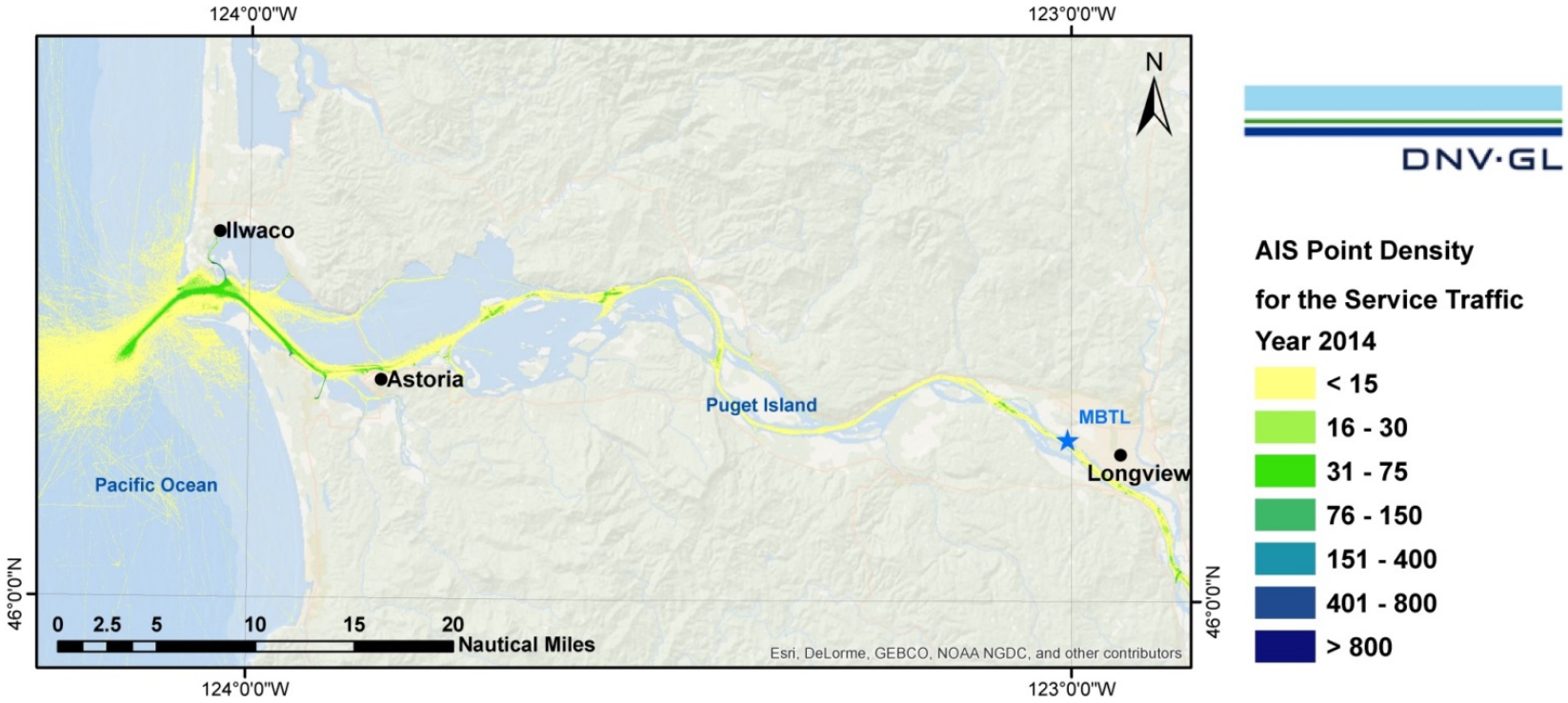


Figure 3-14 2014 AIS Density Profile for Service Transits

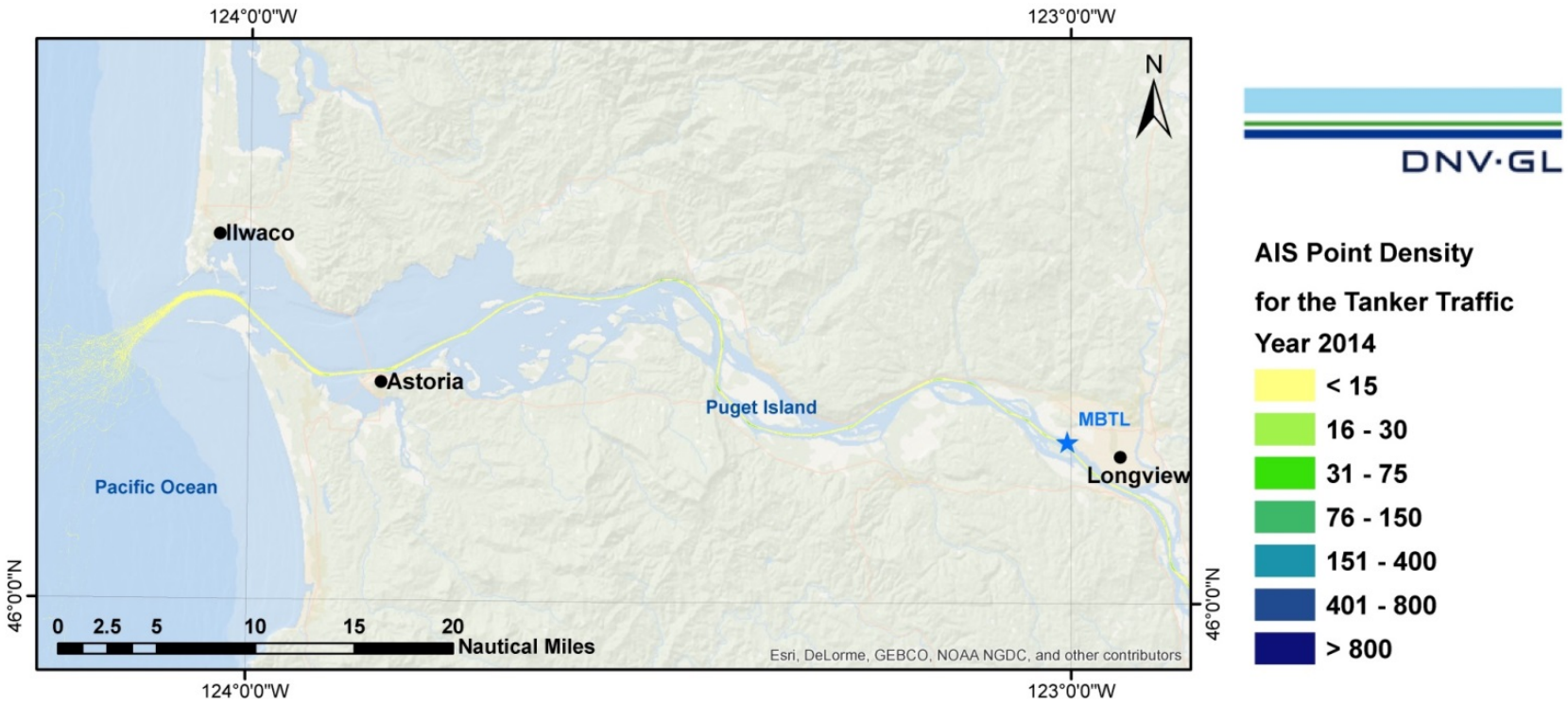


Figure 3-15 2014 AIS Density Profile for Tanker Transits

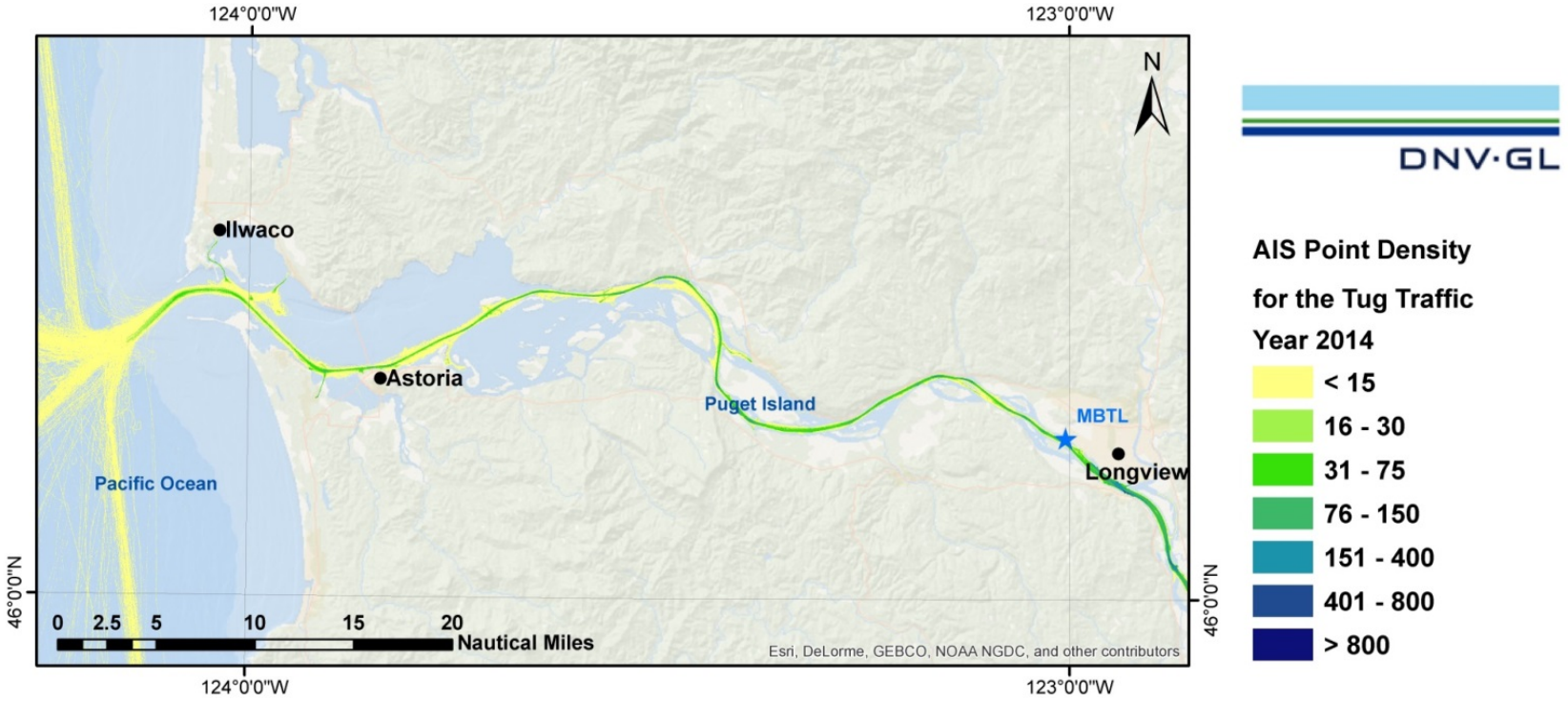


Figure 3-16 2014 AIS Density Profile for Tug Transits

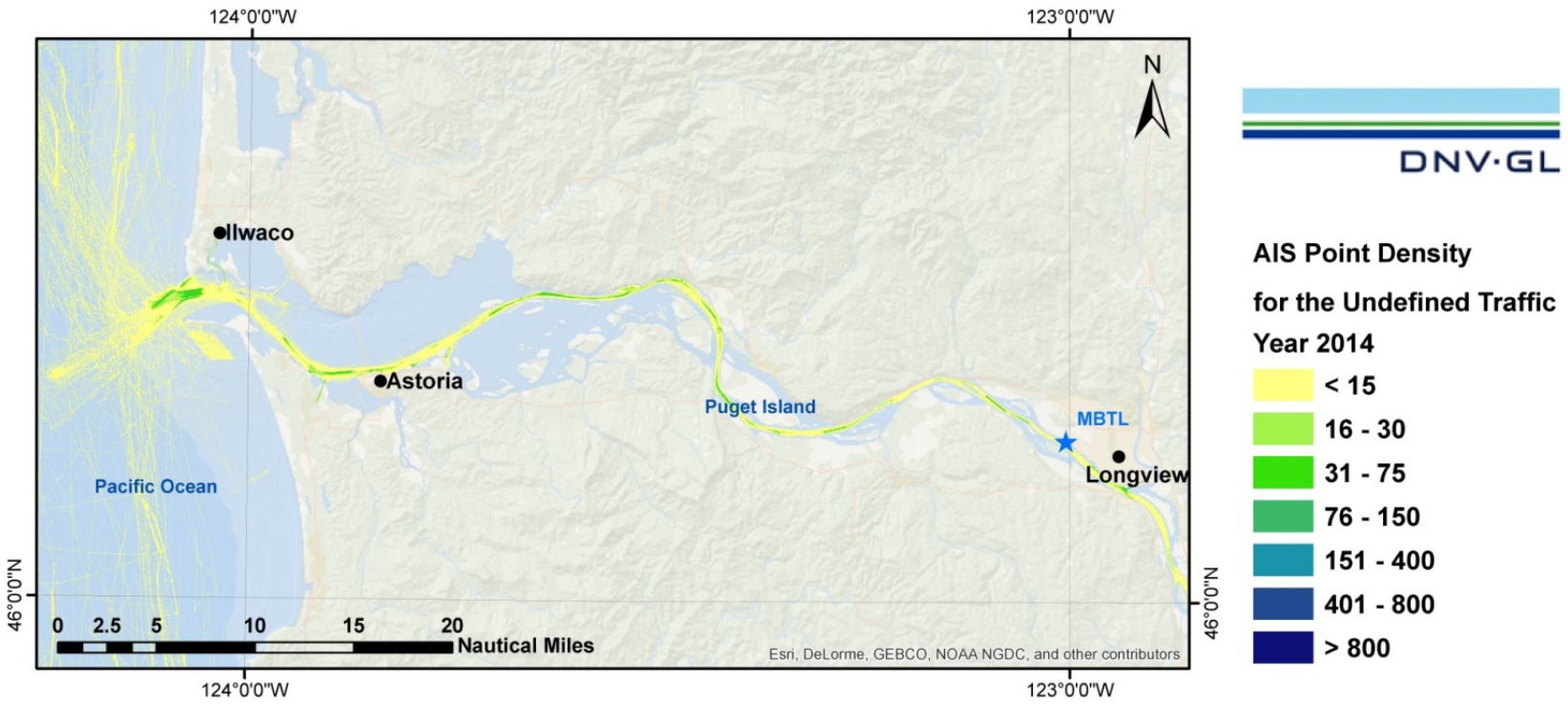


Figure 3-17 2014 AIS Density Profile for Undefined Transits

3.6 Vessel Traffic by Vessel Transit Speed

Figure 3-17 to Figure 3-26 present the average speeds determined from the time stamps in the AIS dataset. The figures show that the vessels along the project vessel route generally transit at a speed between 6 and 12 knots. The estimated average speeds for each vessel type (based on the AIS data) are presented in Table 3-3.

Table 3-3 Average Speed by Vessel Types

Vessel Category	Speed (knots)
Cargo/Carrier	12
Fishing	9
Other / Undefined	9
Passenger	10
Pleasure	9
Service	15
Tanker	12
Tug	8

Figure 3-18 presents the speed profile for all vessel transits.

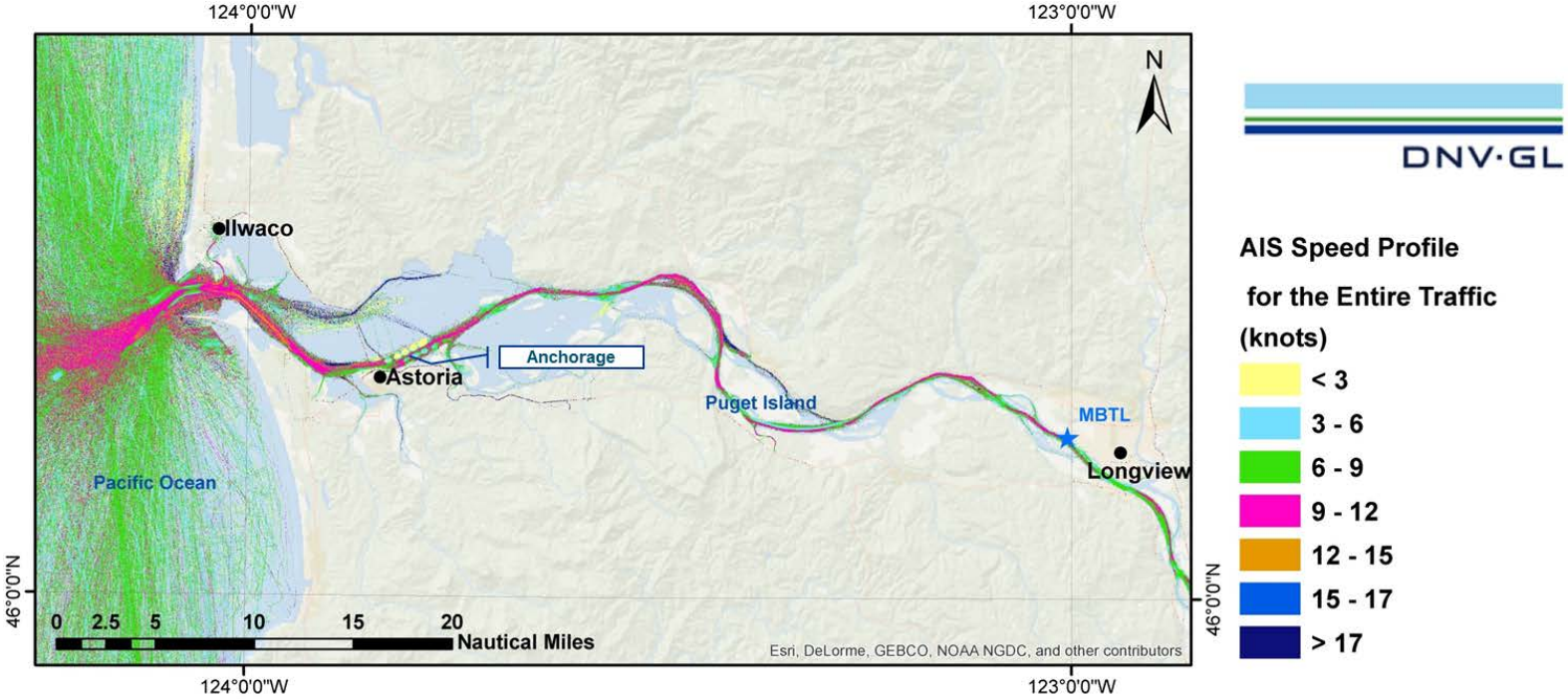


Figure 3-18 2014 AIS Speed Profile for All Vessels Transits

The speed profile of cargo/carrier vessels, Figure 3-19, shows a consistent speed distribution between 9 knots and 15 knots along the navigable channel. Slower speeds due to anchorage areas are present near Astoria.

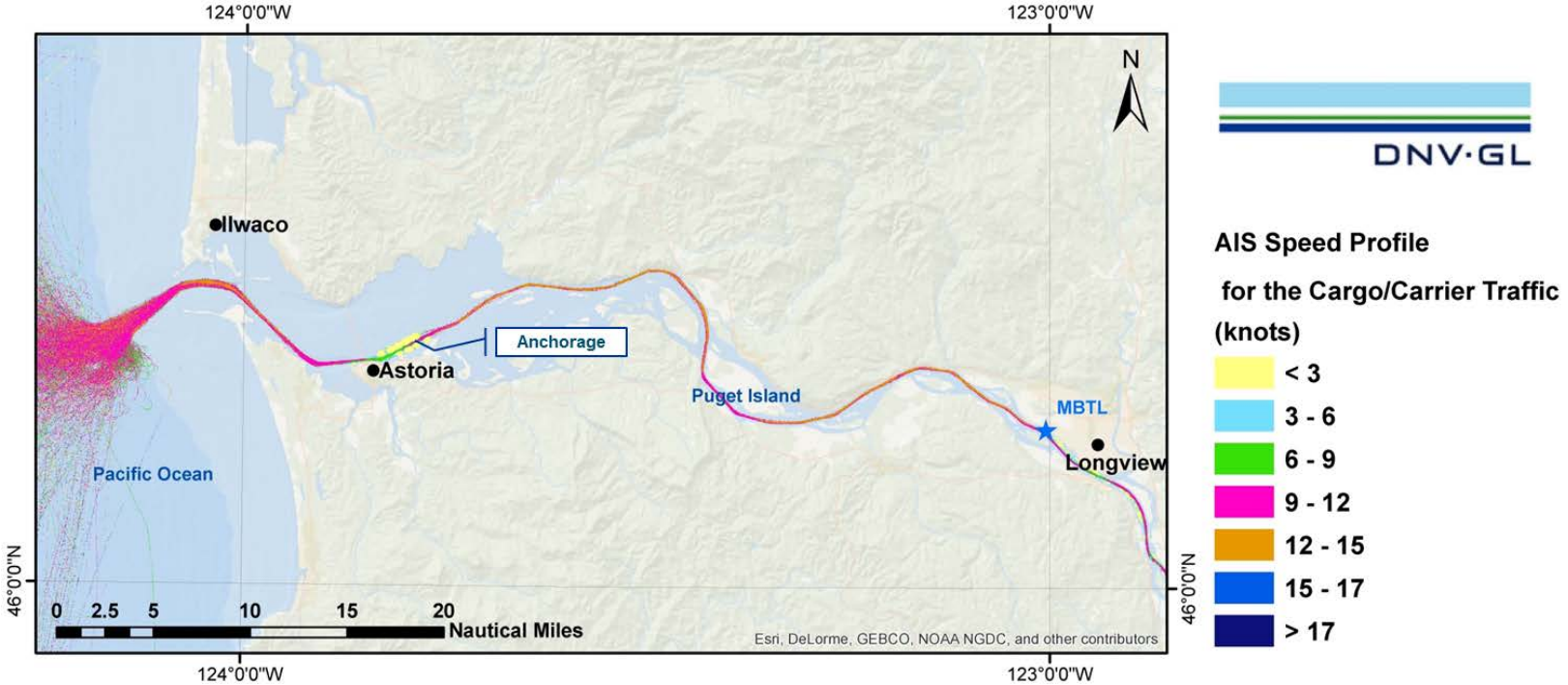


Figure 3-19 AIS Speed Profile for Cargo/Carrier Transits

The speed profile of fishing vessels, Figure 3-20, shows a speed distribution between 6 knots and 12 knots along the navigable channel.

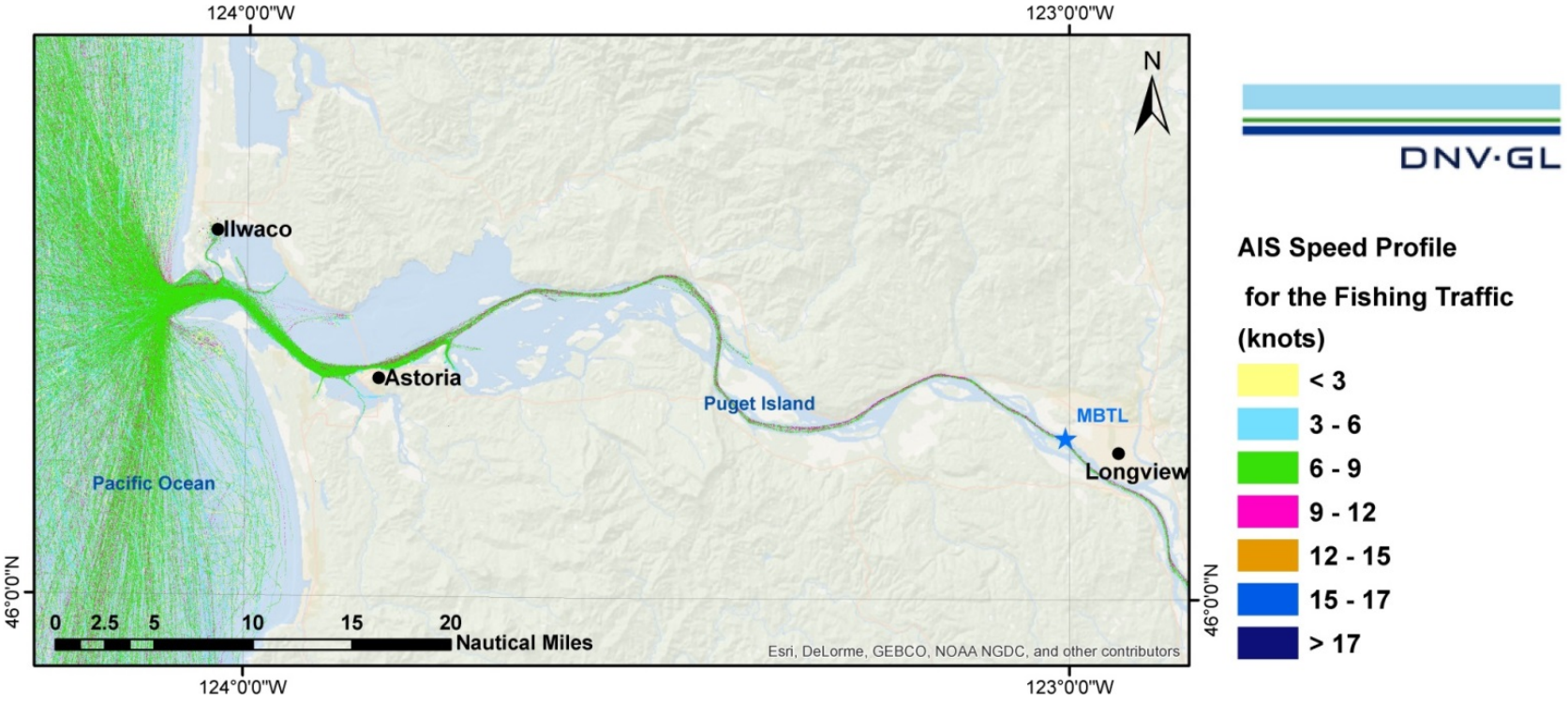


Figure 3-20 AIS Speed Profile for Fishing Transits

The speed profile of other vessels, Figure 3-21, shows many variations in speed along the waterway. The areas of highest speed are on the northeast side of Tenasillahe Island and Puget Island, where the AIS data shows other vessels reach speeds of over 17 knots.

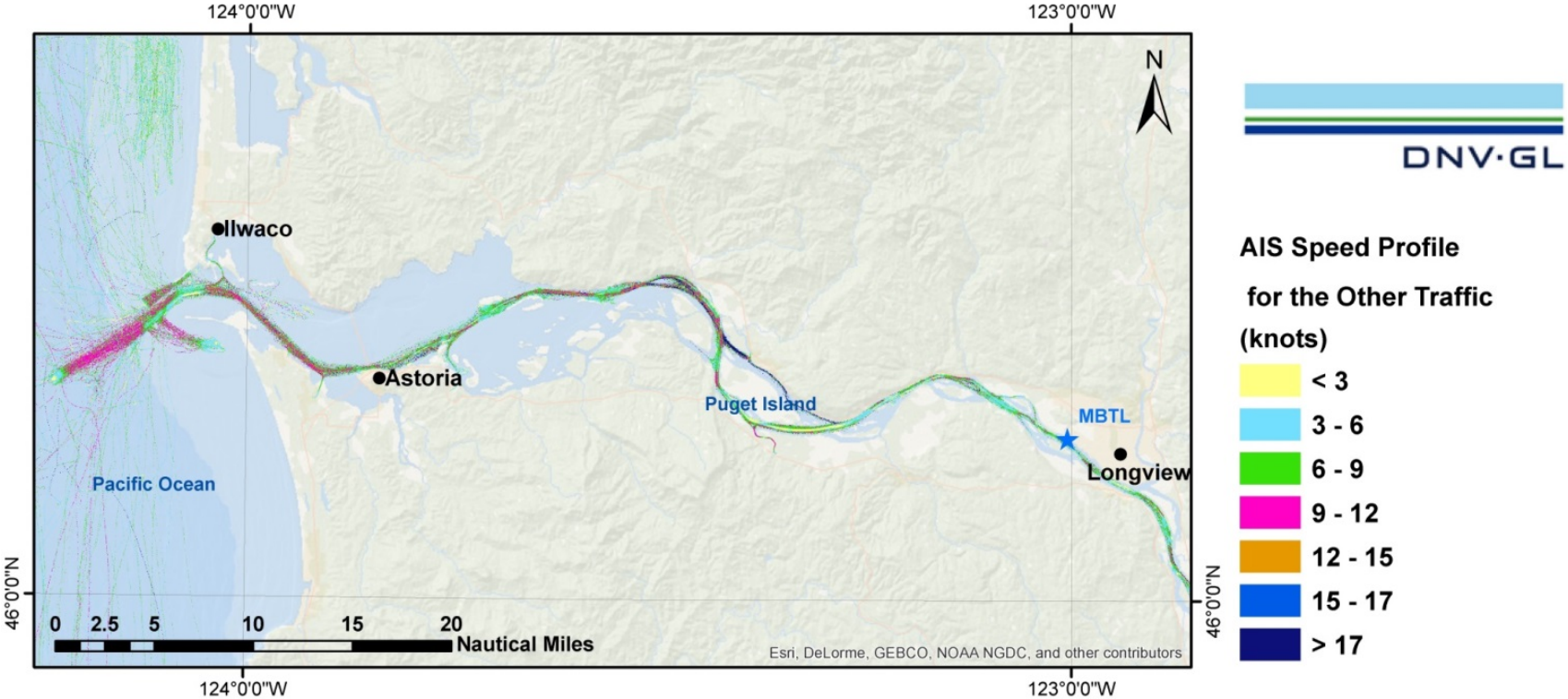


Figure 3-21 AIS Speed Profile for Other Transits

The speed profile of passenger vessels, Figure 3-22, shows a consistent speed distribution between 9 knots and 12 knots along the navigable channel. Areas of reduced speed, between 6 and 9 knots, are present near Astoria.

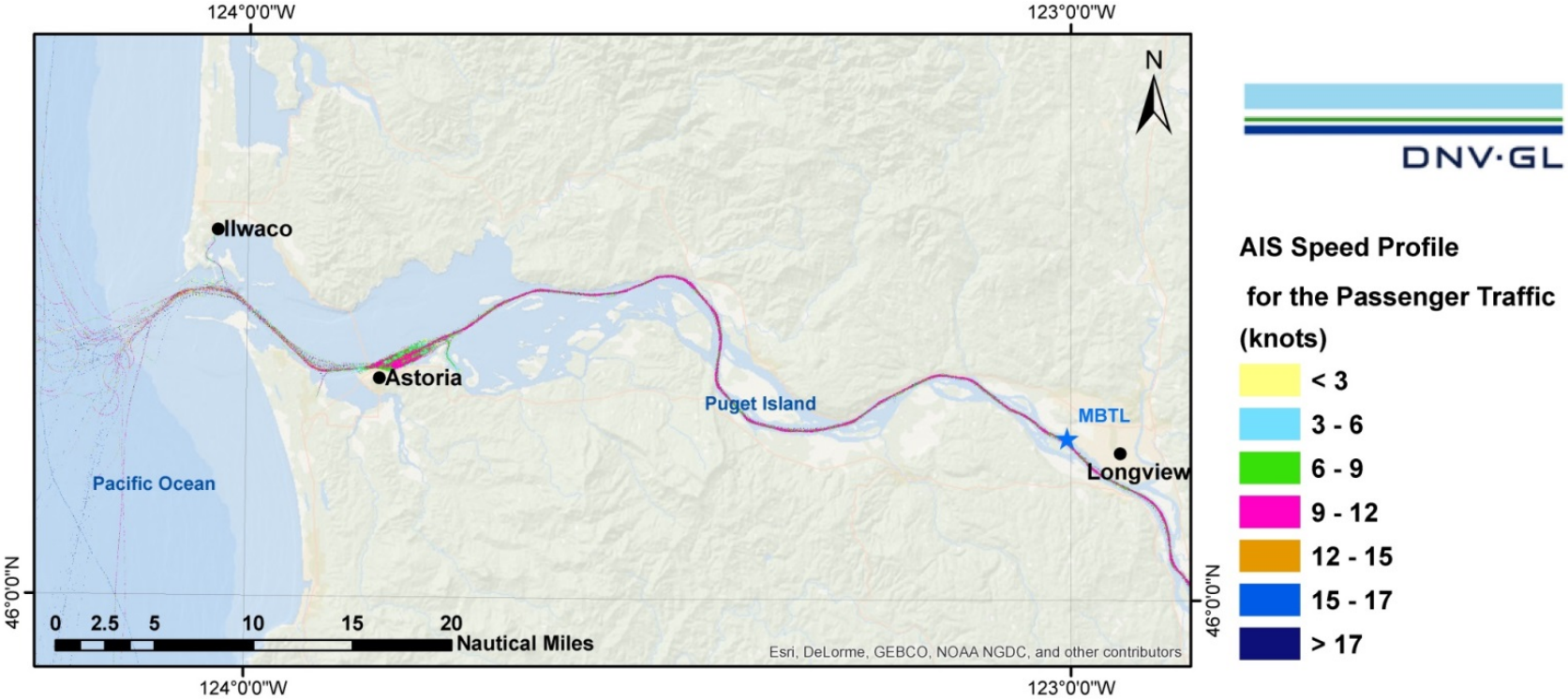


Figure 3-22 AIS Speed Profile for Passenger Transits

Figure 3-23 presents the speed profile for pleasure vessels. Pleasure vessels typically travel at approximately 9 knots, with slower speeds near Astoria.

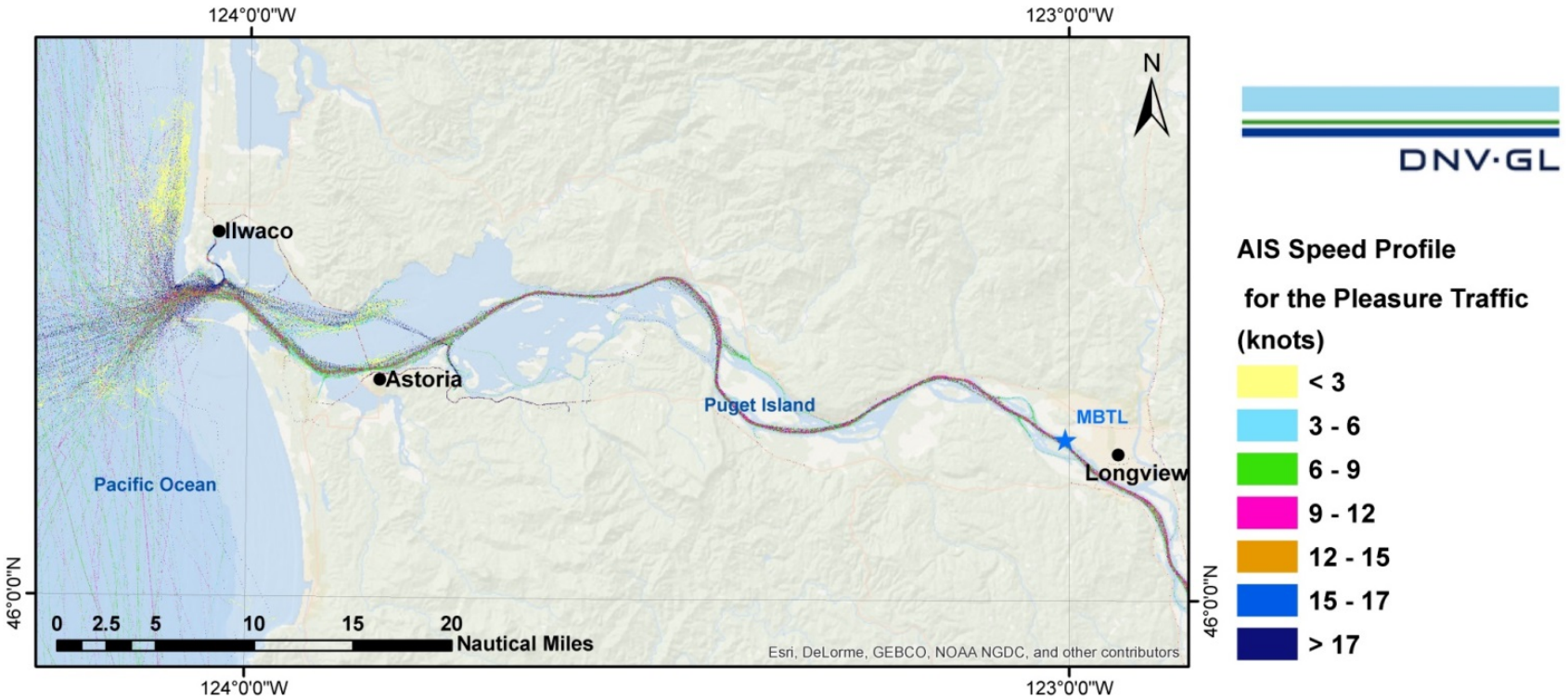


Figure 3-23 AIS Speed Profile for Pleasure Transits

Figure 3-24 presents the speed profile for service vessels. Service vessels travel at approximately 15 knots. Areas of speeds between 6 and 9 knots are present along the route.

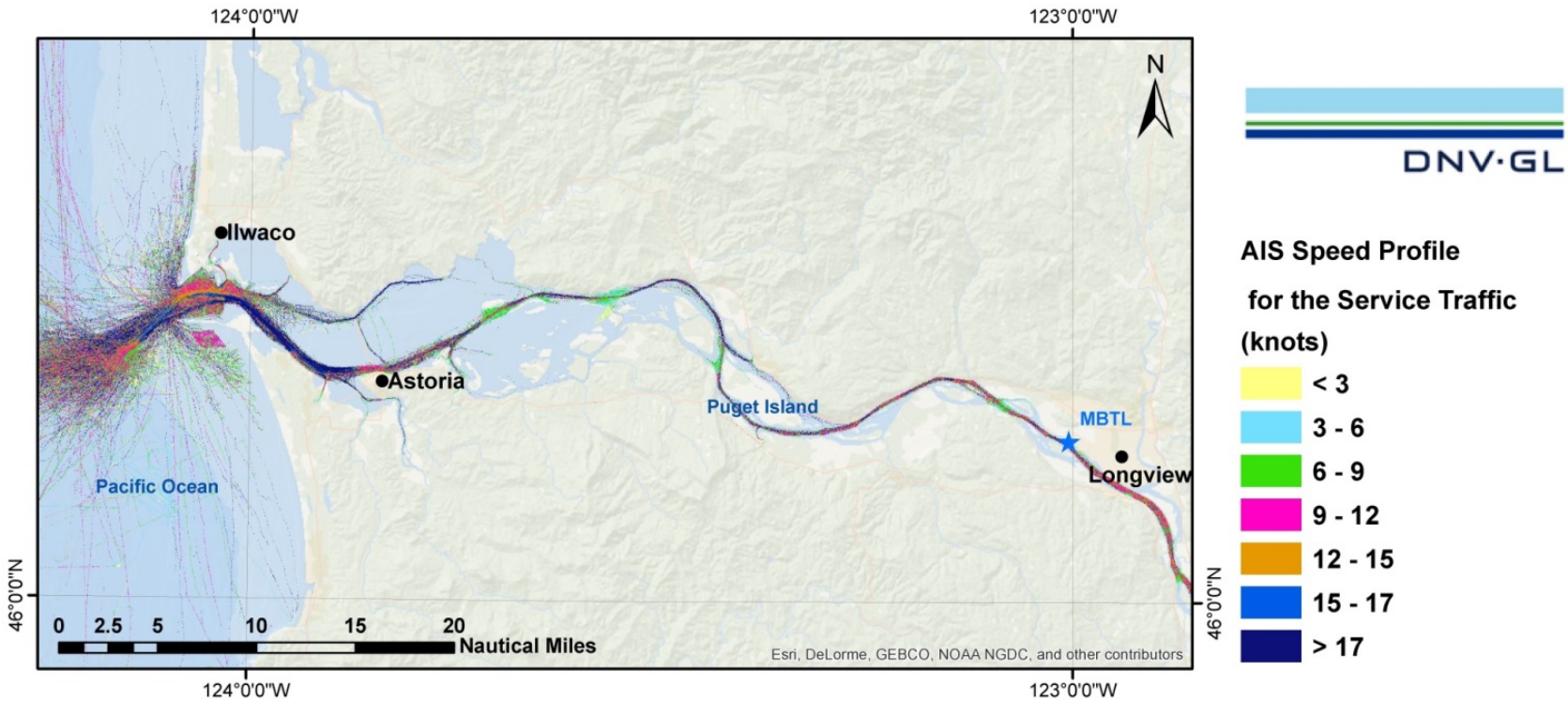


Figure 3-24 AIS Speed Profile for Service Transits

Figure 3-25 presents the speed profile for tankers. The profile shows that tankers travel at a generally uniform speed between 9 and 12 knots.

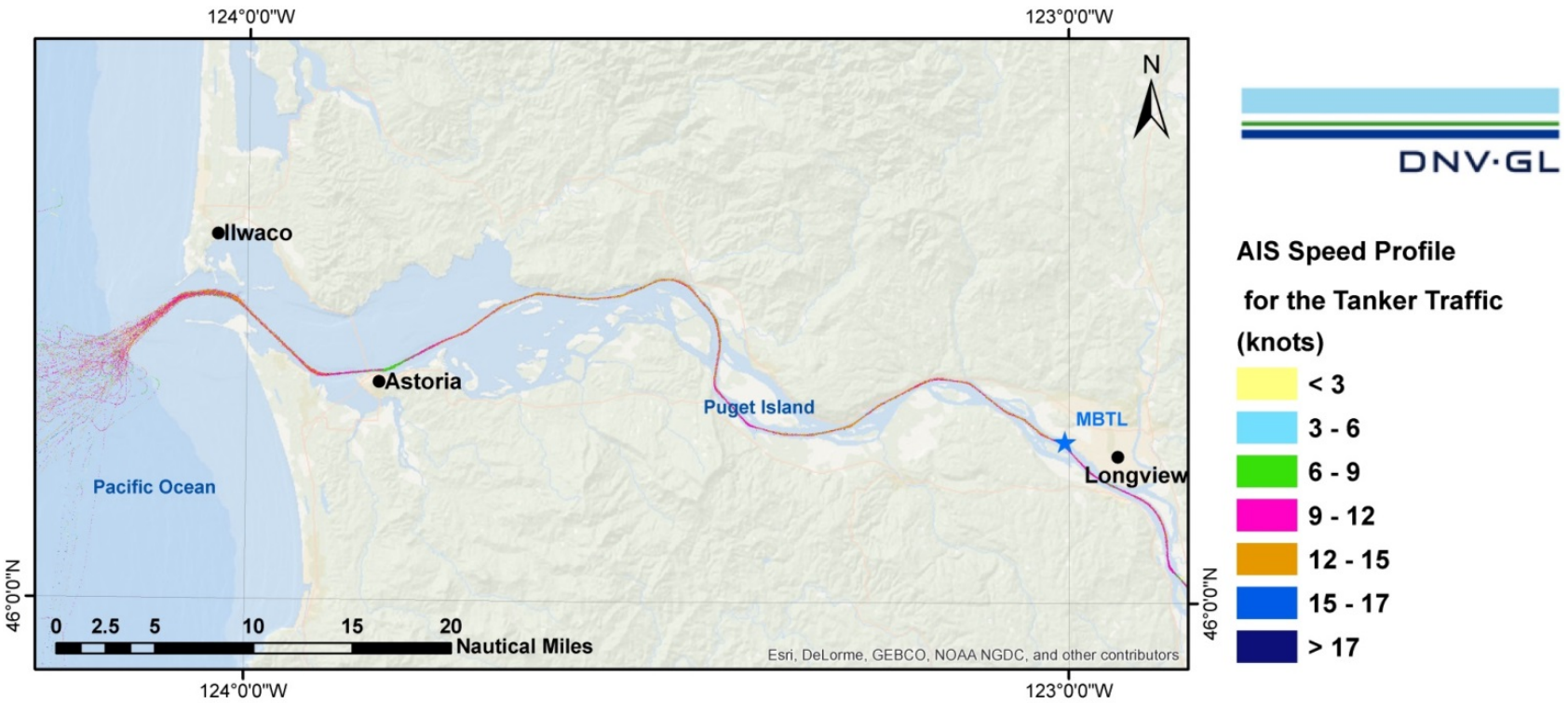


Figure 3-25 AIS Speed Profile for Tanker Transits

Figure 3-26 presents the speed profile for tug transits. Tugs typically travel between 6 and 9 knots, with some areas along the route reaching speeds between 9 and 12 knots.

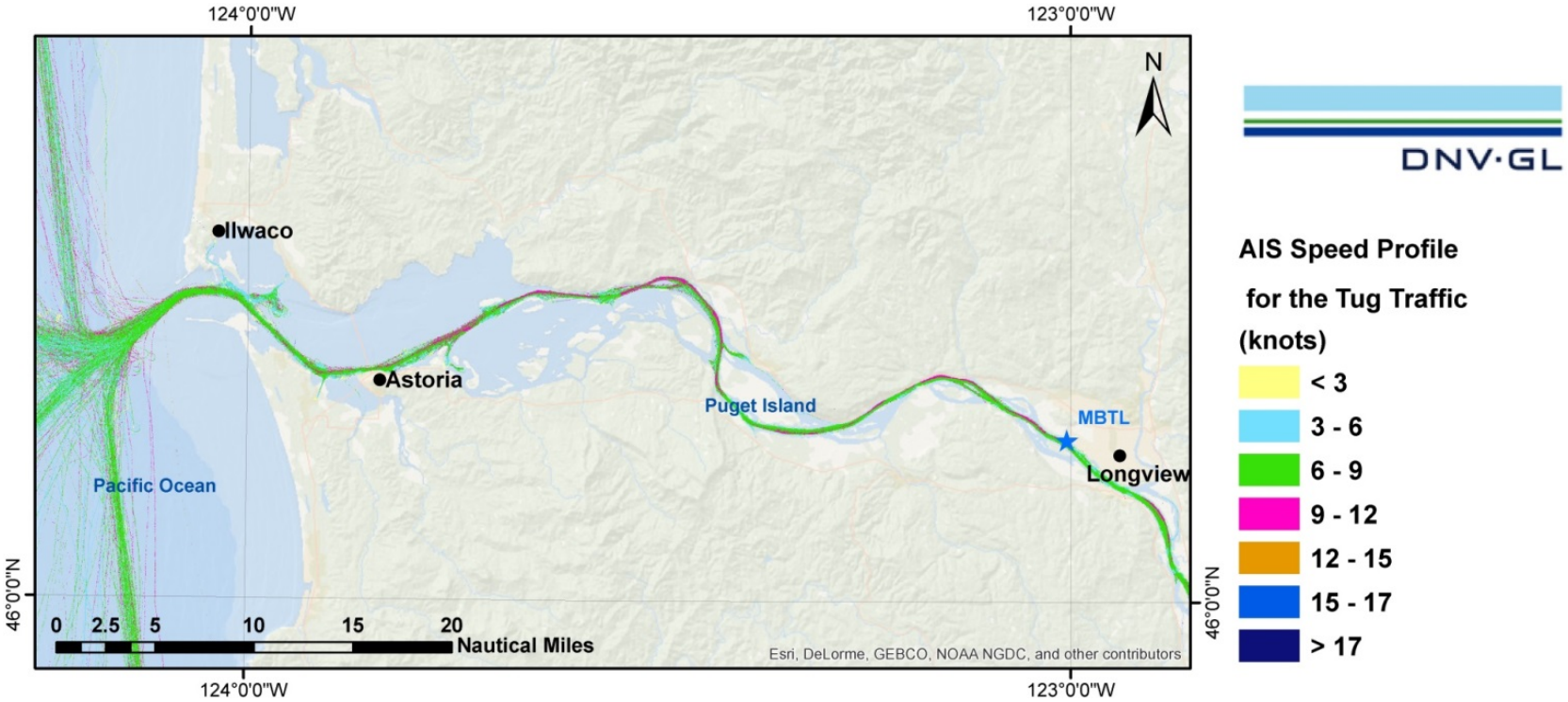


Figure 3-26 AIS Speed Profile for Tug Transits

Figure 3-27 presents the traffic profile for undefined vessels. Typically undefined vessels travel between 9 and 12 knots. However, due to the nature of the "undefined" vessel category, this is much variation in speed.

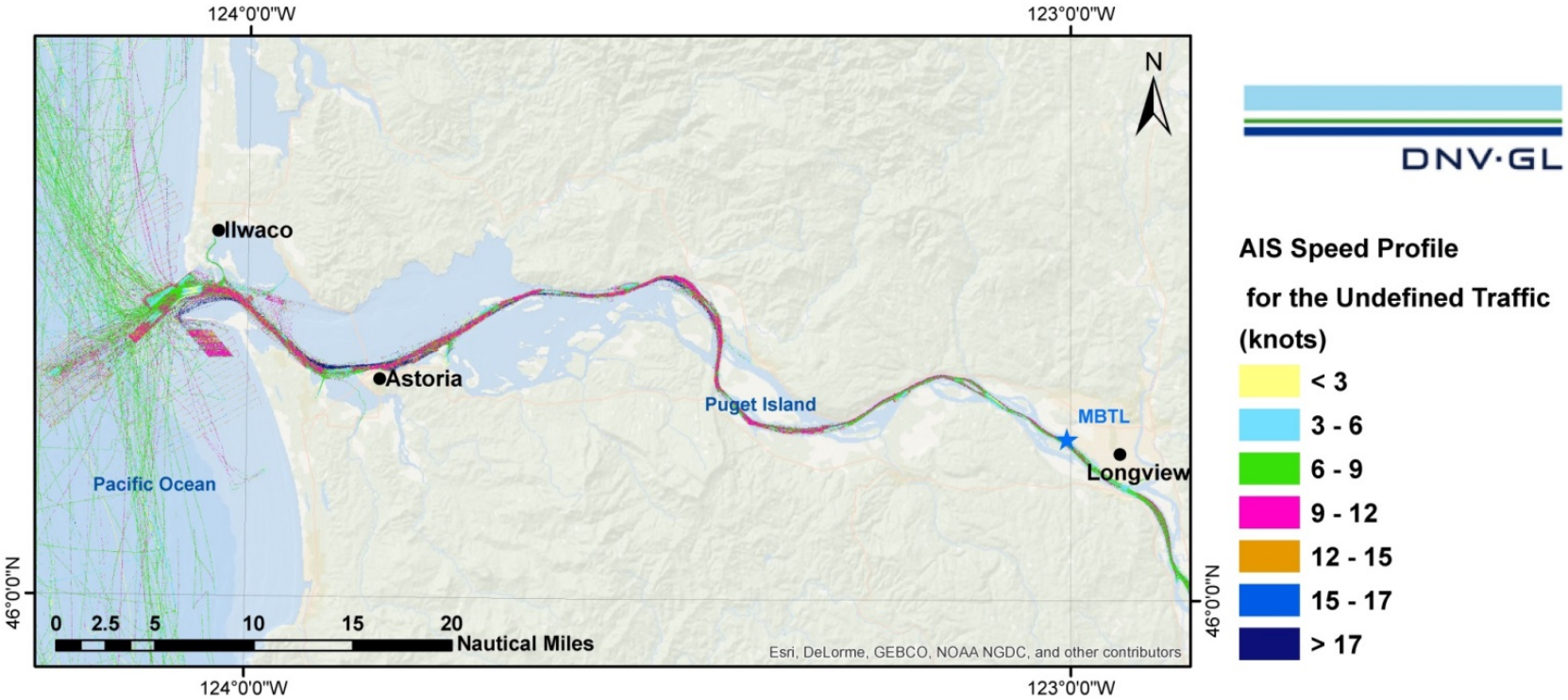


Figure 3-27 AIS Speed Profile for Undefined Transits

4 MARINE INCIDENT AND OIL SPILL DATA SURVEYS

This section presents the results of a survey describing typical damage outcome or severity of marine incidents as well as frequency and severity of reported oil spills in the study area. This survey also provides a coarse review of severity from marine incidents in U.S. waters. The purpose of these data surveys is to provide a basis for evaluating the incremental risk from the proposed project, as estimated in this study.

Figure 4-1 and Figure 4-2 describe the data processing and categorization that were applied for the two objectives listed in Section 2.1.

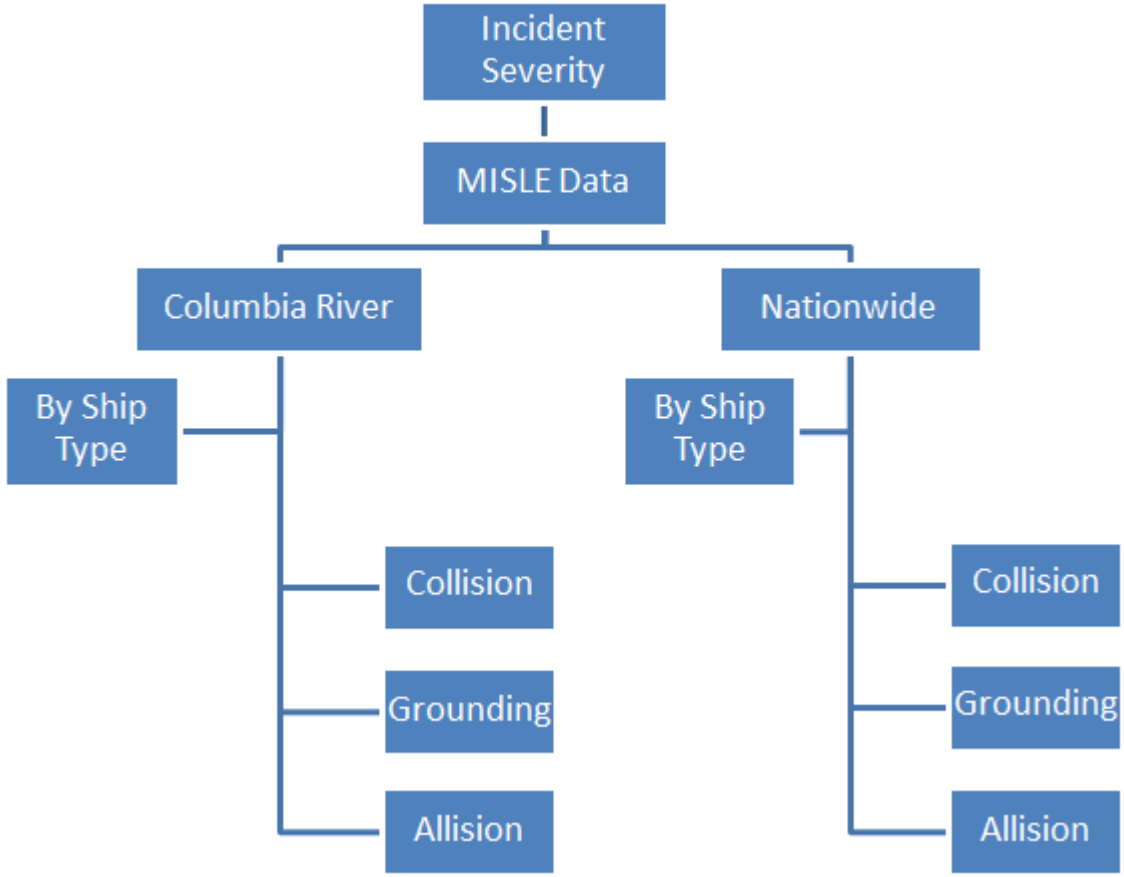


Figure 4-1 Incident Severity Data Survey Methodology

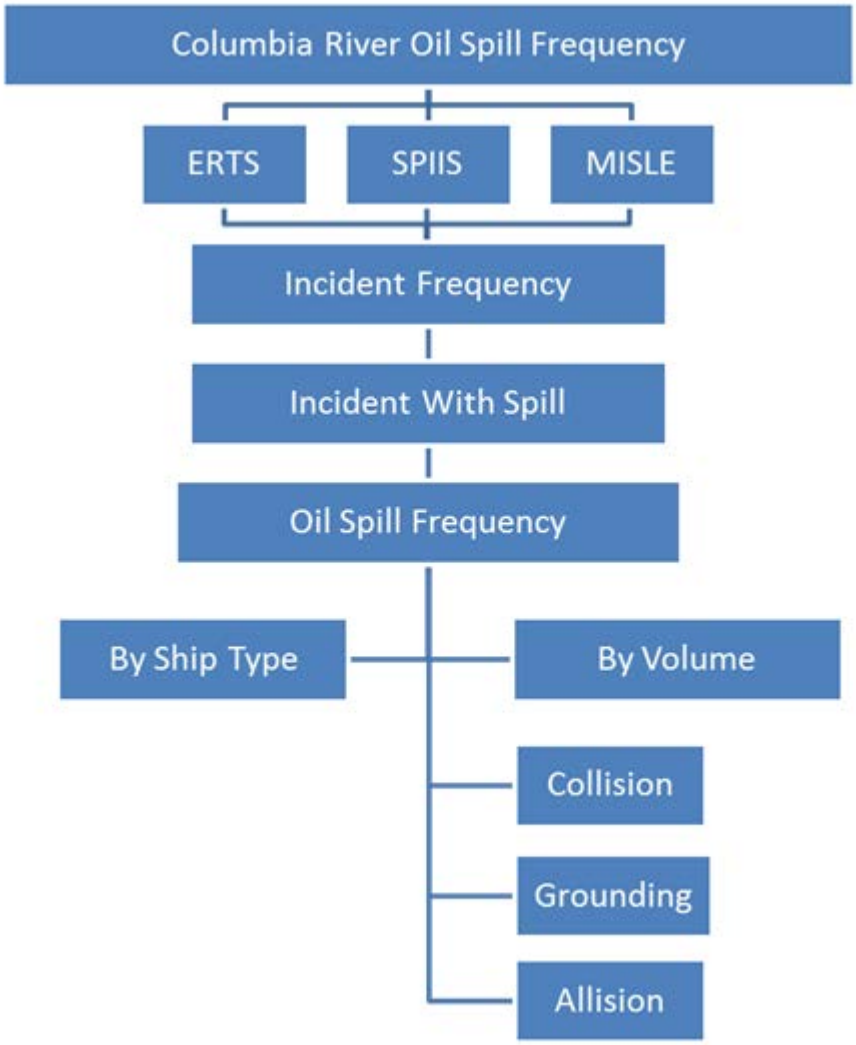


Figure 4-2 Oil Spill Frequency Data Survey Methodology

4.1 Review of Incident Severity in U.S. Waters

The information presented in this section is based on data obtained from the U.S. Coast Guard's Marine Information for Safety and Law Enforcement (MISLE) database and covers all available data from 2001 through 2014 (Ref. /4/). This period was chosen as it covers over 99% of all collision, grounding, and allision incidents reported in the dataset. The remaining 1% of data are sparsely distributed 1900 to 2000. The data are presented for the vessel types reported in the MISLE database, which are comparable to those identified in the AIS data, and are not predictive of bulk carrier casualties.

The "Accident Type" field includes 26 different entry categories. Of these, only incident types *collision*, *allision*, and a combination of *grounding / set adrift* were analyzed because the objective of this data survey

is to provide context around the consequences of the incidents evaluated in this navigational risk study which are limited to collisions, powered and drift groundings, and allisions.

The severity of a marine incident is captured in the "Damage Status" field of the MISLE data, which describes damage to the vessel(s) implicated in the incident and includes five different categories. For the purposes of this analysis, the categories *Actual Total Loss*, *Total Constructive Loss: Salvaged*, and *Total Constructive Loss: Unsalvaged* were combined into a single category called "Total Loss". The other two categories are *Damaged* and *Undamaged*.

Table 4-1 and Table 4-2 present the severity distribution for the three incident types discussed above.

Table 4-1 Incident Severity by Incident Type for U.S. Waters – Incident Count (USCG MISLE data 2001-2014)

Damage Status	Total Loss	Damaged	Undamaged	Total
Allision	149	4,525	5,479	10,153
Collision	114	2,092	1,727	3,933
Grounding / Adrift	364	3,929	12,162	16,455
TOTAL	**627**	**10,546**	**19,368**	**30541**

Table 4-2 Incident Severity by Incident Type for U.S. Waters - % of incidents (USCG MISLE data 2001-2014)

Damage Status	Total Loss	Damaged	Undamaged	Total
Allision	1%	45%	54%	100%
Collision	3%	53%	44%	100%
Grounding / Adrift	2%	24%	74%	100%
TOTAL	**2%**	**35%**	**63%**	**100%**

4.2 Review of Incident Severity in the Lower Columbia River

The same approach was applied to data covering incidents within the study area. Table 4-3 and Table 4-4 present the outcome distribution for marine incidents that took place between the Columbia River mouth and the Port of Portland.

The results of this data survey are very similar to those from nation-wide incidents in that approximately two-thirds of incidents result in no damage, one-third in some damage to the vessel(s) involved and slightly less than 3% result in a vessel total loss.

Table 4-3 Incident Severity by Incident Type for Study Area – Incident Count (USCG MISLE data 2001-2014)

Damage Status	Total Loss	Damaged	Undamaged	Total
Allision	3	24	29	56
Collision	1	9	9	19
Grounding /Adrift	1	16	59	76
TOTAL	**5**	**49**	**97**	**151**

Table 4-4 Incident Severity by Incident Type for Study Area - % of incidents (USCG MISLE data 2001-2014)

Damage Status	Total Loss	Damaged	Undamaged	Total*
Allision	5%	43%	52%	100%
Collision	5%	47%	47%	100%
Grounding /Adrift	1%	21%	78%	100%
TOTAL	**3%**	**32%**	**64%**	**100%**

*Note: Sum of percentages do not always add up to 100% due to rounding.

This data was further parsed to show incident severity by incident type and vessel type. All vessel types presented found in the AIS data and described in Section 3.3 are covered in the USCG MISLE database.

Table 4-5 presents the distribution of incident severity for all incident types by vessel type for the study area. Table 4-6 to Table 4-8 present the distribution of incident severity by incident type and vessel type for the study area. These tables show that collisions appear to result in the highest severity outcomes, with 5% resulting in a vessel loss and 47% resulting in damage to the vessel(s) involved in the incident. Allisions have the second highest severity outcomes with 5% vessel loss and 43% damage. Groundings result in only 1% vessel loss and 21% vessel damage .

It is worth noting that none of the total loss outcomes reported in the data were due to grounding, collision or allision incidents involved carriers or vessels of similar size. The only vessel categories reported as a total loss in any of these incident types were passenger vessels, fishing vessels and recreational vessels.

Table 4-5 Outcome Distribution for All Marine Incidents - Study Area Only (USCG MISLE data 2001-2014)

Damage Status	Total Loss	Damaged	Undamaged	Total
Barge	0%	2%	7%	9%
Bulk Carrier	0%	2%	16%	18%
Fishing Vessel	2%	5%	13%	21%
General Dry Cargo Ship	0%	1%	3%	4%
Miscellaneous Vessel	0%	1%	0%	1%
Passenger Ship	1%	8%	7%	15%
Recreational	1%	3%	0%	3%
Ro-Ro Cargo Ship	0%	1%	1%	2%
Tank Ship	0%	0%	2%	2%
Towing Vessel	0%	7%	13%	20%
UNSPECIFIED	0%	1%	3%	4%
Warship	0%	1%	0%	1%
TOTAL	**3%**	**32%**	**64%**	**100%**

Table 4-6 Outcome Distribution for Allisions - Study Area Only (USCG MISLE data 2001-2014)

Damage Status	Total Loss	Damaged	Undamaged	Total
Barge	0%	2%	14%	16%
Bulk Carrier	0%	4%	5%	9%
Fishing Vessel	5%	2%	4%	11%
General Dry Cargo Ship	0%	4%	0%	4%
Miscellaneous Vessel	0%	2%	0%	2%
Passenger Ship	0%	13%	4%	16%
Recreational	0%	2%	0%	2%
Ro-Ro Cargo Ship	0%	2%	0%	2%
Towing Vessel	0%	11%	23%	34%
UNSPECIFIED	0%	4%	2%	5%
TOTAL	**5%**	**43%**	**52%**	**100%**

Table 4-7 Outcome Distribution for Collisions - Study Area Only (USCG MISLE data 2001-2014)

Damage Status	Total Loss	Damaged	Undamaged	Total
Barge	0%	0%	11%	11%
Fishing Vessel	0%	11%	11%	21%
Miscellaneous Vessel	0%	5%	0%	5%
Passenger Ship	0%	5%	5%	11%
Recreational	5%	16%	0%	21%
Tank Ship	0%	0%	5%	5%
Towing Vessel	0%	5%	11%	16%
UNSPECIFIED	0%	0%	5%	5%
Warship	0%	5%	0%	5%
TOTAL	**5%**	**47%**	**47%**	**100%**

Table 4-8 Outcome Distribution for Groundings - Study Area Only (USCG MISLE data 2001-2014)

Damage Status	Total Loss	Damaged	Undamaged	Total
Barge	0%	3%	1%	4%
Bulk Carrier	0%	1%	28%	29%
Fishing Vessel	0%	7%	21%	28%
General Dry Cargo Ship	0%	0%	5%	5%
Passenger Ship	1%	5%	9%	16%
Ro-Ro Cargo Ship	0%	0%	3%	3%
Tank Ship	0%	0%	3%	3%
Towing Vessel	0%	5%	5%	11%
UNSPECIFIED	0%	0%	3%	3%
TOTAL	**1%**	**21%**	**78%**	**100%**

4.3 Review of Oil Spill Data from the Lower Columbia River

In order to properly assess the potential bunker oil spill risk contributed by the project in 2028 and 2038, a survey of historical oil spill data from the Lower Columbia River was performed. The purpose of this data survey is to establish the baseline risk of any hydrocarbon spill for the study area, and is not limited to spills of bunker oil. Additionally, all vessel and incident types included in the data are considered. Estimates of the oil spill risk contributed by the project can then be compared to this baseline in order to quantify the increase in risk contributed by the project in 2028 and 2038.

Data on all reported oil spills, including bunker oil spills, were reviewed from the following three databases for the period between January 1, 2004 and December 31, 2014. All three datasets overlap during this eleven year time period therefore providing the most complete data coverage of oil spill risk available for the study area.

- USCG MISLE Data: described in Section 4.1.
- SPIIS Data from Washington State Department of Ecology: The Spills Program Incident Information System (SPIIS) tracks Spill Program incidents and actions. The data only include vessels that are "covered" by state requirements for planning, preparedness, and liability in case of any vessel emergency that results in the discharge or substantial threat of discharge of oil into state waters. A "covered" vessel is a commercial vessel of 300 or more gross tons and can be a tank vessel, cargo vessel, or passenger vessel.
- The Washington State's Environmental Report Tracking System (ERTS) database collects data on all incidents reported to the state as required by law (RCW 88.46.100 for "covered" vessels; and RCW 90.56.280 duty of anyone with knowledge of a discharge into the waters of the state to notify Coast Guard and State Division of Emergency Management) that could result in the discharge or substantial threat of discharge oil into state waters.

When combining these three datasets, all duplicative entries were removed and only incidents with actual reported spills of petroleum or petroleum products were considered. All vessel categories and incident types are considered in the data survey as the objective of this survey is to establish the baseline oil spill frequency for the study area.

Table 4-9 and Figure 4-3 present oil spill incident counts and spill frequencies by spill volume and incident type. Spill volumes per incident range from 0.1 to 1,603 gallons. The average oil spill frequency for the study area is 15.6 spills per year with 84% of these spills having a volume of less than 10 gallons. Spills of more than 100 gallons have occurred at a frequency of 0.4 per year or once every 2.2 years. The average size of these larger spills is approximately 630 gallons with the largest being a 1600 gallon spill from a barge in 2011.

Other datasets with sparser coverage of the oil spills on the Columbia River do exist and include records of some larger spills including a 4,600 gallon bunker oil spill from a chemical tanker in 2003. These datasets are not included in this survey as their sparseness makes spill frequency estimates unreliable but they do provide data points on the historical size of oil spills on the Lower Columbia River including several spills larger than 1600 gallons.

Table 4-9 Oil Spill Incident Count and Frequency - Lower Columbia River (2004-2014)

Incident Type	Oil Spill Incident Count by Spill Volume					*Oil Spills /year*
	< 1 gal	1 - 10 gal	10 - 100 gal	> 100 gal	Total	
Allision	1	-	-	-	**1**	***0.1***
Capsize	1	-	-	-	**1**	***0.1***
Damage to the Environment	123	57	28	6	**214**	***15.3***
Grounding	-	-	1	-	**1**	***0.1***
Sinking	-	2	-	-	**2**	***0.1***
Total	**125**	**59**	**29**	**6**	**219**	***15.6***
Spills /year	***8.9***	***4.2***	***2.1***	***0.4***	***15.6***	

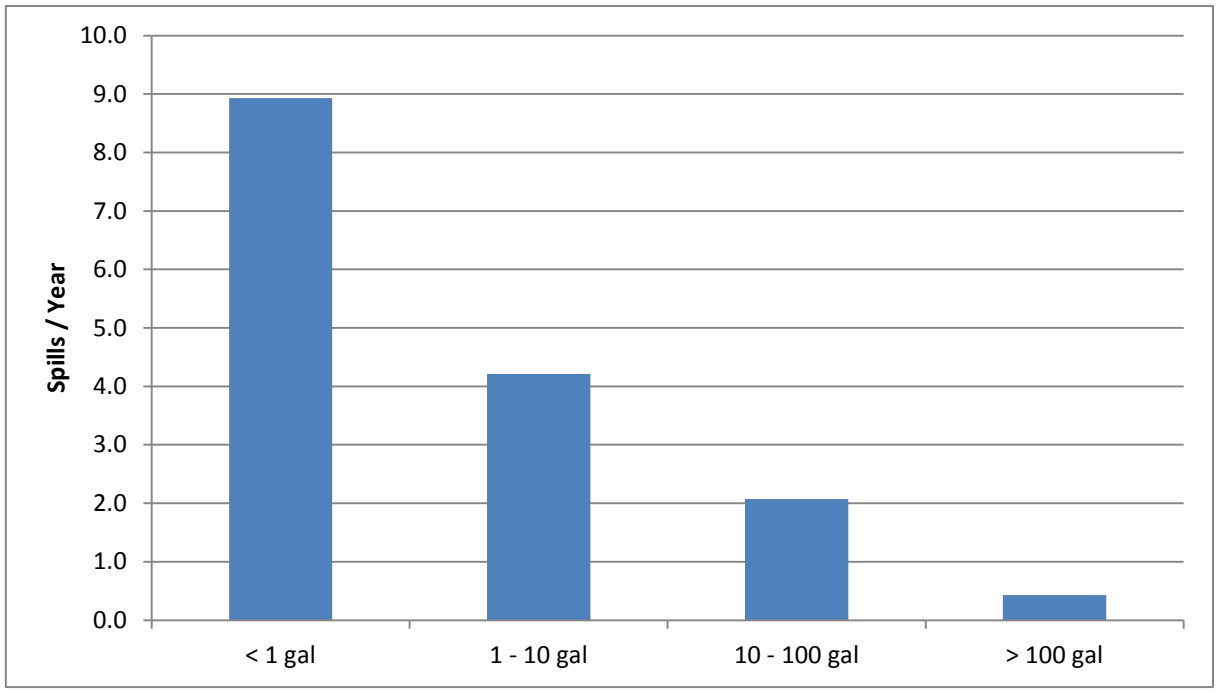


Figure 4-3 Oil Spill Frequency by Volume (Lower Columbia River 2004-2014)

5 MODELING APPROACH

Figure 5-1 presents general approach to DNV GL's navigation study. Inputs and assumptions were applied to two models. DNV GL's proprietary model, Marine Accident Risk Calculation (MARCS) and the allision calculation were used to estimate navigation incident frequencies; further data analysis was performed to measure the incremental impact of the proposed project. MARCS and the oil spill methodology was used to estimate bunker spill frequencies of project and non-project vessels; the Naval Architecture Package (NAPA) was then used to estimate the conditional probabilities of bunker oil spill volumes for project vessels. Further data analysis was performed to measure the incremental impact of the proposed project.

Preliminary MARCS and NAPA results were presented in a stakeholder workshop with DNV GL, ICF International, Washington State Department of Ecology (Ecology), Cowlitz County, U.S. Environmental Protection Agency (EPA), U.S. Coast Guard (USCG), and the U.S. Army Corp of Engineers Sector Columbia River (USACE) on November 9, 2015. Study conclusions are based on the incremental impact of the proposed project in 2028 and 2038, and the conditional probability of bunker oil spill volumes.

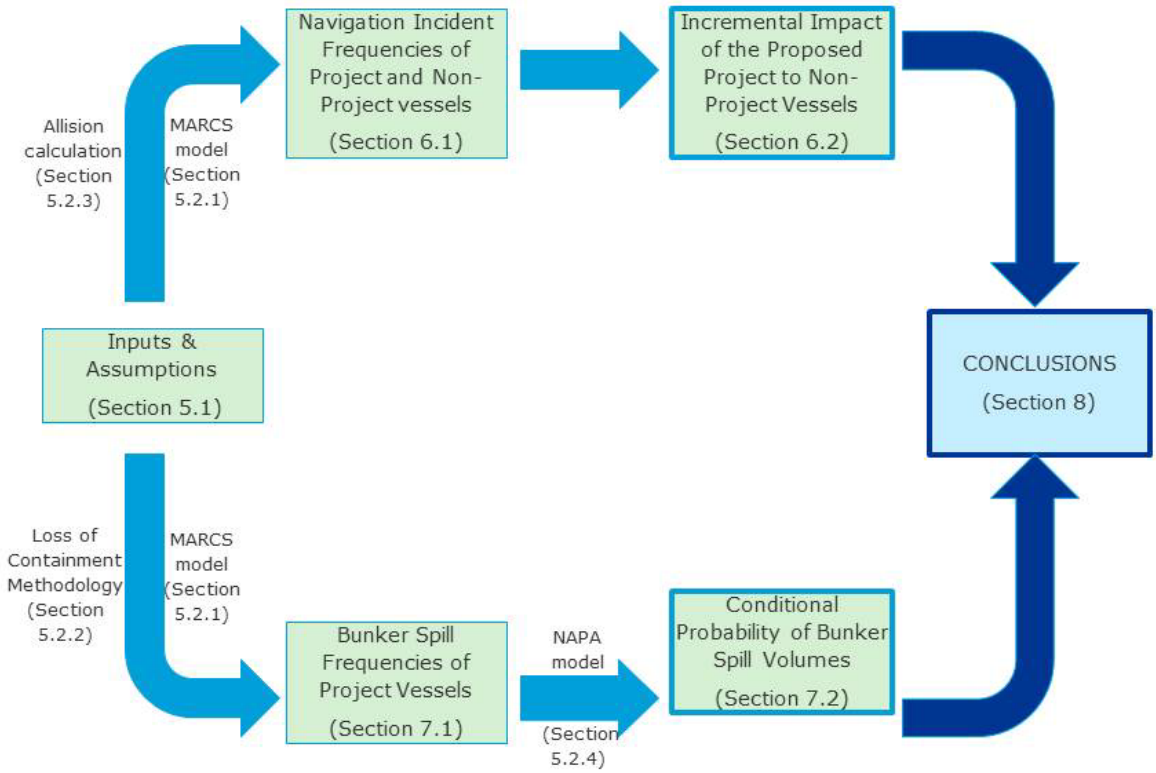


Figure 5-1 General Approach to DNV GL's Navigation Study

5.1 Inputs and Assumptions

5.1.1 Case Definitions

DNV GL has modelled five cases to present a full picture of the risks on the Columbia River due to the proposed project. The cases are defined in Table 5-1.

Table 5-1 Case Definitions

Scenario	1. Existing Conditions 2014	2. No Action 2028	3. Proposed Project 2028	4. No Action 2038	5. Proposed Project 2038
Non-project vessels	2014 AIS data	AIS (including projected growth rate to 2028)	AIS (including projected growth rate to 2028)	AIS (including projected growth rate to 2038) + additional traffic from future projects	AIS (including projected growth rate to 2038) + additional traffic from future projects
Project vessels	6 calls / year (1 ship type)*	26 calls / year (3 ship types)*	840 calls / year (2 ship types)	26 calls / year (3 ship types)*	840 calls / year (2 ship types)

*Will not be studied separately from non-project vessels

The projected growth rate will be further discussed in Section 5.1.3.

5.1.2 Route

The geographic extent of the work is from 0.5 nautical mile (NM) upriver of the proposed terminal to the mouth of the Columbia River at the boundary of the Territorial Sea. The route is presented in Figure 5-2.

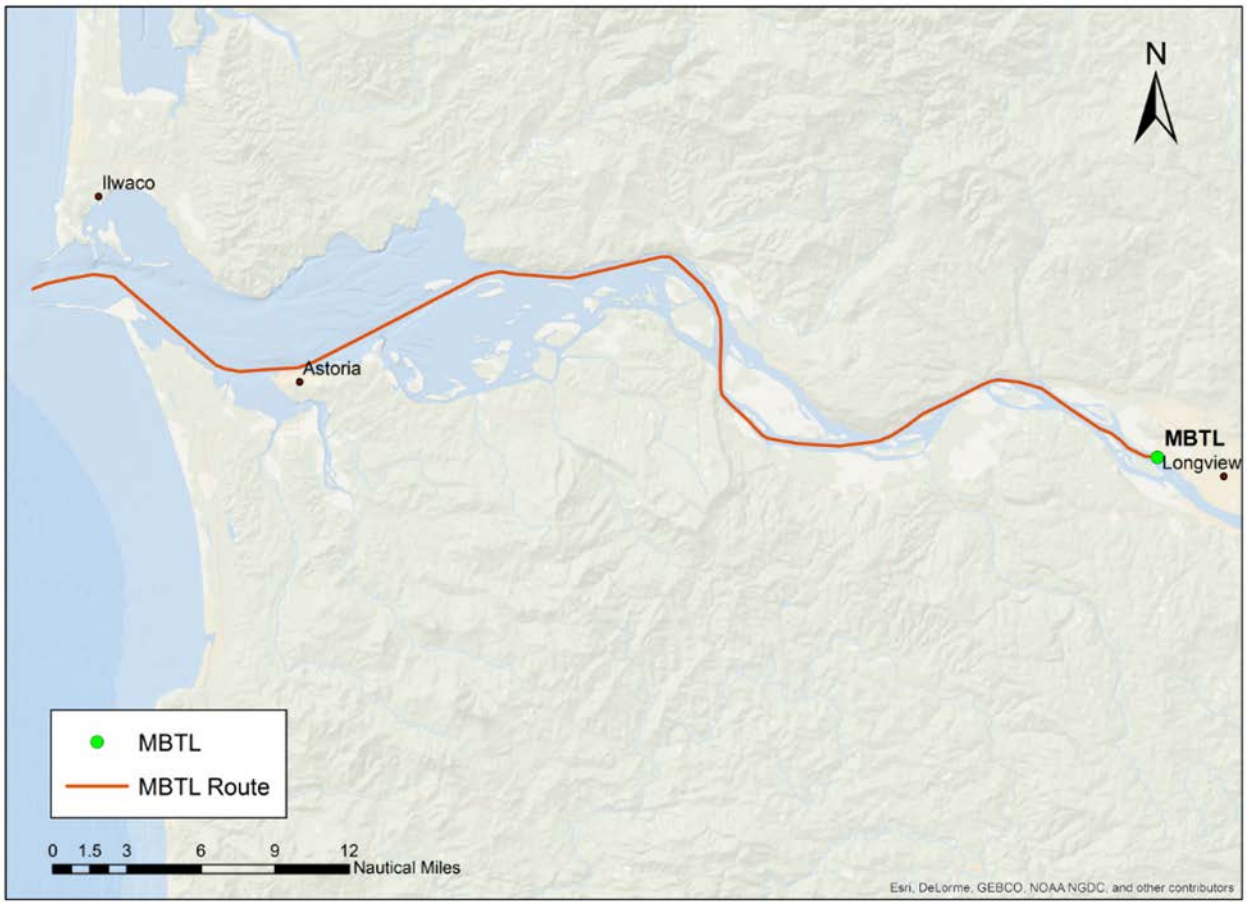


Figure 5-2 Project Vessel Inbound and Outbound Route

5.1.3 Traffic Increase and Potential Projects

An increase of 1% per year was applied to the 2014 baseline traffic data for all vessel categories; with the exceptions of project vessels which will remain constant from 2028 on (Ref. /5/).

Projected increases in vessel traffic from reasonably foreseeable future projects were also included in the analysis. These projects were identified through research and conversations with various stakeholders in the study area. The number of vessels expected to be added to river traffic was added to specified areas after the 1% per year increase has been applied. Vessel traffic from potential future projects are shown in

Table 5-2 and Figure 5-3 below – this additional vessel traffic is applied in case 4 and case 5 only (2038 with and without the project).

Table 5-2 Vessel Traffic from Potential Future Projects

Project	Location	Vessels per Year *	Anticipated Vessel Type and Cargo
Columbia Pacific Bio-Refinery	Port Westward – Clatskanie, OR	108	Tanker – Crude Oil
Columbia River Carbonates	Woodland, WA	24	Cargo – Calcium Carbonate Stone
Coyote Island Terminal Project	Port of Morrow – Broardman, OR	133	Cargo - Coal
Kalama Manufacturing and Marine Export facility	Port of Kalama-Cowlitz County, WA	54	Carrier - Methanol
LPG Facility – Pembina Pipeline Corp.	Port of Portland	30	Carrier - Propane
Northwest Innovation Works, LLC	Port Westward in Clatskanie, OR	54	Carrier - Methanol
Oregon LNG	Warrenton, OR	125	Carrier - LNG
Riverside Refinery	Port of Longview, WA	24	Tanker – Crude Oil
Vancouver Energy Project	Port of Vancouver, WA	290	Tanker - Crude Oil
Vancouver Transportation Logistic Improvement	Port of Vancouver, WA	18	Tanker – Crude Oil
Washington Energy Storage and Transfer	Port of Longview, WA	54	Carrier - LPG

*Included in 2038 MARCS models, no-project and with-project scenarios.

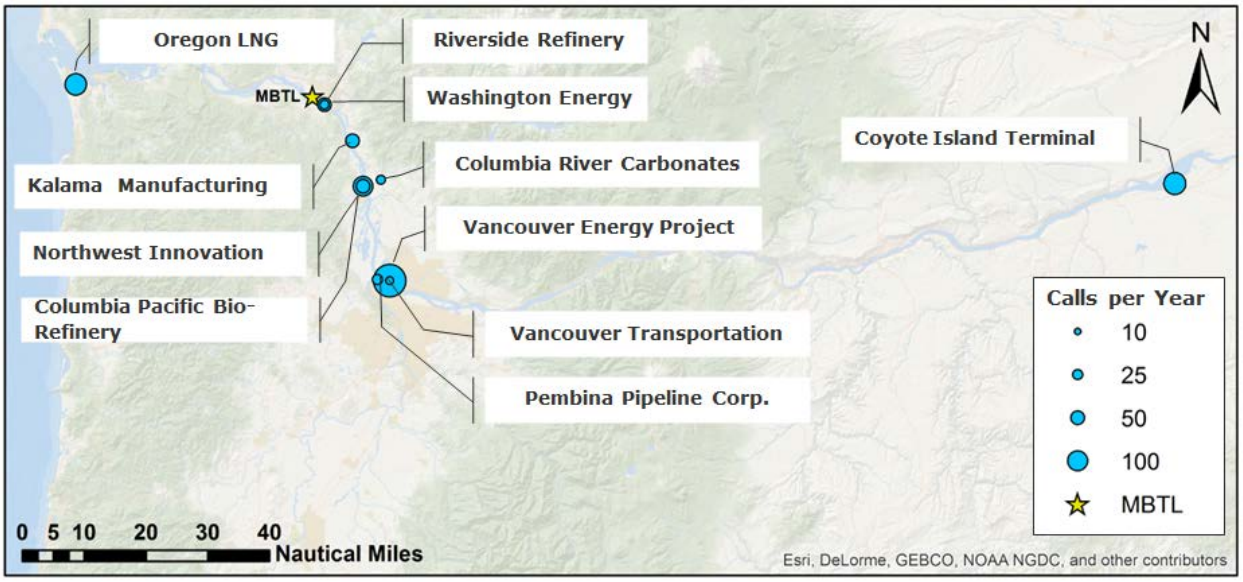


Figure 5-3 Terminal Locations and Annual Call Frequency for Potential Future Projects

5.1.4 Environmental Data

The MARCS model utilized met-ocean data that include wind speed, wind direction, and visibility statistics for the study area. To ensure high levels of accuracy, these data should cover areas in close proximity to the shipping route that project vessels will use at the approach to and from the terminal. The categories of data that would be implemented are as follows:

- Visibility data
- Wind data
- Sea-state data

The stations from which data were obtained are presented in Figure 5-4.

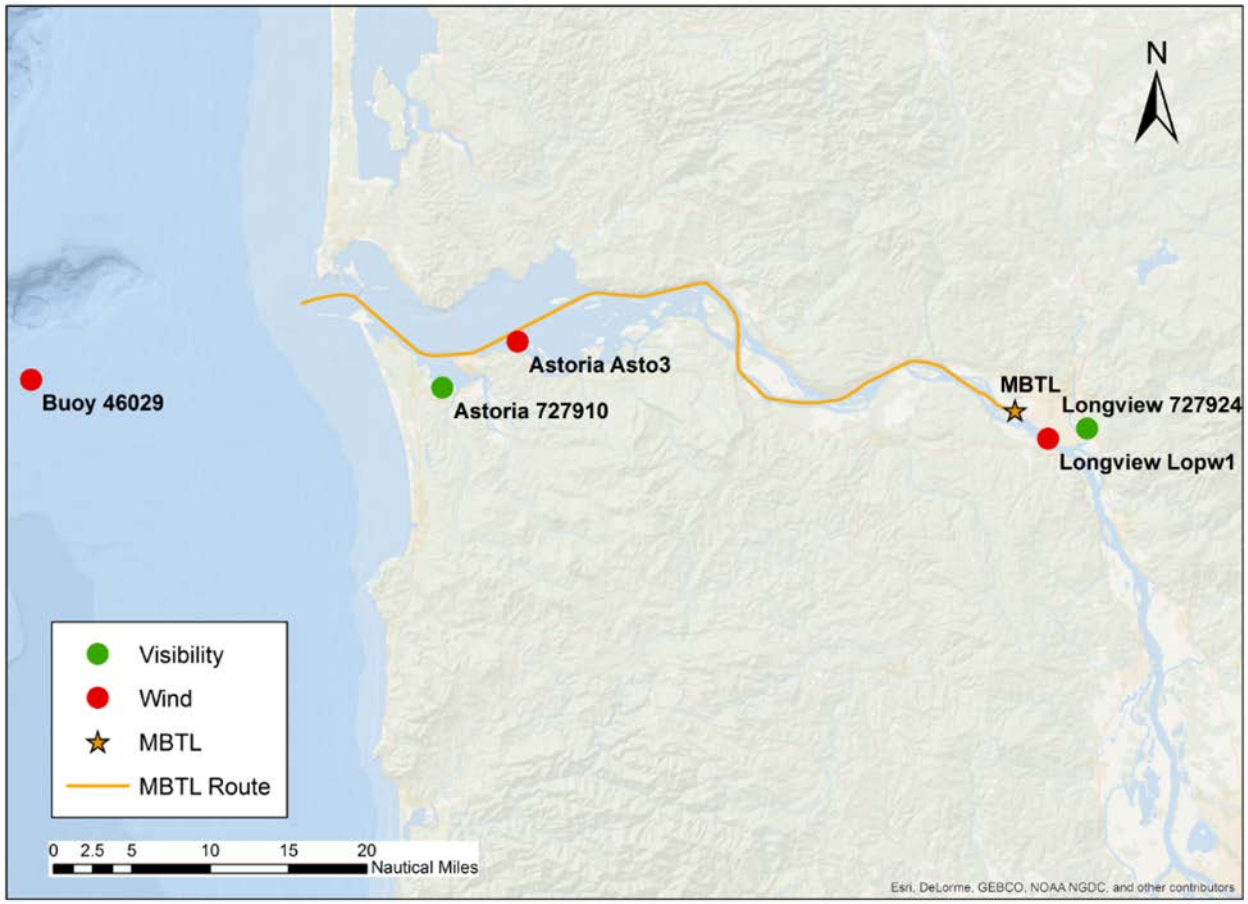


Figure 5-4 Weather Data Station Locations

Each station has a particular area of coverage that must be assigned in the MARCS model. The coverage areas for each station are presented in Figure 5-5.

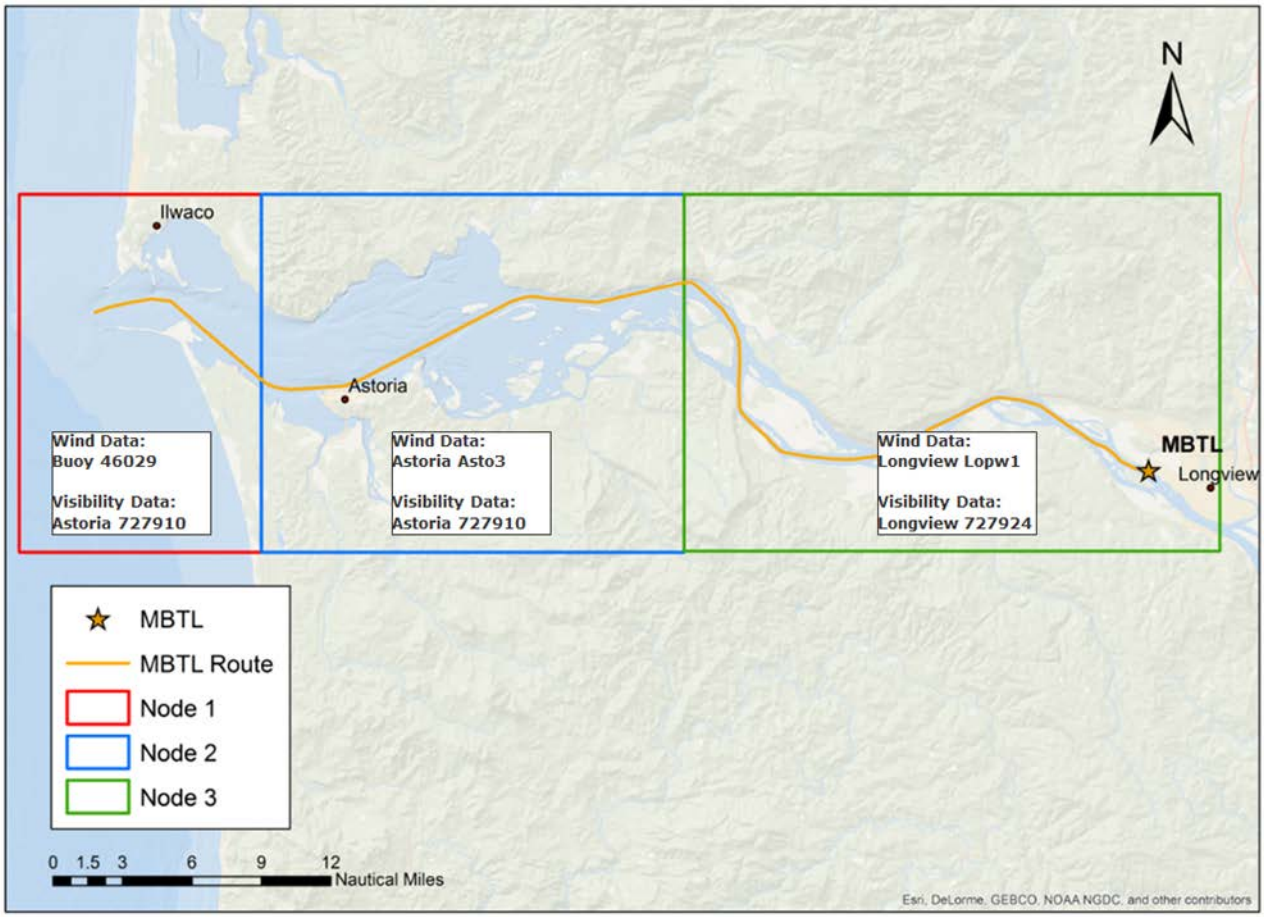


Figure 5-5 Areas of Coverage for Weather Stations

5.1.4.1 Wind Data

The wind data provide magnitude and corresponding probabilities for all relevant scenarios which were input into MARCS as factors that affect grounding frequencies. The wind data were divided into four speed categories (0-20, 20-30, 30-45, 45+ knots).

The probability of occurrence for the wind speed categories applied in MARCS is presented in Table 5-3.

Table 5-3 Wind Speeds Applied in MARCS (probability of occurrence) (Ref. /6/, /7/, /8/, /9/)

Weather Station	0-20 knots	20-30 knots	30-45 knots	>45 knots
Buoy 46029	0.88	0.11	0.01	0.00
Astoria	0.99	0.00	0.00	0.00
Longview	1.00	0.00	0.00	0.00

Due to lack of available sea state data, sea-state is taken as a function of wind speed.

5.1.4.2 Visibility Data

The probability of occurrence for good and poor visibility applied in MARCS is presented in Table 5-4.

Table 5-4 Visibility Data Applied in MARCS (probability of occurrence) (Ref. /7/,/8/,/9/)

Weather Station	Good (>2 nm)	Poor (<2 nm)
Astoria	0.87	0.13
Longview	0.98	0.02

Good visibility is defined as visibility greater than 2 nm; poor visibility is defined as visibility less than 2 nm.

5.1.5 Existing & Assumed Risk Reduction Measures

Risk reduction options are applied to vessels transiting the study area based on vessel type and location. The risk reductions applied in the modeling per vessel category are shown in Table 5-5.

Table 5-5 Risk Reduction Options Applied by Vessel Category

	Project Vessels	Tankers / Cargo Carriers	Tug	All Other Vessels
TV32	Yes	Yes	Yes	No
Pilotage	Yes	Yes	Yes	No
Portable Pilotage Unit	Yes	Yes	Yes	No
Digital Global Positioning Satellite	Yes	Yes	No	No
Conventional Aids to Navigation	Yes	Yes	Yes	Yes
Electronic Chart Display and Information System	Yes	Yes	No	No
Port State Control	Yes	Yes	No	No
Under Keel Clearance Management	Yes	Yes	No	No

The subsequent sections detail the effects of the above risk reduction options.

5.1.5.1 Transview32

TV32 is a real time, vessel traffic information and management system that provides a real-time portrayal of vessel movements and interactions on the river along with water depth, current flow information and updated bathymetry charts. It combines four different systems that provided 2-centimeter spatial resolution accuracy (Ref. /10/):

- AIS
- ENC and ECDIS

- NOAA Nautical Charts
- NOAA Physical Oceanographic Real-Time System (PORTS)
- DGPS

PORTS creates a layered architecture of ocean technologies (i.e., three acoustic sensors, with a back-up pressure sensor for freezing conditions) to measure surface current speeds, water depth, and wind direction and speed. The resolution of all acoustic and pressure sensors is 1 mm and the sample interval is every six minutes. Data are transmitted and displayed on the TV32 interface every six minutes.

TV32 may enhance Bar and River Pilot's performance by:

- Providing redundancy against ship navigational equipment failure or incorrect calibration.
- Providing improved accuracy compared to the ship's own equipment.
- Providing fine spatial and time resolutions
- Providing a layered architecture of technology systems for increased situational awareness.
- Allowing Pilots to accurately determine vessel meeting points to facilitate informed decision making regarding navigation, anchorage, and traffic coordination.

TV32 is considered a Vessel Traffic Information System (VTIS). The risk reduction factor of TV32, as its own unique navigation tool, was not quantified.

Risk reduction factors for a Vessel Traffic Service (VTS) have been quantified by DNV GL. The USCG operates Vessel Traffic Centers (VTC) which provide a VTS in 12 ports in the U.S. One of the differences between a VTS and a VTIS is that in a VTS, vessel location, speed and course data are consolidated in a centralized location, such as a control room (typically staffed by USCG personnel who, when necessary, are authorized by the local Captain of the Port to provide direction to vessel masters) and relevant information is disseminated from the control room to ships in the area. In a VTIS, vessel location, course, and speed data are made available directly to vessels operating in the area so that navigation decisions can be agreed upon between the pilots. As such, TV32 is regarded to be an efficient form of data dissemination given the nature of vessel traffic management on the Columbia River where navigation decisions are made by Columbia River Bar Pilots and Columbia River Pilots.

Table 5-6 summarizes a selection of relevant studies addressing the reduction in collision and grounding frequencies based on implementation of a VTS.

Table 5-6 Summary of Studies that Quantify the Effects of VTS

Study	Information
COST-301: Shore-based Marine Navigation Aid Systems (Ref. /11/)	Estimated radar-based VTS would provide a 40% risk reduction for collisions and groundings
Ship Collision with Bridges (Ref. /12/)	Found a 50% to 67% risk reduction
The Estimation of Collision Risk for Marin Traffic in UK Waters (Ref. /13/)	Indicated that the effects of VTS were most prominent in thick fog Example: In the case of crossing encounters with 99% clear and 1% thick fog, a 57% reduction was found
Safety of Shipping in Coastal Waters Summary Report (Ref. /14/)	Quoted data from the Western Sheldt estuary that indicated a 40% risk reduction for collisions and a 20% risk reduction for powered groundings
Summary Report on Evaluating VTS and Pilotage as Risk Reduction Measures (Ref. /15/)	Reports various studies in the Baltic area obtaining a 55% to 80% risk reduction

The progressive adoption of VTS may contribute to an overall decrease in global incident frequencies of collisions and groundings, as the studies indicate. This collectively resulted in a 43% risk reduction for groundings and 30% risk reduction for collisions.

TV32 does not have USCG 24/7 oversight as a VTS does, although for the purposes of this study, DNV GL finds it appropriate to give TV32 the same level of risk reduction as VTS.

5.1.5.2 Pilotage

Pilotage would be compulsory for all project vessels. The presence of Bar and River Pilots was accounted for in MARCS for project vessels, as well as on cargo/carriers, tankers, and tugs . Pilotage was included as a risk control measure, decreasing the frequency of collision and powered grounding.

When representing the effects of Pilotage, or any risk reduction option, in MARCS, the model parameters are modified according to Performance Shaping Factors (PSFs). A performance shaping factor is a factor that accounts for a risk reduction and is defined as:

$$PSF = \frac{Probability\ of\ model\ parameter\ without\ risk\ reduction\ option}{Probability\ of\ model\ parameter\ with\ risk\ reduction\ option}$$

Previous worldwide research listed in Table 5-7 quantified the effects of Pilotage. PSFs for Pilotage were used to account for an estimated 26% reduction of incident frequency for collision, and a 51% reduction of incident frequency for powered grounding.

Table 5-7 Summary of Studies that Quantify the Effects of Pilotage

Study	Information
Ship Collision with Bridges (Ref. /12/)	Indicates that a Pilot on board reduced incident frequency by 83%
Risk Assessment of Pollution from Oil and Chemical Spills in Australian Ports and Waters (Ref. /16/)	49% risk reduction for compulsory Pilotage for majority of ships
Assessment of the Risk of Pollution from Marine Oil Spills in Australian Ports and Waters (Ref. /16/)	Updated 1999 DNV study recently as a 50% risk reduction for “non-compulsory Pilotage”
Summary Report on Evaluating Pilotage as Risk Reduction Measures (Ref. /15/)	Reports various studies using risk reduction factors in the range of 50%-97% reduction. Note: No data in this report is used in this study to support specific risk reduction factors.

5.1.5.3 Portable Pilotage Unit

The Portable Pilotage Unit (PPU) is a portable GPS unit, which gives Pilots their own source of accurate heading and positioning data, displayed on an electronic chart. It can be seen as a support tool to enhance the pilot's navigational performance. PPUs' benefits include:

- Familiarity to Pilots.
- Provides additional redundancy against ship navigation equipment failure or incorrect calibration.
- Provides onboard VTIS to a Pilot in real time.

Combined with pilotage, it is judged that PPU was modelled to improve the pilot's human error performance with respect to powered grounding by 10%. The effects of collisions are assumed to be negligible in comparison.

5.1.5.4 Differential Global Positioning Systems

Differential Global Positioning Systems (DGPS) signals allow a receiver to calculate its position based on signals received from triangulation of GPS satellites, thereby enhancing GPS.

The advantages of DGPS over conventional aids to navigation (AtoN) are that:

- It provides a very accurate and continuously updated calculation of the ship's position in all weather conditions.
- It requires less time than conventional navigation and hence reduces bridge workload (i.e., by plotting on a conventional chart).

Although DGPS is widely believed to make a major contribution to the safety of navigation, there are no known studies that provide a comparison between incident rates of vessels equipped with DGPS versus vessels with conventional (non-GPS) navigation. Figure 5-6 shows the global historical trend in the frequency of groundings in the world-wide fleet, most of which are powered groundings. The frequency of total losses has declined at an average rate of approximately 5.5% per year. However, when serious casualties and non-serious incidents are included, the frequency appears to increase from 2002 to 2007. The causes were not entirely clear, but the effect was that the global historical trend does not show any clear decline that could be apportioned into its various causes, including aids to navigation, changes in operating procedures and safety management.

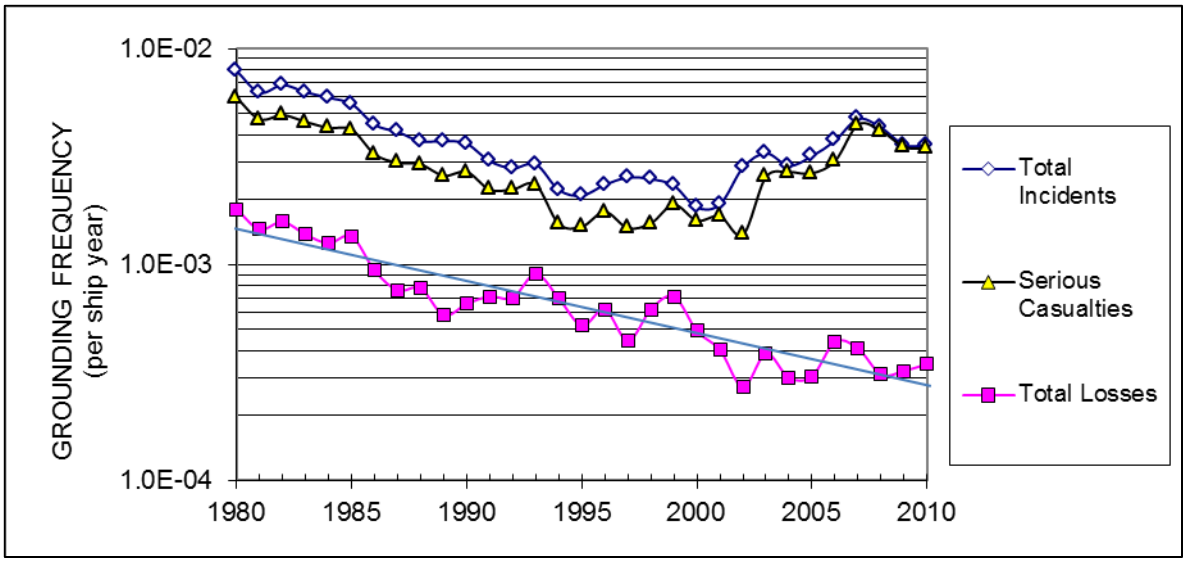


Figure 5-6 Global Grounding Frequency Trends, 1980-2010

The best available data concerning causes of grounding incidents studied Norwegian registered ships over 1,600 Gross register tonnage (GRT) during 1970 to 1978. It described the main causal areas as shown in Table 5-8.

Table 5-8 Causal Factors in Groundings, 1970-78 (Ref. /17/)

Causal Factor		Contribution	
External conditions		**39.9%**	
	Channel and shallow water		18.9%
	Reduced visibility		12.6%
	Fault/deficiency of lights, marks etc.		6.4%
	Other external conditions		2.0%
Technical failure		**8.8%**	
	Fault in the ship's technical systems		5.7%
	Other technical failures		3.1%
Inadequate navigational factors		**18.9%**	
	Bridge manning/organization		8.4%
	Error/deficiency in charts/publications		8.1%
	Other navigational factors		2.4%
Navigational error		**22.9%**	
	Navigation and maneuvering factors		11.7%
	Misinterpretation of lights/marks		8.4%
	Other navigational error		2.8%
Non-compliance		**8.1%**	
	Inadequate coverage of the watch		5.7%
	Other non-compliance		2.4%
Other ship		**1.4%**	**1.4%**
Total		**100.0%**	**100.0%**

Errors in conventional navigation, which might be prevented by GPS, were represented by "misinterpretation of lights/marks", and amounted to 8.4% of incidents. GPS would not necessarily prevent all such errors, and indeed may have some negative impacts that would not be visible in data from this period. However, GPS might have indirect benefits on all navigational errors. Therefore a reduction in groundings of 8.4% is justified by this data as all project vessels will be equipped with GPS.

5.1.5.5 Conventional Aids to Navigation

Conventional aids to navigation are key enablers for spatial awareness, leading to safe navigation. Aids on the Columbia River comprise a group of interacting external reference devices intended to collectively provide sufficient and timely information with which to safely navigate (Ref. /18/). The aids include a series of fixed and floating aids, which are visual, aural, electronic or any combination of all three.

There is no obvious baseline (i.e. risk without AtoN) that could be used for comparison. However, it is possible to consider the benefits of improvements in conventional AtoN.

Data shown in Table 5-8 were used to indicate the effects of conventional AtoN in reducing powered grounding. Using conventional AtoN decreases the number of incidents related to deficiency or fault of lights and markings by 6.4%. Therefore, a reduction in groundings by 6.4% can be justified by these data.

5.1.5.6 Electronic Navigation Charts on ECDIS

An Electronic Chart Display and Information System (ECDIS) is an electronic navigation aid that can be used instead of paper charts and publications to plan and display a ship's route and plot, and monitor its position throughout a voyage.

ECDIS's benefits include:

- It provides a continuous display of a vessel's position in relation to land, charted objects, aids to navigation and possible unseen hazards.
- It provides an improved representation of the vessel's position, compared to paper charts.
- It reduces the workload due to position plotting.
- It can be located where convenient on the bridge, so as to enable the watch-keeper to maintain a good lookout, instead of needing a screened chart table.
- It allows charts to be updated in a more efficient way by inserting a CD into the ECDIS computer, instead of manually annotating paper charts.
- It allows route planning and continuous monitoring.
- It provides improved functionality, such as:
    - Location polygons can be defined and alarms set if the ship exits defined safe areas.
    - AIS data can be displayed.
    - Radar targets can be superimposed on the ECDIS.

The potential risk reduction achieved by implementation of ECDIS was evaluated in previous research. A Formal Safety Assessment (FSA) was submitted to IMO Marine Safety Committee in 2006 in connection with a proposal for ECDIS carriage requirements. The assessment concluded that ECDIS reduced grounding risk by approximately 36%. This was due to a combination of more time available on the bridge for situational awareness, more efficient plotting of the ship's position and more efficient updating routines. A subsequent study (Ref. /19/) that took account of 11 different routes and a mix of ship types found reductions in grounding risk between 11% and 38% due to variations in ECDIS coverage. Where ECDIS coverage was 100% the reduction in grounding risk was 38%.

A 38% reduction in powered grounding was applied because the Columbia River was considered to have 100% ECDIS coverage.

While ECDIS provides a continuous display of a vessel's position in relation to land, charted objects and AtoN, it does not display another vessel's position. Seeing another vessel's location is necessary to reduce the risk of collision. Therefore, no reduction was applied for collision.

5.1.5.7 Port State Control

Port State Control (PSC) is the inspection of ships in national ports to verify that the condition of the ship and its equipment complies with the requirements of international regulations and that the ship is also manned and operated in compliance with these rules. In this report, the term PSC was also used to include other general shipping industry initiatives with similar goals, such as: classification society rules; enhanced surveys; vessel design standards; and bunker fuel oil quality testing.

Knapp et. al., (Ref. /20/) estimated the survival gains for different ship types in the years 2003 to 2007 based on individual ship loss experience and PSC inspections in Australia and the USA. PSC inspections were associated with ship survival gains of 0.1% to 0.5% on base risk rates of 1-3%. Combining the data for four cargo ship types over five years, the average gain was 12% of the risk of total loss. The average benefit may be smaller because not all ships are inspected. On the other hand, the benefit may be increased through the targeting of inspections of high-risk ships, and the possibility that any ship may be inspected and detained if not compliant. Overall, this analysis was considered to provide the best estimate of the benefit of PSC.

The effect of PSC was represented by:

- Applying a PSF of 0.88 for all the technical failure rates in the risk model. This directly affects the frequency of drift grounding, fire / explosion and foundering. It also has a very minor impact on collision and powered grounding (which are dominated by human error and human incapacitation).
- Applying a human error and human incapacitation PSF of 0.88 in the collision and powered grounding incident models. This represents the emphasis placed on International Safety Management (ISM) regulations by PSC inspections and should help ensure reductions in the likelihood of excessively fatigued navigating officers.

5.1.5.8 Underkeel Clearance Management

Underkeel clearance (UKC) is managed by the Pilots and vessel masters and is required by a ship's Safety Management System (SMS). Vessels calling at the Project terminal depart a dock or enter the river only when they can make the transit of the entire river with a minimum 2 feet of underkeel clearance and 10 feet across the bar. UKC management takes into account tide, weather, and vessel characteristics to ensure the underkeel clearance standard is maintained. The availability of water level sensor data via PORTS is a key component of the UKC management system on the Columbia River.

The main benefit of UKC management system is that it ensures adequate clearance between a vessel's keel and the river bottom to avoid grounding by providing improved information to navigators on underkeel clearance.

For an individual transit of a deep-draft vessel, an UKC management system is expected to make a significant reduction in grounding probability. Since UKC management is required on the river and at the port, a 10% reduction in powered grounding probability is reasonable.

5.2 DNV GL Methodologies

This section provides an overview of the methodologies applied in this study. First a description of the method for modeling marine incident frequencies is provided (Section 5.2.1), followed by the method for estimating whether each incident leads to a bunker oil spill (Section 5.2.2 and 5.2.3) and finally the method for estimating the spill volume given a bunker oil spill event has occurred (Section 5.2.4).

5.2.1 MARCS Model

The frequency of marine incidents involving project vessels was estimated using MARCS software. MARCS was developed by DNV GL to support its navigational risk consultancy services.

MARCS combines data for vessel traffic (e.g., vessel types, sizes, routes, and transit frequencies), the marine environment (e.g., location of shallow water, visibility data, and wind data) and operational aspects of shipping (e.g., pilotage, escort tugs) to predict the frequency of incidents at sea, such as:

- Collision
- Drift grounding
- Powered grounding
- Fire / Explosion

Collisions generally occur in the navigable part of the channel where the traffic is most dense. Drift and powered groundings occur near the shoreline or in shallow waters.

Incident frequencies were estimated using MARCS for the proposed route.

5.2.1.1 The Collision Model

The collision model calculates the frequency of serious inter-ship powered collisions at a given geographical location in two stages. The model first estimates the frequency of encounters (critical situations for collision - when two vessels pass within 0.5 nautical miles of each other) from the traffic image data using a pair-wise summation technique, assuming no collision avoidance actions are taken. This enables the calculation of either total encounter frequencies, or encounter frequencies involving specific vessel types.

The model then applies a probability of a collision for each encounter, obtained from fault tree analysis, to give the collision frequency. The collision probability value depends on a number of factors including, for example, visibility or the presence of a Pilot.

Figure 5-7 shows a graphical representation of the way in which the collision model operates.

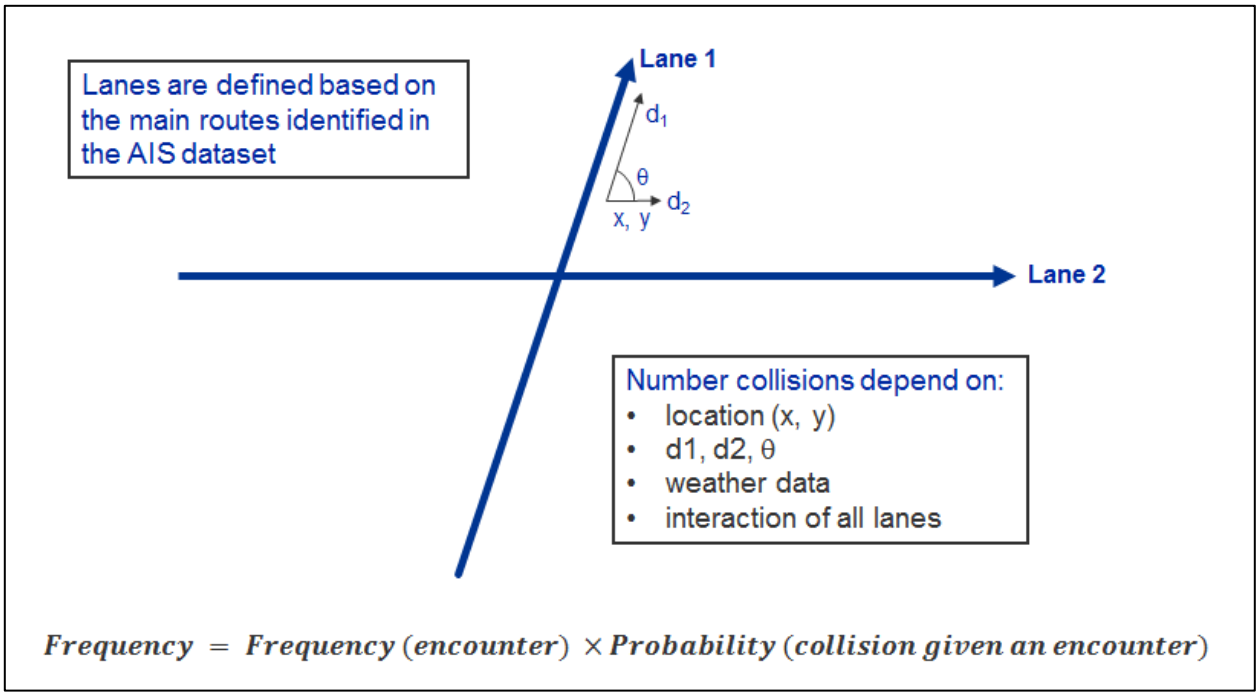


Figure 5-7 Graphical Representation of the Collision Model

In Figure 5-7, d_1 refers to the density of traffic associated with Lane 1 at the location (x, y). The frequency of encounters at location (x, y) through the interaction of Lanes 1 and 2 is proportional to the product of d_1, d_2 and the relative velocity between the lane densities.

5.2.1.2 The Powered Grounding Model

The powered grounding frequency model calculates the frequency of serious powered grounding incidents in two stages. The model first calculates the frequency of critical situations (sometimes called 'dangerous courses' for powered grounding incidents). Two types of critical situations are defined as illustrated in Figure 5-8. The first critical situation arises when a course change point (waypoint) is located such that failure to make the course change would result in grounding within 20 minutes navigation from the planned course change point if the course change is not made successfully. The second critical situation results when a grounding location is within 20 minutes navigation of the course centerline. In this case, crew inattention combined with wind, current or other factors could result in a powered grounding.

The frequency of serious powered groundings is calculated as the frequency of critical situations multiplied by the probability of failure to avoid grounding.

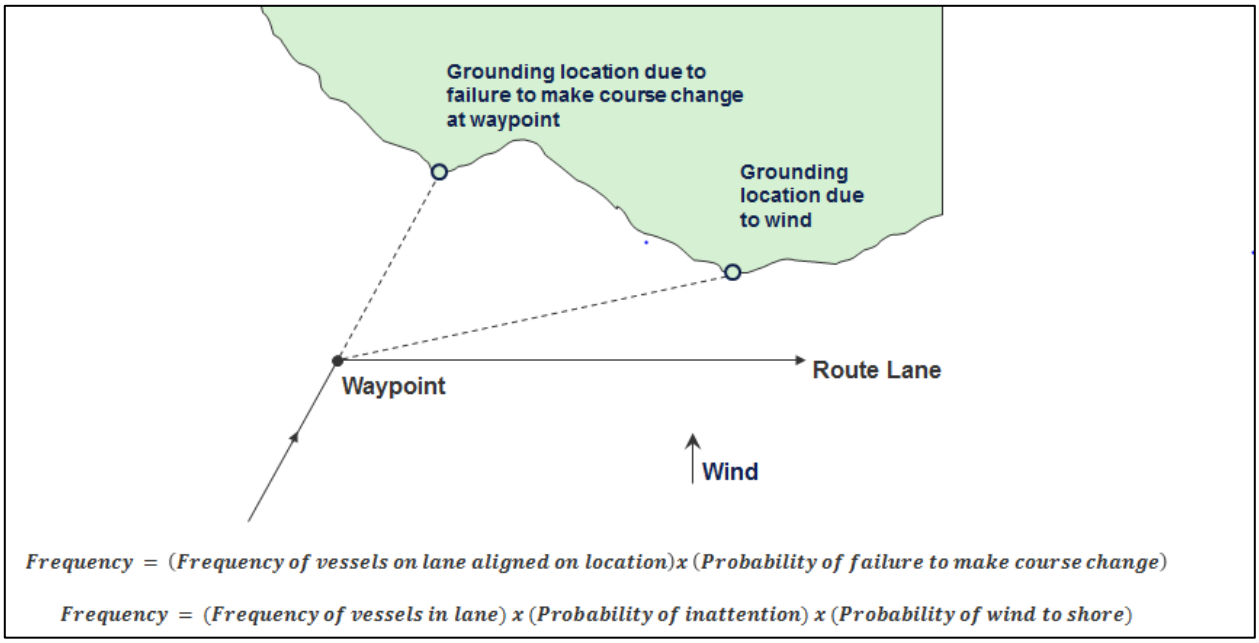


Figure 5-8 Graphical Representation of the Powered Grounding Model

The powered grounding probabilities are derived from the fault tree analysis of powered grounding. The powered grounding fault tree contains two main branches:

- Powered grounding through failure to make a course change whilst on a dangerous course. A dangerous course is defined as one that would ground the vessel within 20 minutes if the course change were not made.
- Powered grounding caused by crew inattention and wind or current from the side when the ship lane runs parallel to a shore within 20 minutes sailing.

Both these branches are illustrated in Figure 5-8. The powered grounding frequency model takes into account internal and external vigilance, visibility and the presence of navigational tools (e.g., radar) in deducing failure parameters.

5.2.1.3 The Drift Grounding Model

The drift grounding frequency model consists of two main elements: first, the ship traffic image is combined with the ship breakdown frequency factor to generate the location and frequency of vessel breakdowns; second, the recovery of control of drifting ships can be regained by one of three mechanisms:

- Repair
- Emergency tow vessel assistance
- Anchoring

Those drifting ships that are not saved by one of these three mechanisms (and do not drift out into the open sea) contribute to the serious drift grounding incident frequency results.

The number and size distribution of ships which start to drift is determined from the ship breakdown frequency, the annual number of transits along the lane and the size distribution of vessels using the lane.

The proportion of drifting vessels that are saved (fail to ground) is determined from the vessel recovery models. The drift grounding frequency model is illustrated in Figure 5-9.

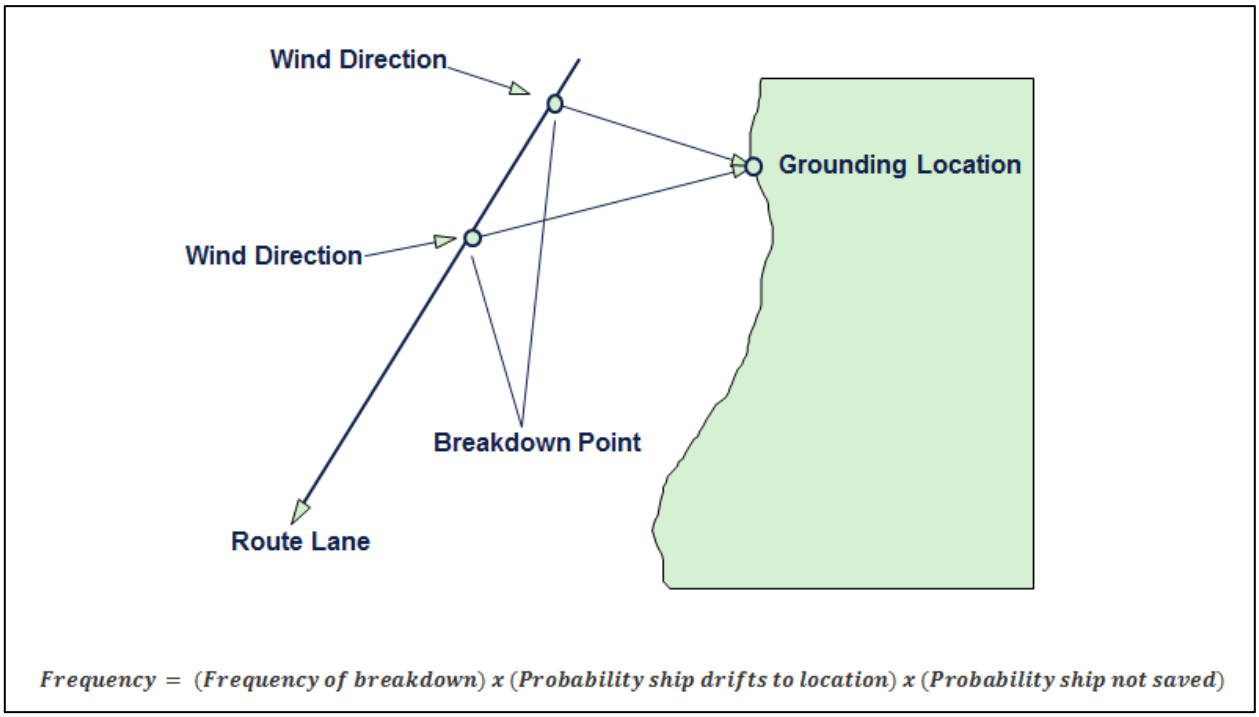


Figure 5-9 Graphical Representation of the Drift Grounding Model

Implicit in Figure 5-9 is the importance of the time taken for the ship to drift aground. When this time is lengthy (because the distance to the shore is large and / or because the drift velocity is small) then the probability that the ship will recover control before grounding (via repair or tug assistance) will be increased.

5.2.1.4 The Fire and Explosion Model

The fire / explosion accident frequency model applies the accident frequency parameters derived from accident data or fault tree analysis with calculations of the ship exposure time to obtain the serious accident frequency. The total ship exposure time (number of vessel hours) in any area can be calculated from the traffic image parameters (locations of lanes, frequencies of movements and vessel speeds). The fire / explosion serious accident frequency is then obtained by multiplying these vessel exposure times by the appropriate fire / explosion frequency factor (accidents per vessel-hour). It should be noted that fire / explosion frequency factors are assumed to be independent of environmental conditions outside the vessel.

5.2.2 Oil Spill Frequency Methodology

Incident frequency results from MARCS are used as input to determine the oil spill frequency. This section describes the methodology used to determine which incidents from MARCS results in an oil spill.

5.2.2.1 Collision

In calculating the conditional release probability for collision incidents, the amount of energy required to breach the bunker tank, referred to as the energy threshold. The energy threshold was taken as 13 MJ, which corresponds with the minimum distance from the bunker tank to the outer hull (1m) as specified by MARPOL requirements (Ref. /21/). The correlation between the indentation depth and the energy absorbed is presented in the Figure 5-10. The graph is based on a DNV GL finite element analysis of vessel collisions.

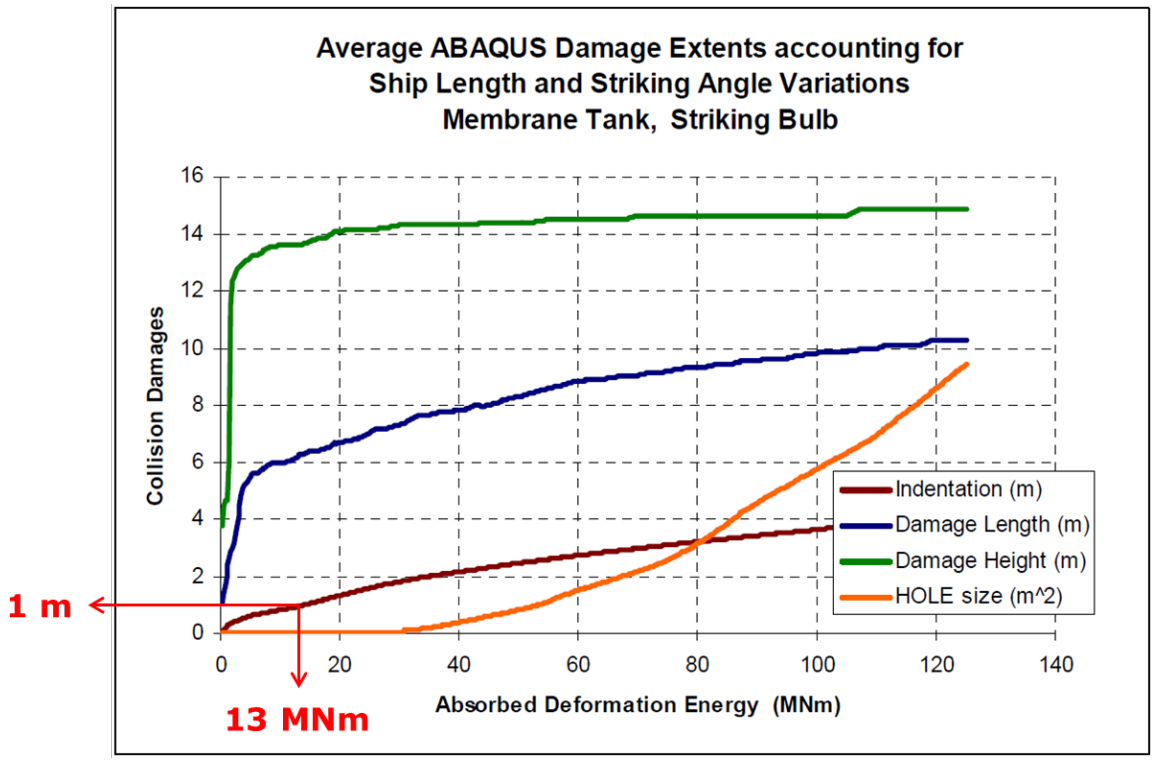


Figure 5-10 Relationship between Indentation Depth and Absorbed Energy

In estimating collision energy, information about vessels' masses and relative velocities is used to estimate the amount of energy involved in the collision, and therefore in the deformation, of the project vessel that could cause a loss of bunker oil to the environment.

The equation for assessing the estimated frequency of a bunker oil release is as follows:

$$F_{Bunker\ Oil\ Release} = F_{Collision} \times P_{E_{abs}>E_{crit}} \times P_{Geometric}$$

Where,

$F_{Collision} = Annual\ collision\ frequency$

$P_{E_{abs}>E_{crit}} = The\ probability\ that\ the\ energy\ absobed\ by\ the\ MBTL\ vessel\ exceeds\ the\ energy\ threshold$

$P_{Geometric} = Geometric\ probability\ of\ striking\ the\ vessel\ at\ a\ location\ of\ bunker\ tank$

As part of applying the theoretical methods to postulated events, several key assumptions are made:

1. 25% of the available impact energy is used towards deformation of the striking vessel. The remainder of the energy is assumed to deform the project vessel.
2. Angles of impact less than 22.5° or greater than 157.5° do not breach a cargo tank. These glancing impacts do not have a sufficiently steep angle to penetrate a project vessel.
3. A release of bunker oil is only credible if a project vessel is struck at a location with a bunker oil tank behind it.

Figure 5-11 provides an overview of the collision oil spill methodology.

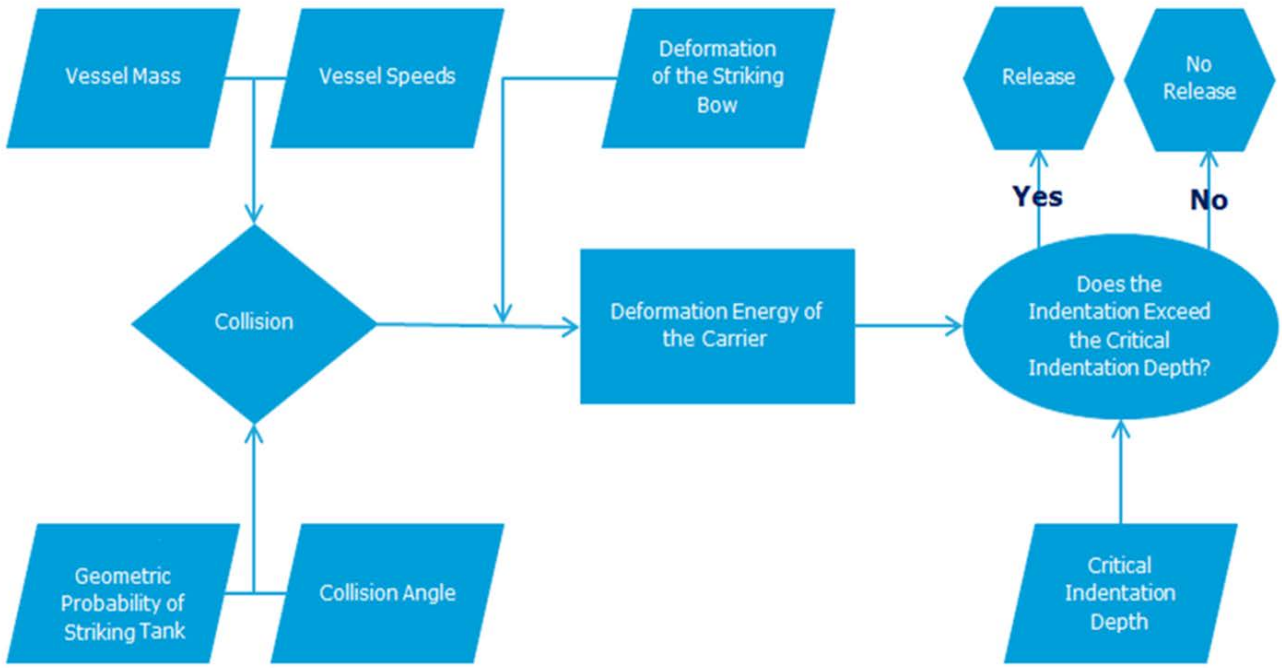


Figure 5-11 Collision Oil spill Methodology

5.2.2.2 Grounding

In order to estimate the probability of oil spill due to drift and powered grounding incidents, historical data are used in combination with route specific characteristics to estimate the potential for a release of bunker fuel. This approach utilizes a best fit cumulative distribution function to determine the probability that the indentation depth, caused by a grounding incident, exceeds the depth required to puncture the bunker oil tank. Based on MARPOL requirements (Ref. /21/), the distance between the outer hull and the bunker tank is assumed to be 1.6 m.

Based on impact data from the European Union-funded HARDER (Harmonisation of Rules and Design Rationale) studies and participation in the GOALDS (goal-based damage stability) project, DNV GL has developed an empirical formulation to estimate the probability of oil spill due to grounding. Vessels with

lengths between perpendiculars greater than 100 m were included in the assessment. A narrower filter on the dataset was not possible without reducing the number of observations to an insignificant sample size.

The results of this analysis were done using a probability distribution estimation tool that showed that the best fit cumulative distribution function of the indentation depth was the Fréchet distribution. By definition, the Fréchet distribution gives the probability that the actual value will be less than the value (I_d) supplied to it. However, in this portion of the assessment we are interested in when the grounding might cause a bunker oil spill. Therefore, to get the probability that the indentation depth exceeds 2 m we subtract the Fréchet distribution from 1 as shown in the below equation and let $I_d = 1.6$.

$$F(I_d) = 1 - \exp\left(-\left(\frac{\beta}{I_d - \gamma}\right)^{\alpha}\right)$$

Where

$\alpha\ (shape\ parameter) = 2.629$
$\beta\ (scale\ parameter) = 1.9368$
$\gamma\ (location\ parameter) = 0$

5.2.3 Allision Calculation

The annual allision frequency is estimated as the likelihood that a non-project vessel will strike a project vessel at berth. The method was developed based on guidelines for vessel collision and bridges from the American Association of State Highway and Transportation Officials (AASHTO). Project vessel characteristics (such as ultimate resistance of the tanker), waterway characteristics, geometry, and marine traffic characteristics were compared to standard acceptance criteria to estimate the extent of damage to a project vessel.

The annual failure rate caused by vessel collisions, A_F, can be expressed as:

$$A_F = N \times P_A \times P_C \times P_G$$

Where:

$N =$ Number of vessels and type that transit the waterway.

$P_A =$ Probability of vessel aberrancy (to stray away from normal navigation channel).

$P_C =$ Probability that the study vessel's bunker tank will be punctured given that a passing vessel struck the study vessel.

$P_G =$ Geometric Probability associated with striking vessel type and the study vessel.

5.2.3.1 Probability of Aberrancy, P_A

The probability of aberrancy is a measure of the risk of a vessel losing control as a result of pilot error, adverse environmental conditions, or mechanical failure. The evaluation of accident statistics indicates that human error (causing 60% to 85% of the aberrancy cases) and environmental conditions are the primary causes of accidents. To evaluate probability of aberrancy, DNV GL accounted for the following factors: the geometry of the navigation channel and the location of project vessels in the channel; the current direction and speed; vessel traffic density; and cross currents.

The equation is:

$$P_A = BR\,(R_B)\,(R_C)\,(R_{XC})\,(R_D)$$

Where:

BR = aberrancy base rate (0.6×10^{-4} for vessel or 1.2×10^{-4} for barges);

R_B = correction factor for Sample Vessel location. $R_B = (1 + \frac{\theta}{90°})$

R_c = correction factor for current acting parallel to vessel path. $R_C = (1 + \frac{V_C}{10})$, with V_C specific to the proposed project.

R_{xc} = correction factor for crosscurrents acting perpendicular to vessel transit path. $R_{XC} = (1 + V_{XC})$, with V_{XC} specific to the proposed project.

R_D = correction factor for vessel traffic density depending on the frequency of vessels.

The specific risk controls that are accounted for in this portion of the analysis are:

- Electronic Chart Display & Information System.
- Pilotage.
- Vessel Traffic Information Service (TV32).

5.2.3.2 Probability of Bunker Tank Puncture, P_C

P_C must be interpreted as if a vessel has become aberrant and struck a project vessel at berth. In order to determine the potential to breach a bunker tank, it is necessary to calculate the available impact energy from the striking vessel. The available energy in the proximity of a project vessel is therefore assessed based on the speed and mass of the ships passing the berth.

The ship movements are defined by average speed and deadweight tonnage for each ship type. From these inputs, the maximum impact energy is estimated. The ratio of ultimate lateral resistance to the vessel impact force is also calculated to estimate the probability of sufficient energy to breach the hull and bunker tank of a project vessel.

5.2.3.3 Geometric Probability of Striking, P_G

In order to estimate geometric probability of striking, the assumption must be made that the striking vessel already strayed away from the navigation channel. Once a vessel has become aberrant, it is then necessary to estimate the probability that the vessel will strike a project vessel. To do this, geometric considerations are necessary.

The geometric probability is based on a number of parameters including the geometry of the waterway, location of the dock, sailing path of vessel, location, heading and velocity of vessel, environmental conditions, width, length, and shape of vessel, and vessel draft.

The lateral position of a vessel in the waterway follows a normal distribution with a mean value centered on the required path line (center line of navigation route). The standard deviation of this lateral position distribution is equal to the overall length of vessel designated as LOA. The use of a standard deviation equal

to length of the vessel was justified based on accident data to reflect the influence of the size of the colliding vessel.

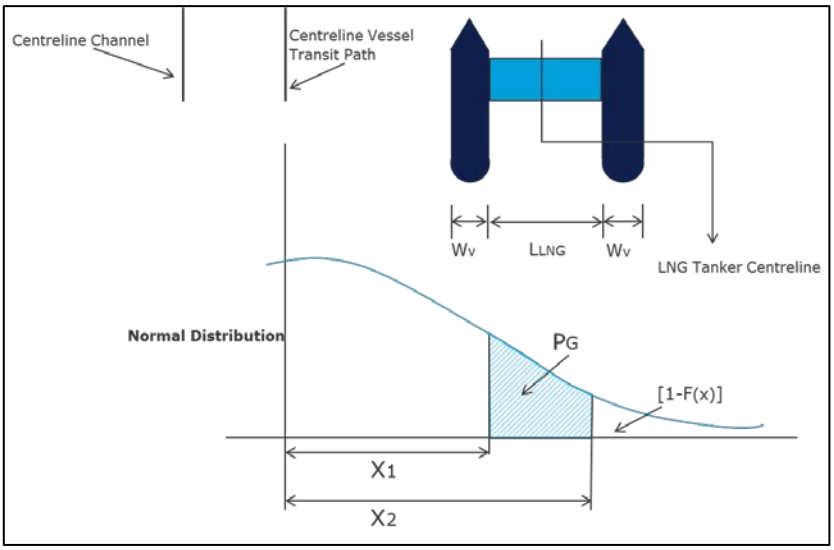


Figure 5-12 Model for Geometric Probability of Vessel Collision with the Sample Vessel

5.2.3.4 Omitting Analysis on Astoria-Megler Bridge

The decision to omit the allision analysis on the Astoria-Megler Bridge was based on feedback from Columbia Bar and River Pilots.

There was an allision at the Astoria-Megler Bridge that involved a piloted vessel approximately 30 years ago. Since this incident, Bar Pilots have implemented risk reduction measures to reduce the probability of allisions at the bridge; they avoid meeting other piloted vessels at the bridge, observe weather and river current conditions, and review weather forecasts before transiting under the bridge.

Given the very low historical frequency of allision at the Astoria-Megler Bridge and the assessment by the Bar and River Pilots that the bridge does not present an allision risk for piloted vessels, this structure has been omitted from the allision analysis.

5.2.4 NAPA Model

A commercial naval architecture package called NAPA is used to estimate the probability of oil outflow from project vessels. Using Monte Carlo simulations, in accordance with IMO Resolution MEPC.110(49) - Probabilistic Methodology for Calculating Oil Outflow, the model estimates oil outflow volumes based on the number of damaged cargo tanks and interaction with tidal influences. Monte Carlo simulations were run for 50,000 damage cases to estimate the potential variability in impact and in oil outflow volumes.

6 INCREMENTAL IMPACT OF PROJECT VESSELS ON RIVER NAVIGATION

6.1 Estimated Navigation Incident Frequencies

For each of the five cases presented in Section 5.1.1, incident frequencies for project vessel transits were estimated. These incident frequencies were estimated using the MARCS model and are limited to the study area. For this analysis, a marine incident was defined as an unintentional event (not a near miss), which may or may not result in a spill event. Incident frequencies were calculated for the following events:

- Collision
- Powered grounding
- Drift grounding
- Fire / Explosion
- Allision at Berth

6.1.1 2014 Existing Traffic

Table 6-1 provides estimated incident frequencies by vessel type for existing conditions (2014).

Table 6-1 Incident Frequency by Vessel Type for Non-Project Vessels (2014)

	Cargo/ Carrier	Fishing	Other / Undefined	Passenger	Pleasure	Service	Tanker	Tug	Total Incident Frequency
Collision	3.96E-01	3.41E-01	3.77E-01	8.53E-02	8.34E-02	3.24E-01	2.29E-02	3.09E-01	1.94E+00
Fire / Explosion	1.02E-03	2.79E-04	4.32E-04	9.21E-05	9.12E-05	1.96E-04	5.85E-05	9.88E-04	3.15E-03
Powered Grounding	2.20E+00	1.70E+00	2.69E+00	6.77E-01	5.25E-01	1.81E+00	1.27E-01	2.07E+00	1.18E+01
Drift Grounding	9.13E-01	2.39E-01	3.85E-01	8.32E-02	8.04E-02	1.68E-01	5.26E-02	9.01E-01	2.82E+00
Total Incident Frequency	3.51E+00	2.28E+00	3.46E+00	8.46E-01	6.89E-01	2.30E+00	2.02E-01	3.29E+00	1.66E+01

6.1.2 2028 No-Action Traffic

Table 6-2 provides estimated incident frequencies by vessel type for 2028 without project vessels.

Table 6-2 Incident Frequency by Vessel Type for Non-Project Vessels (2028 No Action)

	Cargo/ Carrier	Fishing	Other / Undefined	Passenger	Pleasure	Service	Tanker	Tug	Total Incident Frequency
Collision	4.81E-01	4.53E-01	5.01E-01	1.13E-01	1.11E-01	4.29E-01	2.75E-02	4.10E-01	2.53E+00
Fire / Explosion	1.19E-03	3.21E-04	4.97E-04	1.06E-04	1.05E-04	2.26E-04	6.73E-05	1.14E-03	3.65E-03
Powered Grounding	2.56E+00	1.95E+00	3.10E+00	7.79E-01	6.03E-01	2.08E+00	1.46E-01	2.38E+00	1.36E+01
Drift Grounding	1.07E+00	2.74E-01	4.42E-01	9.56E-02	9.24E-02	1.94E-01	6.05E-02	1.04E+00	3.27E+00
Total Incident Frequency	4.11E+00	2.68E+00	4.04E+00	9.88E-01	8.07E-01	2.70E+00	2.34E-01	3.83E+00	1.94E+01

6.1.3 2028 With-Project Traffic

Table 6-3 provides estimated incident frequencies by vessel type for non-project vessels under 2028 with-project conditions.

Table 6-3 Incident Frequency by Vessel Type for Non-Project Vessels (2028 With-Project)

	Cargo/ Carrier	Fishing	Other / Undefined	Passenger	Pleasure	Service	Tanker	Tug	Total Incident Frequency
Collision	5.16E-01	4.91E-01	5.54E-01	1.25E-01	1.22E-01	4.63E-01	2.99E-02	4.56E-01	2.91E+00
Fire / Explosion	1.17E-03	3.21E-04	4.97E-04	1.06E-04	1.05E-04	2.26E-04	6.73E-05	1.14E-03	4.01E-03
Powered Grounding	2.52E+00	1.95E+00	3.10E+00	7.79E-01	6.03E-01	2.08E+00	1.46E-01	2.38E+00	1.44E+01
Drift Grounding	1.05E+00	2.74E-01	4.42E-01	9.56E-02	9.24E-02	1.94E-01	6.05E-02	1.04E+00	3.59E+00
Total Incident Frequency	4.09E+00	2.72E+00	4.10E+00	1.00E+00	8.18E-01	2.74E+00	2.37E-01	3.88E+00	2.09E+01

Table 6-4 provides estimated incident frequencies for project vessels in 2028.

Table 6-4 Incident Frequency by Vessel Type for Project Vessels (2028 With-Project)

	Project vessel (inbound)	Project vessel (outbound)	Total Incident Frequency
Collision	7.63E-02	7.49E-02	1.51E-01
Fire/Explosion	1.90E-04	1.90E-04	3.80E-04
Powered Ground	3.98E-01	4.10E-01	8.07E-01
Drift Ground	1.71E-01	1.71E-01	3.42E-01
Allision at Berth	N/A	N/A	2.56E-02
Total Incident Frequency	6.46E-01	6.57E-01	1.33E+00

Figure 6-1 to Figure 6-3 present the incident results for collision, powered grounding and drift grounding for project vessels in 2028, respectively. It is noteworthy that the results for grounding of project vessels in 2028 are the same as the results for grounding of project vessels in 2038 because the number of project vessels is the same in both cases. Additionally, the reader should note that Figure 6-1 to Figure 6-3 have **different legend categories** and thus, need to be interpreted separately.

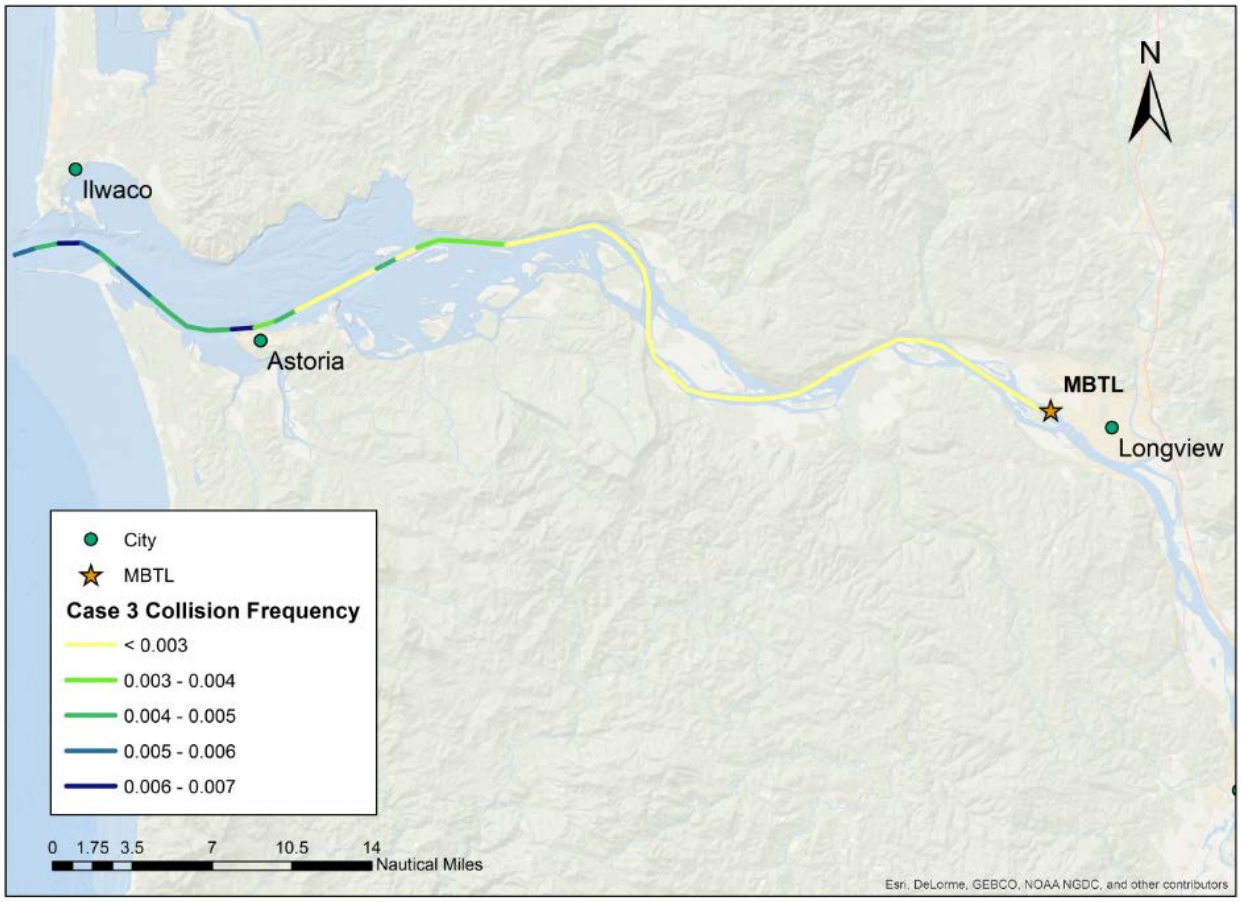


Figure 6-1 2028 Project Vessel Collision Incident Frequency Results

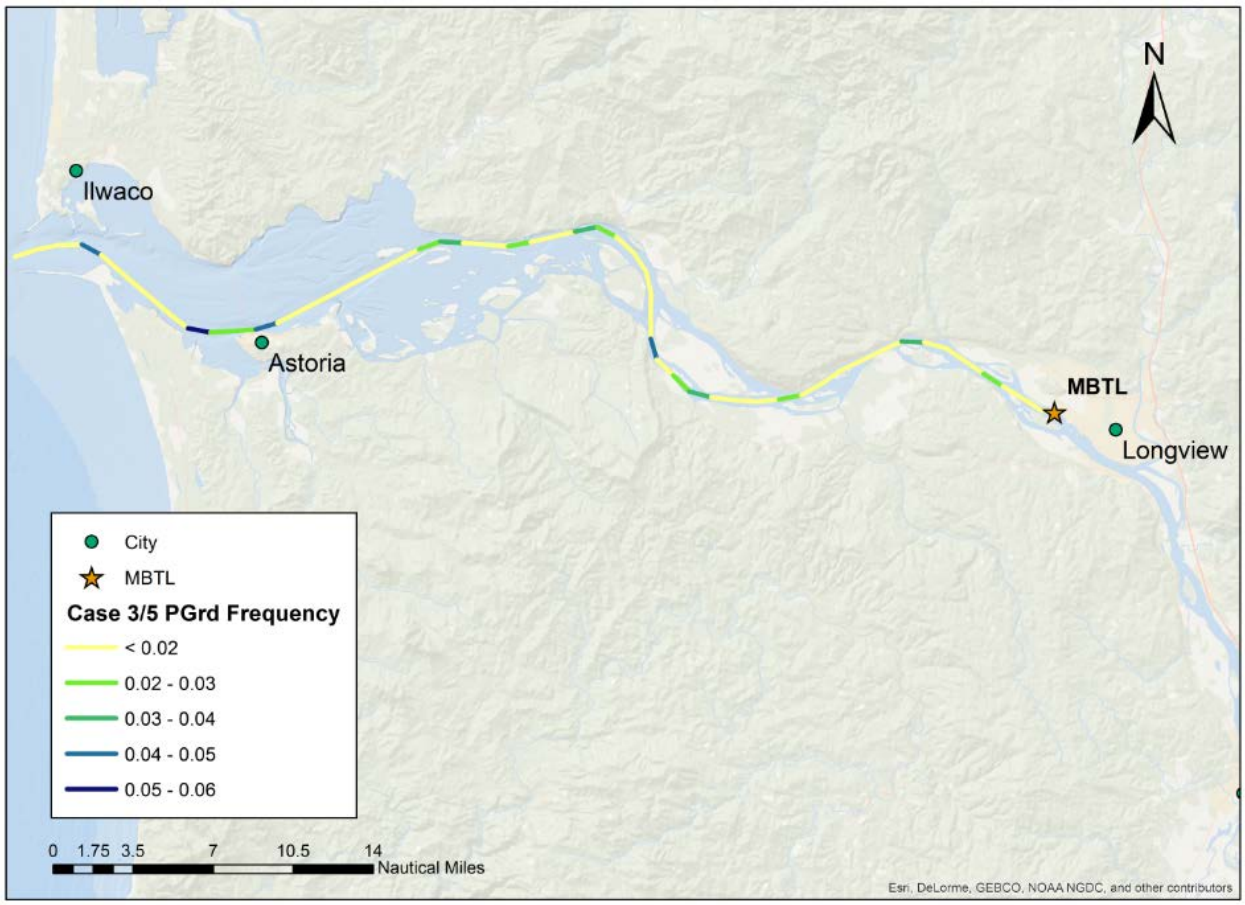


Figure 6-2 2028 Project Vessel Powered Grounding Incident Frequency Results

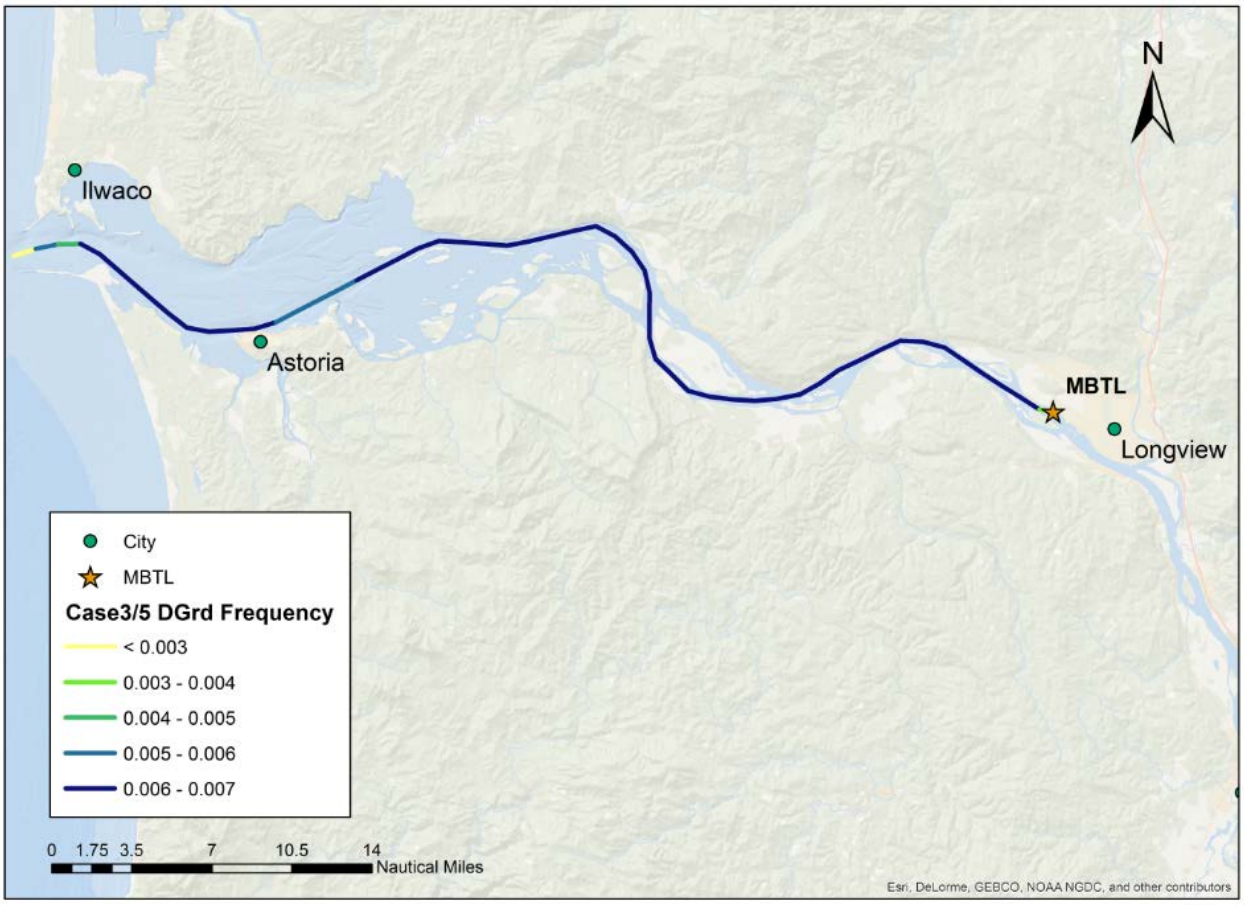


Figure 6-3 2028 Project Vessel Drift Grounding Incident Frequency Results

6.1.4 2038 No-Action Traffic

Table 6-5 provides estimated incident frequencies by vessel type for 2038 without project vessels.

Table 6-5 Incident Frequency by Vessel Type for Non-Project Vessels (2038 No Action)

	Cargo / Carrier	Fishing	Other / Undefined	Passenger	Pleasure	Service	Tanker	Tug	Total Incident Frequency
Collision	1.02E+00	6.45E-01	7.29E-01	1.62E-01	1.60E-01	6.03E-01	3.87E-02	5.97E-01	3.95E+00
Fire / Explosion	2.00E-03	3.54E-04	5.49E-04	1.17E-04	1.16E-04	2.49E-04	7.43E-05	1.26E-03	4.72E-03
Powered Grounding	4.33E+00	2.16E+00	3.42E+00	8.60E-01	6.67E-01	2.30E+00	1.61E-01	2.63E+00	1.65E+01
Drift Grounding	1.80E+00	3.03E-01	4.88E-01	1.06E-01	1.02E-01	2.14E-01	6.68E-02	1.14E+00	4.22E+00
Total Incident Frequency	7.16E+00	3.11E+00	4.64E+00	1.13E+00	9.29E-01	3.12E+00	2.67E-01	4.37E+00	2.47E+01

6.1.5 2038 With-Project Traffic

Table 6-6 provides estimated incident frequencies by vessel type for 2038 non-project vessels under with-project conditions.

Table 6-6 Incident Frequency by Vessel Type for Non-Project Vessels (2038 With-Project)

	Cargo / Carrier	Fishing	Other / Undefined	Passenger	Pleasure	Service	Tanker	Tug	Total Incident Frequency
Collision	1.08E+00	6.87E-01	7.88E-01	1.75E-01	1.72E-01	6.40E-01	4.13E-02	6.48E-01	4.42E+00
Fire / Explosion	1.99E-03	3.54E-04	5.49E-04	1.17E-04	1.16E-04	2.49E-04	7.43E-05	1.26E-03	5.09E-03
Powered Grounding	4.29E+00	2.16E+00	3.42E+00	8.60E-01	6.67E-01	2.30E+00	1.61E-01	2.63E+00	1.73E+01
Drift Grounding	1.78E+00	3.03E-01	4.88E-01	1.06E-01	1.02E-01	2.14E-01	6.68E-02	1.14E+00	4.54E+00
Total Incident Frequency	7.16E+00	3.15E+00	4.70E+00	1.14E+00	9.41E-01	3.15E+00	2.69E-01	4.42E+00	2.63E+01

Table 6-7 provides estimated incident frequencies for project vessels in 2038.

Table 6-7 Incident Frequency by Vessel Type for Project Vessels (2038 With-Project)

	Project vessel (inbound)	Project vessel (outbound)	Total Incident Frequency
Collision	9.64E-02	9.49E-02	1.91E-01
Fire / Explosion	1.90E-04	1.90E-04	3.80E-04
Powered Ground	3.98E-01	4.10E-01	8.07E-01
Drift Ground	1.71E-01	1.71E-01	3.42E-01
Allision at Berth	N/A	N/A	3.97E-02
Total Incident Frequency	6.66E-01	6.77E-01	1.38E+00

The reader should note Figure 6-4 to Figure 6-6 have **different legend categories** and thus, need to be interpreted separately.

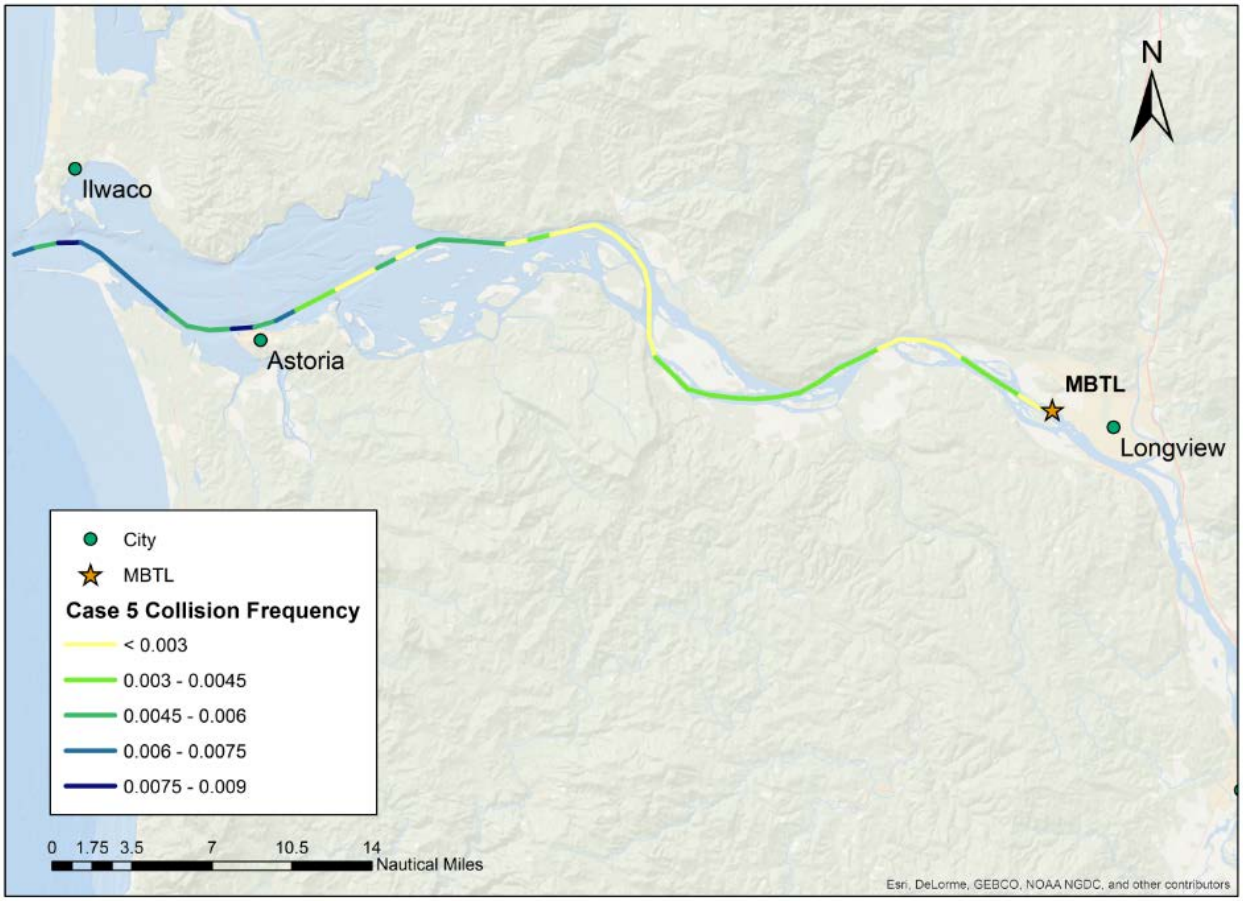


Figure 6-4 2038 Project Vessel Collision Incident Frequency Results

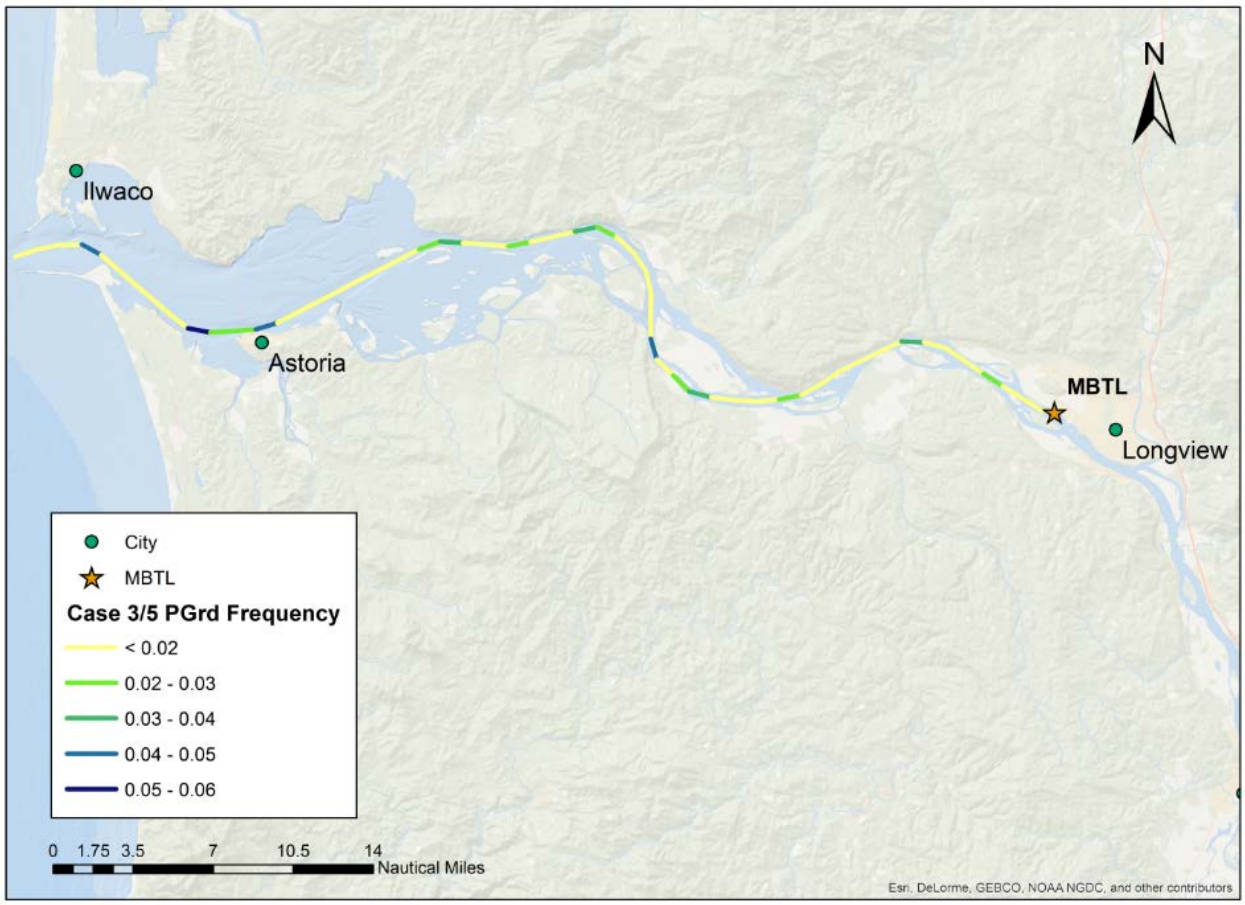


Figure 6-5 2038 Project Vessel Powered Grounding Incident Frequency Results

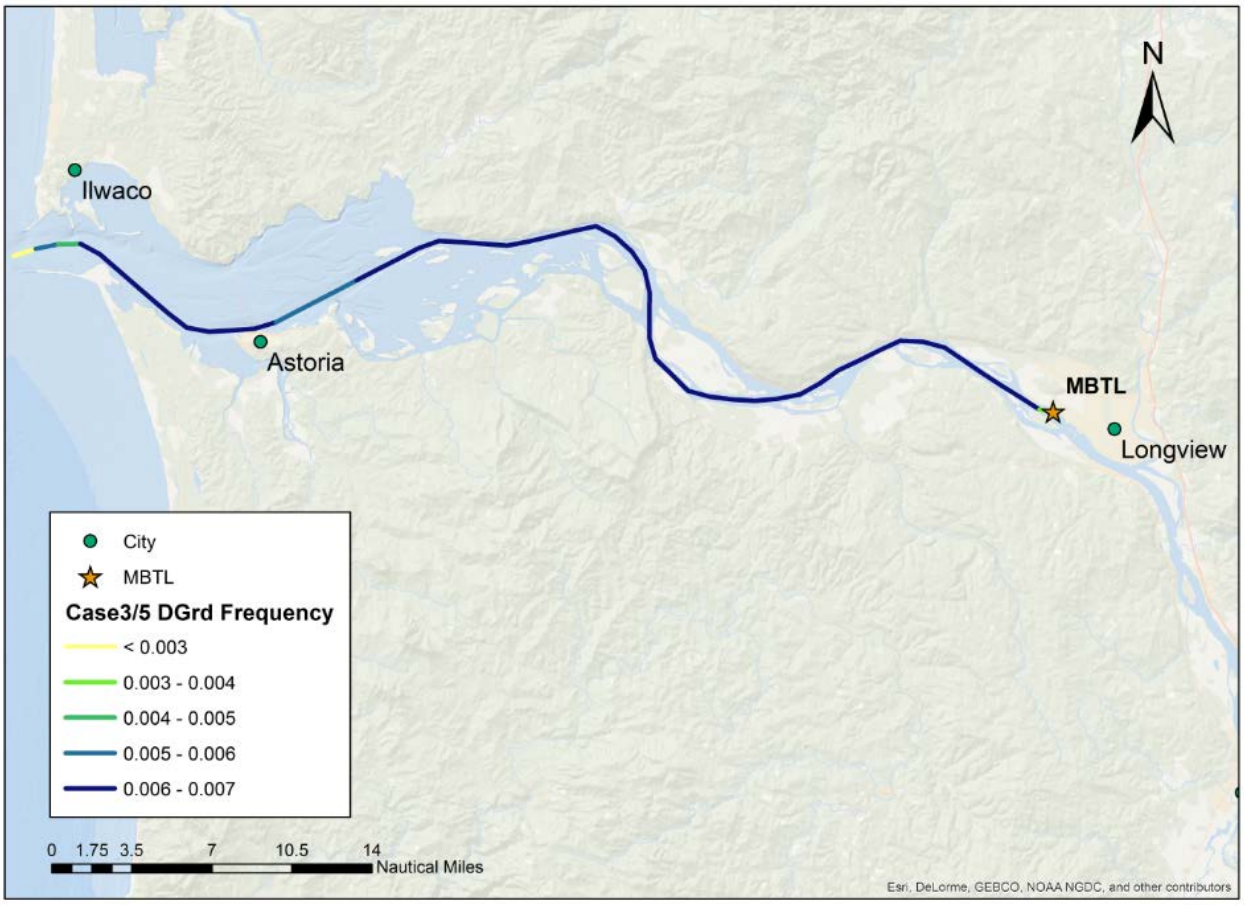


Figure 6-6 2038 Project Vessel Drift Grounding Incident Frequency Results

6.2 Incremental Contribution due to the Proposed Project

Table 6-8 presents the incremental risk that the proposed project contributes to vessel traffic incidents in 2028 and in 2038. These results are presented both in terms of annual frequency for each incident type as well as the percentage increase contributed by the project.

The total incremental incident frequency due to proposed project in 2028 is 1.5 incidents per year which equates to an 8% increase over the no-action scenario in 2028. Of these 1.6 incidents 0.8 are powered groundings, 0.34 are drift groundings, 0.38 are collisions and 0.03 are allisions.

The total incremental incident frequency due to proposed project in 2038 is 1.6 incidents per year which equates to a 6% increase over the no-action scenario in 2038. Of these 1.7 incidents 0.8 are powered groundings, 0.34 are drift groundings, 0.47 are collisions and 0.04 are allisions.

Using the results of the data survey presented in Section 4.1 and 4.2, we can comment on the likely severity of the incremental contribution of marine incidents contributed by the project.

- Based on a survey of historical incident severity, 1--2% of the grounding events contributed by the project are likely to result in a total loss of the vessel, 21-24% are likely to result in damage to

vessel and 74-78% are likely to result in no reported damage. Note: None of the total loss events reported due to grounding involved carriers or vessels of similar size. The only vessel categories reported as a total loss in a grounding event were passenger vessels.

- Based on a survey of historical incident severity, 3--5% of the collision events contributed by the project are likely to result in a total loss of one or more vessels, 47-53% are likely to result in damage to one more vessels and 44-47% are likely to result in no reported damage.
  Note: None of the total loss events reported due to collision involved carriers or vessels of similar size. The only vessel categories reported as a total loss in a collision event were recreational vessels.
- Based on a survey of historical incident severity, 1--5% of the allision events surveyed resulted in a total loss of the vessel, 43-45% resulted in vessel damage and 52-54% resulted in no reported damage.
  Note: None of the total loss events reported due to allision involved carriers or vessels of similar size. The only vessel categories reported as a total loss in an allision event were fishing vessels.

Assuming the distributions described above, the project would contribute fewer than 0.05 incidents with a total loss per year, fewer than 0.5 incidents resulting in reportable damage per year and approximately 1 incident per year resulting in no damage.

The incremental contribution appears to decrease from 2028 (8%) to 2038 (6%) because non-project vessel traffic continues to increase over this 10-year time period while the number of project vessels remains constant at 840 per year. Therefore the relative contribution in 2038 is lower because project vessels make up a smaller portion of overall vessel traffic.

Table 6-8 Incremental Change in Incident Frequency Contributed by Proposed Project

	2028		2038	
	Frequency	% increase	Frequency	% increase
Collision	3.83E-01	15%	4.68E-01	12%
Fire / Explosion	3.80E-04	10%	3.80E-04	8%
Powered Grounding	8.07E-01	6%	8.07E-01	5%
Drift Grounding	3.42E-01	10%	3.42E-01	8%
Allision at Berth	2.56E-02	N/A	3.97E-02	N/A
Total Incident Frequency	1.56E+00	8%	1.66E+00	6%

6.2.1 In 2028 Traffic Conditions

Table 6-9 presents incremental collision frequencies by vessel type for 2028 due to project vessels. This table shows how the total incremental increase in collision incidents is distributed across vessel types.

Table 6-9 Incremental Collision Frequency/Percentage by Vessel Type Contributed by the Proposed Project in 2028

Impacted Vessel	Cargo/ Carrier	Fishing	Other / Undefined	Passenger	Pleasure	Service	Tanker	Tug	Project Vessels	Total
Collision No Action	4.81E-01	4.53E-01	5.01E-01	1.13E-01	1.11E-01	4.29E-01	2.75E-02	4.10E-01	N/A	2.53E+00
Collision With-Project	5.16E-01	4.91E-01	5.54E-01	1.25E-01	1.22E-01	4.63E-01	2.99E-02	4.56E-01	1.51E-01	2.91E+00
Incremental TIF Increase	3.50E-02	3.80E-02	5.30E-02	1.20E-02	1.10E-02	3.40E-02	2.40E-03	4.60E-02	1.51E-01	3.83E-01
Incremental % Increase	7.3%	8.4%	10.6%	10.6%	9.9%	7.9%	8.7%	11.2%	N/A	15%

Figure 6-7 shows how the incremental incident frequency varies by incident type for each river mile segment along the proposed route in 2028.

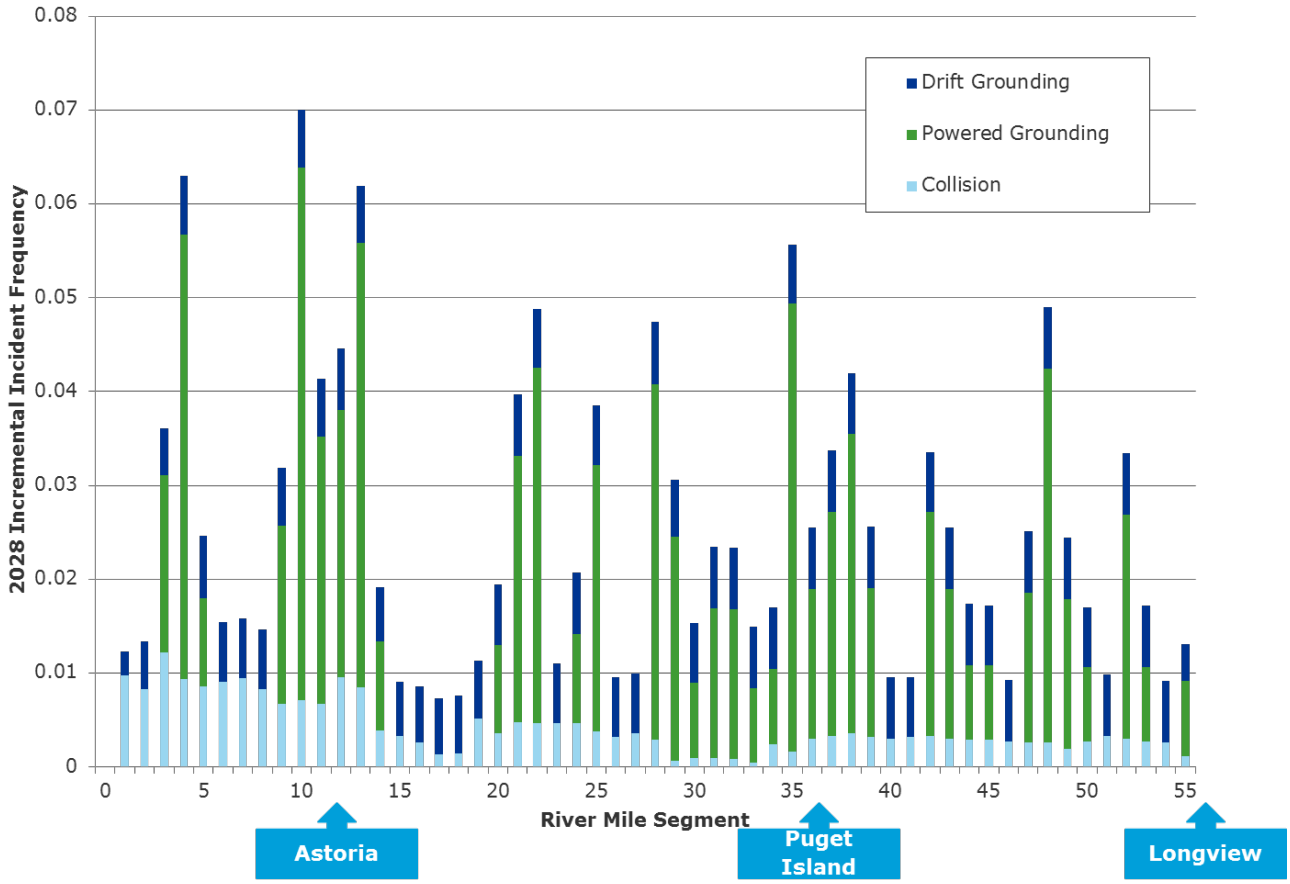


Figure 6-7 Incremental Incident Frequency by Incident Type Contributed by Proposed Project in 2028

6.2.2 In 2038 Traffic Conditions

Table 6-10 presents incremental collision frequencies by vessel type for 2038 due to project vessels. This table shows how the total incremental increase in collision incidents is distributed across vessel types.

Table 6-10 Incremental Collision Frequency/Percentage by Vessel Type Contributed by Proposed Project in 2038

Impacted Vessel	Cargo/ Carrier	Fishing	Other / Undefined	Passenger	Pleasure	Service	Tanker	Tug	Project Vessels	Total
Collision No-Action	1.02E+00	6.45E-01	7.29E-01	1.62E-01	1.60E-01	6.03E-01	3.87E-02	5.97E-01	N/A	3.95E+00
Collision With-Project	1.08E+00	6.87E-01	7.88E-01	1.75E-01	1.72E-01	6.40E-01	4.13E-02	6.48E-01	1.91E-01	4.42E+00
Incremental TIF Increase	6.00E-02	4.20E-02	5.90E-02	1.30E-02	1.20E-02	3.70E-02	2.60E-03	5.10E-02	1.91E-01	4.68E-01
Incremental % Increase	5.9%	6.5%	8.1%	8.0%	7.5%	6.1%	6.7%	8.5%	N/A	12%

Figure 6-8 shows how the incremental incident frequency varies by incident type for each river mile segment along the proposed route in 2038.

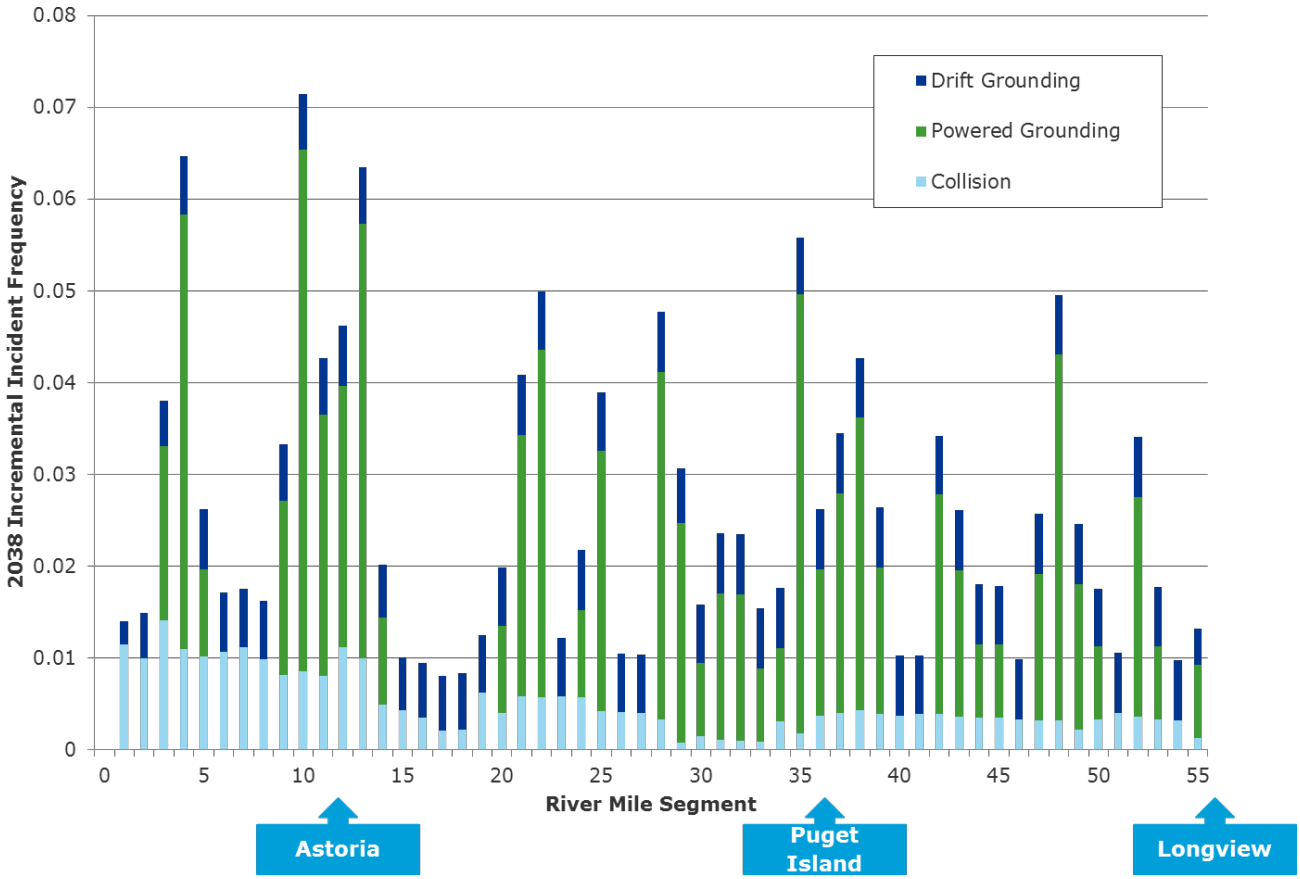


Figure 6-8 Incremental Incident Frequency by Vessel Type Contributed by the Proposed Project in 2038

7 ESTIMATED BUNKER SPILL RISK OF PROJECT VESSELS AT FULL BUILD OUT

The annual bunker spill frequency is calculated for project vessels for collision (grouped with allision at berth for this analysis), powered grounding and drift grounding. To assess the frequency of a release from the bunker tank due to collision the following probabilities are used: the probability that a collision results in sufficient energy to puncture the bunker tank and the geometric probability of striking the location of the bunker tank on the vessel. To assess the frequency of a release from the bunker tank due to drift grounding the following probabilities are used: the probability that the indentation depth exceeds the critical indentation depth required to puncture the bunker tank, the geometric probability of striking the location of the bunker tank on the vessel and the probability that the project vessel grounds on a rocky shoreline. The frequency of a release from the bunker tank due to powered grounding is assumed to be 0.01% of the total incidents. This is applied because a powered grounding that results in a release of bunker fuel is a very unlikely event as the bunker tanks are located in the stern of the vessel while the impact location is almost always near the bow.

7.1 Estimated Bunker Spill Frequencies

As shown below, the estimated bunker spill frequency due to the proposed project is 1.02×10^{-2} in 2028 and 1.17×10^{-2} in 2038. This equates to roughly one spill (of any size) every 98 years in 2028 and one spill every 85 years in 2038. Recall that, based on the survey of oil spill data from 2004 to 2014 (Section 4.3), the Lower Columbia River has experienced a spill greater than 100 gallons approximately once every 2.2 years.

7.1.1 In 2028 Traffic Conditions

Table 7-1 provides estimated bunker oil spill frequencies (of any size) by incident type for project vessels in 2028.

Table 7-1 2028 Bunker Oil Spill Frequency from Project Vessels

	Project Vessel (inbound)	Project Vessel (outbound)	Total Incident Frequency
Collision	1.54E-04	1.54E-04	3.09E-04
Powered Ground	3.98E-05	4.10E-05	8.07E-05
Drift Ground	3.56E-03	3.57E-03	7.13E-03
Allision at Berth	N/A	N/A	2.65E-03
Total Incident Frequency	3.75E-03	3.77E-03	1.02E-02

Figure 7-1 shows how the bunker oil spill frequency varies across each river mile segment along the proposed route in 2028.

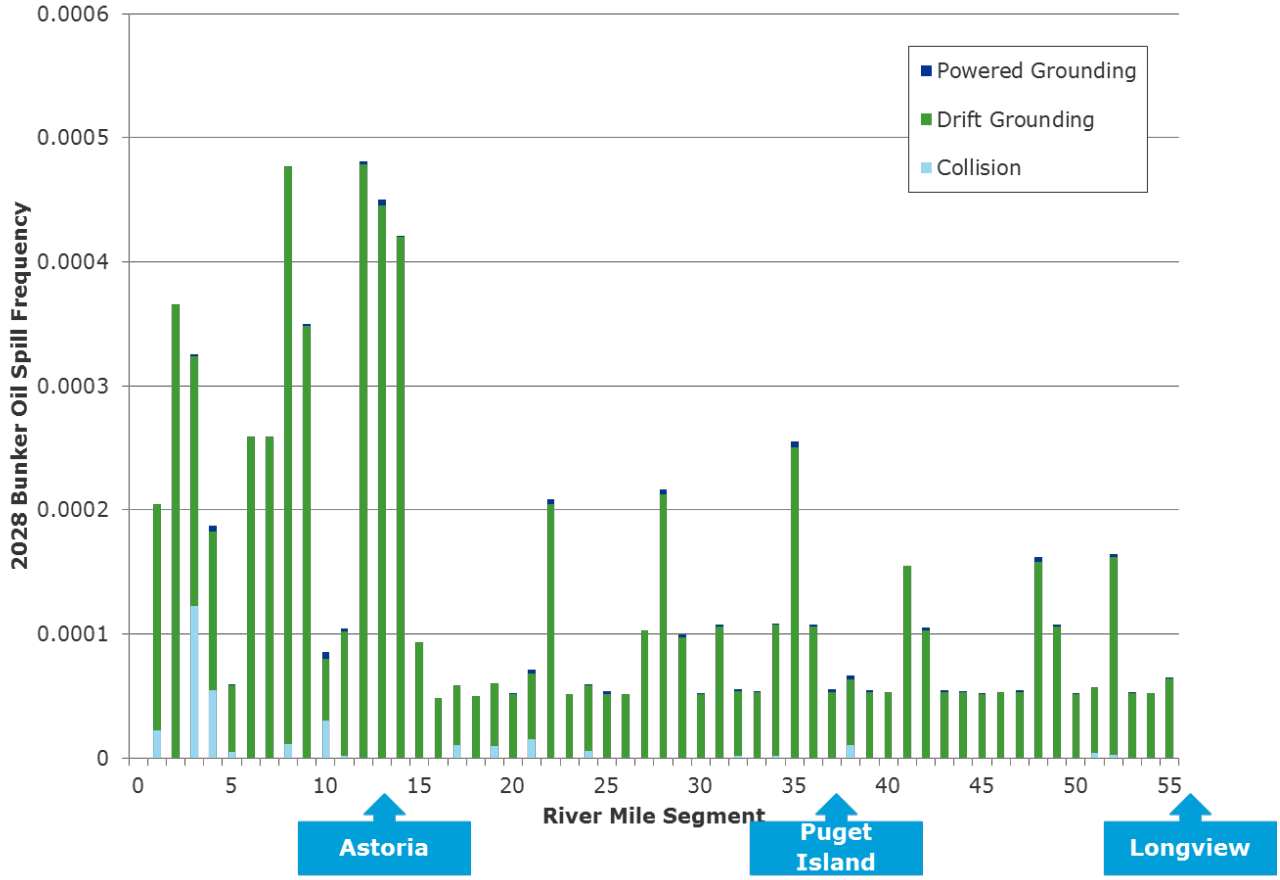


Figure 7-1 2028 Annual Incremental Bunker Oil Spill Frequency

Table 7-2 provides the percentage of incidents that result in a bunker oil spill (of any size) for project vessels in 2028.

Table 7-2 Percentage of Incidents Leading to Bunker Oil Spill (2028)

	Project Vessel (inbound)	Project Vessel (outbound)	Total Incident Frequency
Collision	0.20%	0.21%	0.21%
Powered Ground	0.01%	0.01%	0.01%
Drift Ground	2.08%	2.09%	2.08%
Allision at Berth	N/A	N/A	10.4%
Total Incident Frequency	0.58%	0.57%	0.77%

7.1.2 In 2038 Traffic Conditions

Table 7-3 provides estimated bunker oil spill frequencies by incident type for project vessels in 2038.

Table 7-3 2038 Bunker Spill Frequency from Project Vessels

	Project Vessel (inbound)	Project Vessel (outbound)	Total Incident Frequency
Collision	1.73E-04	1.73E-04	3.47E-04
Powered Ground	3.98E-05	4.10E-05	8.07E-05
Drift Ground	3.56E-03	3.57E-03	7.13E-03
Allision at Berth	N/A	N/A	4.16E-03
Total Incident Frequency	3.77E-03	3.78E-03	1.17E-02

Figure 7-2 shows how the bunker oil spill frequency varies across each river mile segment along the proposed route in 2038.

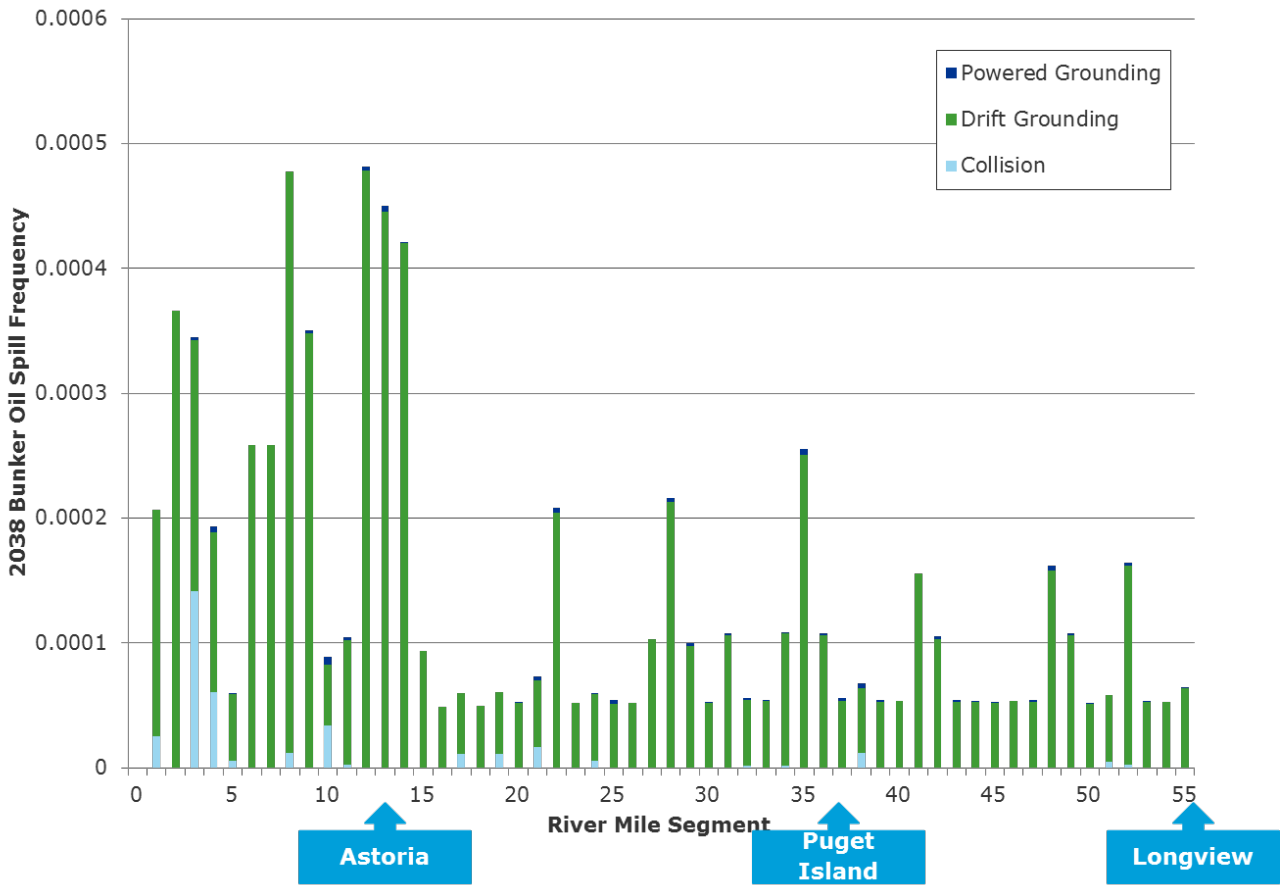


Figure 7-2 2038 Annual Incremental Bunker Oil Spill Frequency

Table 7-4 provides the percentage of incidents that result in a bunker oil spill (of any size) for project vessels in 2038.

Table 7-4 Percentage of Incidents Leading to Bunker Oil Spill (2038)

	Project Vessel (inbound)	Project Vessel (outbound)	Total Incident Frequency
Collision	0.18%	0.18%	0.18%
Powered Ground	0.01%	0.01%	0.01%
Drift Ground	2.08%	2.09%	2.08%
Allision at Berth	N/A	N/A	10.47%
Total Incident Frequency	0.57%	0.56%	0.85%

7.2 Estimated Conditional Probabilities of Spill Volumes

This section presents conditional spill volume probabilities of bunker oil from a project vessel, which was assessed using the Naval Architecture Package (NAPA) model.

These results are presented as curves showing the conditional probability of the volume of bunker oil that would be released given that a bunker oil tank has been breached and oil is flowing out of the tank(s). Figure 7-3 presents these results in gallons for a representative Panamax vessel assuming bunker tanks are 100% full.

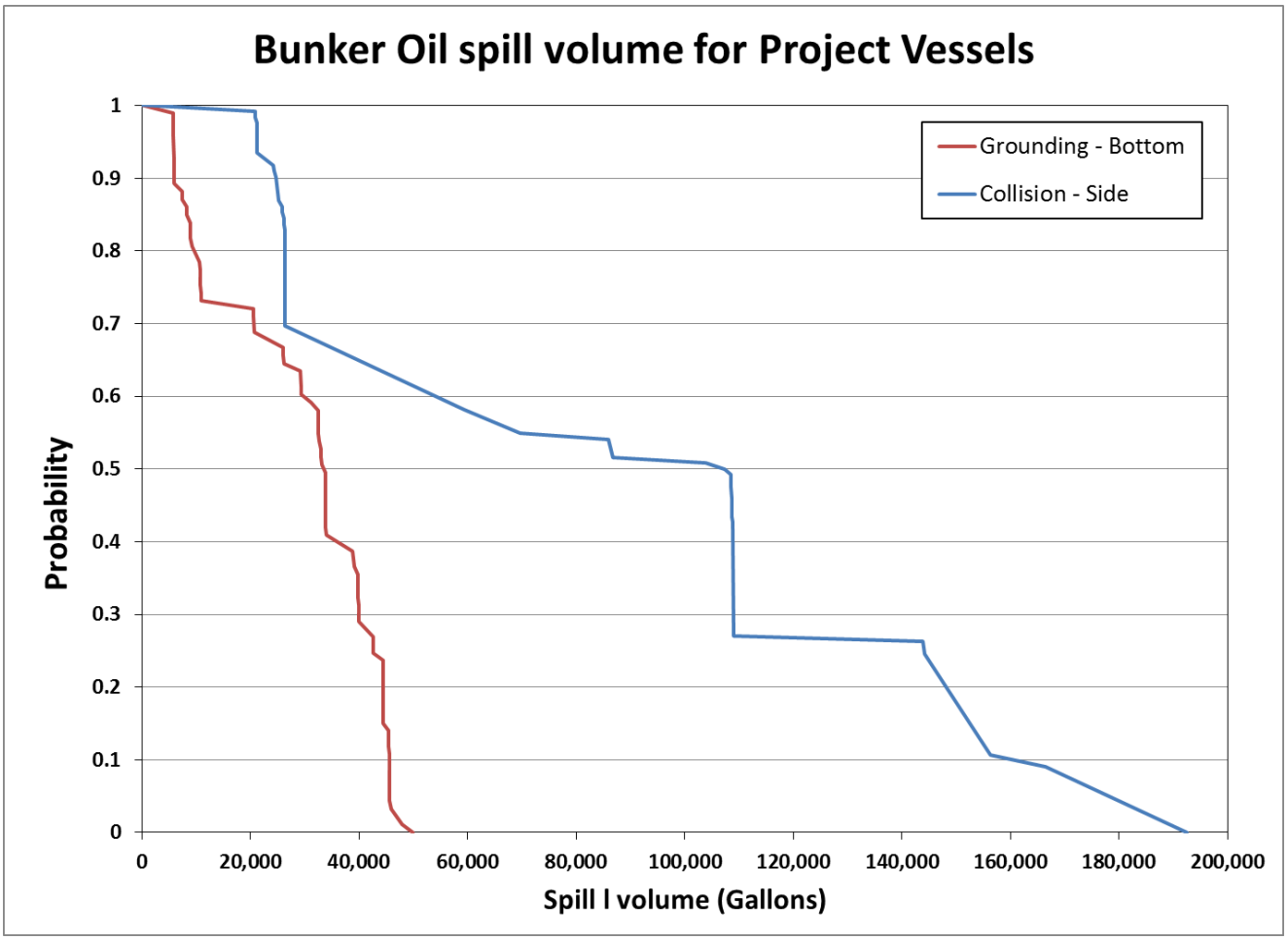


Figure 7-3 NAPA Results - Bunker Oil Spill (gallons)

As shown in Figure 7-3, if a collision or grounding event resulted in a bunker oil spill, the smallest estimated spill volume would be roughly 20 m^3 for a grounding and 80 m^3 for a collision. This equates to 5,700 and 20,900 gallons of bunker oil (respectively).

These volumes can then be paired with the Bunker Oil Spill Frequencies provided in Section 7.1 for a more complete picture of bunker oil spill risk. The frequency of bunker oil spill volumes is provided in Figure 7-4 and Figure 7-5 below for grounding and collision events, respectively. Note that grounding frequencies do not vary from 2028 to 2038 since the number of project vessels remains at 840 in both years. Frequency of collision incidents is higher in 2038 compared to 2028 due to an increase in the overall vessel traffic in the study area.

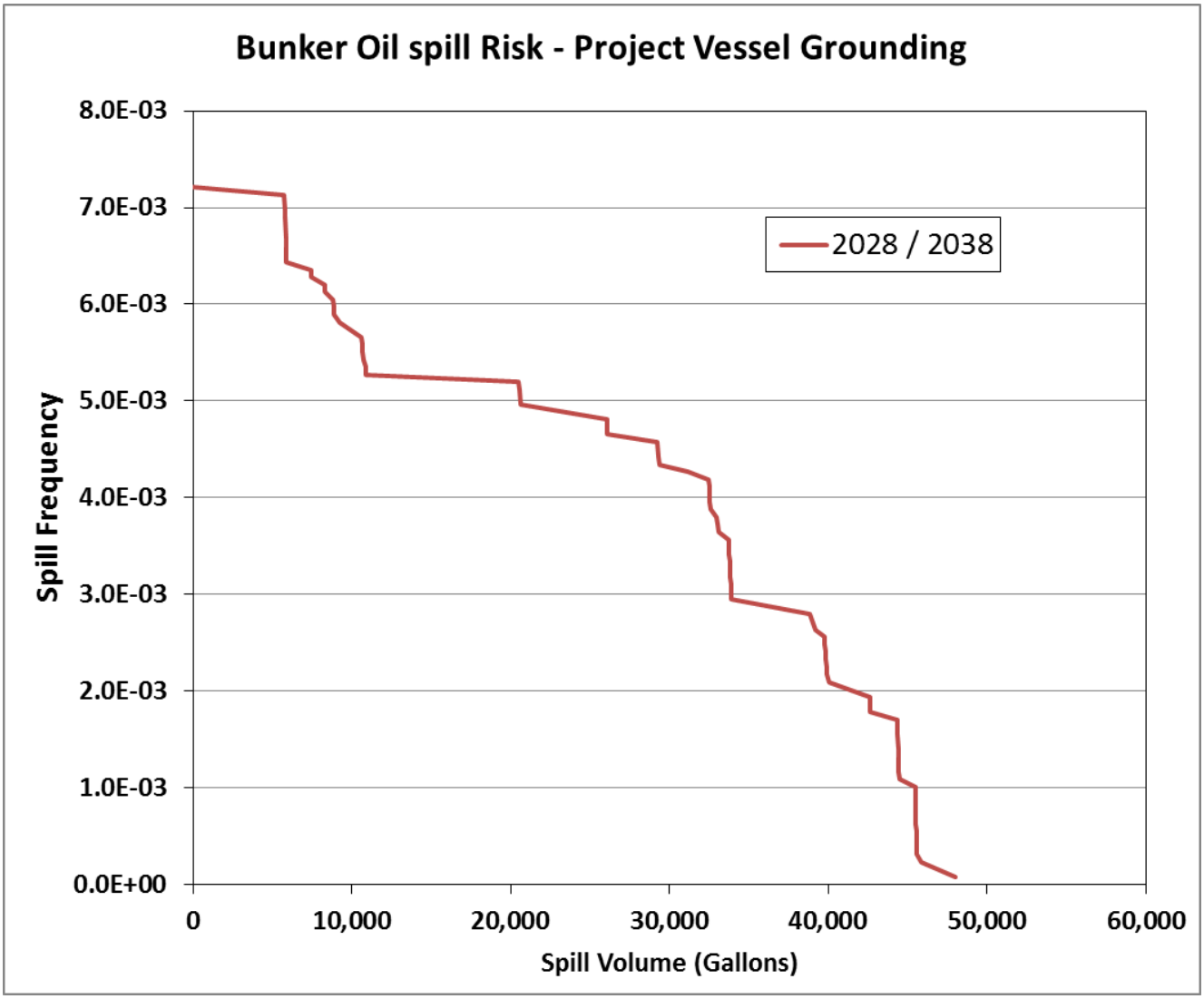


Figure 7-4 Frequency vs volume of Bunker Oil Spill due to Grounding of Project Vessel

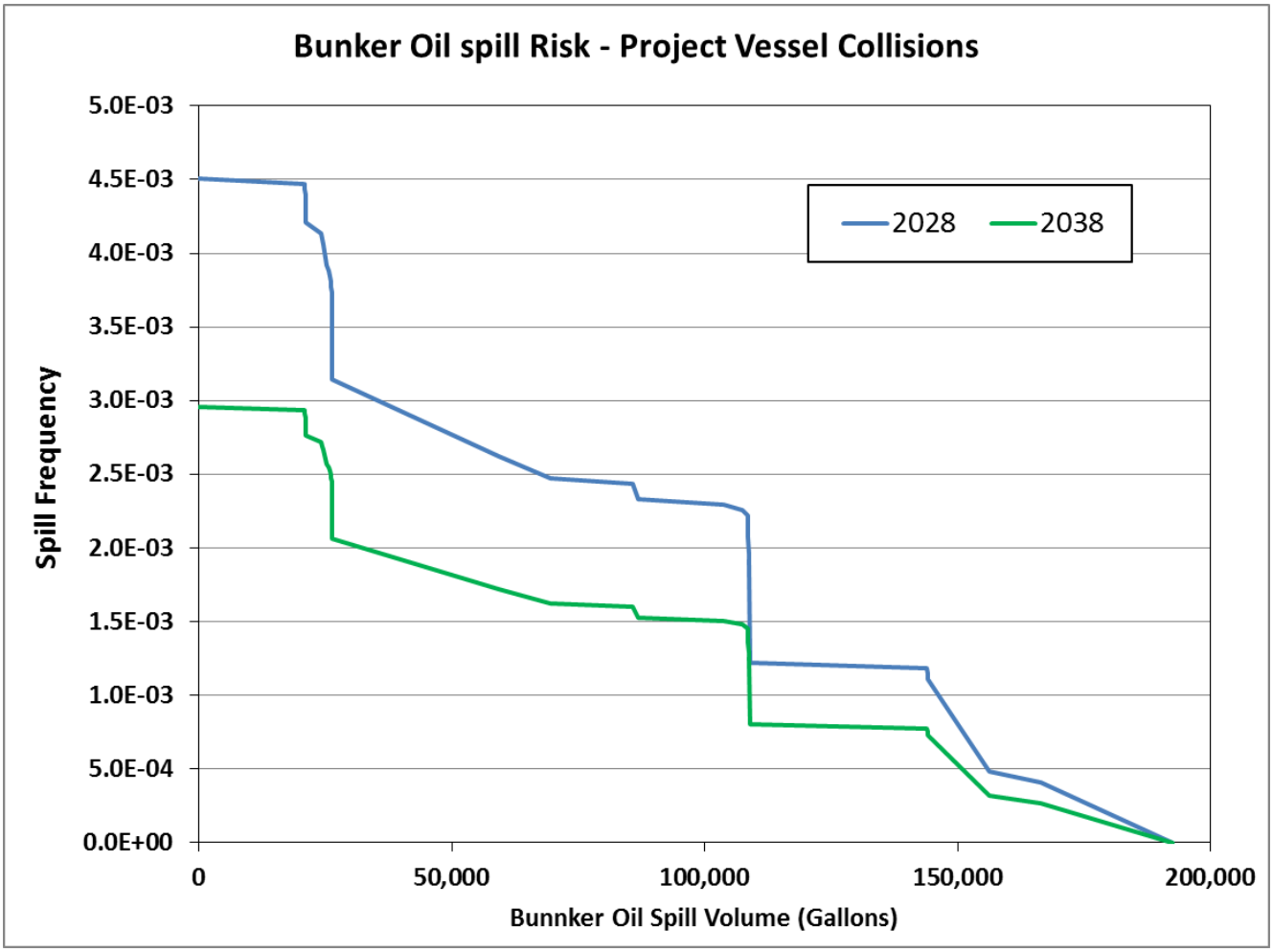


Figure 7-5 Frequency vs volume of Bunker Oil Spill due to Collision involving Project Vessel

Examples of frequency- spill size pairs are provided in Table 7-5 to Table 7-7. It is important to note that this study did not assess the risk of small spills due to activities such as bunkering, damage to the environment and other causes unrelated to navigational incidents.

Table 7-5 Example Bunker Oil Spill Volumes & Frequencies due to Grounding (2028/2038)

Return Period (Years)	Spill Volume (gal)
140	5,700 or less
182	10,700 or less
403	39,700 or less
4,299	45,800 or less

Table 7-6 Example Bunker Oil Spill Volumes & Frequencies due to Collision (2028)

Return Period (Years)	Spill Volume (gal)
341	20,900 or less
581	59,300 or less
676	107,400 or less
3,748	166,500 or less

Table 7-7 Example Bunker Oil Spill Volumes & Frequencies due to Collision (2038)

Return Period (Years)	Spill Volume (gal)
224	20,900 or less
381	59,300 or less
444	107,400 or less
2,461	166,500 or less

8 CONCLUSIONS

8.1 Incremental Contribution to Marine Incidents

The total incremental incident frequency due to proposed project in 2028 is 1.5 incidents per year which equates to an 8% increase over the no-action scenario in 2028. Of these 1.6 incidents 0.8 are powered groundings, 0.34 are drift groundings, 0.38 are collisions and 0.03 are allisions.

The total incremental incident frequency due to proposed project in 2038 is 1.6 incidents per year which equates to a 6% increase over the no-action scenario in 2038. Of these 1.7 incidents 0.8 are powered groundings, 0.34 are drift groundings, 0.47 are collisions and 0.04 are allisions.

In order to provide context around the consequences of a collision, grounding or allision incident, a survey of USCG Marine Information for Safety and Law Enforcement (MISLE) database was conducted for years 2001 to 2014. For the purposes of this study, the various categories used to describe incident severity for each reported incident were aggregated into “Total Loss”, “Damage” and “No Damage”. The data coverage period of 2001 to 2014 was chosen as it covers over 99% of all reported collision, grounding, and allision incidents in the dataset. Data surveys were conducted for the national dataset and for the study area separately in order to test for differences in the distribution of incident severity between the two. Our findings show that for a given incident type, the severity distributions were very similar for national incident data compared to Lower Columbia River incident data.

Using the results of the data survey, we can therefore comment on the likely severity of the incremental contribution of marine incidents contributed by the project.

- Based on a survey of historical incident severity, 1--2% of the grounding events contributed by the project are likely to result in a total loss of the vessel, 21-24% are likely to result in damage to vessel and 74-78% are likely to result in no reported damage. Note: None of the total loss events reported due to grounding involved carriers or vessels of similar size. The only vessel categories reported as a total loss in a grounding event were passenger vessels.
- Based on a survey of historical incident severity, 3--5% of the collision events contributed by the project are likely to result in a total loss of one or more vessels, 47-53% are likely to result in damage to one more vessels and 44-47% are likely to result in no reported damage.
  Note: None of the total loss events reported due to collision involved carriers or vessels of similar size. The only vessel categories reported as a total loss in a collision event were recreational vessels.
- Based on a survey of historical incident severity, 1--5% of the allision events surveyed resulted in a total loss of the vessel, 43-45% resulted in vessel damage and 52-54% resulted in no reported damage.
  Note: None of the total loss events reported due to allision involved carriers or vessels of similar size. The only vessel categories reported as a total loss in an allision event were fishing vessels.

Assuming the distributions described above, the project would contribute fewer than 0.05 incidents with a total loss per year, fewer than 0.5 incidents resulting in reportable damage per year and approximately 1 incident per year resulting in no damage.

The incremental contribution appears to decrease from 2028 (8%) to 2038 (6%) because non-project vessel traffic continues to increase over this ten-year time period while the number of project vessels remains

constant at 840 per year. Therefore the relative contribution in 2038 is lower because project vessels make up a smaller portion of overall vessel traffic.

8.2 Incremental Contribution to Oil Spill Risk

Less than 1% of the collision, grounding and allision incidents involving project vessels are expected to result in a bunker oil spill. As a result, the frequency of a bunker spill of any size due to a marine incident involving a project vessel is estimated to be 1.02×10^{-2} in 2028 and 1.17×10^{-2} in 2038. This equates to roughly one spill (of any size) every 98 years in 2028 and one spill (of any size) every 85 years in 2038. Based on a survey of oil spill data from 2004 to 2014, the Lower Columbia River has experienced a spill of greater than 100 gallons approximately once every 2.2 years. Therefore, the proposed project would increase the frequency of a spill greater than 100 gallons by approximately 2 to 3% to approximately once in every 2.15 years.

In the unlikely event that a collision or grounding event resulted in a bunker oil spill, the smallest estimated bunker oil spill volume from a project vessel would be roughly 20 m^3 for grounding and 80 m^3 for collisions (5,700 and 20,900 gallons, respectively). The frequency of various bunker oil spill sizes is provided in Table 8-1 for grounding scenarios. Since the number of project vessels does not change between 2028 and 2038, frequencies are the same in both years. The frequency of various bunker oil spill sizes is provided in Table 8-2 and Table 8-3 for collision scenarios. Since the number of non-project vessels increases between 2028 and 2038, collision frequencies vary across those years. It is important to note that this study did not assess the risk of small spills due to activities such as bunkering, damage to the environment and other causes unrelated to navigational incidents.

Table 8-1 Example Bunker Oil Spill Volumes & Frequencies due to Grounding (2028/2038)

Return Period (Years)	Spill Volume (gal)
140	5,700 or less
182	10,700 or less
403	39,700 or less
4,299	45,800 or less

Table 8-2 Example Bunker Oil Spill Volumes & Frequencies due to Collision (2028)

Return Period (Years)	Spill Volume (gal)
341	20,900 or less
581	59,300 or less
676	107,400 or less
3,748	166,500 or less

Table 8-3 Example Bunker Oil Spill Volumes & Frequencies due to Collision (2038)

Return Period (Years)	Spill Volume (gal)
224	20,900 or less
381	59,300 or less
444	107,400 or less
2,461	166,500 or less

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